AMERICAN MADE, GLOBALLY RENOWNED

NEW PREMIUM TOOLS

CONICAL™ CUTTING TOOLS

GLOBAL™ CUTTING TOOLS

2015

PRODUCT CATALOG & TECHNICAL RESOURCE

70 YEARS OF INNOVATION

SPT SUNCOAST INC. PRECISION TOOLS

ESTABLISHED 1963

A TRUSTED INDUSTRY LEADER

Conical has not only been a leading manufacturer and provider of carbide and high speed steel end mills throughout the USA, but also one of the chief innovators and trusted resources to the metalworking industry since its founding in 1944.

MANUFACTURING FOR OVER 70 YEARS 1944 - 2014

SEAL OF QUALITY ASSURANCE

100% SATISFACTION GUARANTEED

OUR COMMITMENT TO OUR CUSTOMERS

INNOVATION IN EVERYTHING WE DO

Conical and Global Cutting Tools are committed to providing the highest quality performance and specialty cutting tools and end mills, to our customers. We have developed a rigorous program to do so and we believe our performance is not just measured by our products, but the technical resources we provide as well.

This product catalog has been designed to be the most intuitive and resourceful in the industry. The thoughtfulness of design is simply in our blood. Since 1944, Conical Tool Company has been breaking ground on new products, developing new patents and improving old workhorses.

In the pages that follow, you will find guides and resources to help improve your performance, whether using our tools or a competitor's. We know that by providing resourceful information, in an easy to use format, our new customers will find it easy to familiarize themselves and present customers will continue their patronage.

Each product page is clearly marked with product and application-specific icons. Variations in tool design are grouped to make it easy to find important variables in each tool's geometry. We pride ourselves in having the widest range of sizes and designs in the industry. However, if you are still unable to find the tool you need, call us at the number listed on every product page, or copy and fill out the "Request for Quote" document. Specials are over 30% of our business and there's no tool, large or small, we can't produce.

You may have noticed our new corporate identity, catalogs and resources. We will be adding over three thousand new tools in dozens of new geometries through the upcoming months under our Global Cutting Tools brand. Our tapered end mills will continue to be known by the industry trusted name, Conical. We have included many of these upcoming offerings in this catalog so our customers can be aware of our planned expansion. Any new product may have a slight lead time while we build our inventory levels, but all are available for immediate ordering with as short as a few days lead time.

I would like to sincerely thank our loyal customers who have recognized the quality of the products we produce, the performance our tools deliver and the technical resources our company provides. These next years will be exciting, as we bring new products to the market, while undergoing many improvements in our production capabilities and quality controls. As always, we value our customer's input and look forward to any feedback you may have.

Sincerely,

Robert M. Shindorf
President

CONICAL™
CUTTING TOOLS

GLOBAL™
CUTTING TOOLS

WE STRIVE FOR PERFECTION IN EVERY TURN OF THE TOOL. WE ATTAIN NEW LEVELS OF QUALITY AND PERFORMANCE, WITH EVERY CHIP CAST AWAY. WE ARE A TRUSTED SUPPLIER OF THE FINEST END MILLS ON THE MARKET TODAY.

TABLE OF CONTENTS

1 COMPANY INFORMATION

Company Profile/History 5-8
Patents/Certifications 9
F.A.Q.'s 10

2 PRODUCTS & SERVICES

Product/Service Overview 12-13
Regrinding & Reconditioning 14-15
Tool Modification Program 16-21
Testimonials 22-25

3 CUSTOM TOOL ORDERING

Custom Tooling Abstract/Tearsheet 27
Custom Tool Ordering 28-29
Request For Quote Documents 30-36

4 HOW TO BUY

Sales Distribution Model/US 38
Sales Distribution Model/Global 39
Become a Distributor 40

5 TECHNICAL INFORMATION

Advanced Coatings 42-44
End Mill Attributes & Terminology 46-47
Machining Methods 48-58
Machining Problems & Solutions 59-64
Toubleshooting 65-67

6 END MILL SELECTION GUIDE

Icon Index 74-75
End Mill Selection Guide 70
Coolant Guide 71
Shank Information 72
Helical Angle Selection 73

7 PERFORMANCE END MILLS

VORTEX4 78-87
Pictoral Representation/Infographic 80-81
Product Listing 82-86
Feeds & Speeds 87
VORTEX5 88-94
Pictoral Representation/Infographic 90-91
Product Listing 92-93
Feeds & Speeds 94
CYCLONE MX 96-104
Pictoral Representation/Infographic 98-99
Product Listing 100-103
Feeds & Speeds 104
HYDRA FX 106-112
Pictoral Representation/Infographic 108-109
Product Listing 110-111
Feeds & Speeds 112
XTERRA3 113-117
Pictoral Representation/Infographic 114-115
Product Listing 116
Feeds & Speeds 117
EXTREME3 118-123
Pictoral Representation/Infographic 120-121
Product Listing 122
Feeds & Speeds 123
ZEPHYR3 124-130
Pictoral Representation/Infographic 126-127
Product Listing 128-129
Feeds & Speeds 130
ALUMINUM2&3 131-138
Pictoral Representation/Infographic 132-133
Product Listing 134-137
Feeds & Speeds 138

8 DIE & MOLD END MILLS

DIE & MOLD CUTTERS 140-150
Pictoral Representation/Infographic 142-143
Product Listing 144-149
Feeds & Speeds 150
PROFILE RIB CUTTERS 152-165
Pictoral Representation/Infographic 154-155
Product Listing 156-164
RUNNER CUTTERS 166-171
Pictoral Representation/Infographic 168-169
Product Listing 170
Feeds & Speeds 171
DIE SINKS 172-177
Pictoral Representation/Infographic 174-175
Product Listing 176-177

9 SPECIALTY END MILLS

TAPERED CARBIDE 180-202
Pictoral Representation/Infographic 182-183
Product Listing 184-201
Feeds & Speeds 202
TAPERED HSS 205-226
Pictoral Representation/Infographic 206-207
Product Listing 208-225
Feeds & Speeds 226
TAPERED LEFT HAND SPIRAL 227-231
Pictoral Representation/Infographic 228-229
Product Listing 230-231
CHAMFER CUTTERS 232-241
Pictoral Representation/Infographic 234-235
Product Listing 236-240
Feeds & Speeds 241
TAPERED CARBIDE MINIATURES 242-248
Pictoral Representation/Infographic 244-245
Product Listing 246-248
AUTOMOTIVE TAPERS 249-252
Pictoral Representation/Infographic 250-251
Product Listing 252

10 GENERAL PURPOSE END MILLS

GENERAL PURPOSE END MILLS 254-255
Product Listing 254-255

11 RAW MATERIALS

Solid Carbide Rods 257-264

12 GENERAL INFORMATION

Conversion Charts 267-268
Limitations & Conditions 273
Return Policy 270-271
Tapers & Angles 266
Tool Performance Report 272
Warranty Information 269

PICTORIAL INDEX

PERFORMANCE END MILLS

VORTEX4
78 Series VX4 • 4FL • Micrograin Carbide • AlCrN / Si3N4 Coated
37-39° Variable Helix, Variable Index, Eccentric Relief, Large Core
Square End, Corner Radius & Ball End Configurations

VORTEX5
88 Series VX5 • 5FL • Micrograin Carbide • • AlCrN / Si3N4 Coated
37-39° Variable Helix, Variable Index, Eccentric Relief, Large Core
Square End & Corner Radius Configurations

CYCLONE MX
96 Series CMX • 6 & 8 FL • Micrograin Carbide • AlTiN / Si3N4 Coated
45° Variable Helix, Variable Index, Eccentric Relief
Square End, Corner Radius & Reduced Neck Configurations

HYDRA FX
106 Series HFX • 5, 7, 9 & 11FL • Micrograin Carbide • AlCrN / Si3N4 Coated
35° Helix, Variable Index, Eccentric Relief
Square End & Corner Radius Configurations

XTERRA3
113 Series XT3 • 3FL • Micrograin Carbide • AlTiN / Si3N4 Coated
48-30° Variable Pitch Helix, Variable Index, Eccentric Relief
Corner Radius Configurations

EXTREME3
118 Series EX3 • 3FL • Micrograin Carbide • AlTiN / Si3N4 Coated
45 - 60° Transitional Helix, Variable Index, Eccentric Relief
Square End & Corner Radius Configurations

ZEPHYR3
124 Series AVX • 3FL • Micrograin Carbide • ZrN Coated
45 - 30° Variable Pitch Helix, Variable Index, Eccentric Relief
Square End, Corner Radius & Ball End Configurations

ALUMINUM 2
134 Series AL2 • 2FL • Micrograin Carbide • Uncoated
45° Constant Helix, Integrated Chip Breaker, Eccentric Relief
Square End, Corner Radius & Ball End Configurations

ALUMINUM 3
136 Series AL3 • 3FL • Micrograin Carbide • Uncoated
45° Constant Helix, Integrated Chip Breaker, Eccentric Relief
Square End, Corner Radius & Ball End Configurations

CONICAL™ CUTTING TOOLS

GLOBAL™ CUTTING TOOLS

DIE & MOLD END MILLS

GLOBAL DIE & MOLD CUTTERS
140 Series DMX • 2FL • Micrograin Carbide • AlTiN / Si3N4 Coated
30° Constant Helix, Eccentric Relief, Large Core
Square End, Corner Radius & Ball End Configurations

CONICAL PROFILE RIB CUTTERS
152 Series PRX • 4FL • Micrograin Carbide • AlTiN-X Coated
25 - 30° Variable Lead Helix, Eccentric Relief, Large Core
Square End, Corner Radius & Ball End Configurations

GLOBAL RUNNER CUTTERS
166 Series RCX • 2FL • Micrograin Carbide • AlTiN-X Coated
12° Constant Helix, Varying Angles, Large Core
Ball End Configurations

GLOBAL DIE SINKS
172 Series DSX • 2 &3FL • Micrograin Carbide • Uncoated
High Strength Straight Flutes, Varying Angles
Ball End Configurations

SPECIALTY END MILLS

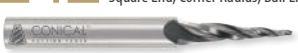
CONICAL TAPERED CARBIDE
181 Series TCX • 3 & 4FL • Micrograin Carbide • Uncoated
25°- 30° Variable Lead Helix, Varying Angles
Square End, Corner Radius & Ball End Configurations

CONICAL TAPERED HSS
204 Series THX • 3 & 4FL • High Speed Steel • Uncoated
25°- 30° Variable Lead Helix, Varying Angles
Square End, Corner Radius Configurations

CONICAL TAPERED LHS
227 Series LHX • 3 & 4FL • High Speed Steel • Uncoated
12° Left Hand Slow Helix, Varying Angles
Square End Configuration

CONICAL CHAMFER CUTTERS
232 Series CFX • 2 & 4FL • Micrograin Carbide • Uncoated
15 - 75°, Varying Angles
Pointed & Flat End Configurations

CONICAL TAPERED CARBIDE MINI
242 Series CCM • 3 & 4FL • Micrograin Carbide • Uncoated
17 - 22° Variable Lead Helix, Varying Angles
Square End, Corner Radius, Ball End Configurations



CONICAL AUTOMOTIVE TAPERS
249 Tapered ATX • 4FL • High Speed Steel • Uncoated
12° Left Hand Slow Helix, 1.5"Taper Per Foot
Square End Configuration

GENERAL PURPOSE

GLOBAL GENERAL PURPOSE
254 Series SL • 4FL • High Speed Steel • Uncoated
30° Constant Helix
Square End, Corner Radius & Ball End Configurations

CUSTOM END MILLS

SPECIAL STRAIGHT
30

TAPERED
31

DOVETAIL CUTTER
32

CHAMFER
33

RIB CUTTERS
34

RUNNER CUTTERS
35

DIE SINKS
36

WEBSITE FEATURES

SUPERIOR DESIGN APPLIES TO MORE THAN JUST TOOLS

We've improved our website design to make finding the information you need easier. Over the next year, we will again redevelop it; applying the principles we learned in the construction of this technical resource and product catalog; add additional information and features; and make it the most comprehensive and up to date resource in the industry.

FIND A DISTRIBUTOR

SEARCH PRODUCTS

CHECK OUR STOCK

REQUEST A QUOTE

DOWNLOADS

Visit our website, call our toll-free number, or contact your distributor to find out how Conical and Global Cutting Tools can improve your performance.

WEBSITE FEATURES

At Conical Tool Company, we continuously advance our cutting tools and our on-line tools.

Now online you'll find:

- Full product offerings
- Distributor listings
- Custom tooling ordering
- Technical research
- Stock checks
- Partnership opportunities
- Request for quote forms
- Downloadable catalogs
- Other technical resources


CUSTOM ORDERING


TECHNICAL INFORMATION


DOWNLOADS


SPEEDS & FEEDS


TROUBLESHOOTING

VISIT US AT CONICALENDMILLS.COM

CATALOG FEATURES

The 2014 catalog features company and product information, an overview of our services and expertise, as well as answers to many frequently asked questions. Request for quote documents, end mill terminology, machining methods and processes, cutting tool applications and a vast amount of technical information is also included.

Collaboration has always been a key to our success. We've included profiles and testimonies from some of our end users and their stories of how our tools and technical expertise have helped their performance and reduced their costs.

COMPANY INFORMATION 1

IT IS OUR MISSION TO PROVIDE SUPERIOR PERFORMING PRODUCTS THAT SOLVE COMPLEX MACHINING CHALLENGES

Everyone knows that it is people with a vision who inspire change and progress. Our founders were successful in creating a legacy of innovation that continues to thrive today.

We encourage you to learn more about our company by reading the following pages and contact us whenever you have questions.

CUSTOM SPECIAL END MILLS

If by chance you can't find the cutting tool you need in our end mill listings, We have always welcomed the chance to produce end mills to your exact specifications, for any application you need. With nearly 35% of our business model dedicated to producing the exact custom end mill or cutter, it's easy to say that at Global Cutting Tools, specials are standard.

70 YEARS OF INNOVATION

We have been a leader in manufacturing and distributing carbide and high speed steel end mills in the USA for 70 years. We have also been one of the chief innovators and trusted resources to the metalworking industry, since our founding in 1944.

CONICAL™ CUTTING TOOLS

GLOBAL™ CUTTING TOOLS

MANUFACTURING FOR OVER 70 YEARS 1944 - 2014

(888) 531-8500 | info@conicaltool.com | www.conicalendmills.com

VISION AND VALUES

OUR HERITAGE, OUR PRINCIPLES AND OUR COMMITMENTS

WHO WE ARE

Premium performance and specialty end mills, manufactured in the USA, without the premium price.

Conical and Global Cutting Tools manufactures a wide range of standard, specialty, performance and custom end mills. We have thousands of stock items, in a wide range of traditional high speed steel, powdered metals, premium micro-grain and ultra-fine carbides; so most orders are shipped the same day. Our distributor network reaches across the country and across borders so you'll be able to have a local expert help you get the most out of your tooling choice.

Each year, we combine thousands of hours of new tool development, hundreds of customer led cutting tool performance evaluations, and continuous improvement processes. This leads to constant product fine-tuning, improved machining methods and inspiration for many of the new tools we develop.

In the event you are unable to find a tool to meet your application needs, or desire to combine multiple processes into a single cutting tool, we have the experts available to consult and design the tool to your exact specifications. Our dedicated custom tooling department, custom built CNC machines, and a staff with hundreds of combined years of experience in the industry; all make us a trusted supplier to some of the most demanding industries and customers.

Simply put, we don't manufacture cutting tools, we engineer solutions for your complex machining challenges.

CUSTOMER SERVICE

We recognize that our loyal customer base is why we are in business. Every company strives for perfection, but just as important is how we effectively address your concerns, if something goes wrong. Our team is trained to provide exceptional service, ensuring accuracy and meeting timelines, while providing a high level of professionalism. We know a single day of downtime can cost a company thousands of dollars, while they are waiting for a replacement end mill or cutting tool. That's why we stock over 3,000 tools with greater than 99% in-stock status and offer same day shipping.

WHERE WE CAME FROM

Spanning the course of over seven decades, our history of manufacturing carbide and high speed steel cutting tools, would take volumes to write. We've developed eight different patents to improve the performance of our tools. The constant helix variable tool, with a variable lead design, was introduced by Conical Tool back in the 1940's and is based on continual calculus formulae, which has never been duplicated.

We have survived many worldwide conflicts, changes in economic outlooks and the pressure of international trade deregulation, with hard work, determination, and innovation. We have continued to provide hundreds of thousands of end mills to the world each year. It is our commitment and perseverance that keeps us moving forward.

We know that we must never forget our history and where we came from. Innovation is our past and will always be our future. In the upcoming pages, you will notice we've added new tooling lines, additional sizes, improved geometries, high-tech coatings, and specialty tooling that reduces cycle time and eliminates tool changing. Moving forward with the newest CNC grinding centers available, while implementing the latest optical scanning equipment, allows us to not only keep up with the changes in the metalworking industry, it allows us to lead those changes. If you need any assistance for your end mill application, or performance, please contact us.

TRADE & MARKET

The manufacturing and materials industry is changing at an unprecedented pace. Simply saying we supply tools to the metalworking industry would leave out a large portion of our customer base. Our tools have been used in every application imaginable, from sculptural ice carving to precision manufacturing of custom nuclear reactor parts.

HISTORY

CONICAL TOOL HAS EXCELLED IN END MILL INNOVATION SINCE 1944

KENNETH STANABACK - *FOUNDER & PRESIDENT*

1944 to 1988

Ken Stanaback was the founder of Conical Tool Company. He recognized early on in his tooling experience, the necessity for a tapered end mill. The design of such a revolutionary cutting tool kept him on a quest that would culminate with his patented "constant spiral" tapered end mill. Countless hours of his time were spent refining what would turn out to be one of the major breakthroughs in the cutting tool industry in the 1940's. From 1944 well into the 1950's, Ken, through much trial and error, was able to offer ten different types of end mills. For nearly a decade Ken was owner, grinder, milling machine operator, flute polisher, and salesman. For Ken, working sixty hour weeks was a way of life. The early sacrifices included having to live and raise a small family in the front of the shop they owned. By the 1960's the ever increasing popularity of the tapered end mill pushed Ken to begin selling worldwide.

Conical was now manufacturing end mills for England, Germany, Japan and over thirty more countries. The 1970's ushered in many new inventions which would help keep up with production levels for a worldwide market. Ken converted eight Cincinnati vertical mills into tapered end mill grinders using "automatic" technology and an ingenious mix of hydraulics and pneumatics. He was able to adapt the machines to grind the flutes and radial back-off using a borazon grinding wheel. The quality they maintained compares closely to today's CNC grinding machine centers. They eventually contributed to about 60% of Conical's overall production of quality end mills and tooling at that time. To keep up with the times, Ken began investing in numerous CNC driven machines. Faster production speeds and improved quality were quickly realized. Always the inventor, Ken developed yet another type of CNC milling machine, adapted from Cincinnati horizontal mills and the clever usage of multiple electric motors. These mills are still producing quality end mills as of this writing. In 1988, Ken was diagnosed with cancer. Even with this on his mind, he still insisted on being taken back to the shop from the hospital to make sure his new milling machines were running properly. Ken's engineering and mathematical brilliance made anyone who knew him hard-pressed to find a better, or fairer employer.

HARRIET STANABACK - *PRESIDENT*

1988 to 2004

After Ken's passing in 1988, Harriet Stanaback took over a growing and changing company. Harriet began working for Conical Tool in 1962. Hired as an office administrator, Harriet worked her way into Ken's respect and trust. By asking Ken frequent questions, she learned many of the intricacies of how the business ran and just as importantly, how end mills were produced. Her thoroughness was an excellent quality to have around. It didn't take long before her creativity began to show. Harriet conceived of a way to better track the progression of tooling through the shop to get a more accurate idea of what the tools actually cost to produce. All of her twenty-six years of earlier experience and knowledge propelled Harriet for the ultimate challenge she would face, running Conical Tool alone after Ken's passing. She handled it with maturity and confidence learned from years of experience working with experts.

The CNC carbide end mill revolution had to be accelerated even quicker than before. The end mill tooling industry was changing very rapidly, so Harriet decided to swing the focus of the company to more progressive machines, like the ANCA tooling centers and the Tru Tech production grinders. Although difficult, phasing out some of Ken's early end mill machinery was necessary to make room for the newer CNC machines needed to produce carbide end mills. The new machines kept Conical competitive through the difficult economic times of the 1990's and into the 21st century. These decisions saved numerous jobs, and kept Conical in the forefront of the very competitive carbide tooling market. After fifteen years in charge, Harriet knew that new blood was necessary to keep Conical on the right path.

DAVID MELINN & DENNIS AVERY - *CEO & PRESIDENT*

2004 to 2012

David and Dennis both began their tooling careers at Conical Tool in the late 1970's. Dave Melinn stayed at Conical from 1975 until 1980, leaving to work for Great Lakes Grinding in Grand Rapids, MI for seven years. Dave left Great Lakes to become the Plant Manager with Wolverine Cutter. There, many unique tool designs, like the crest-cut end mills, roughing end mills, carbide end mills, form tools, t-slot cutters, and milling cutters, continued to be added to Dave's resume. After three years of specialized experience, Dave was ready to take on the task of owning his own regrind business. From 1990 to 2002, Dave and his wife Hanny ran Melinn Tool, regrinding was his forte and it didn't take long before the word spread. Becoming an employer himself gave him the drive to take on an even bigger challenge, the eventual ownership of Conical Tool Company.

Dennis Avery worked in many areas of the shop. One day he might be cutting off steel, the next running lathes, then working in the milling department. He eventually left Conical for three years to explore the job market. In the early 1980's, Denny came back to do cutter grinding and program the new CNC lathes. He was quick to adapt to the CNC controls of the new Mazak lathes, and was put in charge of the production of that department. Soon after this, he was given the responsibilities of the milling department. During the early 1990's, Denny assumed just about every position, ceaselessly learning everything he could absorb.

Not unnoticed by Harriet Stanaback, Denny was made foreman and then operations manager. In 2002, David and Dennis were approached by Harriet Stanaback about her desire to sell the company. The offer was, as they well knew, a very difficult one for Harriet to make. She knew that with the vast experience Dave had accumulated and the long term commitment Denny had shown to the company, they could help Conical Tool thrive. They bought Conical Tool Company after the retirement of Harriet Stanaback in 2004 and took on the legacy that was established since Conical's beginning. Together, they developed multiple new types of cutting tools. Joining the expanding line of high-speed and carbide end mills, they added automotive taper end mills, carbide miniature end mills, profile rib cutters and countersink end mills.

ROBERT M. SHINDORF – *PRESIDENT*

2012 to present

The great recession took its toll on the traditional American business model of a technical entrepreneur. Commodity pricing created an opportunity for massive tungsten mining operations to begin creating cheap and poor performing end mills as a way to sell more powder. It became clear that if the company was to compete with international end mill manufacturing giants, a new executive would be needed with vast experience. The new executive needed the ability to cross international mercantile boundaries, have strong financial skills and make the right decisions in an instant. Developing new market strategies and analyzing the direction and trends of the metalworking industry, would never be more imperative. Robert M. Shindorf had spent the last 10 years starting, developing and improving multiple companies. He began his management consulting career working for an international business consulting firm, traveling around the country, helping privately owned businesses.

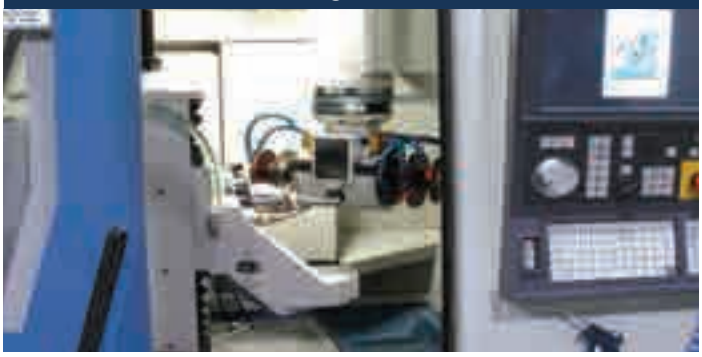
As a driven individual, Robert left the company to start his own management, tax and advisory firm. Having helped to turnaround and improve over 1,800 companies nationwide, Robert decided to develop an "acquire and improve" model to take companies from stagnation to new heights. His experience working directly with financial institutions, to build comprehensive plans for reorganization, allowed him to quickly improve the financial position of the company and begin working on new high performance end mills and cutting tools. Maintaining a wealth of international market experience, Robert began to develop new material sources and new distributors in which to offer the new product lines that were developed. Over the next years, with considerable investment in infrastructure and talent, Robert is taking Conical Tool Company back to its roots of innovation, adaptation and technical experience; unparalleled elsewhere in the carbide end mill and cutting tool industry.

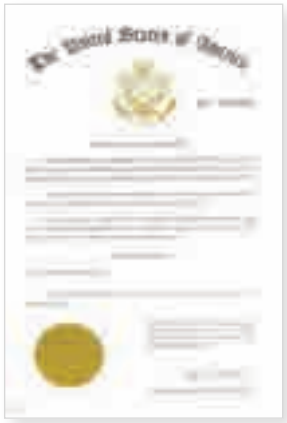
FIND OUT ABOUT OUR GUARANTEED TEST TOOL PROGRAM TODAY
(888) 531-8500 OR
SALES@CONICALTOOL.COM

see page 76 to learn about our program

1949

2014







PATENTS & CERTIFICATES

CONICAL TOOL COMPANY WAS FOUNDED IN 1944 BY KEN STANABACK TO PRODUCE AND MARKET HIS NEWLY INVENTED AND PATENTED CONSTANT-SPIRAL TAPERED END MILLS

Their unique capabilities and proven performance quickly won the interest and respect of diverse industries.

All of us at Conical, many of whom have worked here for 20 years or more, are very proud of this heritage and dedicated to continuing it. Our roster of skilled tool makers and excellent support staff has made the transition from a manufacturer of specialty tapered end mills to a premier manufacturer of high performance cutting tools, seamless. We continue to maintain international patents and actively sell to over 30 countries worldwide.

Every cutting tool is designed and manufactured with performance put before profit. We use premium materials, ultra-precision instruments and hundreds of hours of testing before ever marketing a product. You will reap the rewards of our commitment to perfection with every cutting tool you buy from us.

In the coming months, we will be leaning on our history of innovation and commitment to our customers. Thousands of new tools are being launched with the most advanced geometries available on the market. We will continue to design, engineer, test and improve our tools each and every year.

Your satisfaction is guaranteed.

INTERNATIONAL PATENTS INCLUDE U.S., GREAT BRITAIN, GERMANY, HOLLAND, AND CANADA

visit our website at conicalendmills.com for more information

F.A.Q.'S

FREQUENTLY ASKED QUESTIONS

Q: What type of technical assistance can we expect from Conical Tool Company?
A: You can get technical assistance and help with:

1. Selecting the right application specific end mill (tapered, standard, micro, chamfer, clearance cutter, runner cutter, profile cutter, etc.);
2. Selecting the right end mill material (carbide, cobalt, high speed steel, cbn, etc.);
3. Selecting the right feeds and speeds;
4. Selecting the right coating for your workpiece material and application (TiN, TiCN,TiAlN, AlTiN, AlTiN Nano, ZrN, TiB2, Amorphous Diamond, CVD Diamond, PVD Diamond, or custom coating);

By calling us at (616) 531-8500 or Toll Free at (888) 531-8500. Alternatively, you may visit our research and technical center on our website, if your question arises after-hours. If you prefer email, you may direct general questions to sales@conicaltool.com and advanced / technical questions to tech@conicaltool.com

Q: Does Conical Tool Company have an E-Bay, Amazon or on-line storefront yet?
A: We are currently developing a multi-channel e-commerce site so you may purchase our products through any number of convenient, online methods. Special overrun and discontinued items will be offered at extreme discounts.

Q: I need information on speed and feed rates, how can I get it?
A: All speed and feed rates are available at the end of each product chapter, in our research and technical center on our website and through links at the bottom of each page on our website. RPM tables are also available to make programming and process engineering a little easier.

Q: Are your end mills manufactured here in the U.S.A?
A: Yes. Not only are all of our end mills manufactured in the United States of America, but we also purchase all of our materials from U.S. companies. It's not always the most profitable way of running a business, but quality matters to us and we believe it's the right thing to do. Our primary facilities are located in Grand Rapids, Michigan, USA, though we supply end mills to 60 countries worldwide and every state in the union.

Q: Does Conical Tool Company offer resharpening, regrinding, reconditioning or re-coating of its end mills?
A: Yes. We offer resharpening, regrinding, reconditioning and re-coating of our own end mills as well as the same services for nearly all other manufacturers and cutting tools in the metalworking industry.

Q: Are Conical and Global end mills CNC manufactured?
A: Every carbide and high speed steel end mill or cutting tool is precision made on one of our state of the art CNC machines or our custom built CNC mills. No one holds the tolerances we do for any specialty tooling. That's why we are an approved supplier for the Department of Defense and many aerospace machining and medical manufacturing companies.

Q: Does Conical Tool Company ship internationally?
A: Of course. We have been helping leading companies across the world increase quality and reduce cycle time for decades.

GET ANSWERS TO YOUR QUESTIONS

We aspire to make it as easy as possible for you to find the information you need. If you do not find what you are looking for, please contact us and we can help with any questions you may have. We offer technical support with choosing the correct end mill, your particular machine setup, application questions, or any other inquiry you may have.

CUSTOMER SERVICE

We ensure that every one of our customers needs and expectations are met. We understand that our customers are the most valuable part of our business, and we strive to establish and maintain long term relationships with them. If perchance we make a mistake, we will do everything in our power to correct the mistake. Suggestions and comments are always welcome and appreciated, so please do not hesitate to contact us.

2 PRODUCTS & SERVICES

OUR SENIOR STAFF MEMBERS ALONE HAVE
OVER 250 YEARS OF COMBINED INDUSTRY COMMITMENT

We don't manufacture cutting tools, we engineer solutions for complex machining challenges.

The following pages have information on tool re-conditioning, sharpening, modifications, custom tool ordering, coatings, testimonials, as well as corresponding technical information.

INNOVATION

Each year, we combine thousands of hours of new tool development, hundreds of customer led cutting tool performance evaluations, and contiuous improvement processes. This leads to constant product fine-tuning, improved machining methods and inspiration for many of the new tools we develop.

CUSTOMER SERVICE

Nearly 7,000 distributors worldwide and hundreds of thousands of end users can't be wrong. Our lead-by-example culture has allowed us to provide exceptional customer service, build long lasting customer relationships, and manufacture the highest performing end mills and cutting tools in the industry.

(888) 531-8500 | info@conicaltool.com | www.conicalendmills.com

CONICAL™ CUTTING TOOLS

GLOBAL™ CUTTING TOOLS

MANUFACTURING FOR OVER 70 YEARS 1944 - 2014

PRODUCTS & SERVICES OVERVIEW

WE OFFER THE FOLLOWING SERVICES IN ADDITION TO OUR STOCK TOOLS

STANDARD SERVICES

Resharpening, , Restoring and Reconditioning

Highly advanced geometries require a highly advanced reconditioning program. Through state of the art CNC equipment, we are able to develop a 3D model of every manufacturer's geometry and restore end mills and drills to like-new status. Utilizing our program can result in a tooling cost reduction of over 75%, maximizing the life of your precision, performance cutting tools.

Tool Modification

We pride ourselves on one of the largest inventories of specialty and performance cutting tools in the industry, but we know the sophistication and progression of the metalworking business has required the use of many special cutting tools. Within 48 to 72 hours we can modify tools from stock to meet many of your just-in-time needs and specifications.

Advanced Specialty Coatings (ASC) Selection

Certain applications, materials and performances require the enhancement of a specialty coating and knowledge of the properties and coatings available. Temperature, friction resistance, hardness, lubricity, toughness and cohesion of the resulting process must be examined prior to the selection.

PRE-PRODUCTION BASED

Advanced Material Selection (AMS)

Proper selection of end mill materials is no less important than proper selection of workpiece materials. Using our Advanced Materials Selection (AMS) process can identify the correct end mill material for difficult to machine workpiece materials; improving micro-finishes, performance and tool life.

Custom Tool Design

If by chance you can't find the cutting tool you need in our end mill listings, Conical has always welcomed the chance to produce end mills to your own exact specifications, for any application you need. Nearly 30% of our business model is dedicated to producing custom cutters. It's easy to say at Conical Tool Company, specials are standard.

Custom Tool Manufacturing

Submit an existing tool print to us and we can make recommendations for improvements or begin working on manufacturing your custom tooling needs and deliver your tool through our streamlined, Urgent Tooling Program (UTP). Standard processing is available, but with our dedicated specials department, you'll find delivery is most often 50% faster than our competitors.

PRODUCTION BASED

Manufacturing Process Improvement (MPI)

With engineering requirements accelerating at a demanding pace, it's often difficult to determine how to approach a specific machining challenge. Our technical department is full of experts with insight on tooling options, approaches and machining applications. Often our massive inventory has a solution already, if not, we are able to begin designing a tool to condense multiple operations into a single tool while simultaneously increasing production speeds.

Speeds and Feeds Programming

We spend thousands of hours each year dedicated to tooling development, testing new tools and out-performing our competition. Just as important is providing our customers technical resources to program each tool for its optimal performance. Each tooling line is complete with specific recommendations for speeds and feeds, cross referenced against a plethora of materials.

Troubleshooting

Vibration, noise, workpiece hardening and premature breakage can baffle even the most experienced operator. We've included in this document the most comprehensive troubleshooting guide available to get you through most challenges. If you're still stumped, contact our technical department and we'll figure it out together.

TECHNICAL & RESEARCH

End Mill Terminology

We all had to learn somewhere. Wouldn't it have been nice to have a guide to know exactly what your manufacturing rep was talking about? There's no secrets anymore, we believe educating our customers on the differences in end mill geometries will simply help them understand why we produce the best cutting tools on the market.

Machining Methods

Climb mill or conventional? Ramping or plunge entry? We explain the differences and can be a resource to help you select the proper application to extend tooling life and improve your performance.

Material Data Sheets

You can't be expected to be an expert on everything. We have combined multiple industry guides into single material resource guides to select the proper material for your machining application or custom tool.

ADDITIONAL SERVICES

Specialty Material Distribution

Through our international trade connections, we've developed relationships that allow us to pass on savings for materials to your in-house cutter grinders.

Tool Selection / Thousands of Standards

Knowing is half the battle. No one has a better understanding of the tool selection requirements than our customer service department. If, by chance they are unsure, we've empowered them to pass our customers on directly to our technical resource department.

Help Locating a Distributor

Connecting you to a supplier based on location, lines of coverage, and expertise is easy with our database of nearly 7,000 distributors worldwide.

Quality Control and Conformance Reports

Our tooling is always inspected using ISO conforming optical measuring equipment so you can be sure of its quality. In more exacting industries, we can provide material, batch and individual tooling conformance reports to meet your quality standards.

OVER THE COURSE OF OUR HISTORY, CONICAL TOOL HAS BEEN AN ACTIVE MEMBER OF THE COMMUNITY, A MEMBER OF MANY ORGANIZATIONS, AND FEATURED IN MANY LOCAL AND NATIONAL PUBLICATIONS

GRAND RAPIDS AREA CHAMBER OF COMMERCE

MICHIGAN CHAMBER of Commerce

MMA

BBB

NFIB The Voice of Small Business.

TOOL RECONDITIONING PROGRAM

REGRIND ONLY: 1 WEEK; REGRIND & COATING: 2 WEEKS

OVER 70 YEARS OF TOOL GRINDING EXPERIENCE

It's obvious regrinding, reconditioning and re-coating cutting tools results in a reduction of overall tooling costs. Conical and Global Cutting Tools has a history of regrinding tools to near original specifications, restoring the end mill to as good as new, regardless of its original manufacturer. Our experienced staff is here to help find the right solution for your tooling needs.

Prices vary and are based on coating and diameter size. It does not matter how badly the tool may be damaged, we can regrind nearly any end mill, regardless of condition. By the off chance we cannot recondition an end mill to customer required specification, we will recycle the tooling, unless otherwise noted.

We will resharpen or recondition any tool, regardless of original manufacturer. Sharpening is normally limited to outside diameter primary land and end work only, while reconditioning may apply where excessive chipping or breakage exists and larger stock amounts must be removed. Most any tool can be resharpened, however, when normal re-sharpening is not sufficient, reconditioning may be needed.

BEFORE

AFTER

GENERAL INFORMATION

The operational life of a tool depends on how excessively a dull tool has been used. Continued use of a dull end mill after it's reasonable life expectancy will require additional stock removal to make it usable again or cause the tool to break while in use. In general, resharpening is required when wear is visible on the top cutting edge, excess heat is generated or vibrations create an audible increase in noise.

For cost-effective regrinding, we suggest 1/4" in diameter end mills and above to justify setup costs. For optimal performance, regrinding or reconditioning is imperative before excessive deterioration of the tool is evident.

At the end of the production run, cutting tools should be removed from the machine and examined. Deteriorated or chipped end mills may need to be re-fluted to restore proper flute structure and radial rake. Cavities and chips on the cutting edge will result in built up edge and will usually cause breakage of carbide end mills. After numerous regrinds, the tool will lose its effectiveness. Rake angle and flute depth is diminished and the end mill is no longer able to be reconditioned.

Regrinding reduces the diameter of the end mill and causes the radial rake angle and hook to recede. In general, reducing the diameter by the below equations can still maintain effectiveness by up to 80% of the original tool.

DIAMETER	OPERATIONAL LIFE		LIGHT RECONDITION		HEAVY RECONDITION	
	PERCENT	DIAMETER	REMOVAL AMOUNT	# OF REGRINDS	REMOVAL AMOUNT	# OF REGRINDS
.250	15.00%	.213	.005	7	.020	1
.375	14.00%	.323	.005	10	.020	2
.500	13.00%	.435	.005	13	.020	3
.625	12.00%	.550	.005	15	.020	3
.750	11.00%	.668	.005	16	.020	4
1.000	10.00%	.900	.005	20	.020	5
>1.250	8.00%	>1.150	.005	>20	.020	>5

END MILL RESHARPENING FORM

PLEASE COPY OR VISIT THE DOWNLOAD SECTION OF OUR WEBSITE.
DO NOT TEAR OUT.

CONICAL™ CUTTING TOOLS

GLOBAL™ CUTTING TOOLS

No minimum order. Typical turnaround is 1 week for standard, uncoated tools. For high performance, specialty or coated tools allow approximately 2 weeks for delivery. Pricing listed is for 2 to 5 flute tools for resharpening services only. Tools which require extensive reconditioning, re-ending, refluting or exceptional service requirements may have an additional charge.

DIAMETER		LENGTH OF CUT	GENERAL PURPOSE - UNCOATED				GENERAL PURPOSE - COATED				HIGH PERFORMANCE - COATED			
			SQUARE END		C.R. / BALL END		SQUARE END		C.R. / BALL END		SQUARE END		C.R. / BALL END	
INCH RANGE	METRIC RANGE		QTY	PRICE	QTY	PRICE	QTY	PRICE	QTY	PRICE	QTY	PRICE	QTY	PRICE
Up to 0.250	Up to 6.0	Up to 2.0 x D		9.95		12.85		12.95		16.75		16.75		19.25
		2.1 x D - 3.5 x D		10.95		14.15		13.95		18.05		18.05		20.75
		Over 3.5 x D		11.95		15.45		14.95		19.35		19.35		22.25
0.251 - 0.313	6.0 - 8.0	Up to 2.0 x D		11.35		14.15		14.35		17.85		18.65		21.35
		2.1 x D - 3.5 x D		12.55		15.65		15.55		19.35		20.15		23.15
		Over 3.5 x D		13.65		17.05		16.65		20.75		21.55		24.75
0.314 - 0.375	8.0 - 9.5	Up to 2.0 x D		13.05		16.25		16.55		20.65		20.85		23.95
		2.1 x D - 3.5 x D		14.35		17.85		17.85		22.25		22.45		25.75
		Over 3.5 x D		15.65		19.55		19.15		23.85		24.05		27.65
0.376 - 0.438	9.5 - 11.0	Up to 2.0 x D		14.95		18.65		18.95		23.65		23.85		27.35
		2.1 x D - 3.5 x D		16.45		20.55		20.45		25.55		25.75		29.55
		Over 3.5 x D		17.95		22.35		21.95		27.35		27.65		31.75
0.439 - 0.500	11.0 - 12.5	Up to 2.0 x D		17.15		21.35		22.15		27.65		27.85		31.95
		2.1 x D - 3.5 x D		18.85		23.55		23.85		29.75		30.05		34.55
		Over 3.5 x D		20.55		25.65		25.55		31.85		32.15		36.95
0.501 - 0.563	12.5 - 14.0	Up to 2.0 x D		19.65		24.55		25.15		31.35		31.65		36.35
		2.1 x D - 3.5 x D		21.65		27.05		27.15		33.85		34.15		39.25
		Over 3.5 x D		23.55		29.35		29.05		36.25		36.55		41.95
0.564 - 0.625	14.0 - 16.0	Up to 2.0 x D		22.55		28.15		28.55		35.65		35.95		41.25
		2.1 x D - 3.5 x D		24.85		31.05		30.85		38.55		38.85		44.65
		Over 3.5 x D		27.05		33.75		33.05		41.25		41.55		47.75
0.626 - 0.688	16.0 - 17.5	Up to 2.0 x D		25.85		32.25		31.85		39.75		40.05		46.05
		2.1 x D - 3.5 x D		28.55		35.65		34.55		43.15		43.45		49.95
		Over 3.5 x D		31.05		38.75		37.05		46.25		46.65		53.55
0.689 - 0.750	17.5 - 19.0	Up to 2.0 x D		29.65		37.05		36.15		45.15		45.45		52.25
		2.1 x D - 3.5 x D		32.75		40.85		39.25		49.05		49.45		56.85
		Over 3.5 x D		35.65		44.55		42.15		52.65		53.05		60.95
0.751 - 0.875	19.0 - 22.0	Up to 2.0 x D		34.95		43.65		42.95		53.65		54.05		62.15
		2.1 x D - 3.5 x D		38.55		48.15		46.55		58.15		58.65		67.35
		Over 3.5 x D		42.05		52.55		50.05		62.55		63.05		72.45
0.876 - 1.000	22.0 - 25.0	Up to 2.0 x D		41.15		51.35		51.15		63.85		64.35		73.95
		2.1 x D - 3.5 x D		45.45		56.75		55.45		69.25		69.85		80.25
		Over 3.5 x D		49.55		61.85		59.55		74.35		74.95		86.15

SPECIALTY CUTTING TOOLS

QUANTITY	MANUFACTURER, TOOL NUMBER & DESCRIPTION

SPECIAL INSTRUCTIONS

Damaged end mills beyond repair will be recycled unless otherwise selected:

☐ Recycle ☐ Return ☐ Replace

SHIP TO:

Global Cutting Tools / Conical Cutting Tools
Regrinding Department
3890 Buchanan Ave SW
Grand Rapids, MI 49548

RETURN SHIPPING:

☐ UPS - Next Day Air ☐ UPS - 2 Day Air

☐ UPS - 3 Day Air ☐ UPS - Ground

☐ Pre Pay & Add ☐ Collect #:

RETURN TO (CUSTOMER)

Purchase Order: _____

Contact: _____

Company: _____

Address: _____

_____

_____

Phone / Fax: _____

Email: _____

BILL TO (DISTRIBUTOR):

Purchase Order: _____

Contact: _____

Company: _____

Address: _____

_____

_____

Phone / Fax: _____

Email: _____

3890 Buchanan Ave SW • Grand Rapids, MI 49548 • T: (888) 531-8500 P: (616) 531-8500 F: (616) 531-7742 • conicalendmills.com • quotes@conicaltool.com

TOOL MODIFICATION PROGRAM

MODIFICATION OF IN-STOCK TOOLS IN AS LITTLE AS 48 HOURS

INTRODUCTION TO OUR PROGRAM

In most cases, we will have an in stock tool capable of meeting your manufacturing requirements. Often, what many manufacturers with less product depth would consider a special tool, can be created by modifying an in stock tool to fit your specifications. Our expert engineers will assess each modification request and provide the optimal solution. If deemed a special is necessary to fulfill your requirements, you will be promptly advised. Most special quotes, regardless of the necessary steps to fulfilll your request, can be quoted within 1 business day and will include price and delivery. Modifications ensure faster delivery of your tool (subject to availability), decrease costs and ship within 2-3 business days. Please allow additional time for coatings.

We can modify tools to include a corner radii, ball end, corner chamfer, weldon flats, wiper flats, coolant grooves, whistle notches, LOC & OAL adjustments, cutting diameter adjustments, neck lengthening, and coatings. Several modifications can be made on the same tool, effectively creating a complete custom tool, without the price and lead time issues. However, there are certain multiple mods that can conflict and are impossible. For instance, a corner chamfer cannot be added with a corner radius. All modified tools may not be returned.

PERFORMANCE & TOLERANCE

Modifications may potentially affect tool performance. Each of the following tables will outline tolerances and dimensions for modified tools only and should not be referenced for our standard tools.

END MODIFICATIONS

CUSTOM ENDS FOR FINISHING APPLICATIONS

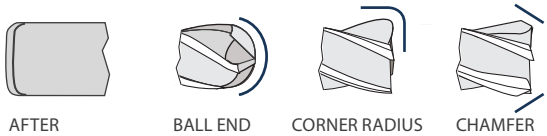
Most of our tool lines have standard and optional end configurations to suit traditionally engineered parts. Occasionally, it's necessary to modify a standard tool, add a ball end, corner chamfer or custom sized corner radius. If modifying a tool with coating, the corners and / or end of the tool may no longer be completely coated, degrading the quality of the tool and its performance. We recommend having the coating reapplied to maximize the performance, value and life of the tool.

BALL, RADIUS, CHAMFER

RADIUS/CHAMFER RANGE	MINIMUM DIAMETER	MODIFICATION COST (BY QTY) 2 - 4 FLUTE				
		1-2	3-6	7-11	12-20	21+
0.015 - 0.031	1/8	49.45	19.95	16.45	14.95	13.45
0.032 - 0.047	3/16	50.95	20.95	16.95	15.45	13.95
0.048 - 0.063	1/4	52.45	21.95	17.45	15.95	14.45
0.064 - 0.094	3/8	53.95	22.95	17.95	16.45	14.95
0.095 - 0.125	1/2	55.45	23.95	18.45	16.95	15.45
0.126 - 0.156	5/8	56.95	24.95	18.95	17.45	15.95
0.157 - 0.188	3/4	58.45	25.95	19.45	17.95	16.45
0.189 - 0.250	1	59.95	26.95	19.95	18.45	16.95

Add 33% for Ball Ends; Radius / Chamfer Diameters < 0.015; and Radius / Chamfer Diameters > 25% of Tool Diameter
Add 25% for 5 Flute and 50% for 6 Flute Tools
Radius & Chamfer Tolerance +/- .005; Tangency Tolerance +/- .003

BEFORE

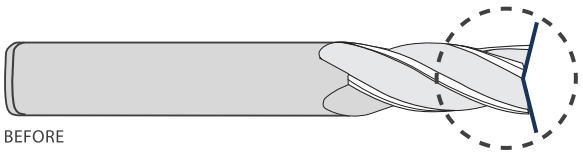


AFTER BALL END CORNER RADIUS CHAMFER

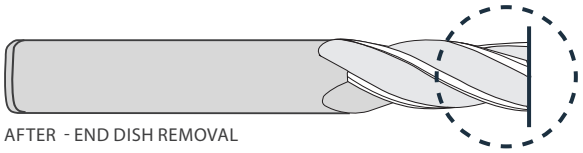
END DISH REMOVAL

CUTTER DIAMETER	MODIFICATION COST (BY QUANTITY)				
	1-2	3-6	7-11	12-20	21+
Up to 0.125	49.45	17.95	12.45	8.45	7.45
0.126 - 0.187	50.95	18.95	12.45	8.45	7.45
0.188 - 0.250	52.45	19.95	12.45	8.45	7.45
0.251 - 0.375	53.95	20.95	12.95	8.95	7.45
0.376 - 0.500	55.45	21.95	13.45	9.45	7.95
0.501 - 0.625	56.95	22.95	13.95	9.95	8.45
0.626 - 0.750	58.45	23.95	14.45	10.45	8.95
0.751 - 1.000	59.95	24.95	14.95	10.95	9.45

Cutter Diameter references the cutting end of the tool and not the shank diameter
Length of Cut and Overall Length will be reduced by up to 0.015 +/- 0.010



BEFORE



AFTER - END DISH REMOVAL

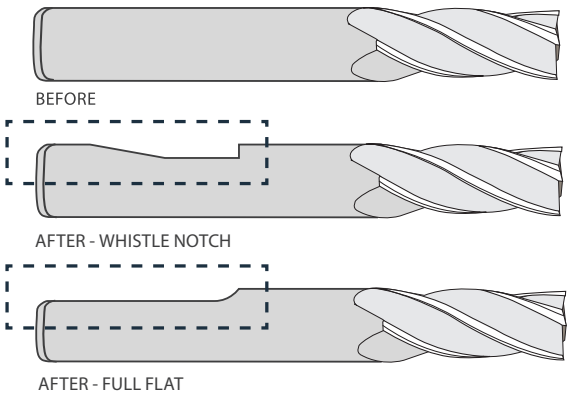
SHANK MODIFICATIONS

IMPROVED HOLDING POWER AND REACH

Our tools are precision manufactured to exceed H6 shrink fit specifications, whether high speed steel, powdered metal or carbide. HSS and PM tooling comes standard with single or double weldon flats, multiple carbide tools have standard weldon flat options, and all can be modified as needed. Many users add hand ground flats themselves, which can result in increased tool runout, decreased productivity, decreased finish and alignment issues. By adding manufacturer ground flats, you ensure minimized runout, parallelism with the centerline of the tool and consistency.

WHISTLE & FULL FLAT

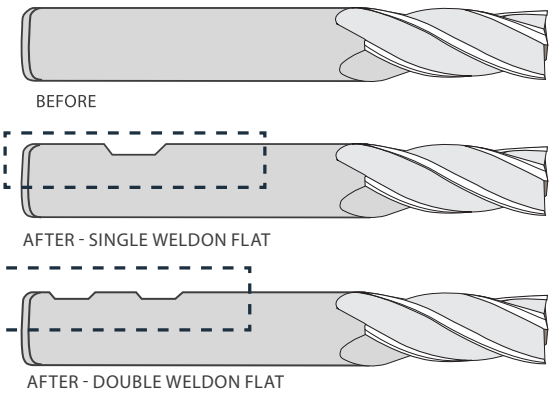
SHANK DIAMETER	MODIFICATION COST (BY QUANTITY)				
	1-2	3-6	7-11	12-20	21+
Up to 0.125	29.95	12.95	8.45	5.95	4.95
0.126 - 0.187	29.95	12.95	8.45	5.95	4.95
0.188 - 0.250	29.95	12.95	8.45	5.95	4.95
0.251 - 0.375	30.95	12.95	8.45	6.95	4.95
0.376 - 0.500	31.95	12.95	8.45	6.95	4.95
0.501 - 0.625	32.95	13.95	8.95	7.95	5.95
0.626 - 0.750	33.95	14.45	9.45	7.95	5.95
0.751 - 1.000	34.95	14.95	9.95	7.95	5.95



WELDON

SHANK DIAMETER	MODIFICATION COST (BY QUANTITY)				
	1-2	3-6	7-11	12-20	21+
Up to 0.125	9.95	9.95	7.95	7.45	5.95
0.126 - 0.187	9.95	9.95	7.95	7.45	5.95
0.188 - 0.250	10.95	10.95	8.45	7.45	5.95
0.251 - 0.375	11.95	11.95	8.95	7.95	6.45
0.376 - 0.500	12.95	12.95	9.45	8.45	6.95
0.501 - 0.625	13.95	13.95	9.95	8.95	7.45
0.626 - 0.750	14.95	14.95	10.45	9.45	7.95
0.751 - 1.250	15.95	15.95	10.95	9.95	8.45
0.751 - 1.250*	19.95	19.95	14.95	11.95	10.95

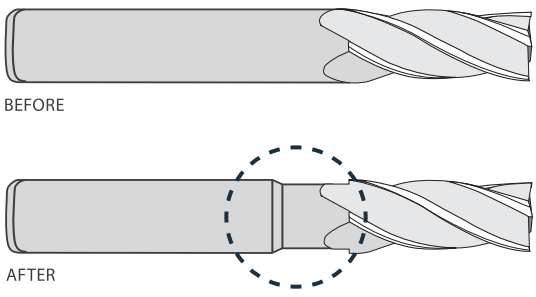
*Indicates Double Weldon Flat Standard



NECK RELIEF

SHANK DIAMETER	DEPTH OF RELIEF	LENGTH OF RELIEF	MODIFICATION COST (BY QUANTITY)				
			1-2	3-6	7-11	12-20	21+
Up to 0.125	0.007	0.250	24.95	11.95	6.95	4.95	4.95
0.126 - 0.187	0.012	0.375	24.95	11.95	6.95	4.95	4.95
0.188 - 0.250	0.015	0.750	25.95	12.95	7.95	5.95	4.95
0.251 - 0.375	0.020	0.750	25.95	12.95	7.95	5.95	4.95
0.376 - 0.500	0.025	0.750	25.95	12.95	7.95	5.95	4.95
0.501 - 0.625	0.035	0.750	29.95	14.95	9.95	7.95	6.95
0.626 - 0.750	0.035	0.750	29.95	14.95	9.95	7.95	6.95
0.751 - 1.000	0.040	0.750	29.95	14.95	9.95	7.95	6.95

Add 25% for longer lengths



FLUTE MODIFICATIONS

PERFORMANCE AND OPERATION ENHANCEMENTS

Modifying a tool with coating, or adjusting the cutter diameter, shortens the flute depth and lessens the radial rake, which removes the coating from already coated tools. We recommend building a custom tool for quantities greater than 3, unless the diameter adjustment is less than 7.5% of the tool's original diameter. Similarly, when adding chip breakers to a tool, the tool should be re-coated to avoid build up edge in the breaks, increased horsepower requirements and to reduce the likelihood of breakage.

CHIP BREAKERS

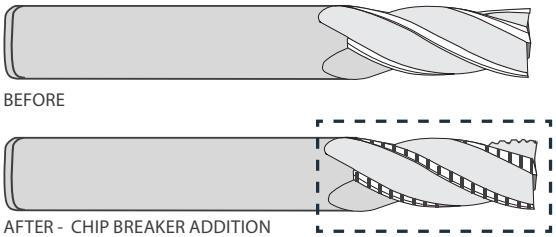
SHANK DIAMETER	MODIFICATION COST (BY QUANTITY) 2 - 4 FLUTE				
	1-2	3-6	7-11	12-20	21+
Up to 0.125	49.45	19.95	16.45	14.95	13.45
0.126 - 0.187	50.95	20.95	16.95	15.45	13.95
0.188 - 0.250	52.45	21.95	17.45	15.95	14.45
0.251 - 0.375	53.95	22.95	17.95	16.45	14.95
0.376 - 0.500	55.45	23.95	18.45	16.95	15.45
0.501 - 0.625	56.95	24.95	18.95	17.45	15.95
0.626 - 0.750	58.45	25.95	19.45	17.95	16.45
0.751 - 1.000	59.95	26.95	19.95	18.45	16.95

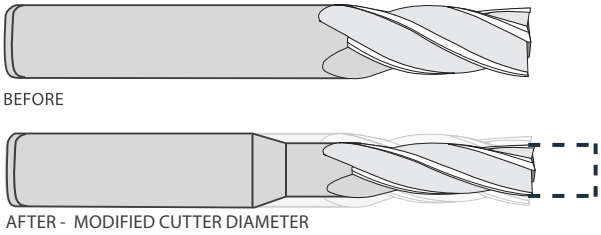
Add 25% for 5 Flute and 50% for 6 Flute Tools
Add 25% for longer lengths

DIAMETER ADJUSTMENT

SHANK DIAMETER	MODIFICATION COST (BY QUANTITY) 2 - 4 FLUTE				
	1-2	3-6	7-11	12-20	21+
Up to 0.125	49.45	19.95	16.45	14.95	13.45
0.126 - 0.187	50.95	20.95	16.95	15.45	13.95
0.188 - 0.250	52.45	21.95	17.45	15.95	14.45
0.251 - 0.375	53.95	22.95	17.95	16.45	14.95
0.376 - 0.500	55.45	23.95	18.45	16.95	15.45
0.501 - 0.625	56.95	24.95	18.95	17.45	15.95
0.626 - 0.750	58.45	25.95	19.45	17.95	16.45
0.751 - 1.000	59.95	26.95	19.95	18.45	16.95

Add 25% for 5 Flute and 50% for 6 Flute Tools
Add 25% for longer lengths





RECONDITIONING PROGRAM

REGRIND ONLY: 1 WEEK; REGRIND & COATING: 2 WEEKS

70 YEARS OF GRINDING EXPERIENCE

RE-SHARPENING SERVICES

Prices vary and are based on coating and diameter size. It does not matter how badly the tool may be damaged, we can regrind most any end mill. We will re-sharpen or recondition any tool, even competitor brands. Most any tool can be re-sharpened, however, when normal re-sharpening is not sufficient, reconditioning may be needed.

SEE PAGES 14 -15 FOR DETAILS

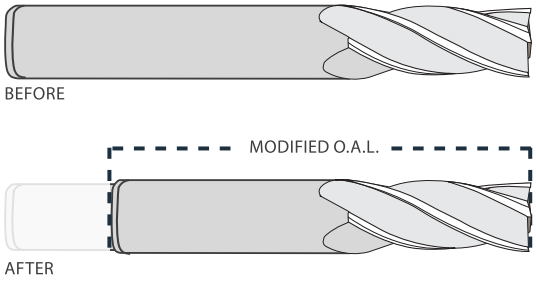
LENGTH MODIFICATIONS

GEOMETRY IMPROVEMENTS FOR MAXIMUM STABILITY

If modifying a tool with a coating, the tool will no longer be coated, degrading the quality of the tool and its performance. We recommend having the coating reapplied to maximize the performance, value and life of the tool.

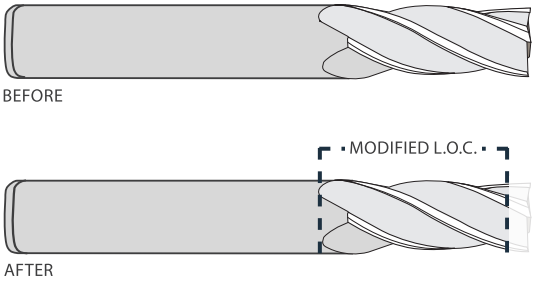
OAL REDUCTION

SHANK DIAMETER	MODIFICATION COST (BY QUANTITY)				
	1-2	3-6	7-11	12-20	21+
Up to 0.125	29.95	9.95	8.45	7.95	6.95
0.126 - 0.187	29.95	9.95	8.45	7.95	6.95
0.188 - 0.250	29.95	9.95	8.45	7.95	6.95
0.251 - 0.375	30.95	9.95	8.45	7.95	6.95
0.376 - 0.500	31.95	10.95	9.45	8.95	7.95
0.501 - 0.625	32.95	12.95	10.95	9.95	8.95
0.626 - 0.750	33.95	14.95	12.45	10.95	9.95
0.751 - 1.000	34.95	16.95	13.95	11.95	10.95



FLUTE REDUCTION

SHANK DIAMETER	MODIFICATION COST (BY QUANTITY) 2 - 4 FLUTE				
	1-2	3-6	7-11	12-20	21+
Up to 0.125	69.45	25.95	16.45	15.95	14.45
0.126 - 0.187	70.95	27.95	17.95	16.95	15.45
0.188 - 0.250	72.45	29.95	19.45	17.95	16.45
0.251 - 0.375	73.95	31.95	20.95	18.95	17.45
0.376 - 0.500	75.45	33.95	22.45	19.95	18.45
0.501 - 0.625	76.95	35.95	23.95	20.95	19.45
0.626 - 0.750	78.45	37.95	25.45	21.95	20.45
0.751 - 1.000	79.95	39.95	26.95	22.95	21.45



SPECIALTY MODIFICATIONS

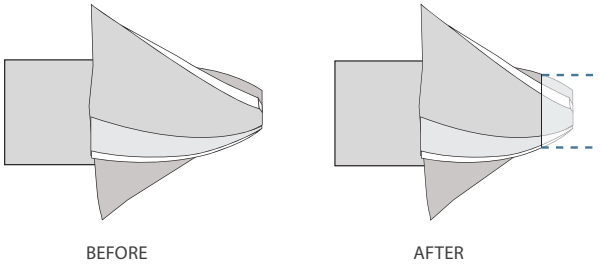
ANGLE AND TIP ALTERATIONS FOR CRITICAL TOLERANCES

While we pride ourselves on the widest selection of tapered end mills and specialty cutting tools available, machining requirements sometimes call for a non-standard angle. Using our state-of-the-art machines we can increase or decrease the taper of an existing tool, producing a tool that is completely new. This is primarily cost effective when modifying smaller quantities of tools or when lead time is critical.

TIP INCREASE

CUTTER DIAMETER	MODIFICATION COST (BY QUANTITY)				
	1-2	3-6	7-11	12-20	21+
Up to 0.125	69.45	25.95	16.45	15.95	14.45
0.126 - 0.187	70.95	27.95	17.95	16.95	15.45
0.188 - 0.250	72.45	29.95	19.45	17.95	16.45
0.251 - 0.375	73.95	31.95	20.95	18.95	17.45
0.376 - 0.500	75.45	33.95	22.45	19.95	18.45
0.501 - 0.625	76.95	35.95	23.95	20.95	19.45
0.626 - 0.750	78.45	37.95	25.45	21.95	20.45
0.751 - 1.000	79.95	39.95	26.95	22.95	21.45

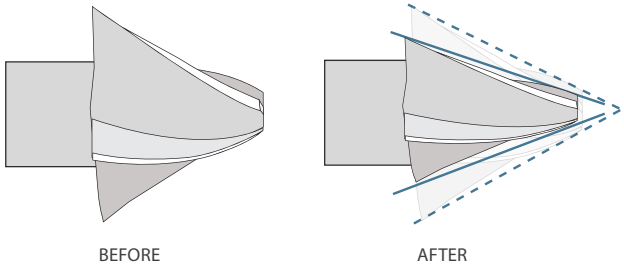
Cutter Diameter references the cutting end of the tool and not the shank diameter



ANGLE DECREASE

ANGLE DECREASE	MODIFICATION COST (BY QUANTITY)				
	1-2	3-6	7-11	12-20	21+
0.00 - 0.50	52.45	21.95	17.45	15.95	14.45
0.51 - 1.00	53.95	22.95	17.95	16.45	14.95
1.01 - 1.50	55.45	23.95	18.45	16.95	15.45
1.51 - 2.00	56.95	24.95	18.95	17.45	15.95
2.01 - 2.50	58.45	25.95	19.45	17.95	16.45
2.51 - 3.00	59.95	26.95	19.95	18.45	16.95

Add 25% for longer lengths



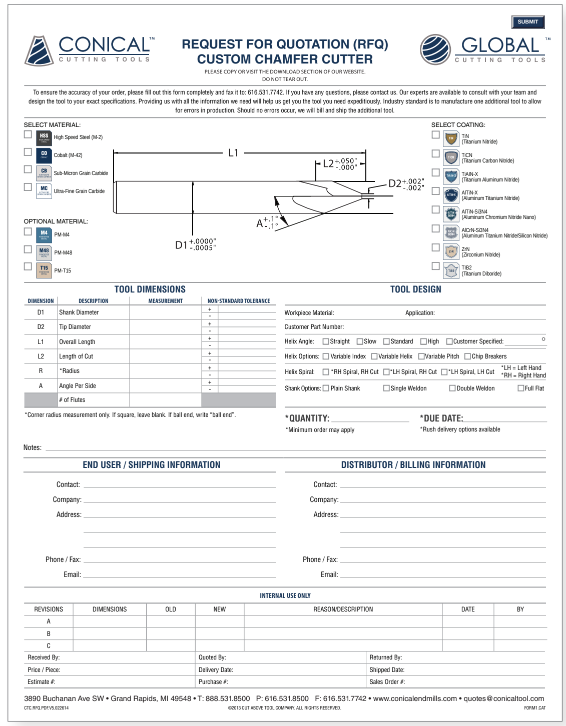
CUSTOM TOOL ORDERING

TO SOLVE MACHINING CHALLENGES

"JUST IN TIME" AVAILABILITY

WE'LL HELP YOU FIND THE SOLUTION

Along with our standard tool offerings, Conical Tool Company manufactures custom carbide and high speed steel end mills and cutters. Whether a variation of a standard tool or specialized tool meant to combine multiple processes into one pass, our custom tools improve performance and reduce cycle time at the best value in the industry.



SUBMIT

CONICAL™ CUTTING TOOLS

REQUEST FOR QUOTATION (RFQ)
CUSTOM CHAMFER CUTTER

PLEASE COPY OR VISIT THE DOWNLOAD SECTION OF OUR WEBSITE.
DO NOT TEAR OUT.

GLOBAL™ CUTTING TOOLS

To ensure the accuracy of your order, please fill out this form completely and fax it to: 616.531.7742. If you have any questions, please contact us. Our experts are available to consult with your team and design the tool to your exact specifications. Providing us with all the information we need will help us get you the tool you need expeditiously. Industry standard is to manufacture one additional tool to allow for errors in production. Should no errors occur, we will bill and ship the additional tool.

SELECT MATERIAL:
- ☐ HSS High Speed Steel (M-2)
- ☐ CO Cobalt (M-42)
- ☐ CB Sub-Micron Grain Carbide
- ☐ MC Ultra-Fine Grain Carbide

OPTIONAL MATERIAL:
- ☐ M4 PM-M4
- ☐ M48 PM-M48
- ☐ T15 PM-T15

L1
L2 +.050" -.000"
D2 +.002" -.002"
A +.1° -.1°
D1 +.0000" -.0005"

SELECT COATING:
- ☐ TiN (Titanium Nitride)
- ☐ TiCN (Titanium Carbon Nitride)
- ☐ TiAlN-X (Titanium Aluminum Nitride)
- ☐ AlTiN-X (Aluminum Titanium Nitride)
- ☐ AlTiN-Si3N4 (Aluminum Chromium Nitride Nano)
- ☐ AlCrN-Si3N4 (Aluminum Titanium Nitride/Silicon Nitride)
- ☐ ZrN (Zirconium Nitride)
- ☐ TIB2 (Titanium Diboride)

TOOL DIMENSIONS

DIMENSION	DESCRIPTION	MEASUREMENT	NON-STANDARD TOLERANCE
D1	Shank Diameter		+ / -
D2	Tip Diameter		+ / -
L1	Overall Length		+ / -
L2	Length of Cut		+ / -
R	*Radius		+ / -
A	Angle Per Side		+ / -
	# of Flutes		

*Corner radius measurement only. If square, leave blank. If ball end, write "ball end".

TOOL DESIGN

Workpiece Material: Application:

Customer Part Number:

Helix Angle: ☐ Straight ☐ Slow ☐ Standard ☐ High ☐ Customer Specified: °

Helix Options: ☐ Variable Index ☐ Variable Helix ☐ Variable Pitch ☐ Chip Breakers

Helix Spiral: ☐ *RH Spiral, RH Cut ☐ *LH Spiral, RH Cut ☐ *LH Spiral, LH Cut *LH = Left Hand *RH = Right Hand

Shank Options: ☐ Plain Shank ☐ Single Weldon ☐ Double Weldon ☐ Full Flat

***QUANTITY:**
*Minimum order may apply

***DUE DATE:**
*Rush delivery options available

Notes:

END USER / SHIPPING INFORMATION

Contact:
Company:
Address:
Phone / Fax:
Email:

DISTRIBUTOR / BILLING INFORMATION

Contact:
Company:
Address:
Phone / Fax:
Email:

INTERNAL USE ONLY

REVISIONS	DIMENSIONS	OLD	NEW	REASON/DESCRIPTION	DATE	BY
A						
B						
C						

Received By:	Quoted By:	Returned By:
Price / Piece:	Delivery Date:	Shipped Date:
Estimate #:	Purchase #:	Sales Order #:

3890 Buchanan Ave SW • Grand Rapids, MI 49548 • T: 888.531.8500 P: 616.531.8500 F: 616.531.7742 • www.conicalendmills.com • quotes@conicaltool.com

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COMBINE MULTIPLE PROCESSES

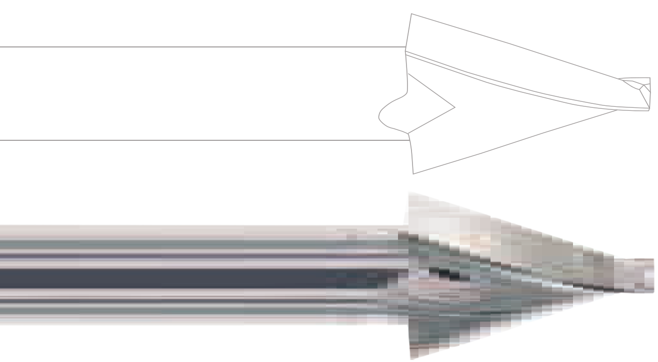
DECREASED PART CYCLE TIME

REDUCED COST PER PIECE

INCREASED PROFIT PER JOB

IMPROVED CUTTING TOOL PERFORMANCE

MANUFACTURED TO YOUR SPECIFICATIONS



SEE PAGES 27-36 FOR DETAILS

VISIT CONICALENDMILLS.COM

OR CALL (888) 531-8500

REQUEST FOR QUOTE

CONICAL™ CUTTING TOOLS

GLOBAL™ CUTTING TOOLS

We can modify our standard tools or manufacture a highly specialized tool to your exact specifications. Request for Quote documents for custom tools are on the following pages. We cannot process your quote without this form. RFQ's are typically returned within 24 hours. A full list of definitions and acronyms can be found on pages 80-81. If you need assistance with your custom tool design or have any questions, please contact us.

MANUFACTURING FOR OVER 70 YEARS 1944 - 2014

IMPROVING TOOL LIFE & PERFORMANCE THROUGH ADVANCED COATING APPLICATIONS

Enhancing tool performance is a critical step in reducing tooling costs and increasing machining time. Proper selection and application can increase feed and speed rates by over 50% and when coupled with our regrinding program, reduce tooling costs by up to 40%.

- General Purpose
- Easy to Machine Materials
- Low Power Machines

- General Purpose
- Wide Range of Materials
- Up to 20% Improvement

- Improved Wear Resistance
- For Abrasive Materials
- Up to 30% Improvement

- Aggressive Machining
- For Ferrous Materials
- Up to 35% Improvement

- High Temp Resistance
- For Ferrous Materials
- Up to 40% Improvement

- Honeycomb-like structure
- Extremely hard and tough
- Provides a diamond-like coating

- Honeycomb-like structure
- Run dry or wet in extreme conditions
- Improved wear performance

- For Abrasive Materials
- High Lubricity Resists BUE
- Excellent Surface Finishes

- Low Affinity to Aluminum
- High Working Temp
- Wide Variety of Materials

- High Speed Machining
- For Graphite & Carbon
- High Hardness & Lubricity

TiN COATING

	MIN SIZE	0.000	2.000	3.000	4.000	5.000	6.000	7.000	8.000	9.000	10.000
MIN SIZE	MAX SIZE	2.000	3.000	4.000	5.000	6.000	7.000	8.000	9.000	10.000	12.000
0.000	0.063	1.95	1.95	1.95	1.95	2.95	2.95	3.95	3.95	3.95	4.95
0.626	0.125	1.95	1.95	1.95	2.95	2.95	2.95	3.95	3.95	4.95	5.95
0.125	0.188	1.95	2.95	2.95	3.95	3.95	4.95	4.95	5.95	5.95	6.95
0.188	0.250	1.95	3.95	3.95	4.95	5.95	5.95	6.95	7.95	8.95	8.95
0.250	0.375	2.95	4.95	5.95	7.95	8.95	9.95	11.95	13.95	16.95	17.95
0.375	0.438	3.95	5.95	6.95	8.95	9.95	10.95	13.95	16.95	19.95	19.95
0.438	0.500	3.95	5.95	7.95	9.95	10.95	12.95	15.95	18.95	21.95	21.95
0.500	0.625	5.95	6.95	8.95	10.95	12.95	14.95	17.95	20.95	24.95	24.95
0.625	0.750	7.95	8.95	9.95	12.95	14.95	16.95	19.95	22.95	26.95	27.95
0.750	1.000	10.95	11.95	14.95	16.95	18.95	21.95	23.95	25.95	27.95	32.95
1.000	1.250	16.95	16.95	18.95	20.95	23.95	26.95	30.95	33.95	35.95	39.95
1.250	1.500	20.95	21.95	24.95	26.95	35.95	41.95	44.95	52.95	54.95	61.95
1.500	2.000	26.95	27.95	29.95	35.95	44.95	55.95	61.95	71.95	82.95	94.95
2.000	2.500	34.95	43.95	56.95	67.95	86.95	94.95	107.95	125.95	141.95	148.95
2.500	3.000	47.95	70.95	85.95	94.95	108.95	124.95	135.95	155.95	165.95	184.95

TiCN, TiAlN-X, AlTiN-X, ZrN COATING

	MIN SIZE	0.000	2.000	3.000	4.000	5.000	6.000	7.000	8.000	9.000	10.000
MIN SIZE	MAX SIZE	2.000	3.000	4.000	5.000	6.000	7.000	8.000	9.000	10.000	12.000
0.000	0.063	2.95	2.95	2.95	3.95	4.95	5.95	6.95	6.95	7.95	8.95
0.626	0.125	2.95	3.95	3.95	4.95	4.95	5.95	6.95	7.95	8.95	10.95
0.125	0.188	2.95	4.95	5.95	6.95	7.95	8.95	9.95	10.95	10.95	13.95
0.188	0.250	3.95	6.95	7.95	8.95	10.95	11.95	13.95	14.95	16.95	17.95
0.250	0.375	5.95	9.95	11.95	14.95	16.95	18.95	23.95	27.95	33.95	35.95
0.375	0.438	7.95	10.95	13.95	16.95	18.95	21.95	26.95	32.95	38.95	39.95
0.438	0.500	7.95	11.95	15.95	18.95	21.95	24.95	30.95	37.95	42.95	43.95
0.500	0.625	11.95	13.95	16.95	21.95	24.95	29.95	35.95	41.95	48.95	49.95
0.625	0.750	15.95	16.95	19.95	24.95	28.95	33.95	39.95	45.95	52.95	54.95
0.750	1.000	20.95	23.95	29.95	33.95	37.95	42.95	47.95	51.95	55.95	64.95
1.000	1.250	33.95	33.95	36.95	41.95	46.95	52.95	61.95	67.95	70.95	79.95
1.250	1.500	40.95	43.95	49.95	52.95	70.95	83.95	88.95	105.95	109.95	123.95
1.500	2.000	52.95	54.95	59.95	71.95	89.95	110.95	123.95	142.95	164.95	188.95
2.000	2.500	68.95	86.95	113.95	134.95	172.95	189.95	214.95	250.95	282.95	297.95
2.500	3.000	95.95	140.95	171.95	188.95	217.95	249.95	271.95	310.95	330.95	369.95

ALTIN/SI3N4 COATING

	MIN SIZE	0.000	2.000	3.000	4.000	5.000	6.000	7.000	8.000	9.000	10.000
MIN SIZE	MAX SIZE	2.000	3.000	4.000	5.000	6.000	7.000	8.000	9.000	10.000	12.000
0.000	0.063	2.95	2.95	3.95	3.95	5.95	6.95	7.95	7.95	8.95	10.95
0.626	0.125	2.95	3.95	4.95	5.95	5.95	6.95	7.95	8.95	9.95	12.95
0.125	0.188	3.95	5.95	6.95	7.95	9.95	10.95	11.95	12.95	12.95	15.95
0.188	0.250	4.95	7.95	8.95	10.95	12.95	13.95	15.95	17.95	19.95	20.95
0.250	0.375	6.95	11.95	14.95	16.95	19.95	21.95	27.95	32.95	39.95	41.95
0.375	0.438	8.95	12.95	15.95	19.95	21.95	25.95	31.95	38.95	45.95	46.95
0.438	0.500	9.95	13.95	17.95	21.95	25.95	28.95	36.95	43.95	49.95	51.95
0.500	0.625	13.95	15.95	19.95	24.95	29.95	34.95	41.95	49.95	56.95	58.95
0.625	0.750	17.95	19.95	23.95	28.95	34.95	38.95	46.95	53.95	61.95	63.95
0.750	1.000	24.95	27.95	34.95	39.95	44.95	49.95	55.95	60.95	65.95	76.95
1.000	1.250	39.95	39.95	42.95	49.95	55.95	62.95	72.95	79.95	82.95	93.95
1.250	1.500	47.95	51.95	57.95	62.95	82.95	97.95	104.95	123.95	128.95	145.95
1.500	2.000	62.95	64.95	70.95	83.95	104.95	129.95	145.95	167.95	193.95	221.95
2.000	2.500	80.95	102.95	132.95	157.95	202.95	222.95	252.95	293.95	331.95	349.95
2.500	3.000	112.95	164.95	201.95	221.95	255.95	293.95	318.95	364.95	388.95	434.95

ALCRN/SI3N4

	MIN SIZE	0.000	2.000	3.000	4.000	5.000	6.000	7.000	8.000	9.000	10.000
MIN SIZE	MAX SIZE	2.000	3.000	4.000	5.000	6.000	7.000	8.000	9.000	10.000	12.000
0.000	0.063	2.95	3.95	3.95	4.95	6.95	7.95	8.95	9.95	10.95	12.95
0.626	0.125	3.95	4.95	5.95	6.95	6.95	7.95	8.95	9.95	11.95	14.95
0.125	0.188	3.95	6.95	7.95	8.95	10.95	11.95	13.95	14.95	14.95	18.95
0.188	0.250	5.95	8.95	10.95	12.95	14.95	15.95	17.95	20.95	22.95	24.95
0.250	0.375	8.95	12.95	16.95	19.95	22.95	25.95	32.95	38.95	46.95	48.95
0.375	0.438	10.95	14.95	18.95	22.95	25.95	29.95	36.95	44.95	53.95	54.95
0.438	0.500	10.95	16.95	20.95	24.95	29.95	33.95	42.95	51.95	57.95	60.95
0.500	0.625	16.95	18.95	23.95	28.95	33.95	40.95	48.95	57.95	66.95	68.95
0.625	0.750	21.95	22.95	27.95	33.95	39.95	45.95	54.95	62.95	71.95	74.95
0.750	1.000	28.95	31.95	40.95	46.95	51.95	57.95	64.95	70.95	76.95	89.95
1.000	1.250	45.95	46.95	50.95	57.95	64.95	72.95	84.95	92.95	97.95	109.95
1.250	1.500	55.95	60.95	67.95	72.95	96.95	114.95	121.95	144.95	150.95	169.95
1.500	2.000	72.95	75.95	82.95	97.95	122.95	151.95	169.95	196.95	226.95	258.95
2.000	2.500	93.95	119.95	155.95	184.95	237.95	259.95	294.95	343.95	388.95	408.95
2.500	3.000	131.95	192.95	235.95	259.95	298.95	342.95	372.95	426.95	454.95	508.95

CASE STUDY

TRACER TOOL & DIE

A GLOBAL CUTTING TOOLS CUSTOMER

Established in 1952, Tracer has developed a wide diversity of engineering and design capabilities including zinc and aluminum die casts, plastic molds, compression molds, CNC machinery and specialty machining.

Tracer, a customer since their founding in 1952, contacted us with the desire to design a custom tool. After careful collaborative analysis, Global Cutting Tools designed a custom cutting tool that led to a boost in productivity and saved money. Our custom variable design tool answered the call and was able to cut production time, thus freeing up valuable machine time.

APPLICATION CHALLENGE

Tracer Tool & Die collaborated with Global Cutting Tools to design tooling that would significantly reduce production time in a difficult to machine hardened tool steel. The current tooling they were using was taking too long to finish the job and creating problems with productivity and efficiency. In addition, they had a variety of demanding applications that the tool would be used on.

GLOBAL CUTTING TOOL SOLUTION

Working with Tracer, we developed a custom designed variable pitch, variable helix, eccentrically relieved carbide end mill to their exact specifications, replacing their standard 1" carbide end mill with an application-specific designed tool. Our design allowed for multiple operations to be combined into a single process, thus increasing productivity.

HOW TO REACH TRACER TOOL & DIE

Tracer Tool & Die
3800 Buchanan Ave SW
Grand Rapids, MI 49548
P: (616) 452-6939
F: (616) 452-7960
E: purchasing@tracertool.com

PERFORMANCE DELIVERED

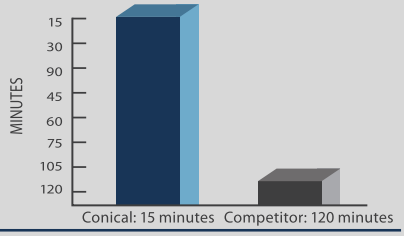
The results were clear and significant immediately. Global's superior custom tool cut Tracer's production time down from two hours to just fifteen minutes. In addition, our team of experts created a tool that lasted 3 times longer than the previous tool.

- Run Times were dramatically reduced
- Less downtime for tool changes and replacements
- Increased feeds and speeds
- Decreased ambient noise created by minimizing tool vibration and chatter

"SINCE SWITCHING OVER TO GLOBAL'S NEW LINE OF COATED CARBIDE ENDMILLS, WE HAVE GREATLY IMPROVED CYCLE TIMES AND PRODUCTION. THEY HAVE PROVEN TO BE A STEP AHEAD OF THEIR COMPETITION."

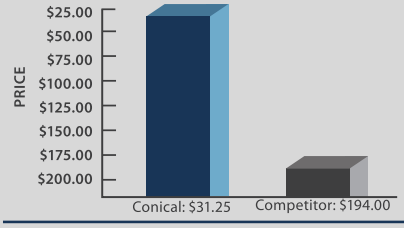
- Nathan Cardosa, Tracer Tool & Die

REDUCTION IN RUN TIME:



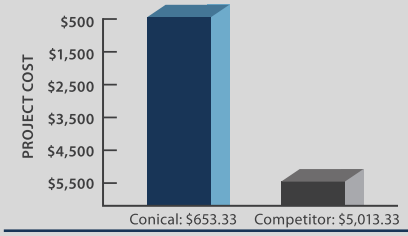
87.5% CYCLE TIME REDUCTION!

COST PER PART:



$162.75 SAVINGS PER PART!

TOTAL PROJECT COST:



$4,360.00 TOTAL PROJECT SAVINGS!

RESULTS:

SIGNIFICANTLY CUT LEAD TIMES WHILE INCREASING PROFIT

- Ran two to three times faster feeds and speeds
- More metal removal in fewer passes / higher removal rates
- Three times longer tool life

CASE STUDY

MICO INDUSTRIES

A GLOBAL CUTTING TOOLS CUSTOMER

Global Cutting Tool specialist, Michael DeKlein, alongside Terence Sammon, CEO of Mico Industries, Inc., teamed up to cut their production costs, increase their profit per job and cut back on overall cycle time. Mico Industries is a minority owned engineering, stamping, welded assemblies and machining, multi-tier supply chain management company. The company was founded in 1983 and is based in Grand Rapids, Michigan.

Mico Industries uses Global Cutting Tools' Vortex VH4 performance line of end mills in hardened steel applications. They provide design, launch and production support services, assembly, tube fabrication, brazing, laser cutting, and buffing-polishing services. Their products include oil tanks for the transportation industry, cosmetic critical assemblies, automotive armrest assemblies, mechanical seat assemblies, office furniture and automotive seat frames.

As a tier 1, 2 and 3 industry supplier, Mico Industries has ISO, TS and MMBDC certification; but performance, precision and delivery are their keys to satisfying a highly demanding customer base, which includes Harley-Davidson and Magna Tool.

MICO INDUSTRIES
MAKING METAL WORK

APPLICATION CHALLENGE

Mico had a large scale production job which required a major reduction in cycle time to avoid being undercut during contract renewal. In addition to their need for cycle time reduction, they were having excess tooling costs for multiple operations.

GLOBAL CUTTING TOOL'S SOLUTION

Global's representative, Michael DeKlein, suggested combining multiple drill and mill operations into a single milling operation. This suggestion reduced the number of tool changes by 3, per part, while allowing the newly designed, custom end mill to be resharpened. This combination eliminated the need to dispose of the cutting tool at the end of the operation and further reduced tooling costs.

HOW TO REACH MICO INDUSTRIES

1425 Burlingame
Grand Rapids, MI 49509
P: (616) 245-6426
F: (616) 245-2661
www.micoindustries.com
sales@micoindustries.com

PMPA
American Welding Society
Sustaining Company Member
PMA PRECISION METALFORMING ASSOCIATION

PERFORMANCE DELIVERED

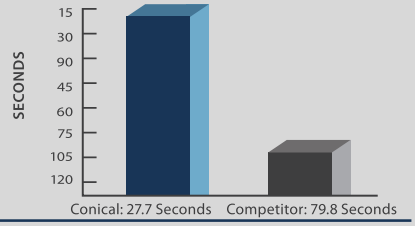
Using a custom diameter version of Global's new Vortex-VH4 line of high performance end mills, Mico replaced 2 drilling operations and their excess tooling costs with a single milling operation and the ability to resharpen their tools. Not only did this increase cycle time, it eliminated unnecessary operations.

- Run times were dramatically reduced
- Less downtime for tool changes and replacements
- 66% less tool changes

"THE CONICAL TOOL SCREAMED THROUGH THE STEEL ALLOWING US TO PERFORM THE APPLICATION 5 TIMES FASTER AND STAY COMPETITIVE."

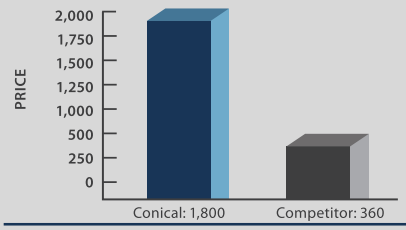
- TERENCE SAMMON, CEO

REDUCTION IN RUN TIME:



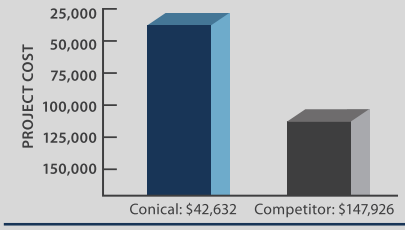
65.3% CYCLE TIME REDUCTION!

PARTS PER TOOL:



1,440 MORE PARTS PER TOOL!

TOTAL PROJECT COST:



$105,294 TOTAL PROJECT SAVINGS!

RESULTS:

SIGNIFICANT C UT IN COST PER HOLE AND IMPROVED QUALITY

- Consistent even cuts
- Very good surface finish
- Extended tool life
- Improved accuracy and shearing capabilities
- Stability for high feed finishing capabilities

MODIFICATION PROGRAM

MODIFICATION OF IN-STOCK TOOLS

IN AS LITTLE AS 48 HOURS

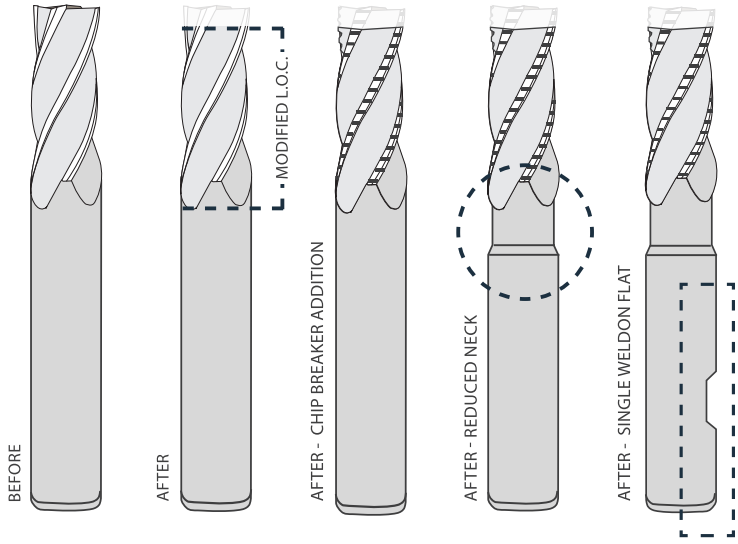
END MODIFICATIONS

SHANK MODIFICATIONS

FLUTE MODIFICATIONS

LENGTH MODIFICATIONS

SPECIALTY MODIFICATIONS



SEE PAGE 16 - 21 FOR DETAILS OR

CONICALENDMILLS.COM OR

(888) 531-8500 EXT. 3

CONICAL™ CUTTING TOOLS

GLOBAL™ CUTTING TOOLS

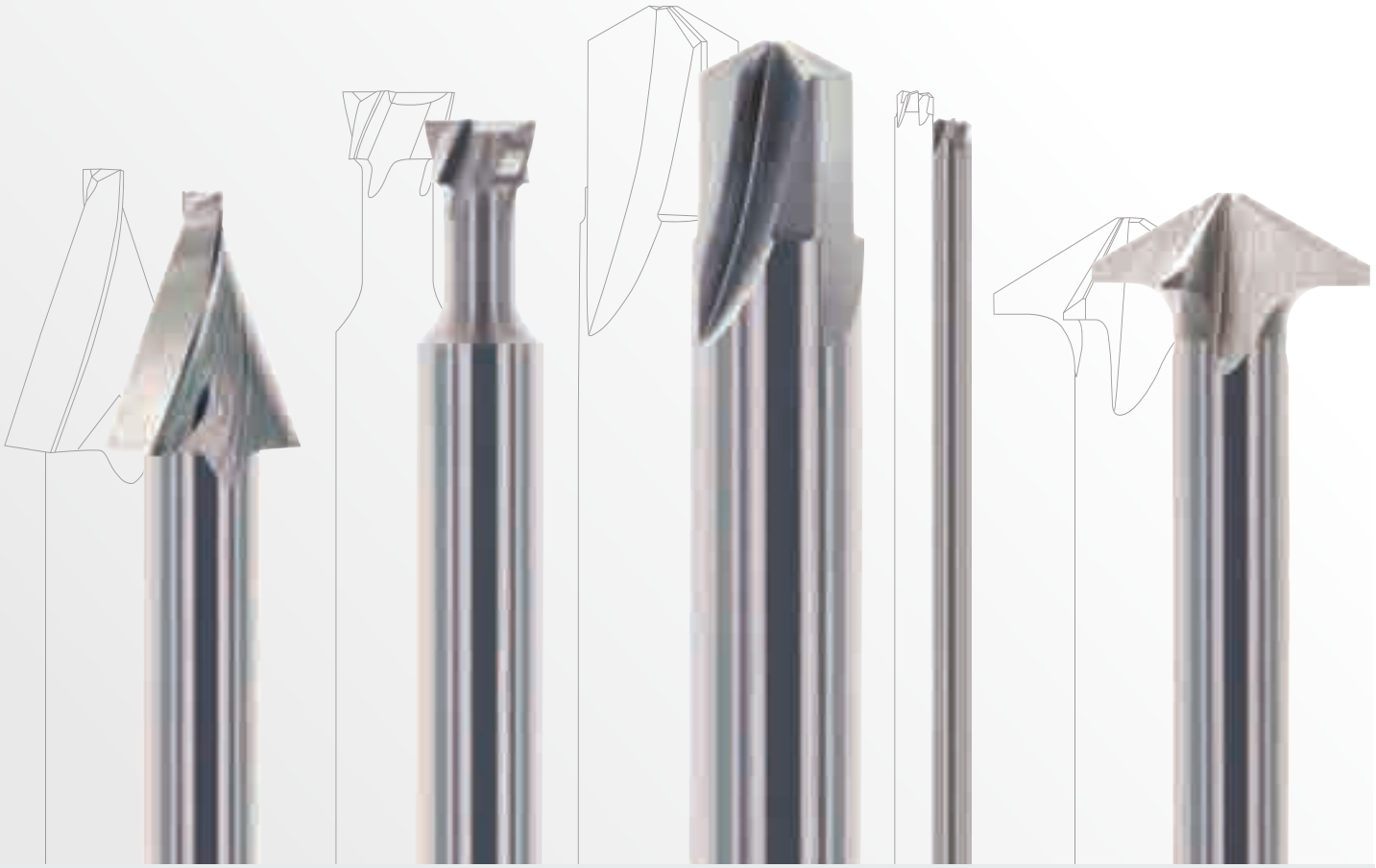
WE CAN MODIFY MOST ANY TOOL

We can modify our standard tools or manufacture a highly specialized tool to your exact specifications. Modifications ensure fast delivery of your tool (subject to availability) and decrease costs on small batch runs. Most modifications ship within 2 - 3 business days. Please allow additional time when adding coatings. If you need assistance with modification selection or have any questions, please contact us.

MANUFACTURING FOR OVER 70 YEARS 1944 - 2014

3 CUSTOM TOOL ORDERING

WE COMBINE ONGOING, CONTINUOUS IMPROVEMENT PROCESSES,
WITH THOUSANDS OF HOURS OF NEW TOOL DEVELOPMENT PER YEAR



We analyze the requests of our customers and use innovative engineering to come up with the most cost effective solutions.

Let our experience and knowledge work for you in creating a custom tool from your specifications. Operators are standing by to help with any questions you may have.

CAREFUL ANALYSIS

Through careful analysis of the part, mold or fixture workpiece, our experts are able to determine the most efficient method of material removal and proper finish. Working backwards, we designed a manufacturing process which optimizes performance, improves cycle time and promotes quality.

CUSTOM SPECIAL END MILLS

Speed, quality, quantity and application are the biggest determining factors in the results of a custom tooling request. By asking the right questions and listening to our customers, we can find the right fit and balance that creates value.

CONICAL™ CUTTING TOOLS

GLOBAL™ CUTTING TOOLS

MANUFACTURING FOR OVER 70 YEARS
1944 - 2014

(888) 531-8500 | info@conicaltool.com | www.conicalendmills.com

CUSTOM TOOL ORDERING

SPECIALTY TOOLING TO EXCEED DEMANDING APPLICATIONS

Along with our standard tool offerings, we manufacture custom carbide and high speed steel end mills and cutters. Whether a variation of a standard tool or specialized tool meant to combine multiple processes into one pass, our custom tools improve performance and reduce cycle time at the best value in the industry.

We use a nine step process on every custom tool, consulting with our distributors and end users along the way, to create the highest possible performance.

1 IDENTIFY APPLICATION METHOD / PROCESS

Through careful analysis of the part, mold, fixture or workpiece, our experts are able to determine the most efficient method of material removal and proper finish. Through reverse engineering, we design a manufacturing process which optimizes performance, improves cycle times and promotes quality.

2 ANALYZE DESIRED OUTCOME

Speed, quality, quantity and expense are the biggest determining factors in the design of a custom tooling request. By asking the right questions and listening to our customers we can find the right fit and balance to create value.

3 DETERMINE PERFORMANCE VALUE LEVEL

Enhancements can always be made, but don't always deliver value. Often times a standard tool with a slight modification can perform in nearly the same way as an engineered custom tool without excess cost and increased lead times. We pride ourselves on not only being an expert resource for your custom tooling needs, but in being a fair and honest partner in building value through the entire supply chain.

4 SELECT ADVANCED PRODUCT MATERIAL

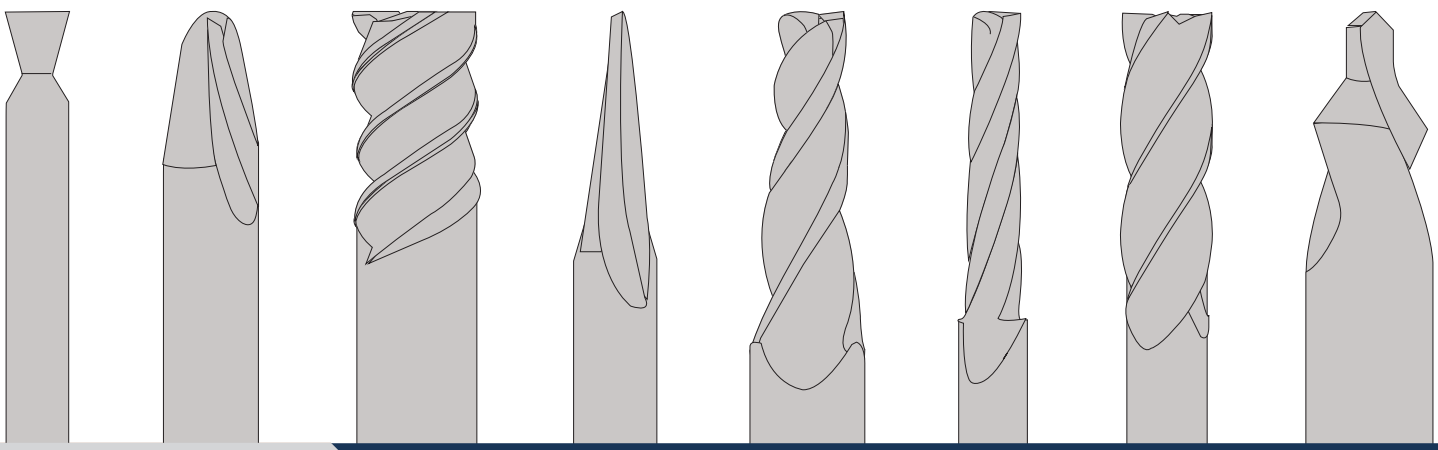
Once the workpiece process, material and performance are determined, we can analyze the properties and cost of the available grades of high speed steel and micro-grain carbide composites. We compare tool life expectancy, durability and machining time.

5 SELECT ADVANCED SPECIALTY COATING

Certain applications, materials or performances simply require the enhancement of a specialty coating and knowledge of the properties of the coatings available. Temperature, friction resistance, hardness, lubricity, toughness and cohesion of the resulting process must be examined prior to the selection.

6 REVIEW FINDINGS WITH TOOLING ENGINEER & CUSTOMER

We follow up with each customer to review our recommendations prior to estimating the cost. Our goal is to strike the perfect balance of value, precision and performance, by manufacturing tools to meet our customers exact specifications.



SELECT FROM A WIDE RANGE OF MATERIALS & COATINGS

STANDARD MATERIALS

HSS HIGH SPEED STEEL | CO COBALT | CB SUB-MICRO GRAIN CARBIDE | MC ULTRA-FINE GRAIN CARBIDE

AVAILABLE MATERIALS

M4 POWDERED METAL | M7 POWDERED METAL | M42 POWDERED METAL | T15 POWDERED METAL

COATINGS

UNC | TiN | TiCN | TiAlN-X | AlTiN-X

AlTiN Si3N4 | AlCrN Si3N4 | ZrN | TiB2 | DIA

more information on pg. 74-75.

7 DESIGN OPERATION PROCESS AND TOOL PRINT

Our internal processes gather the information discovered along the way and allow us to optimize our internal operations, stage and schedule production and get an accurate estimate on the lead time.

8 MANUFACTURE TOOL TO SPECIFICATION

The manufacturing process starts through careful programming of our high tolerance CNC grinding machines, examination of the materials; staging and setup of each machine; and finally first tool and small batch testing. Each custom tool may require one to eight machines to see the tool all the way from inception to production.

9 INSPECT QUALITY AND TOLERANCES

Each custom tool is tested at every stage of the manufacturing process to ensure the desired outcome before completion.

Why choose custom tooling over standard tools or limited modifications?

- Combine multiple processing into one tool
- Decrease cycle time by eliminating tool changes and operations
- Reduce cost per piece by lowering operational costs.

If your requirements need a single or small batch run, it may be best to modify an existing stock tool (see modifications program on pages 16 - 21).

Request for quote documents are located on the upcoming pages and available in an interactive, PDF form on our website conicalendmills.com. To ensure quality, please complete the document in its entirety. A list of definitions and acronyms is available in our technical resource guide found on pages 41 -68.

CALL US TODAY @ (888) 531-8500 TO BEGIN YOUR CUSTOM TOOL

If you need further assistance with your custom tool design or have any questions, please contact us, one of our tooling engineers will be happy to help. If you are an end user, we will route your request through your preferred distributor.

SUBMIT

CONICAL™ CUTTING TOOLS

REQUEST FOR QUOTATION (RFQ)
CUSTOM END MILL

GLOBAL™ CUTTING TOOLS

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DO NOT TEAR OUT.

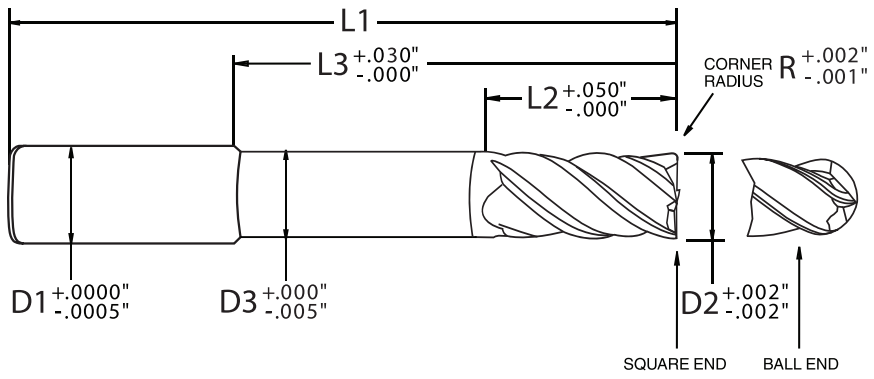
To ensure the accuracy of your order, please fill out this form completely and fax it to: 616.531.7742. If you have any questions, please contact us. Our experts are available to consult with your team and design the tool to your exact specifications. Providing us with all the information we need will help us get you the tool you need expeditiously. Industry standard is to manufacture one additional tool to allow for errors in production. Should no errors occur, we will bill and ship the additional tool.

SELECT MATERIAL:

- ☐ HSS — High Speed Steel (M-2)
- ☐ CO — Cobalt (M-42)
- ☐ CB — Sub-Micron Grain Carbide
- ☐ MC — Ultra-Fine Grain Carbide

OPTIONAL MATERIAL:

- ☐ M4 — PM-M4
- ☐ M48 — PM-M48
- ☐ T15 — PM-T15



SELECT COATING:

- ☐ TiN (Titanium Nitride)
- ☐ TiCN (Titanium Carbon Nitride)
- ☐ TiAlN-X (Titanium Aluminum Nitride)
- ☐ AlTiN-X (Aluminum Titanium Nitride)
- ☐ AlTiN-Si3N4 (Aluminum Chromium Nitride Nano)
- ☐ AlCrN-Si3N4 (Aluminum Titanium Nitride/Silicon Nitride)
- ☐ ZrN (Zirconium Nitride)
- ☐ TIB2 (Titanium Diboride)

TOOL DIMENSIONS

DIMENSION	DESCRIPTION	MEASUREMENT	NON-STANDARD TOLERANCE
D1	Shank Diameter		+ / -
D2	Tip Diameter		+ / -
D3	Neck Diameter		+ / -
L1	Overall Length		+ / -
L2	Length of Cut		+ / -
L3	Reach		+ / -
R	*Radius		+ / -
	# of Flutes		

*Corner radius measurement only. If square, leave blank. If ball end, write ball end.

TOOL DESIGN

Workpiece Material: Application:

Customer Part Number:

Helix Angle: ☐ Straight ☐ Slow ☐ Standard ☐ High ☐ Customer Specified: ○

Helix Options: ☐ Variable Index ☐ Variable Helix ☐ Variable Pitch ☐ Chip Breakers

Helix Spiral: ☐ *RH Spiral, RH Cut ☐ *LH Spiral, RH Cut ☐ *LH Spiral, LH Cut *LH = Left Hand *RH = Right Hand

Shank Options: ☐ Plain Shank ☐ Single Weldon ☐ Double Weldon ☐ Full Flat

***QUANTITY:** _____ *Minimum order may apply

***DUE DATE:** _____ *Rush delivery options available

Notes: _____

END USER / SHIPPING INFORMATION

Contact: _____
Company: _____
Address: _____
Phone / Fax: _____
Email: _____

DISTRIBUTOR / BILLING INFORMATION

Contact: _____
Company: _____
Address: _____
Phone / Fax: _____
Email: _____

INTERNAL USE ONLY

REVISIONS	DIMENSIONS	OLD	NEW	REASON/DESCRIPTION	DATE	BY
A						
B						
C						

Received By:	Quoted By:	Returned By:
Price / Piece:	Delivery Date:	Shipped Date:
Estimate #:	Purchase #:	Sales Order #:

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CONICAL™ CUTTING TOOLS

REQUEST FOR QUOTATION (RFQ)
CUSTOM TAPERED END MILL

GLOBAL™ CUTTING TOOLS

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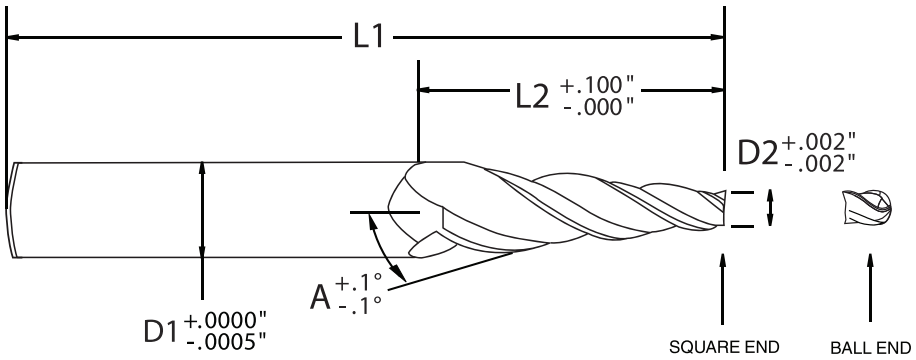
SELECT MATERIAL:

- ☐ HSS — High Speed Steel (M-2)
- ☐ CO — Cobalt (M-42)
- ☐ CB — Sub-Micron Grain Carbide
- ☐ MC — Ultra-Fine Grain Carbide

OPTIONAL MATERIAL:

- ☐ M4 — PM-M4
- ☐ M48 — PM-M48
- ☐ T15 — PM-T15



SELECT COATING:

- ☐ TiN (Titanium Nitride)
- ☐ TiCN (Titanium Carbon Nitride)
- ☐ TiAlN-X (Titanium Aluminum Nitride)
- ☐ AlTiN-X (Aluminum Titanium Nitride)
- ☐ AlTiN-Si3N4 (Aluminum Chromium Nitride Nano)
- ☐ AlCrN-Si3N4 (Aluminum Titanium Nitride/Silicon Nitride)
- ☐ ZrN (Zirconium Nitride)
- ☐ TIB2 (Titanium Diboride)

TOOL DIMENSIONS

DIMENSION	DESCRIPTION	MEASUREMENT	NON-STANDARD TOLERANCE
D1	Shank Diameter		+ / -
D2	Tip Diameter		+ / -
L1	Overall Length		+ / -
L2	Length of Cut		+ / -
R	*Radius		+ / -
A	Angle Per Side		+ / -
	# of Flutes		

*Corner radius measurement only. If square, leave blank. If ball end, write “ball end”.

TOOL DESIGN

Workpiece Material: Application:

Customer Part Number:

Helix Angle: ☐ Straight ☐ Slow ☐ Standard ☐ High ☐ Customer Specified: ____ °

Helix Options: ☐ Variable Index ☐ Variable Helix ☐ Variable Pitch ☐ Chip Breakers

Helix Spiral: ☐ *RH Spiral, RH Cut ☐ *LH Spiral, RH Cut ☐ *LH Spiral, LH Cut
*LH = Left Hand
*RH = Right Hand

Shank Options: ☐ Plain Shank ☐ Single Weldon ☐ Double Weldon ☐ Full Flat

***QUANTITY:** _____
*Minimum order may apply

***DUE DATE:** _____
*Rush delivery options available

Notes: _____

END USER / SHIPPING INFORMATION

Contact: _____
Company: _____
Address: _____
_____
_____
Phone / Fax: _____
Email: _____

DISTRIBUTOR / BILLING INFORMATION

Contact: _____
Company: _____
Address: _____
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Phone / Fax: _____
Email: _____

INTERNAL USE ONLY

REVISIONS	DIMENSIONS	OLD	NEW	REASON/DESCRIPTION	DATE	BY
A						
B						
C						

Received By:	Quoted By:	Returned By:
Price / Piece:	Delivery Date:	Shipped Date:
Estimate #:	Purchase #:	Sales Order #:

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CONICAL™ CUTTING TOOLS

REQUEST FOR QUOTATION (RFQ)
CUSTOM DOVETAIL CUTTER

GLOBAL™ CUTTING TOOLS

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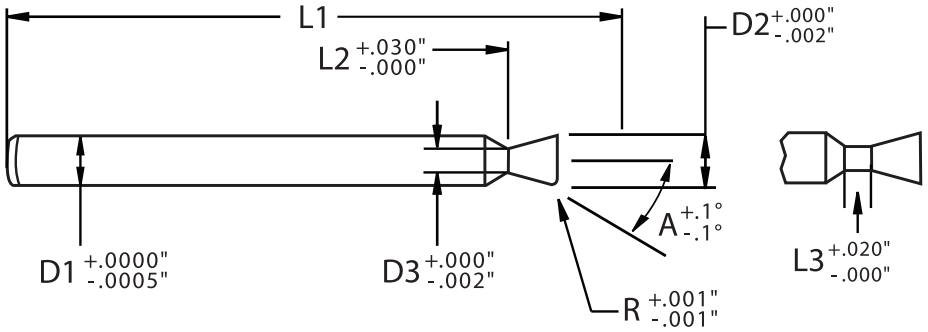
- ☐ HSS — High Speed Steel (M-2)
- ☐ CO — Cobalt (M-42)
- ☐ CB — Sub-Micron Grain Carbide
- ☐ MC — Ultra-Fine Grain Carbide

OPTIONAL MATERIAL:

- ☐ M4 — PM-M4
- ☐ M48 — PM-M48
- ☐ T15 — PM-T15



SELECT COATING:

- ☐ TiN (Titanium Nitride)
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- ☐ TiAlN-X (Titanium Aluminum Nitride)
- ☐ AlTiN-X (Aluminum Titanium Nitride)
- ☐ AlTiN-Si3N4 (Aluminum Chromium Nitride Nano)
- ☐ AlCrN-Si3N4 (Aluminum Titanium Nitride/Silicon Nitride)
- ☐ ZrN (Zirconium Nitride)
- ☐ TiB2 (Titanium Diboride)

TOOL DIMENSIONS

DIMENSION	DESCRIPTION	MEASUREMENT	NON-STANDARD TOLERANCE
D1	Shank Diameter		+ / -
D2	Tip Diameter		+ / -
D3	Neck Diameter		+ / -
L1	Overall Length		+ / -
L2	Length of Cut		+ / -
L3	Reach		+ / -
R	*Radius		+ / -
A	Angle Per Side		+ / -
	# of Flutes		

*Corner radius measurement only. If square, leave blank. If ball end, write “ball end”.

TOOL DESIGN

Workpiece Material: Application:

Customer Part Number:

Helix Angle: ☐ Straight ☐ Slow ☐ Standard ☐ High ☐ Customer Specified: ____ °

Helix Options: ☐ Variable Index ☐ Variable Helix ☐ Variable Pitch ☐ Chip Breakers

Helix Spiral: ☐ *RH Spiral, RH Cut ☐ *LH Spiral, RH Cut ☐ *LH Spiral, LH Cut *LH = Left Hand *RH = Right Hand

Shank Options: ☐ Plain Shank ☐ Single Weldon ☐ Double Weldon ☐ Full Flat

***QUANTITY:** _____ *Minimum order may apply

***DUE DATE:** _____ *Rush delivery options available

Notes: _____

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Email: _____

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Company: _____
Address: _____
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Phone / Fax: _____
Email: _____

INTERNAL USE ONLY

REVISIONS	DIMENSIONS	OLD	NEW	REASON/DESCRIPTION	DATE	BY
A						
B						
C						

Received By:	Quoted By:	Returned By:
Price / Piece:	Delivery Date:	Shipped Date:
Estimate #:	Purchase #:	Sales Order #:

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SUBMIT

CONICAL™ CUTTING TOOLS

REQUEST FOR QUOTATION (RFQ)
CUSTOM CHAMFER CUTTER

GLOBAL™ CUTTING TOOLS

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SELECT MATERIAL:

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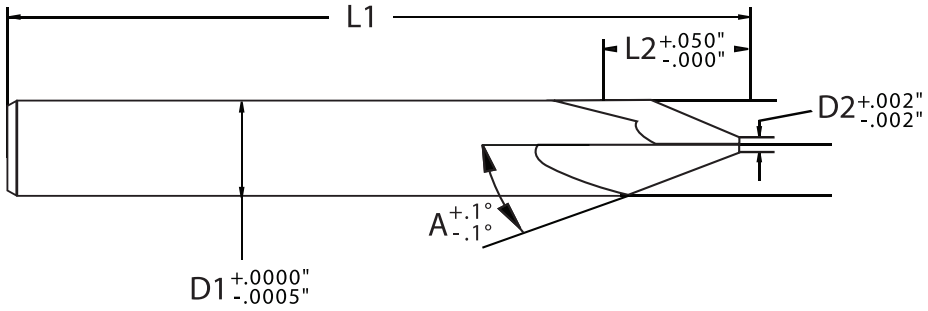
- ☐ CO — Cobalt (M-42)
- ☐ CB — Sub-Micron Grain Carbide
- ☐ MC — Ultra-Fine Grain Carbide

OPTIONAL MATERIAL:

- ☐ M4 — PM-M4
- ☐ M48 — PM-M48
- ☐ T15 — PM-T15



SELECT COATING:

- ☐ TiN (Titanium Nitride)
- ☐ TiCN (Titanium Carbon Nitride)
- ☐ TiAlN-X (Titanium Aluminum Nitride)
- ☐ AlTiN-X (Aluminum Titanium Nitride)
- ☐ AlTiN-Si3N4 (Aluminum Chromium Nitride Nano)
- ☐ AlCrN-Si3N4 (Aluminum Titanium Nitride/Silicon Nitride)
- ☐ ZrN (Zirconium Nitride)
- ☐ TIB2 (Titanium Diboride)

TOOL DIMENSIONS

DIMENSION	DESCRIPTION	MEASUREMENT	NON-STANDARD TOLERANCE
D1	Shank Diameter		+ / -
D2	Tip Diameter		+ / -
L1	Overall Length		+ / -
L2	Length of Cut		+ / -
R	*Radius		+ / -
A	Angle Per Side		+ / -
	# of Flutes		

*Corner radius measurement only. If square, leave blank. If ball end, write “ball end”.

TOOL DESIGN

Workpiece Material: Application:

Customer Part Number:

Helix Angle: ☐ Straight ☐ Slow ☐ Standard ☐ High ☐ Customer Specified: ____ °

Helix Options: ☐ Variable Index ☐ Variable Helix ☐ Variable Pitch ☐ Chip Breakers

Helix Spiral: ☐ *RH Spiral, RH Cut ☐ *LH Spiral, RH Cut ☐ *LH Spiral, LH Cut

*LH = Left Hand
*RH = Right Hand

Shank Options: ☐ Plain Shank ☐ Single Weldon ☐ Double Weldon ☐ Full Flat

***QUANTITY:** _____
*Minimum order may apply

***DUE DATE:** _____
*Rush delivery options available

Notes: _____

END USER / SHIPPING INFORMATION

Contact: _____
Company: _____
Address: _____
_____
_____
Phone / Fax: _____
Email: _____

DISTRIBUTOR / BILLING INFORMATION

Contact: _____
Company: _____
Address: _____
_____
_____
Phone / Fax: _____
Email: _____

INTERNAL USE ONLY

REVISIONS	DIMENSIONS	OLD	NEW	REASON/DESCRIPTION	DATE	BY
A						
B						
C						

Received By:	Quoted By:	Returned By:
Price / Piece:	Delivery Date:	Shipped Date:
Estimate #:	Purchase #:	Sales Order #:

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SUBMIT

CONICAL™ CUTTING TOOLS

REQUEST FOR QUOTATION (RFQ)
CUSTOM PROFILE RIB CUTTER

GLOBAL™ CUTTING TOOLS

PLEASE COPY OR VISIT THE DOWNLOAD SECTION OF OUR WEBSITE.
DO NOT TEAR OUT.

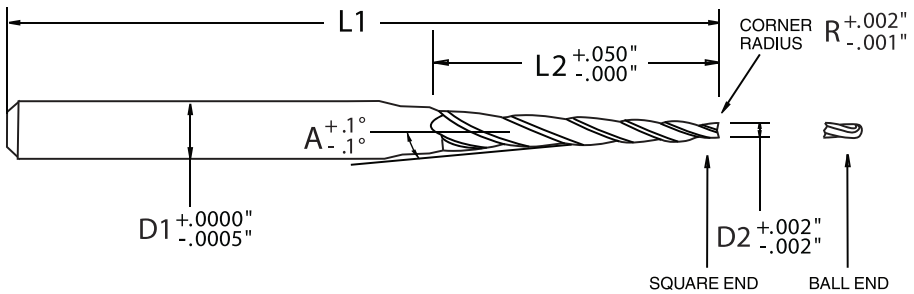
To ensure the accuracy of your order, please fill out this form completely and fax it to: 616.531.7742. If you have any questions, please contact us. Our experts are available to consult with your team and design the tool to your exact specifications. Providing us with all the information we need will help us get you the tool you need expeditiously. Industry standard is to manufacture one additional tool to allow for errors in production. Should no errors occur, we will bill and ship the additional tool.

SELECT MATERIAL:

- ☐ HSS — High Speed Steel (M-2)
- ☐ CO — Cobalt (M-42)
- ☐ CB — Sub-Micron Grain Carbide
- ☐ MC — Ultra-Fine Grain Carbide

OPTIONAL MATERIAL:

- ☐ M4 — PM-M4
- ☐ M48 — PM-M48
- ☐ T15 — PM-T15



SELECT COATING:

- ☐ TiN (Titanium Nitride)
- ☐ TiCN (Titanium Carbon Nitride)
- ☐ TiAlN-X (Titanium Aluminum Nitride)
- ☐ AlTiN-X (Aluminum Titanium Nitride)
- ☐ AlTiN-Si3N4 (Aluminum Chromium Nitride Nano)
- ☐ AlCrN-Si3N4 (Aluminum Titanium Nitride/Silicon Nitride)
- ☐ ZrN (Zirconium Nitride)
- ☐ TIB2 (Titanium Diboride)

TOOL DIMENSIONS

DIMENSION	DESCRIPTION	MEASUREMENT	NON-STANDARD TOLERANCE
D1	Shank Diameter		+ / -
D2	Tip Diameter		+ / -
L1	Overall Length		+ / -
L2	Length of Cut		+ / -
R	*Radius		+ / -
A	Angle Per Side		+ / -
	# of Flutes		

*Corner radius measurement only. If square, leave blank. If ball end, write “ball end”.

TOOL DESIGN

Workpiece Material: Application:

Customer Part Number:

Helix Angle: ☐ Straight ☐ Slow ☐ Standard ☐ High ☐ Customer Specified: ____ °

Helix Options: ☐ Variable Index ☐ Variable Helix ☐ Variable Pitch ☐ Chip Breakers

Helix Spiral: ☐ *RH Spiral, RH Cut ☐ *LH Spiral, RH Cut ☐ *LH Spiral, LH Cut
*LH = Left Hand
*RH = Right Hand

Shank Options: ☐ Plain Shank ☐ Single Weldon ☐ Double Weldon ☐ Full Flat

***QUANTITY:** _____
*Minimum order may apply

***DUE DATE:** _____
*Rush delivery options available

Notes: _____

END USER / SHIPPING INFORMATION

Contact: _____
Company: _____
Address: _____
_____
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Phone / Fax: _____
Email: _____

DISTRIBUTOR / BILLING INFORMATION

Contact: _____
Company: _____
Address: _____
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Phone / Fax: _____
Email: _____

INTERNAL USE ONLY

REVISIONS	DIMENSIONS	OLD	NEW	REASON/DESCRIPTION	DATE	BY
A						
B						
C						

Received By:	Quoted By:	Returned By:
Price / Piece:	Delivery Date:	Shipped Date:
Estimate #:	Purchase #:	Sales Order #:

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SUBMIT

CONICAL™ CUTTING TOOLS

REQUEST FOR QUOTATION (RFQ)
CUSTOM RUNNER CUTTER

GLOBAL™ CUTTING TOOLS

PLEASE COPY OR VISIT THE DOWNLOAD SECTION OF OUR WEBSITE.
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To ensure the accuracy of your order, please fill out this form completely and fax it to: 616.531.7742. If you have any questions, please contact us. Our experts are available to consult with your team and design the tool to your exact specifications. Providing us with all the information we need will help us get you the tool you need expeditiously. Industry standard is to manufacture one additional tool to allow for errors in production. Should no errors occur, we will bill and ship the additional tool.

SELECT MATERIAL:

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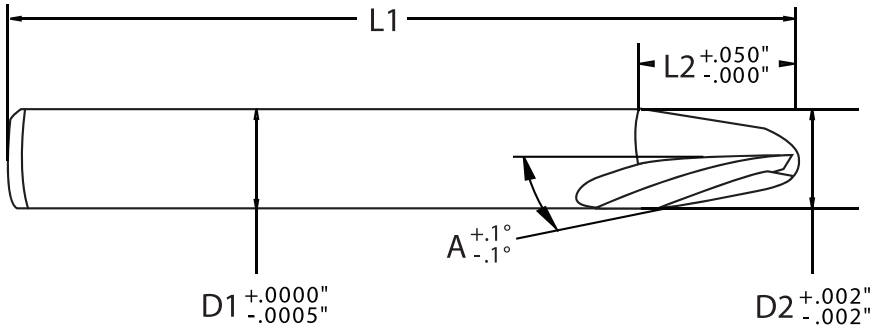
- ☐ CO — Cobalt (M-42)
- ☐ CB — Sub-Micron Grain Carbide
- ☐ MC — Ultra-Fine Grain Carbide

OPTIONAL MATERIAL:

- ☐ M4 — PM-M4
- ☐ M48 — PM-M48
- ☐ T15 — PM-T15



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- ☐ TiN (Titanium Nitride)
- ☐ TiCN (Titanium Carbon Nitride)
- ☐ TiAlN-X (Titanium Aluminum Nitride)
- ☐ AlTiN-X (Aluminum Titanium Nitride)
- ☐ AlTiN-Si3N4 (Aluminum Chromium Nitride Nano)
- ☐ AlCrN-Si3N4 (Aluminum Titanium Nitride/Silicon Nitride)
- ☐ ZrN (Zirconium Nitride)
- ☐ TiB2 (Titanium Diboride)

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D2	Tip Diameter		+ / -
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L2	Length of Cut		+ / -
R	*Radius		+ / -
A	Angle Per Side		+ / -
	# of Flutes		

*Corner radius measurement only. If square, leave blank. If ball end, write “ball end”.

TOOL DESIGN

Workpiece Material: Application:

Customer Part Number:

Helix Angle: ☐ Straight ☐ Slow ☐ Standard ☐ High ☐ Customer Specified: ____ °

Helix Options: ☐ Variable Index ☐ Variable Helix ☐ Variable Pitch ☐ Chip Breakers

Helix Spiral: ☐ *RH Spiral, RH Cut ☐ *LH Spiral, RH Cut ☐ *LH Spiral, LH Cut
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*RH = Right Hand

Shank Options: ☐ Plain Shank ☐ Single Weldon ☐ Double Weldon ☐ Full Flat

***QUANTITY:** _____
*Minimum order may apply

***DUE DATE:** _____
*Rush delivery options available

Notes: _____

END USER / SHIPPING INFORMATION

Contact: _____
Company: _____
Address: _____
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Phone / Fax: _____
Email: _____

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INTERNAL USE ONLY

REVISIONS	DIMENSIONS	OLD	NEW	REASON/DESCRIPTION	DATE	BY
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B						
C						

Received By:	Quoted By:	Returned By:
Price / Piece:	Delivery Date:	Shipped Date:
Estimate #:	Purchase #:	Sales Order #:

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SUBMIT

CONICAL™ CUTTING TOOLS

REQUEST FOR QUOTATION (RFQ)
CUSTOM DIE SINK

GLOBAL™ CUTTING TOOLS

PLEASE COPY OR VISIT THE DOWNLOAD SECTION OF OUR WEBSITE.
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To ensure the accuracy of your order, please fill out this form completely and fax it to: 616.531.7742. If you have any questions, please contact us. Our experts are available to consult with your team and design the tool to your exact specifications. Providing us with all the information we need will help us get you the tool you need expeditiously. Industry standard is to manufacture one additional tool to allow for errors in production. Should no errors occur, we will bill and ship the additional tool.

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- ☐ CB — Sub-Micron Grain Carbide
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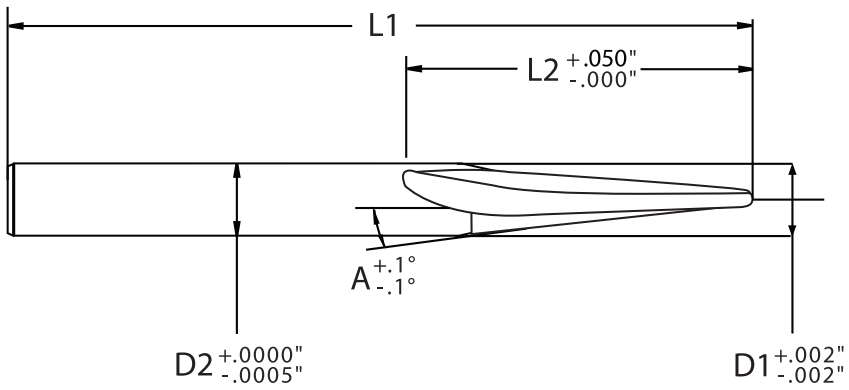
OPTIONAL MATERIAL:

- ☐ M4 — PM-M4
- ☐ M48 — PM-M48
- ☐ T15 — PM-T15



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- ☐ TiB2 (Titanium Diboride)

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	# of Flutes		

*Corner radius measurement only. If square, leave blank. If ball end, write “ball end”.

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Shank Options: ☐ Plain Shank ☐ Single Weldon ☐ Double Weldon ☐ Full Flat

***QUANTITY:** _____ *Minimum order may apply

***DUE DATE:** _____ *Rush delivery options available

Notes: _____

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Company: _____
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Email: _____

DISTRIBUTOR / BILLING INFORMATION

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Phone / Fax: _____
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REVISIONS	DIMENSIONS	OLD	NEW	REASON/DESCRIPTION	DATE	BY
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C						

Received By:	Quoted By:	Returned By:
Price / Piece:	Delivery Date:	Shipped Date:
Estimate #:	Purchase #:	Sales Order #:

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4 HOW TO BUY

WE ARE ALWAYS THE GO TO RESOURCE
WHEN VALUE IS A MUST

Ready to buy? Find a distributor online or call us. It is probable your current supplier already sells our products. Need more information? Call us today.

Need a custom tool? Call us or submit a request for quote online. No need to call your distributor, we'll connect you with a local preferred representative.

CAPACITY

Our end users have facilities across the world. They demand consistency and performance from their suppliers. We deliver by using international relationships and flexible capacity. We are able to produce blanket stock and standard orders, for international customers, whether large or small.

LOGISTICS

We sell our products to end users via a network of professional industrial tool supply and cutting tool distributors. We have been around since 1944 and have over 7,000 distribution partners throughout the world.

(888) 531-8500 | info@conicaltool.com | www.conicalendmills.com

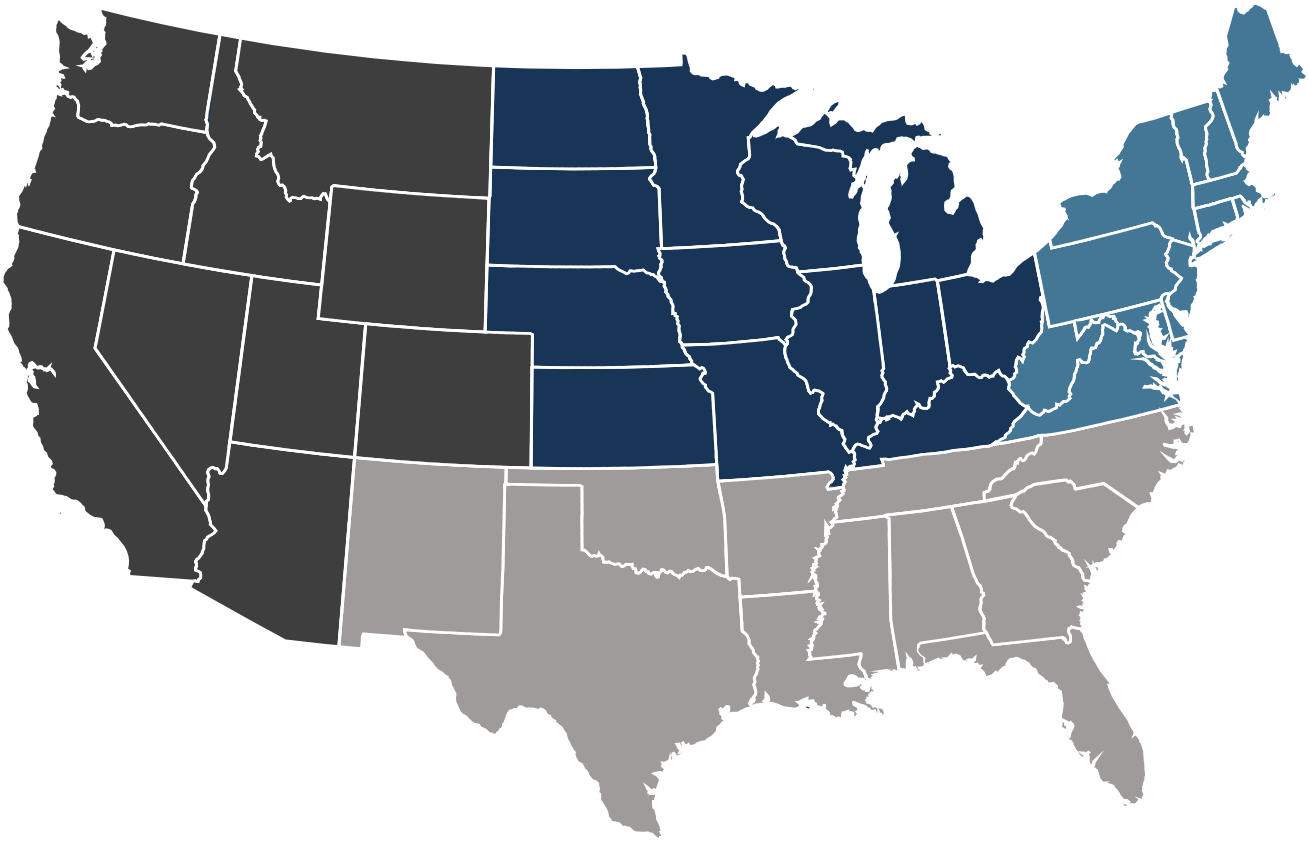
CONICAL™ CUTTING TOOLS

GLOBAL™ CUTTING TOOLS

MANUFACTURING FOR OVER 70 YEARS 1944 - 2014

DISTRIBUTION NETWORK

UNITED STATES FACTORY REPRESENTATIVES



REGIONAL SHIPPING WAREHOUSES

Conical and Global Cutting Tools sell our products to end users via a network of professional industrial tool supply and cutting tool distributors. The map above matches our Regional Sales Directors to territories throughout the United States.

We maintain thousands of high performance and specialty cutting tool variations in stock at our Michigan production facility and many of our premium distributor partners stock our best selling tools. If you are interested in becoming a distributor, please contact us for more information. If you need help finding a distributor, visit our website, contact us directly, contact your Regional Sales Director or just call your preferred distributor. After all, we've been around since 1944 and have over 7,000 distribution partners throughout the world.

If you believe your organization has the technical expertise and commitment to excellence to support a local, regional or multi-state distribution territory, contact the corresponding Regional Sales Director below to learn about our program, tools and resources to build a lasting partnership.

MIDWESTERN REGION SALES DIRECTOR

Robert M. Shindorf
3890 Buchanan Ave S.W.
Grand Rapids, MI 49503
T: (888) 531-8500
P: (616) 531-8500
F: (616) 531-7742
conicalendmills.com
rshindorf@conicaltool.com

SOUTHERN REGION SALES DIRECTOR

Michael A. DeKlein
3890 Buchanan Ave S.W.
Grand Rapids, MI 49503
T: (888) 531-8500
P: (616) 531-8500
F: (616) 531-7742
conicalendmills.com
mdeklein@conicaltool.com

WESTERN REGION SALES DIRECTOR

Robert M. Shindorf
3890 Buchanan Ave S.W.
Grand Rapids, MI 49503
T: (888) 531-8500
P: (616) 531-8500
F: (616) 531-7742
conicalendmills.com
rshindorf@conicaltool.com

EASTERN REGION SALES DIRECTOR

Michael A. DeKlein
3890 Buchanan Ave S.W.
Grand Rapids, MI 49503
T: (888) 531-8500
P: (616) 531-8500
F: (616) 531-7742
conicalendmills.com
mdeklein@conicaltool.com

PERFORMANCE HAS NO BORDERS

The manufacturing industry competes globally and our end users have facilities all across the world. They demand consistency and performance from their suppliers and Conical and Global Cutting Tools delivers it.

We currently have openings for premium level distributors to handle and process our international ordering in the areas indicated below:

AMERICAS

UNITED STATES

Global Cutting Tools
3890 Buchanan Ave SW
Grand Rapids, MI 49548
T: (888) 531-8500
P: (616) 531-8500
F: (616) 531-7742
conicalendmills.com
sales@conicaltool.com

CANADA

Sowa Tool & Machine Co.
500 Manitou Drive
Kitchener, ON N2C 1L3
T: (800) 265-8221
P: (519) 748-5750
F: (519) 748-9304
www.sowatool.com
sales@sowatool.com

MEXICO

Hertek Herramental
C. Joaquin Terrazas #2426
Cd. Juarez, Chih. 32160

P: (656) 614-0209
F: (656) 632-2159
www.hertekherramental.com
info@hertekherramental.com

BRAZIL

Open

EUROPE, ASIA & AUSTRALIA

UNITED KINGDOM

Drill Service, Ltd.
23 Albert Road
Horley
RH6 7HR
P: +44 (0)1293 774911
F: +44 (0)1293 820463
www.drill-service.co.uk
sales@drill-service.co.uk

EUROPE

Open

ASIA

Open

AUSTRALIA

Open

BECOME A DISTRIBUTOR

BOOST YOUR SALES WITH THE LEADING END MILL INNOVATOR

Thank you for your interest in becoming a Conical or Global distributor. Your customers, of all sizes, will love the benefits of our product lines, programs and resources and you'll love the added revenue and business opportunities.

Becoming a distributor, manufacturer's rep or reseller has numerous competitive advantages. Two of the most important and intangible advantages are the Conical Cutting Tools and Global Cutting Tools name and brand, which stands for integrity, quality, commitment and innovation. Selling the leading end mill innovator in the industry can open the door to increased sales – not to mention new and enduring business relationships.

Now is the perfect time to partner as a distributor. Our philosophy has always held a strong focus on our customers and each new product introduction is driven by our customers' needs. Our goal is to develop long term relationships with individuals and/or companies who share our dedicated commitment to the industry.

The following information should be helpful as you determine whether this opportunity is right for you. Please note that the instructions for how to be considered for a distributorship are included below. If you would like more information on becoming a distributor, please email us at info@conicaltool.com or call (888) 531-8500.

We select authorized distributors and manufacturing representatives on the basis of securing adequate market coverage for our products, along with satisfactory opportunities for distributor volume, inventory turns and profit in every key market area in the United States. To achieve our customer service goals, it is necessary for the Authorized Distributor to recognize and accept that we will determine the number of our distributorships in any given area. We may increase or decrease Authorized Distributors based on market demand and coverage. In order to ensure customers prompt service and delivery, Conical supports programs for direct to customer same-day-drop shipping and local stocking. The amount of inventory required for local stocking is contingent upon the location and size of the market serviced by the distributorship. Though we encourage a local stock at each distributor, we have streamlined our distribution process and increased our inventory and stock programs so distributors don't have to carry excess costs and customers can get their tools the next day.

RESPONSIBILITIES OF A CONICAL TOOL DISTRIBUTOR:

A distributor of Conical and Global products is responsible, first and foremost, for serving the manufacturing customers in his or her area. Of course, this includes visiting plants on a regular basis, marketing our products and providing technical advice. However, our distributors are also responsible for the following:

- Leading a local team of sales reps and resources to meet the needs of their customers
- Managing the finances of their businesses properly
- Holding educational workshops and events (as warranted) in their markets, with manufacturer's support
- Marketing their businesses locally
- Communicating market conditions to us, so their customers' needs can be met more effectively

IF QUALIFIED AND INTERESTED, FOLLOW THESE NEXT STEPS:

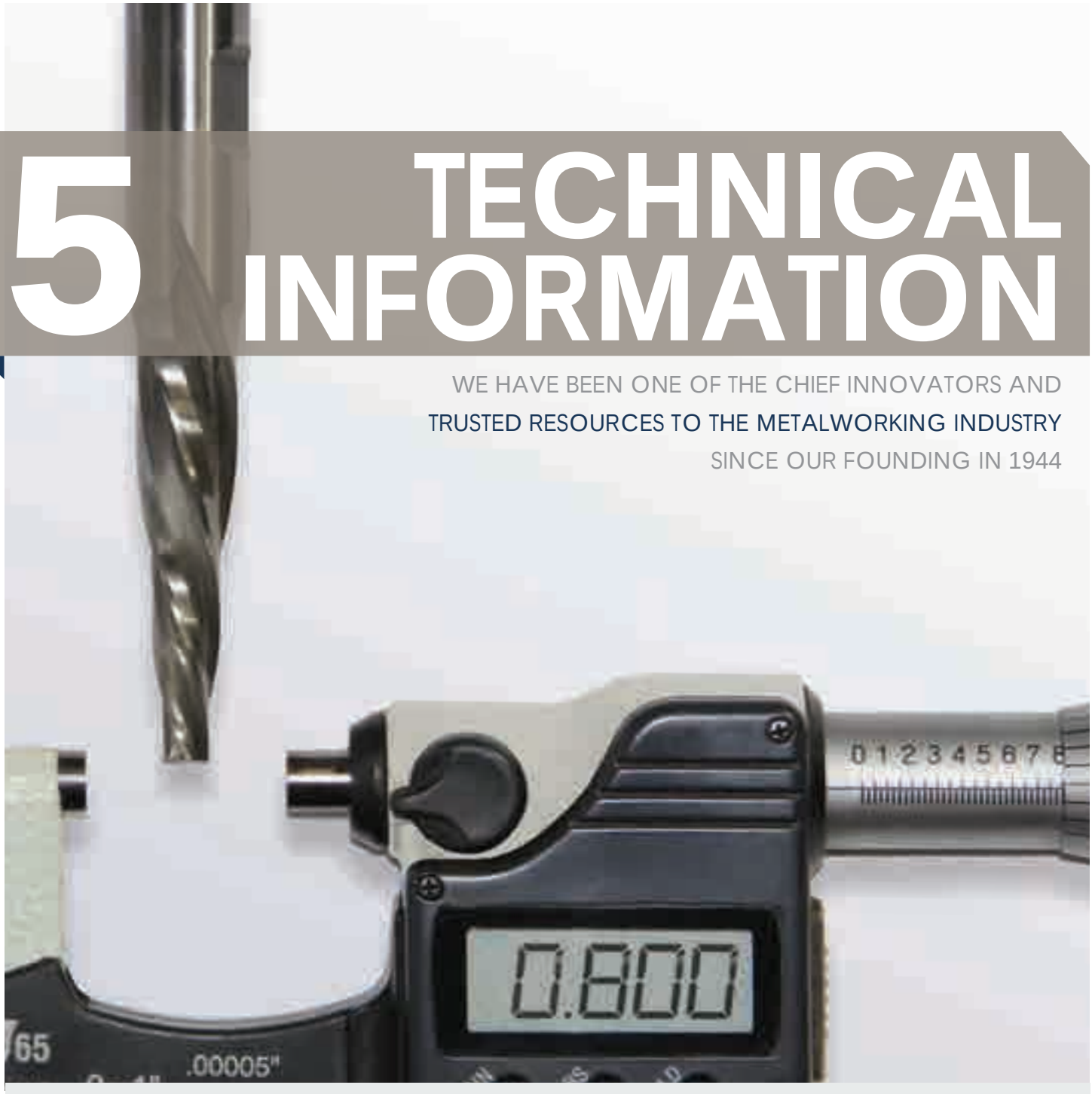
A. Please contact us and request our Credit Application

B. Fill out all relevant information regarding credit requested and potential sales revenues

C. All candidates who submit a request will be contacted and alerted of their status within 48 hours.

5 TECHNICAL INFORMATION

WE HAVE BEEN ONE OF THE CHIEF INNOVATORS AND
TRUSTED RESOURCES TO THE METALWORKING INDUSTRY
SINCE OUR FOUNDING IN 1944



Do technical terms and formulas get confusing sometimes? We have experts who can explain everything standing by for your call.

Having the right tools for the job is not just an expression in the metalworking industry, but knowing how to use them effectively requires technical prowess.

KNOWLEDGE

Many companies have unique needs and specific applications. We realize the myriad of end mills we offer at Conical Tool Company require charts and technical data to help you decide which end mills best suite your needs.

TECHNICAL DATA

All high speed steel end mills are produced from premium grade, high speed steels, heat treated to a high Rockwell, for shock and abrasion resistance. Carbide end mills are produced with all virgin micro-grain carbide powder produced through an extrusion-only process which results in a lower chance of fracturing, then using a 1200 grit ground to a high grade h6 polish for shrink fit collets.

(888) 531-8500 | info@conicaltool.com | www.conicalendmills.com

CONICAL™ CUTTING TOOLS

GLOBAL™ CUTTING TOOLS

MANUFACTURING FOR OVER 70 YEARS 1944 - 2014

SURFACE TREATMENTS & COATINGS

SELECT ADVANCED SPECIALTY COATING

Certain applications, materials or performances simply require the enhancement of a specialty coating and knowledge of the properties of the coatings available. Temperature, friction resistance, hardness, lubricity, toughness and cohesion of the resulting process must be examined prior to the selection.

UNCOATED

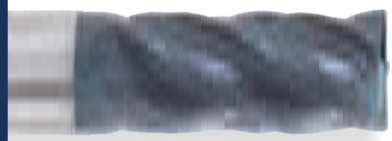
- For general purpose machining on low power machines
- Not recommended for most cutting applications

TIN (TITANIUM NITRIDE)

- Suitable for use as a general purpose coating in a wide range of materials
- Intended for moderate improvements in tool life and machining
- Increased machining speeds of 20 – 30%

TICN (TITANIUM CARBON NITRIDE)

- For aggressive machining of tool steels, high carbon steels and high silicon aluminums
- Improved wear resistance, 30% higher hardness than TiN
- Increased machining speeds of 25 – 35%



TIALN-X (TITANIUM ALUMINUM NITRIDE NANO)

- Aggressive machining of stainless & high carbon steels; nickel-based hi-temp & ti-alloys
- Ideal for roughing and interrupted cuts
- Increased machining speeds 30 – 45% and tolerates thermal stresses

ALTIN-X (ALUMINUM TITANIUM NITRIDE NANO)

- Has the highest temperature resistance of any of the standard available coatings
- Similar to TiAlN-X; Best for dry machining cast iron, titanium, Inconel, and stainless alloys where machine power is available to generate adequate heat; Increased machining speeds 35 – 45%

ALTIN/SI3N4 (ALUMINUM TITANIUM NITRIDE/ SILICON NITRIDE)

- Unique nanocrystalline AlTiN and amorphous Si3N4 deposits create a honeycomb-like structure
- Extremely hard and tough with excellent wear and abrasion resistance. Up to 35% greater tool life.
- Provides a near diamond-like coating (DLC) for high temp alloys and hardened materials

ALCRN/SI3N4 (ALUMINUM CHROMIUM NITRIDE NANO)

- Unique nanocrystalline AlCrN and amorphous Si3N4 deposits create a honeycomb-like structure
- Run dry or wet in extreme cutting conditions. Increased machining speeds of 40 -50%
- Improved wear performance at the cutting edge by uniform distribution of mechanical force

ZRN (ZIRCONIUM NITRIDE)

- Ideal for machining aluminum, plastics and other non-ferrous materials
- High lubricity reduces built up edge and hardness improves tool life
- Excellent surface finishes

TIB2 (TITANIUM DIBORIDE)

- Reduced costs when machining aluminum, titanium, magnesium and copper
- Higher speeds and chip removal rate due to its smooth surface and low coefficient of friction
- Provides increased wear resistance

AMORPHOUS DIAMOND

- For high speed machining of graphite, carbon fiber, composites and abrasive materials
- Extremely high thermal conductivity, hardness and lubricity
- Removes heat from the cutting edge and has best tolerance retention

Additionally, 16 specialty coatings are available for specific applications as may be necessary. Due to the small batch nature of these unlisted coatings, minimum batch orders may apply.

APPLICATION, IDENTIFICATION AND BENEFITS

The correct coating for your tool can produce significant time and money savings. Additionally, coatings will increase tool life and performance. The chart below can help you identify the correct coating for your particular application.

	INADVISABLE	GENERAL PURPOSE		FERROUS	
	UNC	TiN	TiCN	TiAlN-X	AlTiN-X
APPLICATION / BENEFITS		General purpose coating for machin ing ferrous materials. Improves tool life by acting as a thermal and chmical barrier betwee ltool and workpiece. A good low cost alternative to AlTiN in applications with low material removal rates.	Increased tool productivity over TiN with higher feed and speed capabilities. Considered supplimental and offered as an option when AlTiN-X cannot be used, as in applications which do not generate the speeds and feeds required for high cutting temperatures.	High performance coating designed for machining in demanding, dry, hard metal milling applications. Excellent high temperature resistance and hardness. Maintains high surface hardness even at elevated temperatures, improving tool life and allowing faster feed rates.	Premium coating for ferrous materials, the latest generation of AlTiN coating with a unique nanocomposite structure which improves hardness, heat resistance and toughnes over traditional AlTiN cotings. Superior results, extended tool life and reduced cycle tmes over traditional AlTiN coatings in demanding applications.
MATERIALS		Easy to machine ferrous and non ferrous materials.	Moderate machinability ferrous, cast irons, brass, bronze, copper, plastics and high silicon aluminum alloys.	Moderate to difficult to machine alloy steels, stainless steels, tool steels, titanium, inconel, nickel, and other aerospace materials.	Moderate to difficult to machine harneded steels, stainless steels, tool steels, nickel based alloys, titanium alloys, inconel and other aerospace materials.
COLOR		Gold	Silver-Gray	Dark Gray / Black	Violet / Black
STRUCTURE		Monolayer	Gradient	Nano Monolayer	Nano Multilayer
HARDNESS (HV 0.05)		2300 - 2500	3000 - 3200	3200 - 3400	3300 - 3800
COEFFICIENT OF FRICTION		0.40 - 0.65	0.30 - 0.45	0.45 - 0.55	0.45 - 0.55
COATING THICKNESS		1 - 4	1 - 4	1 - 4	1 - 4
MAX WORKING TEMP		1100 F / 600 C	750 F / 400 C	1450 F / 800 C	1650 F / 900 C

	FERROUS		NON-FERROUS / EXOTICS		HI-TEMP & EXOTICS
	AlCrN Si3N4	AlTiN Si3N4	ZrN	TiB2	DIA
APPLICATION / BENEFITS	Features a unique nanocrystalline AlCrN deposit, where the voids are filled with Si3N4, creating a honeycomb effect which greatly increases both hardness and heat resistance. Designed to wear evenly and resist chipping which occurs in other materials, resulting in extremely high temperature resistance and consitent performance in challenging applications. Dry or wet, the AlCrN-X excels in interupted cuts.	Features a unique nanocrystalline AlTiN deposit, where the voids are filled with Si3N4, creating a honeycomb effect which greatly increases both hardness and heat resistance. The hardness and heat resistant properties of this coating are the highest available, outside of DLC. Incredibly extended tool life and reduced cycle times when high speed machining without coolant.	Excellent non-ferrous material solution due to high hardness, lubricity and abrasion resistance. Works well with gummy workpiece materials due to its lubricity and edge retention properties.	Maintains extremely high metal removal rates in aluminum due to its incredibly low affinity to the material. Prevents edge material building up on the edge and chip packing. Has a high hardness, toughness and working temp making it an excellent cross over into hi-temp alloys.	A thick crystaline diamond (CVD) is grown directly on the substrate. Hardness and abrasion resistance are increased for extended tool life in abrasive materials. Amorphous diamond is similar in performance to a CVD diamond, though it is deposited through a PVD process, reducing both price and performance in comparable materials. The thinner PVD coating lends well to machining applications which require a sharper tool edge.
MATERIALS	Moderate to difficult to machine harneded steels, stainless steels, tool steels, nickel based alloys, titanium alloys, inconel and other aerospace materials.	Moderate to difficult to machine harneded steels, stainless steels, tool steels, nickel based alloys, titanium alloys, inconel and other aerospace materials.	Specifically designed for aluminum, works well in abrazive non-ferrous alloys such as brass, copper, bronze, fiberglass and composites.	High silicon aluminium alloys, titanium alloys, magnesium alloys and copper alloys.	Abrasive materials, plastics, graphite, carbon fiber, high silicon alloys, composites, green carbides and green ceramics.
COLOR	Silver-Gray	Blue-Black	Light Gold / Champagne	Light Gray / Silver	Black
STRUCTURE	Nano Composite	Nano Composite	Monolayer	Monolayer	Monolayer
HARDNESS (HV 0.05)	4000 - 4200	4400 -4600	2300 - 2500	3800 - 4200	8500 - 10000
COEFFICIENT OF FRICTION	0.35 - 0.40	0.40 - 0.45	0.50 - 0.60	0.40 - 0.50	0.05 - 0.30
COATING THICKNESS	1 -5	1 - 4	2 - 5	1 - 3	0.5 - 8
MAX WORKING TEMP	2010 F / 1100 C	2190 F / 1200 C	1100 F / 600 C	1550 F / 850 C	1100 F / 600 C

FOR MORE INFORMATION ON OUR SPECIALTY COATING PROGRAM, SEE PAGE 21

COATING SELECTION GUIDE

SELECTING THE OPTIMAL COATING FOR YOUR APPLICATION & MATERIAL

The chart below will guide you to the best choice of coating for you tool, dependent on your application's material. Feeds and speeds can be increased significantly when using the proper coating. All coatings create a benefit, provided the best coating is selected.

ISO GROUP	SYMBOL	HARDNESS	DESCRIPTION	TiN	TiCN	TiAlN-X	AlTiN-X	AlCrN Si3N4	AlTiN Si3N4	ZrN	TiB2	DIA
P 1 - 11	ST CARBON STEEL LOW CARBON	≤ 38 HRC	10xx; 11xx; 12xx; 12Lxx; 15xx; etc	★	★★	★★	★★★					
	ST CARBON STEEL MEDIUM CARBON	≤ 38 HRC	13xx; 41xx; 43xx; 86xx; 92xx; etc		★	★★	★★★					
	TS TOOL STEEL ≤ 38 HRc	≤ 38 HRC	A2; A3; D2; H11; H13; M1; O1; S7; NAK 55; etc		★	★	★★	★★★	★★★			
	TS TOOL STEEL 39-48 HRc	39 - 48 HRC	P20; P21; S-136; PX-5; NAK 80; etc		★	★	★★	★★★	★★★			
H 38 - 41	HS HARDENED STEEL 48-57 HRc	48 - 57 HRC			★	★	★★	★★★	★★★			
	HS HARDENED STEEL 58-65 HRc	58 - 65 HRC			★	★	★★	★★★	★★★			
M 12 - 14	SS STAINLESS STEEL EASY	72 - 85 HRB	410; 416; 420; 430F; 440C; 302; 303; etc		★	★	★★	★★★	★★★			
	SS STAINLESS STEEL MODERATE	25 - 41 HRC	304; 304L; 316; 316L; 320; 321; 347; Invar 36; Kovar		★	★	★★	★★★	★★★			
	SS STAINLESS STEEL DIFFICULT	31 - 50 HRC	13-8 PH; 15-5 PH; 17-4 PH; Carpenter; Invar		★	★★	★★	★★★	★★★			
K 15 - 20	CI CAST IRON GRAY	100 - 200 HRB	Gray		★★	★	★★	★★★	★★★			
	CI CAST IRON DUCTILE	150 - 300 HRB	Ductile		★★	★	★★	★★★	★★★			
	CI CAST IRON MALLEABLE	150 - 310 HRB	Malleable		★★	★	★★	★★★	★★★			
S 31 - 37	TI TITANIUM ALLOYS 25-36 HRc	25 - 36 HRC	6AL4V; Grades 5-38; etc			★	★★	★★★	★★★		★★★	
	HI HI-TEMP ALLOYS 30-52 HRc	30 - 52 HRC	Inconel, Model, Hastalloy, etc			★	★★	★★★	★★★		★★★	
N 21 - 28	AL ALUMINUM ALLOYS Low Si (<10%)	LOW SI (< 10%)	20xx; 50xx; 60xx; 70xx; etc	★	★★					★★★	★★★	
	AL ALUMINUM ALLOYS High Si (>10%	HIGH SI (> 10%)	A-38x; A-39x; B-39x; etc		★					★★	★★★	★★★
	MG MAGNESIUM ALLOYS ≤ 38 HRc	≤ 38 HRC			★					★★	★★★	
	CA COPPER ALLOYS 39 - 48 HRc	39 - 48 HRC	Manganese & Tin Bronze, Beryllium Copper	★	★★					★★	★★★	
	CG CARBON & GRAPHITE 48 - 57 HRc	48 - 57 HRC		★	★★							★★★
	PL PLASTICS & COMPOSITES 28 - 57 HRc	28 - 57 HRC		★	★★					★★		★★★

★ = good ★★ = better ★★★ = best

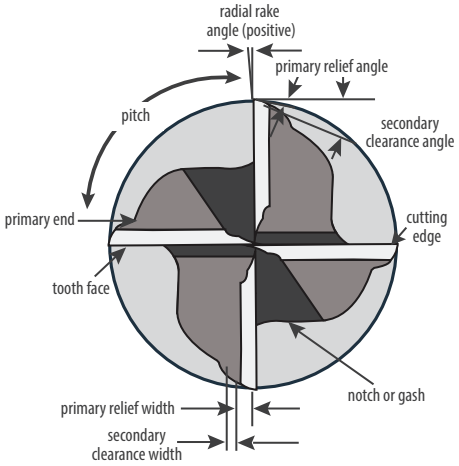
OUR TOOLS HAVE BEEN USED IN EVERY APPLICATION IMAGINABLE, FROM SCULPTURAL ICE CARVING TO PRECISION MANUFACTURING OF CUSTOM NUCLEAR REACTOR PARTS.

END MILL ATTRIBUTES & TERMINOLOGY

COMMONLY USED INDUSTRY LANGUAGE AND DEFINITIONS

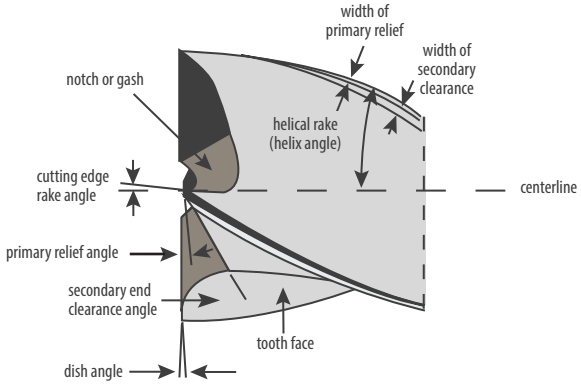
END VIEW

figure 1



CROSS SECTION VIEW

figure 2



AXIAL RELIEF – Measured in the axial direction between a plane perpendicular to the axis at the cutting edge and the relieved surface.

CLEARANCE (SECONDARY RELIEF) - The additional space provided behind the relieved land, eliminates contact between the mill and workpiece.

CORE DIAMETER - The diameter measured tangent from bottom of all flutes, determines the strength of your end mill.

CUTTING DIAMETER - Measured from margin-to-margin on cutting end of tool. Even number of flutes can be measured 180° apart.

CUTTING EDGE - Leading edge of the cutter tooth.

DISH ANGLE - Angle perpendicular to centerline of tool and allows proper end cut characteristics which reduces full diameter contact.

FLUTE - The number of cutting edges and the chip space between the back of one tooth and the face of the following tooth. The number of flutes will determine the feed rate.

FLUTE LENGTH - Length of flutes or grooves. Often confused with cutting length.

FLUTE WASH - Amount of non-cutting flute area past the length of cut.

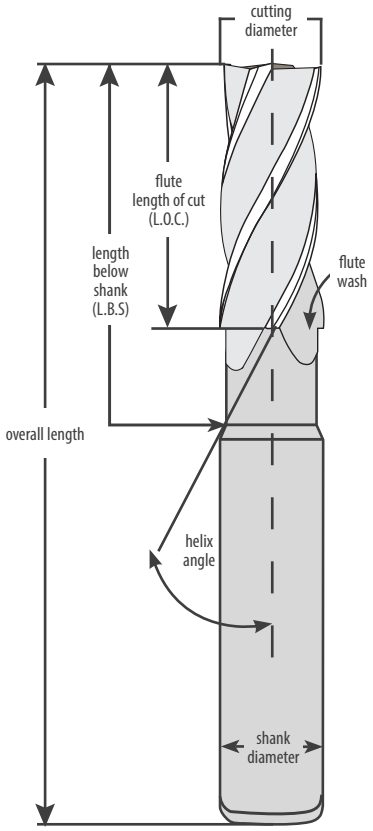
GASH ANGLE - Angle that the gash relief is developed which provides chip room.

HAND OF CUT - Right Hand (RH): Counterclockwise rotation of the end mill is required in order to cut. Most end mills are right hand. Left Hand (LH): Clockwise rotation of mill is required to cut.

HEEL - The back edge of the relieved land.

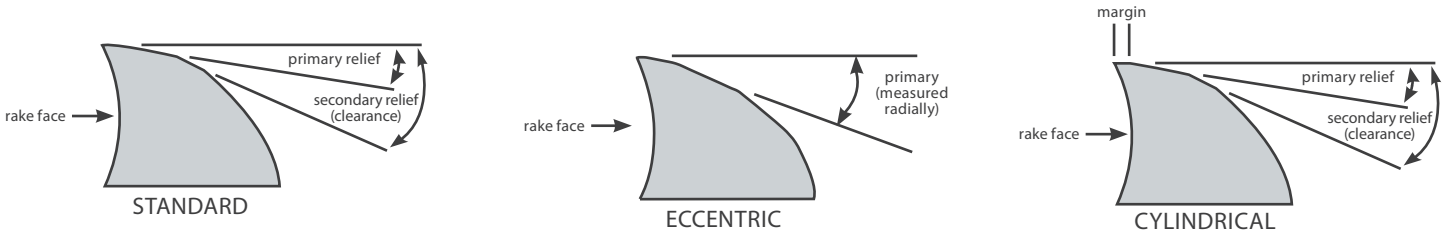
SIDE VIEW

figure 3



RELIEF TYPES

figure 4



HELIX ANGLE - Angle formed by a line tangent to the angle of the flute grind, and parallel to the centerline of the tool. The cutting edge angle which a helical cutting edge makes with a plane containing the axis of a cylindrical mill.

LAND - Defines the width of a specified surface.

LENGTH BELOW SHANK (LBS) - Length measured from front of tool to the shank, allowing for deep pocketing.

LENGTH OF CUT (LOC) - Actual cutting depth of the tool in the axial direction. Axial length of the peripheral cutting edge which has been relieved to cut.

OVERALL LENGTH (OAL) - Measurement from end to end.

PITCH - Angular measurement from flute to flute. Variable pitch has unequal spacing.

PRIMARY RELIEF - Relief measured in the axial direction between a plane perpendicular to the axis at the cutting edge, and the relieved surface.

RADIAL RAKE - Angle of rake face measured from center of the tool. The angle between the tooth face and a radial line passing through the cutting edge in a plane perpendicular to the cutting axis. Results in the removal of tool material behind or adjacent to the cutting edge which provides clearance.

RADIAL RELIEF - Area where cutting face is relieved, behind the cutting edge, to avoid rubbing.

Cylindrical - Primary and secondary relief angles, effective for non-ferrous alloys.

Eccentric - Primary relief measured radially along its edge, ideal for ferrous and tough materials.

Standard - Allows for high degree of primary and secondary radial relief.

RAKE - Angular relationship between the tooth face or a tangent to the tooth face.

RELIEF ANGLE - Angle formed between a relieved surface and a given plane, tangent to the axis at the cutting edge.

SHANK - Extending part of a cutter which propels the cutter from the machine spindle.

TOOTH - The cutting edge.

TOOTH FACE - The surface of the tooth on which the chip invades.

WELDON SHANK - Shank with a locking drive flat.

MACHINING METHODS

CLIMB & CONVENTIONAL MILLING

There are drastic differences between climb milling and conventional milling which produce dramatically different results. Understanding the differences is key to extending tool life, promoting quality and optimizing machine time utilization. Desired speed, finish, material, chip clearing, shear direction, and end mill construction are just a few things to consider when deciding on your choice of milling method. Regardless of your preferred method, your workpiece should be braced sufficiently in the direction you are milling.

CONVENTIONAL MILLING

Conventional milling requires lower forces and is preferred for roughing cuts. The cutter is revolving in the opposite direction as the table feed and the workpiece is fed into the rotation of the cutter. The width of the chip increases to a maximum at the end of the cut, advancing tool wear.

Characteristics of Conventional Milling:

- Conventional milling is preferred for rough, abrasive surfaces when removing or breaking through material scale, welded, work hardened or flame cut areas.
- Increased rubbing, harmonics, work hardening and premature tool wear
- The tooth meets the workpiece at the bottom of the cut
- Produces upward force on part, increasing part movement
- More torque is required to conventional mill than climb mill
- Surface finish is worse because chips are carried upward by teeth and dropped in front of cutter
- The width of the chip starts from zero and increases to the maximum width of the cut
- Tool deflection during Conventional milling will tend to be parallel to the cut

CLIMB MILLING

Climb milling produces excellent surface finishes and works best in most cases. The cutter is revolving in the same direction as the table feed, meeting the workpiece at maximum thickness, producing the largest chips first. When cutting in the direction of the table feed and rotation of the cutter combine, the mill will try to draw away from the work.

Characteristics of climb milling:

- Desired method for high performance solid carbide cutters
- Increased surface finish; decreased rubbing and work hardening; up to 50% increased tool life
- The tooth meets the workpiece at the top of the cut
- Produces downward force on part, decreasing part movement
- Less torque required to climb mill than conventional mill
- Higher initial spindle load and increased spindle load as end mill dulls
- Helps to prolong tool life, tools lasting up to 50% longer
- Chips are dropped behind the cutter (less re-cutting)
- The width of the chip starts at maximum at the maximum width of the cut and decreases to zero
- Tool deflection during climb milling will tend to be perpendicular to the cut, so it may increase or decrease the width of cut and affect accuracy

CONVENTIONAL MILLING

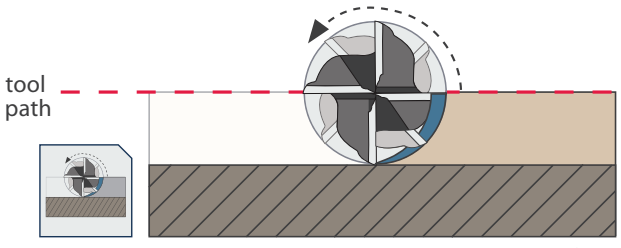


figure 1

CLIMB MILLING

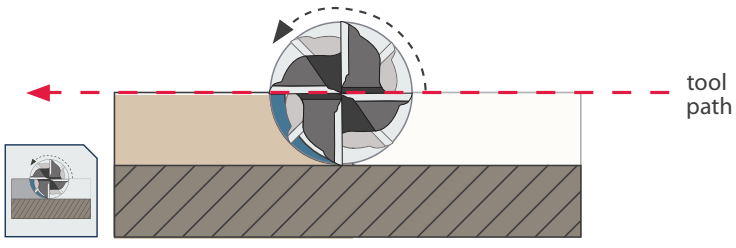


figure 2

ENGAGEMENT ANGLE

ENHANCING TOOL LIFE & MACHINE PERFORMANCE

The angular measurement of the cutter in which the contact between the tool and the workpiece occurs is referred to as the Tool Engagement Angle ("TEA"). Radial chip thickness is directly connected to the angle of engagement and increasing the axial depth of cut increases the tool engagement angle considerably.

When contouring (see figure 1), the tool engagement angle varies dramatically along a curved cut. As the tool approaches an inside corner (see page 51 for additional technical information), its engagement angle is increased dramatically and therefore its radial chip thickness is as well. This dramatic and quick increase in chip load per tooth can cause spikes in spindle load and horsepower requirements, a need to decrease the feed rate, increased tool deflection, lower tolerances, decreased surface finish and result in excess wear and tear on the cutter and machine.

As the tool engagement angle is decreased, either through a lower radial depth of cut or while cutting an outside corner, the stresses on the machine and tool are lessened. While decreased horsepower requirements, decreased tool deflection, tighter tolerances and improved finishes are all desirable, the programmed chip load per tooth may be too low and require an increase in feed rate (see page 50 for additional technical information) to avoid the tool from rubbing and prematurely wearing. This can present a perfect opportunity for high speed machining if the machine has high spindle speed capabilities.

CONTOURING AND CORNER ENGAGEMENT

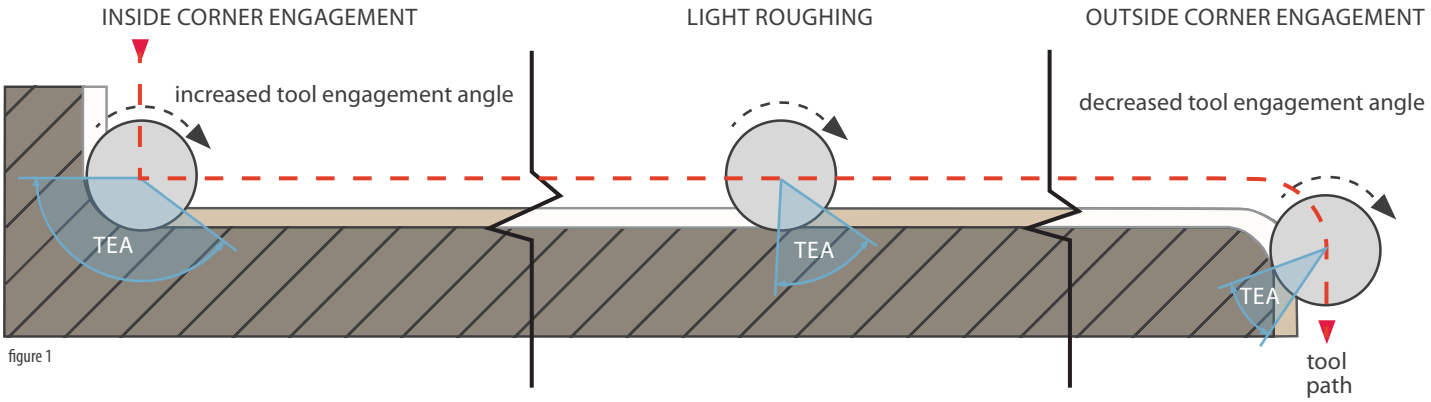


figure 1

ROUGHING AND FINISHING PASSES

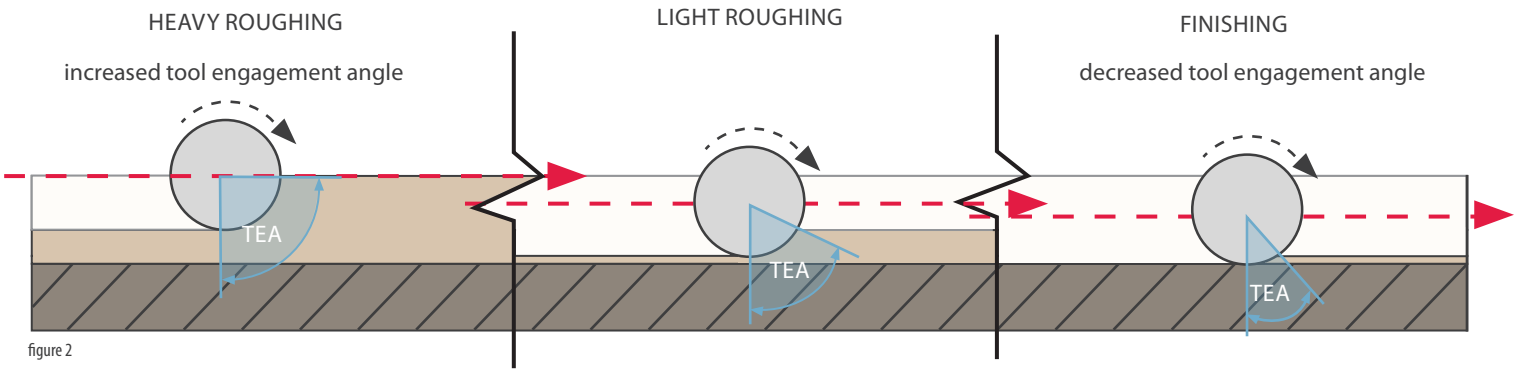


figure 2

CHIP THINNING

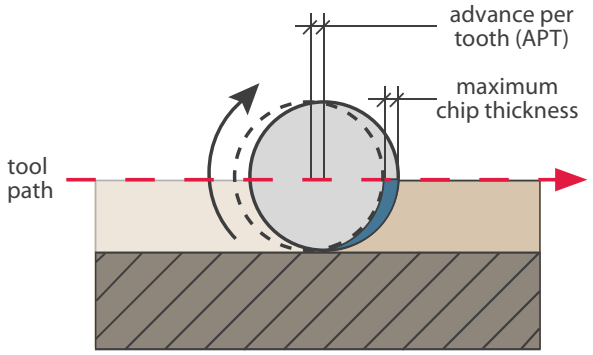
PROCEDURES AND CALCULATIONS FOR PROPER CHIP REMOVAL

A light radial depth of cut (less than half of the cutter diameter) causes the chip formation to be much thinner than the programmed feed rate. The end mill begins to rub, rather than cut, causing excessive tool wear by creating increased friction, work hardening and degrading the ability of cutting tool to transfer detrimental heat away from the tool and workpiece. This greatly diminishes and limits the cutting tool's performance in terms of chip load per tooth.

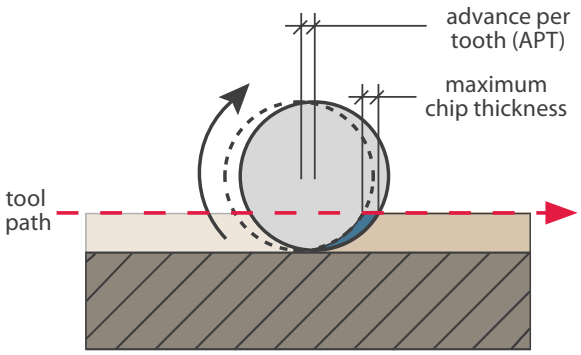
Many programs and speed and feed calculators show only the Advance Per Tooth (APT) and it is commonly used interchangeably with the Chip Load Per Tooth (CLPT). While taking a Radial Depth of Cut (RDOC) of 50% (see figure 1), the APT is the same as the CLPT which lends to the confusion. The APT is actually the measurement of forward feed that takes place in the time necessary for the cutter to rotate a single revolution, whereas the CLPT is the thickness of the chip produced. When the RDOC is equal to or greater than 50% of the diameter of the tool, the chip is thickest along the centerline of the tool, then decreases to zero as the cutting edge exits the material.

When programming a Radial Depth of Cut ("RDOC") less than half the tool diameter (see figure 2), use the calculation in Figure 5 to determine the Adjusted Chip Load Per Tooth ("ACLPT") to prolong tool life and lessen cycle time. If your width of cut is less than half the diameter of the cutter (unless otherwise listed on supplement feeds and speeds), your chip thickness is less than the programmed advance per tooth feed rate.

You also must consider the extent of the tool engagement when using this adjustment in feed rate. For instance, when milling into corners, the tool engagement angle ("TEA") increases dramatically and tool deflection and cutting forces are increased. Feed rate reductions in these areas may be required and will need consideration.



50% RADIAL DEPTH OF CUT (RDOC) figure 1



<50% RADIAL DEPTH OF CUT (RDOC) figure 2

figure 3

ADJUSTED CHIP LOAD PER TOOTH CALCULATION

SYMBOL	EQUATION
Adjusted CLPT =	$\frac{\text{CLPT x (D/2)}}{\sqrt{(D*RDOC) - RDOC^2}}$

figure 4

ADVANCE PER TOOTH CALCULATION

SYMBOL	EQUATION
APT =	$\sqrt{\frac{IPM}{RPM \times T}}$

figure 5

ACTUAL CHIP LOAD PER TOOTH CALCULATION

SYMBOL	EQUATION
Actual CLPT =	$\left(\frac{(D/2)}{RDOC}\right)^2$ x CLPT

KEY

SYMBOL	ELEMENT
APT =	Advance Per Tooth
IPM =	Inches Per Minute (Feed Rate)
RPM =	Revolutions Per Minute (Spindle Speed)
T =	Number of Teeth
CLPT =	Chip Load Per Tooth
D =	Diameter of Cutting Tool
RDOC =	Radial Depth of Cut

CONICAL™ CUTTING TOOLS

GLOBAL™ CUTTING TOOLS

CORNER ENGAGEMENT

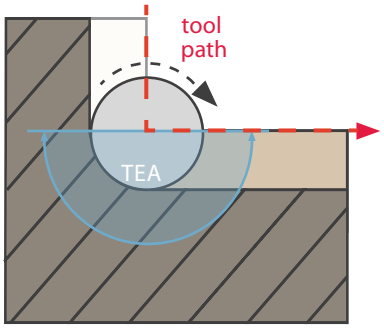
CREATING QUALITY CORNERS AND INCREASING PERFORMANCE

Improperly programmed tool paths can create a wide spectrum in spindle torque variations and result in uncontrolled parameters and premature tool wear. Traditional conservative programming results in lower productivity and simultaneously increases tool wear by causing chip thinning. Alternative programming may cause the tool's engagement angle to increase significantly, resulting in a spike in cutting forces which can weaken performance and lead to breakage. When milling inside corners, cutting forces are increased dramatically and unacceptable conditions may be apparent.

Indicators of a difficult to machine area:

- Chatter – Visible: finish level is noticeable worse
- Deflection – Measurable: taper increases along wall
- Sound – Audible: squawking or chirping when cutter is engaged
- Tool Breakage – Visible: chipping forms near the end of the tool,flutes are stripped or tool breaks

TRADITIONAL PROGRAMMING – NOT RECOMMENDED FOR MOST SCENARIOS



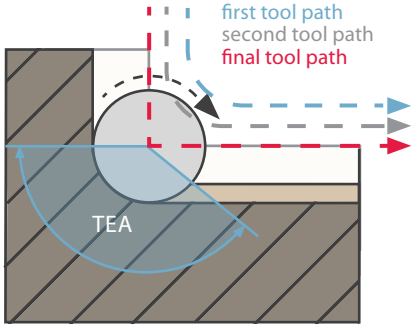
HEAVY ROUGHING
50% RADIAL DEPTH OF CUT

Match an end mill radius to that of the inside corner being machined and execute a 90° turn in cut direction. This increases the tool engagement angle to nearly 180° at a 50% RDOC, resulting in significant additional cutting forces, increased likelihood for chatter, tool deflection, breakage and ultimately poor surface finish.

Acceptable Scenario: This method should only be used when slotting or pocketing and clearance is an issue.

Programming Considerations: If employing a 90° turn in cut direction, feed rate will need to be lessened.

IMPROVED PROGRAMMING – GENERALLY ACCEPTABLE IN MANY SCENARIOS



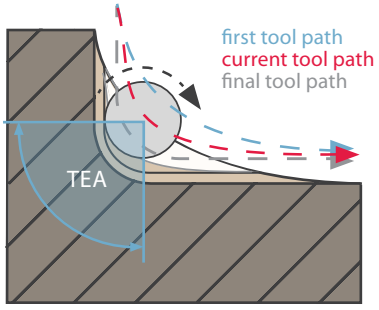
LIGHT ROUGHING
<50% RADIAL DEPTH OF CUT

Cutting in a sweeping direction that matches the radius of the tool reduces the tool engagement However, the final cut will have a drastic engagement angle which results in less than optimal machining. Again, chatter, deflection, poor surface finish and breakage can all occur. Utilizing this method will also require a reduction in feed rate on the final pass due to the increased tool engagement angle

Acceptable Scenario: When machining without tool changes and programming using the existing tool.

Programming Considerations: A smaller Radial Depth of Cut ("RDOC") will have to utilized and feed rate lessened on the each pass as the engagement angle increases to create the desirable surface finish.

OPTIMIZED PROGRAMMING – GENERALLY ACCEPTABLE IN MOST SCENARIOS



LIGHT ROUGHING
<50% RADIAL DEPTH OF CUT

Combining a smaller end mill and larger, sweeping radial tool path is the optimal condition for corner engagement. The tool engagement angle varies less and becomes much more manageable with smaller tool engagement, thus allowing for higher speeds and feeds. The engagement angle will still increase at the full depth of cut, but feed reduction will be minimized. Furthermore, surface finishes are improved and end mill life is prolonged.

Acceptable Scenario: In most scenarios where adequate room exists for the returning tool path.

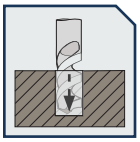
Programming Considerations: Feed rate may need to be heightened to eliminate chip thinning due to a less than 90° tool engagement angle.

TOOL ENTRY METHODS

APPROACHES & PROCESSES

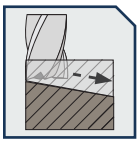
Tool entry is one of the most imperative operations to the performance of the tool and can have the most effect on a tool's life. Listed below are some conventional methods of tool entry, as well as tips on how to optimize performance.

TOP ENTRY



Pre- Drilling

Pre-drilling a hole slightly larger than the end mill diameter to full cutting depth is the best way of entering your end mill into a pocket. This creates the least amount of excessive end wear and reduces tool stress.



Ramping In

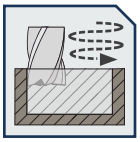
Ramping gradually increases the depth while moving the cutter in a linear path. There are multiple variations on ramping, some follow the contour of the pocket and not necessarily a straight line. In others, referred to as zig zag, the cutter moves back and forth in a straight line, at each pass increasing its depth.

This method can be very advantageous but exerts various cutting forces that the tool must endure. Proper chip size, evacuation and core strength are crucial to minimizing wear and built up edge. Utilizing a corner radius will reduce corner wear on the most fragile part of the tool.

General guidelines for ramp angles:
Ferrous Materials 1 - 3˚
Non-Ferrous Materials 3 - 10˚

Straight Plunge

Plunging can easily break an end mill and requires a center cutting tool. Therefore, this is the least favorable method of tool entry. Feed rate is typically a fraction of a straight linear feed rate. Drills are intended for straight plunging and should be used instead of an end mill. End milling utilizes a flat or concave entry point creating natural chip packing and making evacuation difficult. Cutting forces on the tool are extremely high and the stresses make performance unpredictable when executing this operation.

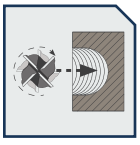


Helical Interpolation

Helical Interpolation is the process of using the end mill to define a helical motion, producing a circular hole, to the full cutting depth. End mills with a corner radius decrease tool wear and corner breakdown. Tool engagement angle is consistent and cutting forces are reduced by the end mill's own tool path. A programmed helix between 115-130% of the cutter size is suggested for optimal performance.

SIDE ENTRY

Use a corner radius for optimal performance



Straight Entry

A linear entry using the side of the end mill to enter the workpiece. This method is much harder on the end mill and makes it more susceptible to wear and shorter tool life. The feed rate during entry must be cut in at least half and speed reduced at a similar rate, until the tool is completely engaged at its operating RDOC.

Roll in Entry

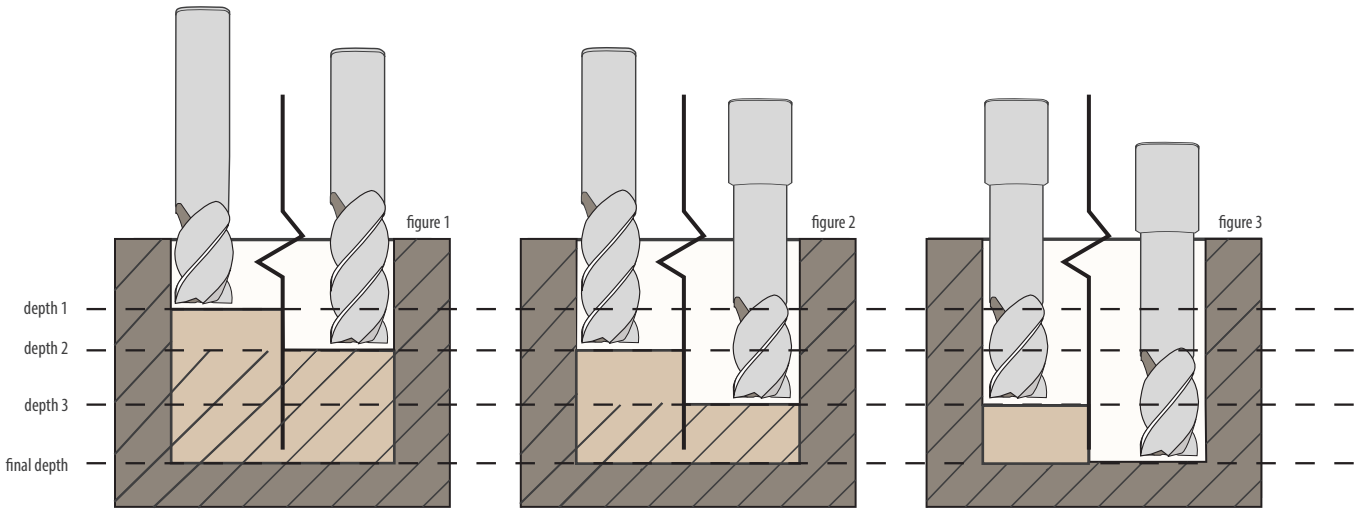
To execute a roll in entry, start the cutter out half the diameter to the right of the desired entry location. Then roll it along a path in an arched direction, with the same radius as the cutter. Rolling into the cut inherently generates proper chip thickness and yields complete engagement. The feed rate should be cut in half until the tool is fully engaged.

MATERIAL REMOVAL

DEEP POCKET MILLING

Removing material deep in a pocket is consistently one of the most challenging operations. Chip packing can occur due to poor chip evacuation, coolant flooding is not an option and air pressure may be inadequate to remove chips from the pocket. Without chip evacuation, the existing chips are recut. It may be required to periodically halt operations to clear chips and pooled coolant. To make matters worse, long flute length and overall length tools tend to deflect causing chatter, wall taper, reduced finishes, chip thinning and potential breakage.

In order to optimize speeds and feeds, employ a step down method to maintain a consistent axial depth, while using the largest diameter cutter possible. Utilize a stub length or regular length tool (figure 1) to get to at least 2 to 3 times the diameter of the cutting tool in depth. Using a stub or standard length tool will allow you to create a higher metal removal rate in the beginning steps of the pocket, reducing the overall machine time. Once this is achieved, change tools to a short flute length, reduced neck, extended reach tool. (figure 2)



BEGIN WITH REGULAR OR SHORT TOOL

EMPLOY MEDIUM LENGTH TOOL AND REDUCE NECK

EMPLOY REDUCED NECK TO AVOID WALL

Extended reach tools are much stronger than standard or length tools due to a shorter length of cut. They can maintain higher feeds and speeds without exposing the tool to the wear and deflection a standard tool would be subjected to. This is in part due the neck diameter being smaller than the cutting diameter, which allows for more clearance and a shorter flute length, strengthening and extending the core. If possible, a high speed machining technique should be used, increasing the spindle speed and feed rates while taking light cuts. Implementing this milling procedure will ensure maximum efficiency and the least tool wear while actually increasing the metal removal rate.

Resist the desire to reduce the feed per tooth and radial depth of cut to the point of generating thin chips. If less than half the tools diameter is engaged in cutting, the chips will be thinner than calculated and excess heat and pressure will be created in the cut. Use the Adjusted Chip Load Per Tooth calculation on page 35 to compensate.

Do not use conventional endmills with weldon flats and holders with setscrews. They pin the tool to a single side of the holder, pushing the tool between .0001 and .0005" off center. As the length of tool extended from the holder increases, the total indicated runout compounds, increasing chatter, deflection and poor surface finish.

MATERIAL REMOVAL

THIN WALL MILLING

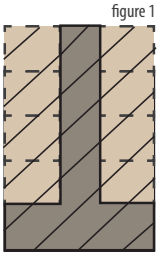
Creating thin walls while holding part tolerance and finish, requires careful programming and expertise. The force generated by metal removal along a thin wall's relatively weak structure, often creates a reverse taper along the wall, tolerance issues and surface finish problems.

Vibration and chatter must be controlled by harmoniously marrying the toolholder, cutter, material and tool path. Assuming the workpiece and table has been properly secured and is rigid enough for the operation, take care in selecting the proper shrink-fit collet holder and indicate the cutter to minimize any runout. Ensure the machine selected for the milling does not have excess spindle wear which will contribute to total indicated runout at the cutting edge.

Large core, rigid cutters work best for thin wall milling. Avoid tooling with a long overall length and a long length of cut when progressing into the pocket to minimize deflection, chatter and breakage. Just as with deep pocket milling, so long as adequate clearance exists, the largest diameter tool possible should be used. After reaching a depth of 2-3 times the diameter of the tool being used, the regular or stub length tooling should be replaced with a short flute length, necked down, extended reach tool. If the material allows, a flute count and a higher helix, extended reach tool is the optimal selection as more of the tool is engaged in the cut. It's shear plane pulls up on the workpiece material more than a traditional helix end mill, which tends to push either the cutter or the wall away from the tool.

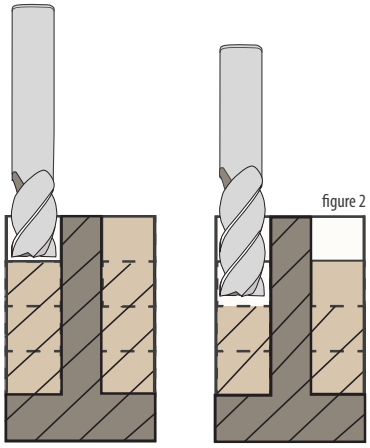
Climb milling will also assist in dampening vibration and eliminating chatter and should be used if possible. Because the rotational direction of the cutter is moving in the same direction as the part, it pulls the wall towards the cutter, rather than pushing it away from the cutter, using the cutter itself for stability in the cut.

figure 1



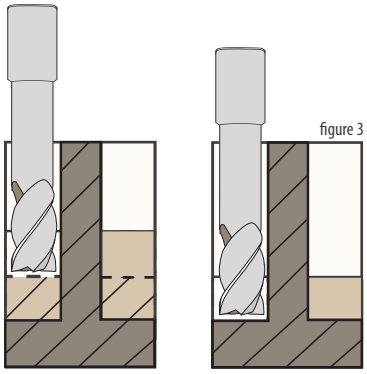
MATERIAL TO BE REMOVED

figure 2



EMPLOY REGULAR OR STUB LENGTH TOOL

figure 3

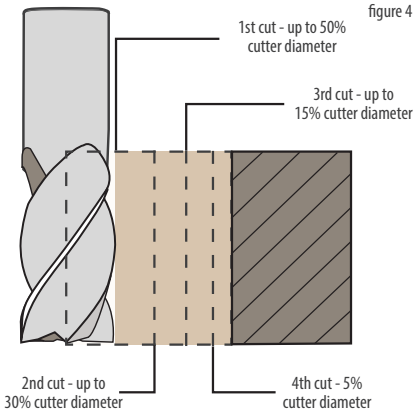


EMPLOY REDUCED NECK TO AVOID WALL

The cut should be segmented into equal segments (see figure 1) on both sides of the part, each with similar axial depths of cut. Beginning on one side of the wall, remove the material with a stub or standard length end mill, then alternate to the opposite side of the wall on each new pass. This leaves the wall supported from both sides throughout the cut and progresses in an incremental “stepped down” method. Upon reaching 2 times the cutter diameter, the tool should be changed to a reduced neck tool, as previously discussed, for the remainder of the cuts.

Depending upon the wall thickness and depth, a progressive radial depth of cut strategy may need to coincide with the above recommendations. This reduces the tool pressure against the wall after the opposite side’s support stock has been removed. After machining the opposing side, reduce the depth of cut as you approach the wall. Dependent upon the wall thickness and amount of stock to be removed adjacent to the wall, four to five passes should be implemented (see figure 2). The final pass may be an extremely light finishing pass, minimizing the vibration of the wall in its weakened form while maximizing surface finish.

figure 4



FINISHING
TECHNIQUES & SUGGESTIONS

The objective in finishing is to eliminate or reduce final manual retouching and to achieve the desired dimensions, tolerances and surface finishes. There are many factors to consider when planning for finish passes. The material, workholding, toolholder, and cutter all contribute variables when programming an appropriate tool path.

Surface finish requirements vary from part to part. Finishing passes ensure accurate part measurement as well as create an aesthetically pleasing finish. Being aware of the many variables present and choosing the right procedures are vital to achieve the desired outcome.

Generally, using a cutting tool with a helix angle of 45 degrees or greater when the workpiece is aluminum and 38 degrees or higher for hardened or ferrous materials, will improve finish due to the greater shearing action of the cutting flutes. Simultaneously combining an increased helix and an increased number of flutes will improve tool engagement, minimize tool deflection, maintain dimensional accuracy and maximize the surface finish. Selecting a tool with an odd number of flutes staggers the entering and exiting of the flutes and contributes to smoother machining.

Be sure to use precision tool holders to minimize runout and cut with multiple progressively shallower radial depths of cut. A single pass maximizes cutter deflection and restricts chip evacuation, making surface finish harder to control.

Use climb milling whenever possible to create the best surface finish and dimensional accuracy. If the finishing depth is greater than two times the diameter of the tool, use reduced neck tooling to maintain stability in the cut while eliminating any rubbing that may occur from the shank. The Axial Depth of Cut (ADOC) should be approximately 75% of the tools length of cut, progressing at equal incremental passes to allow the top 25% of the tool's flutes to blend the radius at the bottom of the last cut with the top of the current cut. When finishing an existing hole, use an end mill with a slightly smaller diameter than the finished hole dimensions and circular interpolate the cutting path.

To maximize your cutters tool life, you may want to downgrade your visibly worn tools and use them in roughing operations only.

Further suggestions:

- The Radial Depth of Cut (RDOC) Should be between 1.5% and 5% of the cutter diameter
- Increasing the RPMs and decreasing the feed per tooth will improve surface finishes
- For walls greater than two times the diameter of the tool, use long reach end mills
- Advanced geometry cutting tools will dampen chatter and increase part finish

SURFACE ROUGHNESS

DEFINITIONS & CALCULATIONS

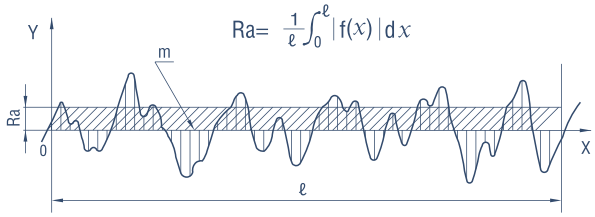
Achieving the required surface finish is generally the last step in production. Level of finish is specified for functional, dimensional and aesthetic reasons and has varying methods of measurement. The measurement of surface roughness is a mathematical equation, for a randomly sampled area, expressed as a constant or range.

TYPICAL WAYS FOR OBTAINING SURFACE ROUGHNESS

ARITHMETICAL MEAN ROUGHNESS (RA)

A section of standard length is sampled from the mean line on the roughness chart. The mean line is laid on a Cartesian coordinate system where in the mean line runs in the direction of the x-axis and magnification is the y-axis. The value obtained with the formula on the right is expressed in micrometer (µm) when y=f (*x*).

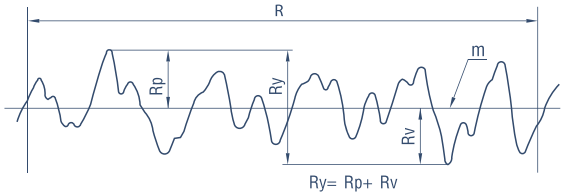
$$Ra = \frac{1}{\ell}\int_0^{\ell} |f(x)|\,dx$$



MAXIMUM PEAK (RY)

A section of standard length is sampled from the mean line on the roughness chart. The distance between the peaks and valleys of the sampled line is measured in the y direction. The value is expressed in micrometer (µm).

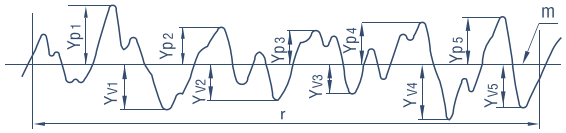
Note: To obtain Ry, sample only the standard length. The part, where peaks and valleys are wide enough to be interpreted as scratches, should be avoided.



Ry= Rp+ Rv

TEN-POINT MEAN ROUGHNESS (RZ)

A section of standard length is sampled from the mean line on the roughness chart. The distance between the peaks and valleys of the sampled line is measured in the y direction. Then, the average peak is obtained among 5 tallest peaks (Yp), as is the average valley between 5 lowest valleys (Yv). The sum of these two values is expressed in micrometer (µm).



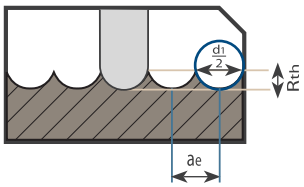
$$Rz = \frac{|Yp1 + Yp2 + Yp3 + Yp4 + Yp5| + |Yv1 + Yv2 + Yv3 + Yv4 + Yv5|}{5}$$

Yp1 Yp2 Yp3 Yp4 Yp5: Tallest 5 peaks within sample

Yv1 Yv2 Yv3 Yv4 Yv5: Lowest 5 peaks within sample

SPACING AND THEORETICAL SURFACE ROUGHNESS OF BALL NOSE END MILL:

The spacing "ae" of ball nose will be decided how the theoretical surface roughness you need, please use following information to decide "ae".



DESIGNATION			FORMULA
ae	Spacing	mm	$Rth = \frac{d1}{2} - \sqrt{(d1^2 - ae^2)/4}$
Rth	Theoretical surface roughness	mm	$ae = 2 \cdot \sqrt{Rth \cdot (d1 - Rth)}$
d1	Ball nose diameter	mm	

RELATIONSHIP BETWEEN ARITHMETICAL MEAN ROUGHNESS(RA)AND CONVENTIONAL SYMBOLS

ARITHMETICAL MEAN ROUGHNESS (RA)			MAX. HEIGHT (RY)	TEN POINT MEAN ROUGHNESS (RZ)	STANDARD LENGTH OF RY • RZ	TRIANGULAR INDICATION
PREFERRED NUMBER SERIES	CUT-OFF VALUEC(MM)	INDICATION OF SURFACE TEXTURE ON DRAWINGS	PREFERRED NUMBER SERIES		ℓ (MM)	
0.012	0.08		0.05 s	0.05 s	0.08	
0.025	0.25		0.1 s	0.1 s		
0.05		0.012/ ~ 0.2/	0.2 s	0.2 s	0.25	
0.01			0.4 s	0.4 s		
0.2			0.8 s	0.8 s		
0.4	0.8		1.6 s	1.6 s	0.8	
0.8		0.4/ ~ 1.6/	3.2 s	3.2 s		
1.6			6.3 s	6.3 s		
3.2	2.5	3.2/ ~ 6.3/	12.5 s	12.5 s	2.5	
6.3			25 s	25 s		
12.5	8	12.5/ ~ 25/	50 s	50 s	8	
25			100 s	100 s		
50		50/ ~ 100/	200 s	200 s		~
100	-		400 s	400 s	-	

The above charts and graphs are excerpts from JIS B 0601 (1994) and JIS B 0031 (1994)

BALL NOSE APPLICATIONS

90º MACHINING TECHNIQUES AND SUGGESTIONS

BALL NOSE AT 90º INCLINE

Ball nose end mills are used to add a radius between perpendicular surfaces, reducing the concentration of stress. In addition, they are excellent for improved surface finishes and machining three dimensional contoured shapes, common in molds and dies. Follow the process below for optimum tool life and surface finishes when machining at 90° from the work piece.

Procedure for ball nose machining 90° (perpendicular) from the work piece

1. The effective cutting diameter (Deff)) should be calculated when using an Axial Depth of Cut (ADOC) that is less than half the diameter of ball nose end mill, or less than the full radius of the ball. Using the calculation in figure 4 will generate the effective cutting diameter of the ball end, when cutting at 90 degrees. If using a common axial depth of cut, you may be able to quickly determine the effective cutting diameter by using figure 3 of the chart below.

2. The machines RPMs will need to be adjusted to compensate for the smaller effective cutting diameter when using less than the full diameter of the tool. The velocity adjustment (Vadj) calculation in figure 5 will need the previously calculated effective cutting diameter (Deff) to determine the new RPMs.

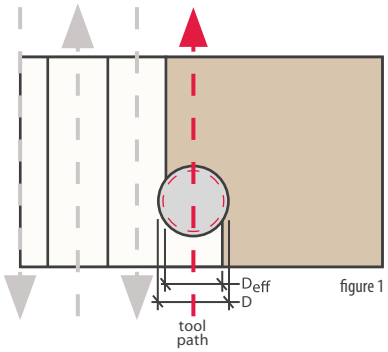


figure 1

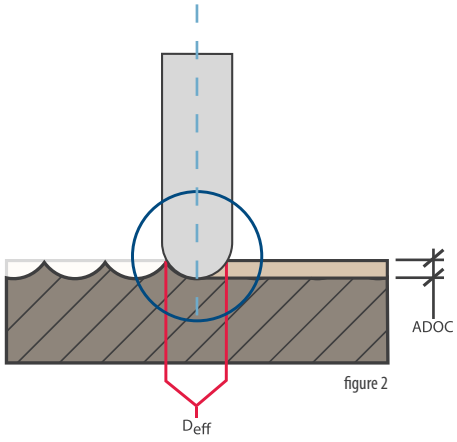


figure 2

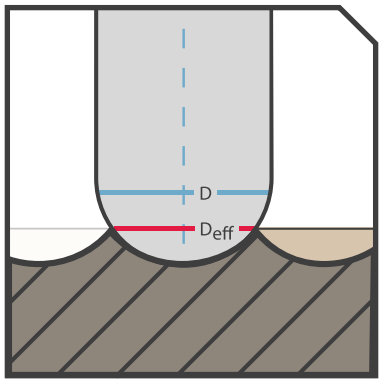


figure 2 detail

90° BALL NOSE EFFECTIVE CUTTING DIAMETER (Deff) AT COMMON ADOC'S

CUTTER DIAMETER	AXIAL DEPTH OF CUT (ADOC)															
	0.010	0.020	0.030	0.050	0.070	0.090	0.100	0.125	0.150	0.175	0.210	0.250	0.300	0.375	0.400	0.500
1/8	0.068	0.092	0.107	0.122												
3/16	0.084	0.116	0.137	0.166	0.181	0.187										
1/4	0.098	0.136	0.162	0.200	0.224	0.240	0.245									
3/8	0.121	0.169	0.203	0.255	0.292	0.320	0.332	0.354	0..367	0.374						
1/2	0.140	0.196	0.237	0.300	0.347	0.384	0.400	0.433	0.458	0.477	0.494					
5/8	0.157	0.220	0.267	0.339	0.394	0.439	0.458	0.500	0.534	0.561	0.590	0.612	0.624			
3/4	0.172	0.242	0.294	0.374	0.436	0.487	0.510	0.559	0.600	0.634	0.673	0.707	0.735	0.750		
1	0.199	0.280	0.341	0.436	0.510	0.572	0.600	0.661	0.714	0.760	0.815	0.866	0.968	0.968	0.980	1.000

figure 3

KEY	
SYMBOL	ELEMENT
ADOC	Axial Depth of Cut
D	Cutting Diameter
D_{eff}	Effective Cutting Diameter
R	Tool Radius (Dia. x 2)
SFM	Surface Feet per Minute
V_{adj}	Adjusted Revolutions per Minute

$$D_{eff} = 2 \times \sqrt{R^2 - (R - ADOC)^2}$$

figure 4

$$V_{adj} = \frac{SFM \times 3.82}{D_{eff}}$$

figure 5

BALL NOSE APPLICATIONS

15º INCLINE TECHNIQUES AND SUGGESTIONS

BALL NOSE AT 15º INCLINE

To avoid a zero surface feet per minute (SFM) at the center of the tool, ball nose tools should be used at a 15° incline. This strategy will increase tool life and surface finish. For maximum performance, it is highly recommended to use a climb milling technique and feed the tool in the direction of the incline. Follow the process below for optimum tool life and surface finishes when machining at a 15° incline from the work piece.

Procedure for ball nose machining at 15° from the work piece

1. Calculate the effective diameter using the calculation in figure 4 or if using a common axial depth of cut and diameter tool, by using figure 3. When using an angle other than 15°, you must use the calculation, rather than the chart and treat the angle of incline as a variable and substitute the programmed angle in its place.

2. The machines RPMs will need to be adjusted to compensate for the smaller effective cutting diameter when using less than the full diameter of the tool. The velocity adjustment (V_{adj}) calculation in figure 5 will need the previously calculated effective cutting diameter (D_{eff}) to determine the new RPMs.

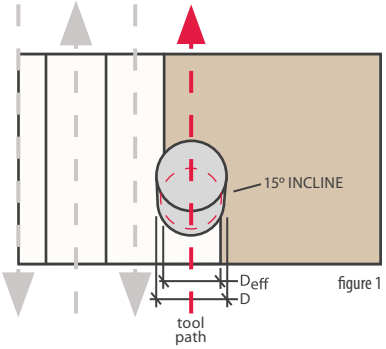


figure 1

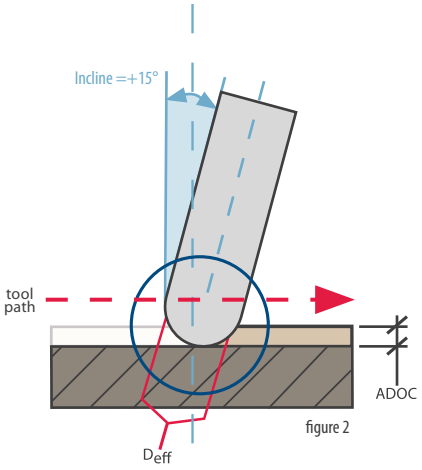


figure 2

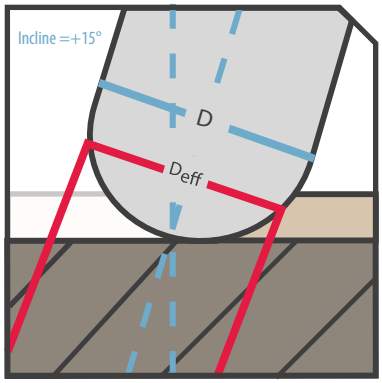


figure 2 detail

15° BALL NOSE EFFECTIVE CUTTING DIAMETER (D_{eff}) AT COMMON ADOC'S

CUTTER DIAMETER	AXIAL DEPTH OF CUT (ADOC)															
	0.010	0.020	0.030	0.050	0.070	0.090	0.100	0.125	0.150	0.175	0.210	0.250	0.300	0.375	0.400	0.500
1/8	0.093	0.111	0.120	0.125												
3/16	0.124	0.150	0.165	0.182	0.187											
1/4	0.154	0.185	0.206	0.232	0.245	0.250										
3/8	0.209	0.249	0.278	0.317	0.343	0.360	0.366	0.374								
1/2	0.259	0.308	0.343	0.393	0.428	0.454	0.464	0.483	0.494	0.500						
5/8	0.308	0.364	0.404	0.463	0.506	0.539	0.553	0.580	0.600	0.615	0.623	0.624				
3/4	0.355	0.417	0.463	0.530	0.579	0.618	0.635	0.669	0.696	0.720	0.736	0.748	0.749			
1	0.446	0.519	0.573	0.654	0.715	0.765	0.787	0.833	0.871	0.908	0.937	0.966	0.989	1.000		

figure 3

KEY

SYMBOL	ELEMENT
ADOC	Axial Depth of Cut
D	Cutting Diameter
D_{eff}	Effective Cutting Diameter
R	Tool Radius (Dia./2)
RDOC	Radial Depth of Cut
SFM	Surface Feet per Minute
V_{adj}	Adjusted Revolutions per Minute

$$D_{eff} = D \times \text{Sine}\left[I \pm \text{Arccos}\left(\frac{D-2 \times ADOC}{D}\right)\right]$$

figure 4

$$V_{aj} = \frac{SFM \times 3.82}{D_{eff}}$$

figure 5

MACHINING PROBLEMS & SOLUTIONS

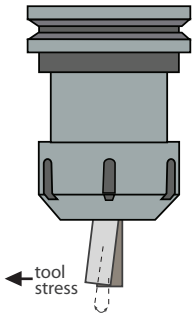
OUR HIGH-PERFOMANCE TOOLS ALLEVIATE MANY COMMON PROBLEMS

TOOL DEFLECTION

The most important factor in achieving tool performance and desired results is tool rigidity. Tool diameter increases rigidity and tool overhang decreases rigidity. Minimizing deflection is imperative for successful milling of your job.

Suggestions to minimize deflection:

- Use a more rigid tool (i.e. vibration dampening geometries, larger core design, etc)
- Maintain sharp tools
- Increase tool diameter
- Decrease depth of cut
- Decrease inches per minute (IPM)
- Use a climb milling approach
- Use shorter overall length tools and shorter flute lengths
- Use long reach end mills
- Increase the number of flutes
- Modify Surface Feet / Minute (SFM) parameters



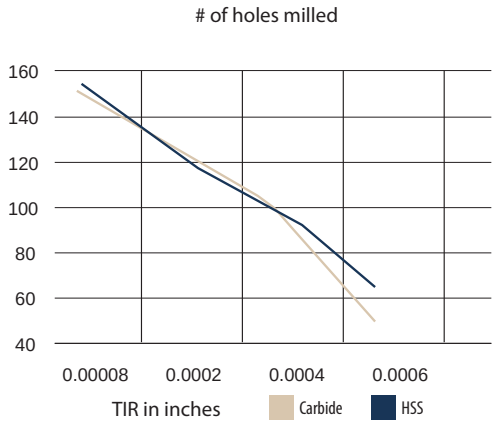
DEFLECTION RESULT

TOOL RUNOUT

To disperse heat quickly, running the spindle at high speeds is required. However, running at high speeds can also cause runout. More force is exerted if the tool does not run concentric to its centerlines, causing more wear on one side. Runout greatly affects accuracy and tool life. If the tools run-out are high, cutting edges become rough, which in turn can cause tool breakage, shorten tool life and decrease accuracy.

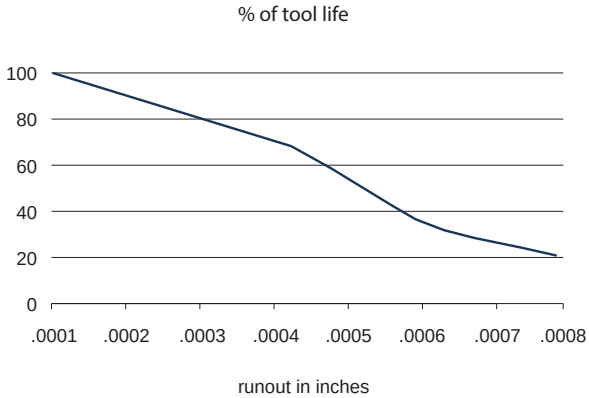
Furthermore, run-out increases the average chip thickness for the teeth engaged in the cut and increases the ratio of the maximum to average force. Run-out also shifts the frequency content of the force signal away from the tooth passing frequency to the spindle rotational frequency. The ratio of the run-out to the feed rate is identified as an important parameter which determines the effect of run-out on the cutting force.

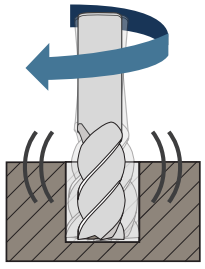
Controlling runout is imperative for maximum tool life and reducing costs. Improving run-out can be achieved by using correct tool holders and collets as well as choosing correct feeds and speeds.



EFFECT OF RUNOUT ON CARBIDE AND HSS

Tool size and material are important factors when calculating appropriate runout. In general, for 3/4" tools in diameter or larger, runout of 0.0005" is an acceptable measurement to control runout. However, smaller tools may require runout to be much better than 0.0005". Tool materials are also critical. The right run-out is relative not just to tool size, but also to tool material.
If run-out is controlled properly, carbide tools can last much longer than HSS. However, carbide is more affected due to run-out. Cutting forces that are evenly distributed on each flute (less run-out) stabilizes the cutting depth on each flute and produces a finer surface finish. Excessive force will be applied to only one flute with run-out of 0.0005" or higher.
Runout causes a tool's resonating edges to strike the side walls during the milling operation. This can result in uneven wall surface and poor finishes.





Runout causes a tool's resonating edges to strike the side walls during the milling operation. This can result in uneven wall surface and poor finishes.

RUNOUT CONSIDERATIONS

Although a higher-quality tool holder is more expensive, it can improve tool life dramatically and the savings can be measured in cost per hole. Allowing runout exceeding 0.0005" is equivalent to failing to cut milling costs by up to 65%.

Even the best collet cannot perform optimally in a worn spindle. Spindles should be checked regularly for run-out using a precision gage bar. Other influences on run-out include taper-to-taper contact, and the angle of the collet and corresponding clamping range. Basing tool holder purchase decisions solely on the price of the tool holder, or tool life and cost per hole, may sacrifice quality and accuracy. Other features to control run-out should be examined additionally, such as taper-to-taper contact, as well as collet angles and corresponding clamping ranges. More concentric clamping and increased clamping force can also improve run-out. A smaller range provides a more concentric clamping of the tool shank.

TOTAL INDICATED RUNOUT (TIR)

Rotary tools have two types of runout, static and dynamic. Static runout (static TIR), is the result of problems with the physical dimensions of, or arrangement of the components of the tool/collet/spindle system. Dynamic runout (dynamic TIR) might also result for dimensional inconsistencies, but can include other factors such as uneven material density, worn out spindle bearings, poor collet to spindle coupling, loose bits and spindle motor vibration.

Dynamic TIR

Dynamic TIR is usually more difficult to measure than Static TIR because it is normally smaller. Static TIR measurements can be reached by affixing a bit into the spindle to measure the concentricity via a test indicator. In most cases combining Angular and Radial TIR is the resulting Static TIR. At the spindle's operational speeds, runout can change as a result of heat, vibration and centrifugal force.

Angular TIR

Angular TIR is caused by an improper positioning between the rotational axis of the tool and the central axis of the collet/spindle system. Origins of the misalignment may include particles between the spindle bore taper and collet, misaligned central collet bore, deteriorated spindle taper, or improper setting of screws in the collet.

Radial Runout

Radial Run out results from a parallel offset of the central axis of the collet/spindle and the rotational axis of the tool. A common cause is a shank smaller than the minimum diameter of the collet gripping range. If a spindle assessment indicates that it can handle small runout on its own, then the determining factor to a low runout may very well be the tool holder itself.

By identifying, calculating and improving runout, significant increases in efficiency and savings can be seen almost immediately. Using the correct tool holder is crucial for any machine shop, large or small.

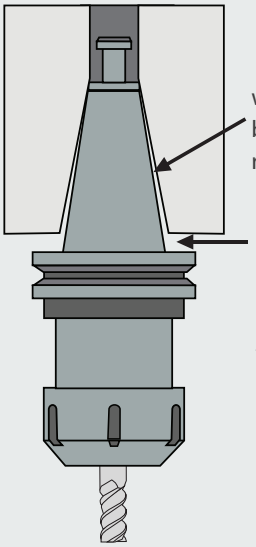
TOOLHOLDER OVERVIEW

SELECTION, UTILIZATION & MAINTENENCE

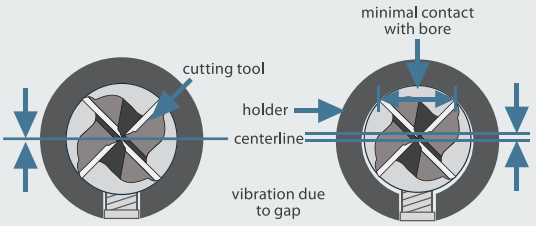
Multiple options exist for securing your cutting tool in your machine. The selection of the right holder is as important as the selection of the right tool. There are advantages and disadvatages to each style of holder and determining the needs of your application will direct you in the selection. All cutting tools, especially high performance end mills, need minimum runout to maximize performance. Approximtely every 0.0001" of total indicated runout degrades the life of the cutting tool by 10% and can be compounded further at high spindle speeds. Excessive runout can contribute to increased machine repair expenses by prematurely wearing the spindle bearings and increases machine time. Simply put, selecting the right tool holder and tooling can result in a 50% greater performance while being the lowest cost component of your operation. Always take a few minutes to properly indicate a new tool in the spindle.

Primarily, there are six types of tool holders for use in cnc machining operations: shrink fit, hydraulic, milling chucks, collet chucks, end mill holders and drill chucks. Regardless of the choice, operators should be taught to recognize wear and when a holder has reached the end of its operational life. Replacing worn toolholders can prevent premature cutting tool failure and extend the life of the spindle. Check the spindle frequently for bellmouthing, a worn spindle will cause runout and a direct increase in tooling cost. Tooling should be incidated on the bench first, securing the tool with a tightening stand and torque wrench, then indicated once again in the spindle. If the runout is componded in the spindle, a service technician will likely need to be called to repair the spindle.

Each toolholder should be examined for wear, as a worn holder will not provide accurate alignment, will prematurely wear out your cutting tools, create a poor finish and potentially cause costly spindle damage. Check the taper for visible signs of wear or damage where it contacts the spindle mouth. Any noticable spotting, fretting or imperfections are likely evidence that the toolholder is no longer usable. This fretting occurs as a result of two steel parts rubbing against each other, creating vibration and heat. A new toolholder that quickly develops fretting on the taper is an indicator of a spindle which needs to be reground.



Collets require more frequent replacement than toolholders as they are manufactured using softer metals and designed to collapse underpressure to tightly grip the tool. When collets wear, they cause the same issues as previously discussed costing countless dollars in increased machine time and machine wear. Any visible damage to the outside or inside of the collet, whether scoring, pitting, rust or abrasions are a general indicator they need to be replaced. Collet nuts must maintain balance when securing the collet and are often designed with internal bearings which tend to fail and need replacement.



Clean all collets, collet nuts, toolholders and the internal diameter of the spindle. Apply rust inhibitor to all metal parts when not in use, clean all dust, dirt, chips, from all surfaces. Minor contaminants can become major problems at high spindle speeds.

End mill holders with set screws are the most common and most economical for milling applications. When selecting an end mill for use in the holder, be sure to use one with a factory ground flat. An irregular flat can cause centerline deflection that is already common with this type of tool holder. Since the set screw pushes the end mill to the opposing side of the holder, if creates an air gap which off centers the tooling. Using ultra precision holders (H5) can reduce the baseline run out from .0015" to .0003", creating a dramatic increase in tool life. These holders are best when used with forgiving end mill materials, such as high speed steels and powdered metals.

Collet chuck holders are common and economical. A single holder is capable of quickly interchanging collets to fit a wide range of cutting tool diameters. Their relatively low rigidity and holding power are detriments to high performing tools. Collets require additional attention as they wear faster than any other type of toolholder. Make sure the collets are clean, examined for cracks, bellmouthing and scoring from slipping or broken tools. Runout is significantly better than tradional endmill holders as the collet concentrically tightens and self centers on the tool.

Likely the least common is the hydraulic toolholder. It ofers an extremely high holding power and rigidity, excellent repeatability and vibration dampening properties with quick and easy tool changes. Hydros are significantly more expensive than other toolholders and mechanically complex. While they offer incredible accuracy, they can be challanging in demanding applications and machines.

High speed or high torque machining requires precision setting of end mills to extend tool life and improve machining performance. With shrink fit toolholders, vibration is reduced and cutting is measurably faster and smoother resulting in high tolerance and finish workpieces. Shrink fit toolholders use the expansion and contraction properties of metal to provide extremely powerful tool holding. The inside diameter of the tool holder is slightly smaller than the outside diameter of the cutting tool shank. When heated, it expands slightly to allow the shank to be inserted. As it cools, the contraction of the metal provides 10,000 pounds of force for unparalleled accuracy and torque. Shrink fit holders have a maximum total indicated runout of 0.0002", permit increased feeds and speeds; increase metal removal rate; reduce tooling cost; increase spindle bearing life; eliminate slippage; provide quick changes; and improve accuracy and reliability. Additionally, the thin profile design of the toolholder allows for extended reach in deeper cavities.

STANDARD MILLING CALCULATIONS

COMMON EQUATIONS FOR OPTIMAL PERFORMANCE

The speed and motion of the cutting tool is determined by several factors. This page provides calculations to determine common industry measurements that will be required to program effective and optimized tool paths. Every application is different and may require varying feeds & speeds.

Cutting feed

The distance that the cutting tool advances during one revolution is measured in inches per revolution (IPR). Dependent on the procedure, the tool may feed into the workpiece or the workpiece may feed into the tool.

Feed rate

Feed rate is the speed of the end mill's movement correspondent to the workpiece. The feed rate is measured in inches per minute (IPM) and is the result of the cutting feed (IPR) and the spindle speed.

Speed and feed considerations are crucial for optimal results. Incorrect speeds and feeds can cause increased chatter, poor finish, hamper production, chip packing, damage the cutter, etc.

Too high of a speed or too light of a feed leads to reduction in tool life. Speed is measured in feet per minute and is referred to as cutting speed, surface speed, or peripheral speed. In the tables below, the relationship of peripheral speed to the diameter of the tool, and the rotational speed of the machine spindle are explained.

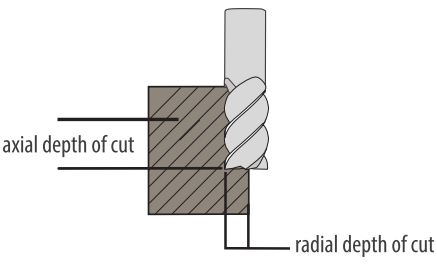
Inches per minute (IPM) is the standard for which feed is commonly measured. Feed is calculated by the number of cutting teeth in the end mill, multiplied by feed per tooth, multiplied by the revolutions per minute. Feed rates should be calculated from the chip load or feed per tooth.Regardless of the number of teeth in the tool, it is necessary that individual cutting teeth can adequately manage the feed that has been applied without breaking. Feed per tooth (FPT) affects thickness and is directly related to tool life. Maximum FPT creates longer tool life. Too high of a feed can strain the teeth causing breakage of the cutting edge. Sensible starting feeds for diameters under 0.5" range from 0.0002 to 0.002 IPT. Starting feeds for end mills over 0.5" diameter will range from 0.002 to 0.003 IPT.

Starting Points

Note that these are just starting parameters and basic information, we do not account for your particular machine or setup and there are many variables to consider. If you have any questions please do not hesitate to contact us.

KEY

ABBREVIATION	VARIABLE
D	Tool Diameter
R	Tool Radius
Z	Number of Flutes
RPM	Revolutions per Minute
SFM	Surface Feet per MInute (speed)
IPM	Inches per Minute (feed)
IPR	Inches per Revolution
FPT	Feed per Tooth
FPR	Feed per Revolution
MRR	Metal Removal Rate (Cubic Inches per Minute)
RDOC	Radial Depth of Cut
ADOC	Axial Depth of Cut
AFPT	Adjusted Feed per Tooth (Chip Thinning)
r_i	Part Radius (inside arc)
r_o	Part Radius (outside arc)



Feed Per Tooth	$= \frac{IPR}{Z}$	Feed Rate Adjustment - Outside Arc	$= FPT_o = \frac{IPM \times (r_o + (R/2))}{\sqrt{r_o}}$
Inches Per Minute	$= RPM \times FPT \times Z$	Feed Rate Adjustment - Inside Arc	$= FPT_i = \frac{IPM \times (r_i + (R/2))}{r_i}$
Inches Per Revolution	$= \frac{IPM}{RPM}$	IPT (Inches per Tooth)	$= \frac{(IPM / RPM)}{Z}$
Metal Removal Rate	$= RDOC \times ADOC \times IPM$	SFM (Surface Feet per Minute)	$= \frac{(RPM \times D)}{3.82}$
Revolutions Per Minute	$= \frac{SFM \times 3.82}{D}$	Ball Nose Effective Diameter	$= D_{eff} = 2 \times \sqrt{R^2 - (R - ADOC)^2}$
Surface Feet Per Minute	$= RPM \times D \times .262$	Ball Nose Velocity Adjustment	$= V_{adj} = \frac{SFM \times 3.82}{D_{eff}}$
Actual CLPT	$= \left(\frac{(D/2)}{RDOC}\right)^2 \times CLPT$	Adjusted Chip Load Per Tooth	$= FPT_{act} = \frac{CLPT \times (D/2)}{\sqrt{(D*RDOC) - RDOC^2}}$

ADJUSTING STARTING SPEEDS AND FEEDS

Speed and feed considerations are crucial for optimal results. Incorrect speeds and feeds can cause increased chatter, poor finish, hamper production, chip packing, damage the cutter, etc. Too high of a speed or too light of a feed leads to reduction in tool life. Speed is measured in feet per minute and is referred to as cutting speed, surface speed, or peripheral speed. In the tables below, the relationship of peripheral speed to the diameter of the tool, and the rotational speed of the machine spindle are explained.

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Starting Points

Note that these are just starting parameters and basic information, we do not account for your particular machine or setup and there are many variables to consider. If you have any questions please do not hesitate to contact us.

KEY

SYMBOL	ELEMENT	UNIT OF MEASUREMENT
HP	CUTTING POWER INPUT	horsepower
SFM	CUTTING SPEED	surface feet per minute
DOC	DEPTH OF CUT	inches
D	END MILL DIAMETER	inches
IPR	FEED PER REVOLUTION	inches per revolution
IPT	FEED PER TOOTH	inches per tooth
IPM	MACHINE FEED RATE	inches per minute
K	POWER CONSTANT	horsepower/cubic inch/minute
RPM	ROTATIONAL SPEED	revolutions per minute
WOC	WIDTH OF CUT	inches

SPEED ADJUSTMENTS

USE LOWER SPEEDS FOR:	USE HIGHER SPEEDS FOR:
hard materials	softer materials
tough materials	better finishes
abrasive materials	small diameter mills
heavy cuts	light cuts
minimum tool wear	frail workpiece or set-ups
maximum mill life	maximum production rates
	non metallics

FEED ADJUSTMENTS

USE HIGHER FEEDS FOR:	USE LIGHTER FEEDS FOR:
heavy roughing cuts	light and finishing cuts
rigid set-ups	frail set-ups
easy to machine work materials	hard to machine work materials
rugged heavy duty mills	deep slots
high tensile strength materials	frail and small diameter mills
coarse tooth mills	low tensile strength materials
abrasive materials	

MILLING CORRECTIONS

TROUBLE	CORRECTIVE ACTION
lack of rigidity	increase speed, decrease feed
excessive abrasion of the tool	decrease speed, increase feed
chipping of the cutting edge	decrease feed per tooth
burning of the cutting edge	decrease speed
chatter	use other combinations of speed and feed

SPEED AND FEED CALCULATIONS

FOR CALCULATING:	KNOWN VALUES	FORMULAE
CUTTING POWER INPUT - HP	width of cut, WOC depth of cut, DOC machine feed rate, IPM workpiece material constant, K	HP = WOC x DOC x IPM x K
FEED PER REVOLUTION - IPR	machine feed rate, IPM	IPR = IPM / RPM
FEED PER TOOTH - IPT	machine feed rate, IPM rotational speed, RPM number of teeth, T	IPT = IPM / (RPM x T)
MACHINE FEED RATE - IPM	rotational speed, RPM number of flutes (Teeth), T feed per tooth, IPT	IPM = T x IPT x RPM
PERIPHERAL CUTTING SPEED – SFM	mill diameter, D rotational speed RPM	SFM = 0.262 x RPM x D SFM estimated = (RPM x D) / 4
ROTATIONAL SPEED – RPM	peripheral cutting speed, SFM mill diameter, D	RPM = SFM /(0.262 x D) RPM estimated = (4 x SFM) / D

CONSTANTS

WORKPIECE MATERIAL	CONSTANT (K)	WORKPIECE MATERIAL	CONSTANT (K)	WORKPIECE MATERIAL	CONSTANT (K)
ALUMINUM	.3	**HIGH TEMP. ALLOYS**		**HIGH TENSILE ALLOYS**	
MAGNESIUM	.3	Ferritic	1.7	180,000 - 220,000 psi	2.0
COPPER	.5	Austenitic	2.0	220,000 - 260,000 psi	2.5
BRASS	.4	Nickel Base	2.5	260,000 - 300,000 psi	3.3
BRONZE	.5	Cobalt Base	2.5	**TITANIUM**	
CAST IRONS		**STEEL**		under 100,000 psi	1.3
FERRITIC	.7	up to 150 Brinell	1.4	100,000 - 135,000 psi	1.7
PEARLITIC	1.0	up to 300 Brinell	1.7	135,000 psi & over	2.5
CHILLED	1.7	up to 400 Brinell	2.0	**STAINLESS STEEL**	
MALLEABLE IRON	1.0	up to 500 Brinell	2.5	Free Machining	1.0
				Other	1.7

TROUBLESHOOTING

ANSWERS TO COMMON MILLING PROBLEMS

Welcome to the Troubleshowoting Guide. In this section, end milling problems are addressed with potential solutions listed below. There can be many variables when encountering an issue and the charts listed below should narrow down your solution. These charts are not meant to be 100% accurate for your particular setup, as every application is different and may require a variety of adjustments. However, this information is a good start to determine your ideal conditions for your particular machining needs.

PROBLEM	CAUSE	SOLUTION
BREAKAGE	Too large cutting amount	Adjust to smaller cutting amount per teeth
	Too long flute length or long overall length	Hold shank deeper, use shorter end mill
	Too much wear	Regrind at earlier stage
	Workpiece rigidity	Ensure workpiece is secure and supported
	Speed too low	Increase the cutting speed (RPM's)
	Feed rate too high	Reduce FPT
	Heavy depth of cut	Reduce RDOC & ADOC
	Part entry	Reduce FPT on entry - implement radius in sweeping entrances - avoid 90º (perpendicular) entry
	Milling strategy	Review tool path and ensure there are no arbitrary moves, extreme angle of engagement increases & undesirable situations for the tool
	Tool overhang	Use shortest OAL, shortest LOC & reduce overhang from tool holder. Consider necked down tooling for long reach
	Tool runout	Check tool runout in holder/spindle. utilize collet, milling chuck or shrink fit holders if possible. Hand ground shank flats can be suspects
	Reconditioning	Improper regrind/reconditioning
	Poor chip evacuation	Reposition coolant lines, use air blasting
	Poor tool rigidity	Shorten LOC, place shank further up holder
BURR	Too much wear on primary relief	Regrind at earlier stage
	Incorrect conditions	Correct milling conditions
	Improper cutting angle	Change to correct cutting angle
	Tool wear	Replace or regrind tool
	Improper helix angle	Change to recommended helix angle
	Feed rate too high	Reduce feed rate
	Depth of cut too large	Reduce depth of cut
	Incorrect feed and speed rates	Correct cutting parameters
	Improper cutting parameters	Adjust feed and speed
BUILT UP EDGE	Chip welding	Utilize proper tool coating for material being cut
	Feed rate too low	Increase FPT
	Speed too low	Increase RPM's
	Coolant Strategy	Re-adjust coolant flow & check coolant mixture percentage
CHATTER/VIBRATION	Workpiece rigidity	Check that workpiece is secure and supported
	Tool holder rigidity	Use shortest holder possible and investigate for no tool slippage
	Lack of rigidity (machine)	Use better machine or change parameters
	Poor spindle rigidity	Use larger spindles or different tool
	Tool overhang	Use shortest length tool, shortest loc & reduce overhang from tool holder. Consider necked down tooling for long reach
	Tool run out	Check tool run out in holder/spindle. Utilize collet, milling chuck or shrink fit holders if possible. Hand ground shank flats can be suspects
	Speed too high	Lower the RPM's
	Feed rate too low	Increased FPT
	Angle of engagement violation	Use smaller tools generating corner radi in pockets - avoid tool diameters that match corner diameter/radius
	Too much surface contact	Utilize a lower flute count tool
	Chip Thinning	Utilize chip thinning adjustment
	Milling Strategy	Ensure you are climb milling unless the material has hard/abrasive outer skin then conventional milling is preferred for breakthrough
	Feed and speed too fast	Correct feed and speed
	Poor set up	Improve clamping rigidity
	Cut is too heavy	Decrease width and depth of cut
	Overhang of tool is too much	Hold shank deeper, use shorter end mill
	Lack of relief	Decrease relief angle, make margin: (touch primary with oil stone)
	Loose hold of workpiece	Hold workpiece tightly
	Cutting too deep	Decrease depth of cut
	Too long flute or overall length	Hold shank deeper, use shorter end mill or try down cut
	Cut too aggresive	Reduce width and/or depth of cut
CHIP COMPACTION	Insufficient chip room	Use tool with less flutes, increase helix
	Feed rate too high	Reduce FPT and increase RPM
	Heavy depth of cut	Reduce ADOC/RDOC in side milling & ADOC in slotting
	Coolant flush	Re-adjust coolant flow, air blast or "op stop" to clear chip build up
	Large chip size	Utilize chip breaker style tool to better manage chip size, adjust feed or speed
	Cut too heavy	Decrease width and depth-of-cut
	Not enough coolant	Use higher coolant pressure and reposition nozzle to point of cut or use air pressure; Increase volume of coolant
	Low cutting speed	Increase RPM or reduce feed rate
	Too great cutting amount	Adjust feed or speed
	Feed and/or speed too aggresive	Adjust feed or speed
DEFLECTION	Tool overhang	Use shortest length tool, shortest loc & reduce overhang from tool holder
	Milling strategy	Climb milling can help reduce the amount of deflection in some cases
	Too heavy of a RDOC	Reduce ADOC/RDOC in side milling & ADOC in slotting
	Feed rate too high	Decrease FPT
	End mill diameter	Increase diameter of end mill for higher strength-to-length ratio
	Increase number of flutes	Higher number of flutes = larger core diameter = increased strength

PROBLEM	CAUSE	SOLUTION
DIMENSIONAL INACCURACIES (TAPERED WALL)	Coolant Strategy	Re-adjust coolant flow & check coolant mixture percentage
	Deflection	Refer to deflection section above
	Feed rate too high	Lower feed rate (clpt)
	RDOC too high	Reduce RDOC
	Tool Run out	Check tool run out in holder/spindle. Hand ground shank flats can be suspect and a common cause of run out. (<.0003 TIR desired)
	Cut is too heavy	Decrease width and depth of cut
	Lack of accuracy (machine & holder)	Repair machine or holder
	Rigidity is not enough (machine & holder)	Change machine or tool holder or change parameters
	Too few flutes	Use multiflute end mills, use end mill with higher rigidity
	Excessive cutting	Decrease depth and width of cut
	Lack of accuracy (machine and holder)	Repair machine or holder
	Not enough rigidity (machine)	Change machine or cutting conditions
	Loose/worn tool holder	Repair of replace
	Poor tool holder rigidity	Replace with shorter/more rigid tool holder
	Poor spindle rigidity	Use larger spindle or different tool
	Too tough condition	Change to easier condition
	Cut too aggresive	Reduce width and/or depth of cut
	Feed rate too heavy	Reduce feed rate
	Overhang of tool is too much	Hold shank deeper , use shorter end mill
EXCESSIVE CORNER WEAR	No Corner Radius	Implement corner radius on tool - adds strength & tool life
	Speed too high	Reduce RPM's
	Tool Run out	Check tool run out in holder/spindle. Hand ground shank flats can be suspect and a common cause of run out. (<.0003 TIR desired)
	Tool Overhang	Ensure you are using the shortest OAL/LOC possible. Utilize necked tooling for longer reach
POOR FINISH	Feed rate too high	Reduce FPT
	Speed too low	Increase RPM's
	Too light of a RDOC	Increase RDOC to stabilize tool in cut.
	Tool Run out	Check tool run out in holder/spindle. Hand ground shank flats can be suspect and a common cause of run out. (<.0003 TIR desired)
	Helix Angle	Change to tool with higher helix angle
	Need more Flutes	Choose end mill with higher number of flutes
	Recutting Chips	Redirect/evaluate coolant flush – or use less number of flutes
	Built Up Edge	Increase RPM, use higher helix tool
	Wear is too much	Regrind at earlier stage
	No end tooth concavity	Grind concave angle on bottom teeth
	Depth of cut too large	Reduce depth of cut
	Chip welding	Increase volume of coolant
	Chip biting	Cut less amount per pass
	Speed not aggresive enough	Increase RPM
	Cut too aggresive	Reduce width and/or depth of cut
	Tool overworn	Regrind/Recondition sooner
SHORT TOOL LIFE	Cutting friction is too much	Regrind at earlier stage
	Hard work material	Use Coatings (TiN, TiCN,TiAlN)
	Improper helix and relief angle	Change to correct helix angle and primary relief
	Poor coolant	Replace coolant or correct mixture
	Poor material condition	Use coated tool, clean material surface
WEAR	No Corner Radius	Implement corner radius on tool - adds strength & tool life
	Speed too high	Reduce RPM's, Decrease spindle speed, use another coolant
	Tool Run out	Check tool run out in holder/spindle. Hand ground shank flats can be suspect and a common cause of run out. (<.0003 TIR desired)
	Tool Overhang	Ensure you are using the shortest OAL/LOC possible. Utilize necked tooling for longer reach.
	Hard work material	Use higher grade tool material and coating
	Biting chips	Change feed and speed. Change chip size or clear chips with coolant or air pressure
	Improper feed and speed (too slow)	Increase feed and speed. Try down-cut
	Improper cutting angle	Change to correct cutting angle
	Too small primary relief angle	Change to larger relief angle
	Low feed rate	Increase feed rate
	Up milling (conventional)	Change to down milling (climb)
	Hard material	Use coated tool
	Poor chip evacuation	Reposition coolant lines, use air blasting
	Improper cutter helix	Change to recommended helix angle
	Poor coolant	Replace coolant or correct mixture
CHIPPING	Workpiece rigidity	Check workpiece is secure and supported - a common issue. Use better machine or tool holder or change parameters
	Tool holder rigidity	Use shortest holder possible and investigate for tool slippage. Use better machine or tool holder or change parameters. Clean or replace
	Lack of rigidity (tool)	Use shorter tool, hold shank deeper, try climb milling
	Feed rate too high	Reduce FPT
	Tool Heavy of a RDOC	Reduce RDOC
	Part Entry	Reduce FPT on entry – implement radius in or sweeping entrances - avoid 90º (perpendicular) entry
	Milling Strategy	Ensure you are climb milling unless the material has hard/abrasive outer skin then conventional milling technique is preferred for breakthrough
	Tool Overhang	Use shortest OAL, shortest LOC & reduce overhang from tool holder. Consider necked down tooling for long reach
	Tool Run out	Check tool run out in holder/spindle. Hand ground shank flats can be suspect and a common cause of run out. (<.0003 TIR desired)
	Tool Coating	Implement proper tool coating for material to be cut
	Edge prep	Ensure tool has proper edge prep
	Built Up Edge (BUE)	See BUE section for detailed explanation
	Feed too heavy on first cut	Reduce feed rate on first cut
	Tool cutting corner too sharp	Decrease primary relief and cutting angle, reduce radial width-of-cut
	Up milling (conventional)	Change to down milling (climb)
	Chattering	Redue RPM
	Low cutting speed	Inrease RPM
	Feed too aggresive	Reduce feed rate
	Cut too aggresive	Decrease width and/or depth of cut

PROBLEM	CAUSE	SOLUTION
SHORT TOOL LIFE	Cutting friction is too much	Regrind at earlier stage
	Hard work material	Use Coatings (TiN, TiCN,TiAlN)
	Improper helix and relief angle	Change to correct helix angle and primary relief
	Poor coolant	Replace coolant or correct mixture
	Poor material condition	Use coated tool, clean material surface
WEAR	No Corner Radius	Implement corner radius on tool - adds strength & tool life
	Speed too high	Reduce RPM's, Decrease spindle speed, use another coolant
	Tool Run out	Check tool run out in holder/spindle. Utilize collet, milling chuck or shrink fit holders if possible. Hand ground shank flats can be suspect and a common cause of run out. (<.0003 TIR desired)
	Tool Overhang	Ensure you are using the shortest OAL/LOC possible. Utilize necked tooling for longer reach.
	Hard work material	Use higher grade tool material and coating
	Biting chips	Change feed and speed. Change chip size or clear chips with coolant or air pressure
	Improper feed and speed (too slow)	Increase feed and speed. Try down-cut
	Improper cutting angle	Change to correct cutting angle
	Too small primary relief angle	Change to larger relief angle
	Low feed rate	Increase feed rate
	Up milling (conventional)	Change to down milling (climb)
	Hard material	Use coated tool
	Poor chip evacuation	Reposition coolant lines, use air blasting
	Improper cutter helix	Change to recommended helix angle
	Poor coolant	Replace coolant or correct mixture
CHIPPING	Workpiece rigidity	Check workpiece is secure and supported - a common issue. Use better machine or tool holder or change parameters
	Tool holder rigidity	Use shortest holder possible and investigate for tool slippage. Use better machine, tool holder or change parameters. Remove from spindle, clean or replace
	Lack of rigidity (tool)	Use shorter tool, hold shank deeper, try climb milling
	Feed rate too high	Reduce FPT
	Tool Heavy of a RDOC	Reduce RDOC
	Part Entry	Reduce FPT on entry – implement radius in or sweeping entrances - avoid 90º (perpendicular) entry
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	Tool Coating	Implement proper tool coating for material to be cut
	Edge prep	Ensure tool has proper edge prep
	Built Up Edge (BUE)	See BUE section for detailed explanation
	Feed too heavy on first cut	Reduce feed rate on first cut
	Tool cutting corner too sharp	Decrease primary relief and cutting angle, reduce radial width-of-cut
	Up milling (conventional)	Change to down milling (climb)
	Chattering	Redue RPM
	Low cutting speed	Inrease RPM
	Feed too aggresive	Reduce feed rate
	Cut too aggresive	Decrease width and/or depth of cut

SURFACE TREATMENTS & COATINGS

SELECT ADVANCED SPECIALTY COATING

SELECTING YOUR COATING

Certain applications, materials or performances simply require the enhancement of a specialty coating and knowledge of the properties of the coatings available. Temperature, friction resistance, hardness, lubricity, toughness and cohesion of the resulting process must be examined prior to the selection.

SEE PAGES 42 - 44 FOR DETAILS

OUR INDUSTRIES

The original tapered end mill manufacturer, Conical Tool's industry expertise runs deep and we have maintained exceptional relationships with some of the world's largest companies. Our commitment to the industry as hands-on technical experts cross many sectors and geographies. Our 70 year history coupled with analytical, innovative thinking allows us to provide our customers with the most practical and efficient solutions to their tooling needs.

Our industry foresight is based on identifying the key issues our customers face, and developing rigorous programs to provide the most appropriate and beneficial solutions. These are only a small percentage of the industries we serve, contact us today for more information and to find out what we can do for you.

- Hard Milling
- Aerospace
- Tool & Die
- Medical
- Automotive
- Dept. of Defense
- Casting & Foundries
- General Machining
- Electronics
- Agriculture
- Furniture / Wood
- Energy

NEARLY 7,000 DISTRIBUTORS WORLDWIDE & HUNDREDS OF THOUSANDS OF END USERS CAN'T BE WRONG

The manufacturing and materials industry is changing at an unprecedented pace and simply saying we supply tools to the metalworking industry would leave out a large portion of our customer base. Our tools have been used in every application imaginable, from sculptural ice carving to precision manufacturing of custom nuclear reactor parts.

CONICAL™ CUTTING TOOLS

GLOBAL™ CUTTING TOOLS

MANUFACTURING FOR OVER 70 YEARS 1944 - 2014

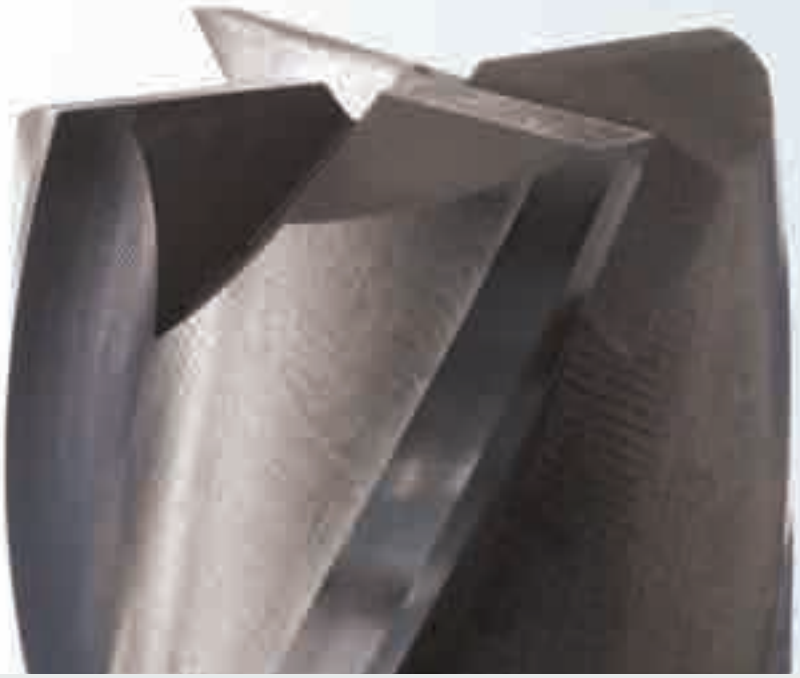
SEAL OF QUALITY ASSURANCE

100% SATISFACTION GUARANTEED

(888) 531-8500 | info@conicaltool.com | www.conicalendmills.com

6 END MILL SELECTION GUIDE

WE ARE THE GO-TO RESOURCE
WHEN TECHNICAL EXPERIENCE IS REQUIRED



We know being prepared with the correct tool for the job is essential, especially when the amount of hours worked will determine your productivity and profit.

That's why it's imperative to spend some time selecting the features that your end mill needs, in order to get the job done most efficiently.

SELECTING YOUR END MILL

We realize that selecting the optimal end mill for your particular job can be confusing. That's why our team of experts are here to help. Our outstanding customer service can help you select the best end mill for your job while we put our expertise to work for you, to take your complex machining needs from start to finish.

PRODUCT INFORMATION

In addition to our exceptional customer service and expertise, we have also provided informative charts and formulas to aid in your tooling choice. These charts will guide you to the tool best suited for your needs.

CONICAL™ CUTTING TOOLS

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END MILL SELECTION GUIDE

SELECTING SUITABLE CHARACTERISTICS OF YOUR CUTTING TOOL

The information on the following pages will help you to determine the proper tool for your specific application. Consider the material, application and type of cut to identify the end mill you need. Note that the information provided is basic in nature and we can not account for your particular machine, setup or application and there are many variables to consider. If you have any questions please do not hesitate to contact us.

TOOL MATERIAL SELECTION

We use only the finest materials available to meet our customers demanding range of applications. Our stock includes high speed steel (M-2, M-4, M-7, M-42), powdered metal (PM M-4, PM M-48, PM T-15), & virgin carbide (sub-micron grain, ultra-fine) in varying concentrations.

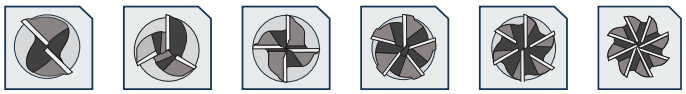
High speed steel tools are economical for general purposes and very versatile. Cobalt is ideal for more difficult to machine materials and has increase abrasion resistance. Powdered metals (PM) use a special manufacturing process and are operable under higher feed rates and produce longer tool life.

Carbides are classified by the grain size and concentration of tungsten to cobalt binder. As the grain size of tungsten carbide gets smaller, the material becomes denser, more rigid and more wear resistant. Using only sub micro and ultra fine carbide allows a higher performance and quality to be achieved. Smaller grains allow a sharper edge preparation and precision grinding down to the micron.

The choice of tool material depends on several factors:

- Feeds and speeds
- Rigidity needed
- Preferred chip evacuation
- Method of tool engagement
- Depth of cut
- Desired finish
- Helical angle
- Workpiece hardness
- Workpiece condition
- Number of workpieces

CONSIDER THE NUMBER OF FLUTES



To determine whether a two, three, four or greater flute end mill is needed, several factors need to be considered. Two and three flute end mills have better stock removal than multiple flute end mills but a significantly decreased finish. End mills with five or more flutes are ideal for finishing cuts and cuts in harder materials, but must operate at lower material removal rates due to their poor chip evacuation properties. When run at similar rates, multiple flute end mills will take a lighter chip load per tooth, resulting in an improved finish and smoother machining. Consider the type of cut needed to be performed, the chip space required based on the cut and material, the production and metal removal rate needed and the desired surface finish when selecting.

FLUTE CONSTRUCTION AND CONFIGURATION

Higher helix angles produce higher chip evacuation, thus the capacity to increase speeds and feeds and decrease horsepower requirements. Tool deflection is transferred vertically versus horizontally which dampens vibrations, and increases speeds and surface finish quality.

Traditionally, roughing operations or hard to machine materials benefit from the improved flute strength of a lower helix end mill. While using general purpose end mills, this may still hold true, however newer high performance geometries take into consideration flute and core strength, while adding the benefits of a higher helix. Immediate edge build-up can occur with lower helix end mills and create excessive chatter.

For an axial plunge cut, it is essential to use a center cutting tool. Two flute end mills are center cutting, where multi-flute end mills can vary. Multi-flute end mills create better surface finishes due to a lighter chipload - per flute. Side loading is dramatically reduced with lower helix angles, making it easier to mill thin walls.

ROUGHING END MILLS

Roughing cuts are generally for preparing the surface before the finishing cut. The purpose is to bring the diameter of the hole to a “rough” size of the final cut. How this cut looks is of little importance. Roughing cuts also allow for mistakes. Roughing cuts may consist of several heavy cuts and the primary purpose is to clear material away, in anticipation of the finishing cut.

FINISHING END MILLS

A minimal amount of leftover material from the roughing cut is removed with the finishing cut, machining the work to size in addition to refining the surface of the workpiece.

COOLANT GUIDE

SELECTING & APPLYING THE CORRECT APPLICATION

There are many variables as to when coolant may be beneficial. In addition to reducing temperatures, coolant provides the benefit of reducing re-cutting chips by flushing chips away from the tool. If your application requires coolant, we can modify or create a custom tool to accomodate your coolant fed tooling needs.

COOLANT USES AND INFORMATION

Heat is the single most damaging effect to an end mill in the machining process and proper coolant usage is imperative. Coolant can help control several issues that may arise but must be applied with consistency and accuracy. Applying coolant intermittently can cause the end mill to obtain thermal shock and can have detrimental effects on the end mill.

Coolant creates a layer of lubrication between the endmill, the chip and the workpiece, helping to control the temperature by minimizing friction. Using the wrong coolant or application can damage the tool as well as the workpiece by allowing heat generation to continuously build. Proper coolant application reduces the cutting temperature as well as promotes good chip evacuation, extending tool life and producing quality surface finishes.

In general, a dull end mill creates more heat than a sharp end mill. The proper amount and precision application of the coolant will disperse the heat and ensure maximum tool life. Depending on your application, a steady stream, mist or occasionally flooding may be applied. Furthermore, many coatings can minimize, or altogether eliminate, the need for coolants. Some properties of coatings are not realized until the cutting temperature reaches a certain point.

Applying an abundance of coolant doesn't necessarily mean that the coolant is being used appropriately. Administering multiple streams to select areas of the end mill, generally positioned at the point where the cutting tool rotates into the workpiece, has been shown to be more effective than simply dousing the end mill or workpiece with coolant. It is always important to make sure that coolant lines are not impeding the operation, even a momentary interruption in coolant can damage the cutting tool or workpiece. Constant interruptions in the coolant supply can create thermal shock in the tool and result in premature breakage.

When using high speed steel end mills to mill steel, coolant is required. Water emulsified cutting oil is the cheapest for most materials and is generally sufficient for traditional milling applications. However, certain materials are commonly milled dry and harder to machine materials can benefit from coolants that use sulfurized, lard, or mineral cutting oils. For cutting aluminum, emulsified cutting oil is ideal, applied in appropriately directed jets or as a mist. Cast iron and plastics usually use air or are dry milled

When used correctly, coolant can have several benefits:

- improved tool life
- reduced damage from heat
- improved cutting speeds
- reduced cutting force
- improved chip control
- reduced built up edge
- decreased damage from re-cutting chips
- improved surface finish

SHANK INFORMATION

SHANK VARIATIONS WE OFFER

Determining the shank that will suit your needs best is an important element for improved machining and rigidity. In general, selecting the largest diameter will maximize rigidity and minimize deflection and chatter. Shank designs are targeted towards specific applications, therefore choosing the best shank for how your collet will hold the tool is essential. We offer a standard straight shank, single weldon flat, double weldon flat, full flat and reduced neck shanks. Specialty shank configurations are available on request.

SINGLE WELDON FLAT

DOUBLE WELDON FLAT

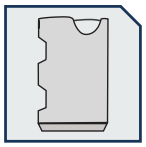
FULL FLAT

REDUCED NECK

STRAIGHT

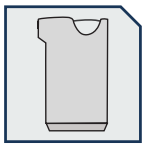
SINGLE WELDON

- allows for increased torque
- minimizes tool slippage and pull out
- provides a guide for proper tool projection length



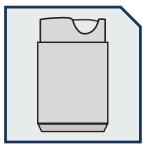
DOUBLE WELDON

- allows for increased torque
- minimizes tool slippage and pull out
- stabilizes large diameter tooling



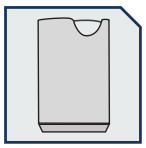
FULL FLAT

- for quick change tooling
- allows for varying degrees of projection
- same tool can be used at regular and extended lengths



REDUCED NECK

- best for long reach/deep pocketing applications
- improved core rigidity with decreased flute length
- minimized tool deflection for high finish / tight tolerance machining



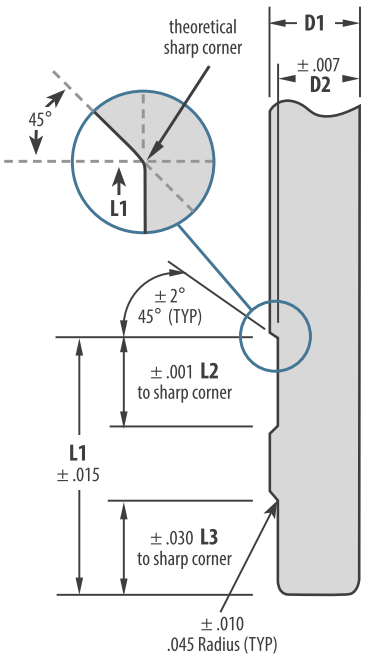
STRAIGHT SHANK

- for use in shrink fit collets to minimize tool runout
- for high performance machining applications
- improved tool concentricity; generally found on carbide tooling

WELDON FLAT

Weldon flats are a cantilevered shaft held by screws, which secure the end mill and prevent it from rotating. Weldon flats are measured from neck/shank intersection and are based on a high speed tool standard, NAS 986, which is measured between .125" - 3" diameters. There is currently no industry standard specified for carbide. There are several advantages and disadvantages in using flat:

- set screws prevent the tool from pulling out; increasing speeds and feeds
- set screws prevent the tool from slipping; adding torque
- set screws push the tool against the opposite side of the holder, guaranteeing some runout
- hand ground flats degrade tool performance



SHANK DIAMETER D1	LENGTH TO FLAT L1	WIDTH OF FLAT L2	DEPTH OF FLAT D2	WIDTH OF FLAT L3
.375	.922	.281	.318	-
.500	1.057	.331	.433	-
.625	1.154	.401	.553	-
.750	1.243	.456	.668	-
.875	1.243	.456	.803	.500
1.000	1.399	.516	.918	.500
1.250	1.399	.516	1.149	.500
1.500	1.446	.516	1.399	.562

HELICAL ANGLE SELECTION

CHOOSING THE CORRECT ANGLE END MILL FOR YOUR JOB

Helix angles generally come as low as 12° to as high as 60°. Most general purpose end mills use between a 25° and 30° angle where basic sharpness and cutting edge strength is maintained. Increasing the helix angle improves stock removal and is useful in machining at increased speeds and feeds. A higher helix angle also reduces tool deflection and transfers stress vertically through the spindle, as opposed to horizontally. In addition, it also reduces the amount of torque needed and the amount of heat generated. Chip evacuation is also increased, though the smaller flute spacing may cause build up when machining gummy materials or in slotting operations. Difficult to machine materials use a lower helix, where maximum edge strength and rigidity are imperative to efficient machining.

Edge build-up can accumulate immediately with straight flutes, creating excessive chatter. Chip load in higher flute angles is ejected progressively along the entire flute length. Thus, the cutting force is more consistent with less chatter. Higher helix end mills produce a finer finish. 45° and higher helix angles significantly reduce side loading and make it possible to periphery mill thin wall sections with much less deflection.

While selecting a tool, it is also important to consider other tool characteristics which may enhance the performance of the tool by eliminating traditional negative characteristics of the helix. For instance, as helix angle is increased, flute strength and core stability are diminished. That's why we've designed our higher helix tools with maximum core diameters and eccentrically relieved flutes to increase edge strength and stability, achieving performances that were once not be possible. Below are some common angles and their characteristics:

12º HELIX – FOR SPECIALTY APPLICATIONS

- Greatest tool strength; ideal for hardened materials and reaming operations
- Decreased axial forces & cutting aggressiveness; lower feed rates and material removal rates
- Less potential tool pull-out; flute engagement is minimized; less potential for chatter
- Edge build up potential is increased and tool life diminished

25 - 30º HELIX - IDEAL FOR GENERAL PURPOSE MACHINING

- Moderate tool strength; balanced core and flute stability
- Not ideal for performance driven or finishing applications
- Moderate aggressiveness; facilitates chip formation, clearance and control
- Less potential tool pull-out do to cutting forces and moderate speeds and feeds

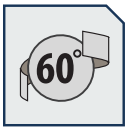
38º HELIX - IDEAL FOR HIGH SPEED MACHINING FINISHING OF FERROUS MATERIALS

- Moderate tool strength and increased aggressiveness when balanced with core design
- Increased speeds & feeds utilizing variable pitch, variable helix, variable index and variable rake
- Ideal finishing helix in ferrous and hi temp alloy materials
- Increased chip clearance and control; chip formation is facilitated by core design

45º HELIX - IDEAL FOR HIGH SPEED MACHINING & FINISHING OF NON FERROUS MATERIALS

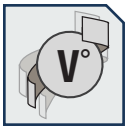
- A high shear angle & aggressiveness reduces tool deflection; increases tool engagement and finish
- Lower tool strength; torsional stresses are increased as the tool engages
- High speed machining with low RDOC's and increased feed rates
- Increased tool pull-out potential as load is distributed vertically

60º HELIX - IDEAL FOR FINISHING OF EASY TO MACHINE MATERIALS



- The greatest shearing action; lower horsepower requirements
- Tooth edge integrity reduced; should be used in easy to machine materials only
- High speed machining with low radial depths of cut and increased feed rates
- Increased tool pull-out potential; may require weldon flats

VARIABLE HELIX / VARIABLE PITCH HELIX - IDEAL FOR HIGH PERFORMANCE MACHINING



- Advanced geometries dampen harmonics while increasing cutter engagement
- Tooth edge integrity improved through eccentric reliefs and rake angles
- Improved stability, harmonics and strength allow dramatic improvements in performance
- The best choice for nearly all applications when designed with application specific purpose

ICON INDEX

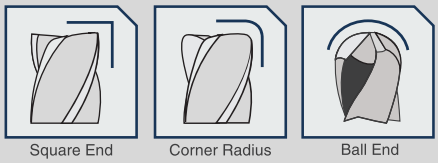
THESE ICONS WILL GUIDE YOU IN YOUR PROPER TOOL SELECTION

The following pages use these icons to help you quickly locate your tooling needs. Variations in tool design are grouped to help you easier find important variables in the tools design. If you are unable to find the tool you need, call us at the number listed below and fill out the "Request For Quote" document included at the end of every product chapter. These are only general guidelines for choosing the proper end mill for your particular job and application.

TOOL FEATURES

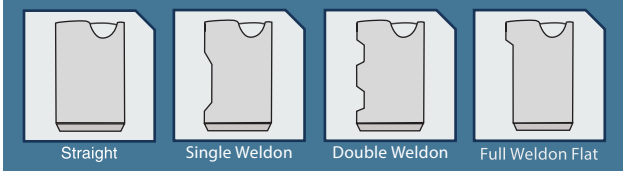
TIP

END CONFIGURATIONS

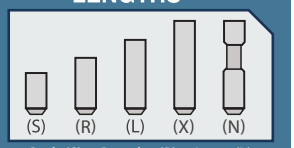


SHANK

SHANK TYPE



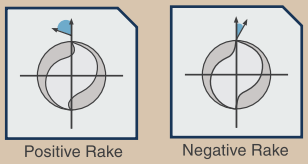
LENGTHS



Stub (S) Regular (R) Long (L)
Extra Long (X) Reached Neck (N)

FLUTE

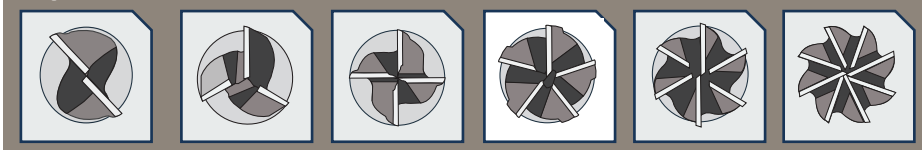
RAKE ANGLE



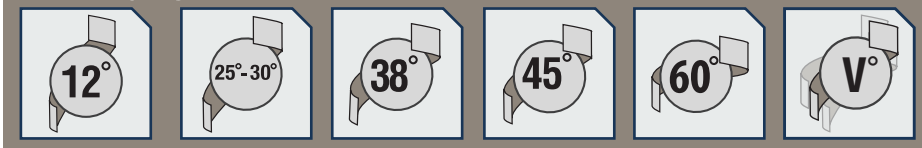
see pg. 72 for more information

FLUTE

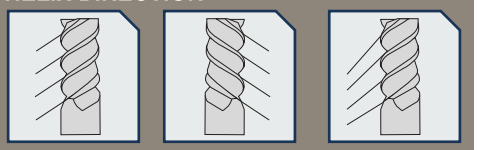
FLUTE



HELIX ANGLES



HELIX DIRECTION

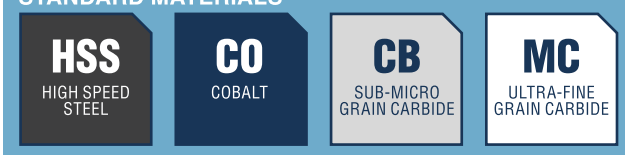


ADDITIONAL GEOMETRY

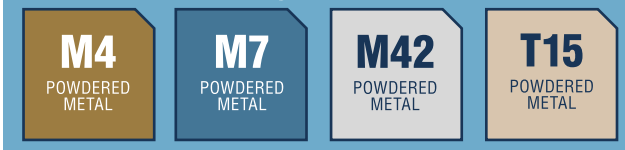
see pg. 76 for more information

MATERIALS & COATINGS

STANDARD MATERIALS



AVAILABLE MATERIALS



COATINGS

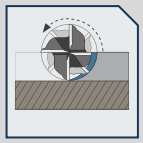
see pgs. 44-57 for more information

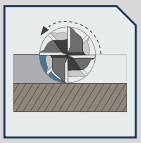
The following pages use these icons to help you quickly locate your tooling needs. Variations in tool design are grouped to help you easier find important variables in the tools design. If you are unable to find the tool you need, call us at the number listed below and fill out the "Request

PROCESSES

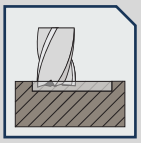
APPLICATIONS

MATERIAL REMOVAL


Conventional Milling


Climb Milling


Roughing


Pocketing


Slotting

FINISHING


Finishing


Ball Nose


Reaming

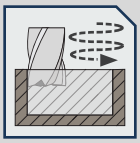
ENTRY

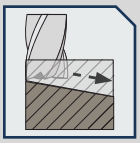

Straight Entry


Side Entry


Pre-Drilling


Plunging

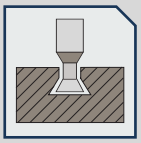

Helical Interpolation


Ramping

SPECIALTY


Tapered


Chamfering


Dovetail

COOLING PROCESSES


Dry


Air


Wet


Flooding


Any Available

For information on processes and applications, please see our technical information guide on pages 41 - 67.

see pages 48-64 for more information

WORKPIECE MATERIALS

ST CARBON STEEL LOW CARBON	**ST** CARBON STEEL MEDIUM CARBON	**TS** TOOL STEEL ≤ 38 HRc	**TS** TOOL STEEL 39-48 HRc	**HS** HARDENED STEEL 48-87 HRc	**HS** HARDENED STEEL 58-65 HRc	**SS** STAINLESS STEEL EASY	**SS** STAINLESS STEEL MODERATE	**SS** STAINLESS STEEL DIFFICULT	**CI** CAST IRON GRAY
CI CAST IRON DUCTILE	**CI** CAST IRON MALLEABLE	**TI** TITANIUM ALLOYS 25-36 HRc	**HI** HI-TEMP ALLOYS 30-52 HRc	**AL** ALUMINUM ALLOYS Low Si (<10%)	**AL** ALUMINUM ALLOYS High Si (>10%)	**MG** ALUMINUM ALLOYS ≤ 38 HRc	**CA** COPPER ALLOYS 39 - 48 HRc	**CG** CARBON & GRAPHITE 48 - 57 HRc	**PL** PLASTICS & COMPOSITES 28 - 57 HRc

see pg. 45 for more information

INDUSTRIES


Hard Milling


Aerospace


Tool & Die

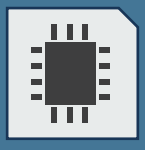

Medical


Automotive


Dept. of Defense


Casting & Foundries


General Machining


Electronics


Agriculture


Furniture / Wood


Energy

GUARANTEED TEST TOOL

*TEST OUR STANDARD END MILLS

CARBIDE | HSS | COBALT

SELECTING YOUR END MILL

We realize that selecting the optimal end mill for your particular job can be confusing. That's why our team of experts are here to help. Our outstanding customer service can help you select the best end mill for your job, as well as the expertise needed to choose the most advantageous tool for your machining needs.

VISIT OUR WEBSITE OR CALL FOR YOUR TOOL TODAY!

CONICAL™ CUTTING TOOLS

GLOBAL™ CUTTING TOOLS

TOOL PERFORMANCE REPORT

In order to serve you better, please print out our "tool performance report" on pg. 272. Fill in the information completely and fax it to: (616) 531-7742. We are always striving for excellence in everything we do. By filling out this form, we will continue to do everything we can to make your experience with Conical Tool as efficient and effective as possible.

MANUFACTURING FOR OVER 70 YEARS 1944 - 2014

(888) 531-8500 | info@conicaltool.com | www.conicalend mills.com

*not applicable to specials

7 PERFORMANCE END MILLS

HIGH PERFORMANCE TOOLS DESIGNED
FOR EXTREME MACHINING RESULTS

Our new performance tool lines will give you the edge you need to reduce downtime, increase speeds and feeds, combine operations, and will ultimately increase profits.

These qualities, taken into account, create the most productive and indispensable tools available.

ENHANCED PERFORMANCE

We are committed to providing the highest performing cutting tools and end mills in the industry and have been breaking ground on new products, developing new patents and improving old workhorses. Our tools have a proven record of being highly successful in their respective applications.

STATE-OF-THE-ART

We combine ongoing, continuous improvement processes with thousands of hours of new tool development per year. We provide comprehensive pre-production research, which allows us to design a manufacturing process that optimizes performance, improves cycle times and promotes quality.

CONICAL™ CUTTING TOOLS

GLOBAL™ CUTTING TOOLS

MANUFACTURING FOR OVER 70 YEARS 1944 - 2014

(888) 531-8500 | info@conicaltool.com | www.conicalendmills.com

CONICAL™ CUTTING TOOLS

GLOBAL™ CUTTING TOOLS

70 YEARS OF INNOVATION

VORTEX4™
ADVANCED VARIABLE GEOMETRY

STATE-OF-THE-ART DESIGN

The metalworking industry is always competitive and overlooking a resource can make any successful company fail to perform. Our Vortex4 end mills demonstrate our history of innovation, through an advanced variable geometry that cannot be matched.

The usefulness of a tool is determined by its ability to perform in various applications. The Vortex4 gives you the flexibility required to perform slotting, light or heavy roughing, and finishing operations. These end mills do more than just replace your old and worn out tools; they will reframe the way you look at machining.

When you use only the best materials, rely on our 70 years of experience and trust in our products, nothing will prevent your success. Call us today to find out about our guaranteed test tools.

CONTINUOUS IMPROVEMENT

Since our founding, we have been a formidable leader of innovation, adaptation and technical experience; unparalleled elsewhere in the cutting tool industry. We strive to provide superior preforming products, which solve complex machining challenges. We have developed a rigorous program to do so and we believe our performance is not just measured by our products, but the technical resources we provide as well.

Global Cutting Tools
Conical Tool Company

3890 Buchanan Ave SW
Grand Rapids, MI 49548

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MANUFACTURING FOR OVER 70 YEARS 1944 - 2014

SEAL OF QUALITY ASSURANCE

Global Cutting Tools are distributed by:

OVER 7,000
DISTRIBUTORS WORLDWIDE

Made in the U.S.A.

NEW PREMIUM TOOL LINE!

VORTEX 4™

ADVANCED VARIABLE GEOMETRY

AMERICAN MADE

GLOBALLY RENOWNED

HIGH PERFORMANCE END MILLS

FOR CHATTER-FREE MACHINING OF FERROUS MATERIALS

GLOBAL™ CUTTING TOOLS

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VORTEX4™

ADVANCED VARIABLE GEOMETRY

CHATTER FREE MACHINING

OF FERROUS MATERIALS

FEATURES & BENEFITS

Our new high performance Vortex4, sub-micron grade carbide end mills have been put to the test. Featuring an industry leading advanced variable geometry, we combine variable helix and variable index flutes with our innovative engineering. The tool performs silently and flawlessly at incredible feeds & speeds. The Vortex4 performs without exception, which mirrors the mission of Global Cutting Tools. We set out to provide our customers with immediate improvement in performance and quality beyond what was available before in the market.

General Inquiries:
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Grand Rapids, MI 49548

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E: info@conicaltool.com

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E: sales@conicaltool.com

Custom Tooling:
E: quotes@conicaltool.com
W: conicalendmills.com/custom-tool-ordering

GLOBAL™
CUTTING TOOLS

SERIES: VX4

For high feed / material removal rate and chatter-free milling of most ferrous materials to create excellent surface finishes while slotting, pocketing, heavy roughing and finishing; wet or dry; low carbon steel to titanium.

Square end option to create sharp corners in finishing operations

Coated for heat resistance, wear resistance and increased lubricity

Four flute design improves chip evacuation for heavy roughing and slotting operations

High strength flutes reduce edge chipping, built up edge and extends tool life

Eccentric relief for improved flute strength

Proprietary design combines roughing and finishing operations into one

Ball end option for high performance contour milling in finishing operations

Corner radius option protects corners in roughing operations and difficult to machine materials by preventing corner chipping and tool failure

Large core design for increased stability; higher speeds & feeds; and reduced tool deflection

Premium micro-grain carbide substrate resists chipping, tool deflection, and has a high transverse rupture strength for greater feeds and speeds

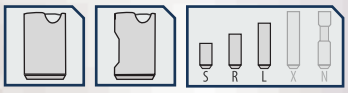
Vibration dampening geometry (variable helix, variable index, improved core)

Edge prep drag finishing increases tool life by improving the surface quality in the flute and radiusing the cutting edge of the tool, reducing the potential for premature failure

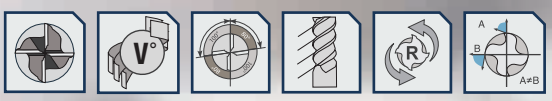
Post polishing is performed after the tools are coated to remove surface inconsistencies and increase lubricity. This also increases feed rates and allows for smoother operations. The tool runs cooler and performs longer

TIP & END

SHANK & LENGTH



FLUTE CONFIGURATION



MATERIAL

CB
SUB-MICRO GRAIN CARBIDE

COATING

AlCrN Si3N4

RESULTS

Combining roughing and finishing operations, the Vortex4 will make your chips disappear with ease, leading to higher productivity and profitability. You will dramatically cut production times and have up to five times longer tool life, leading to significantly increased profit per job. The Vortex4 is excellent for pocketing, slotting, roughing and finishing at high feed rates. Instead of tying up more machine time, utilizing the correct end mill is indisputably a better solution. When you combine cost saving engineering with the ability to join multiple machine operations into one; the results will speak for themselves.

Series VX4: Micro-Grain Carbide, 4 Flute, Advanced Variable Geometry, AlCrN/Si3N4 Coated
SubSeries: VX4SS, VX4SR, VX4SL, VX4CS, VX4CR, VX4CL, VX4BR
Configuration: Varying Diameters; Stub, Regular & Long Lengths; 37/39° Variable Helix; Variable Index; Variable Rake; Eccentric Relief; Square End, Corner Radius & Ball

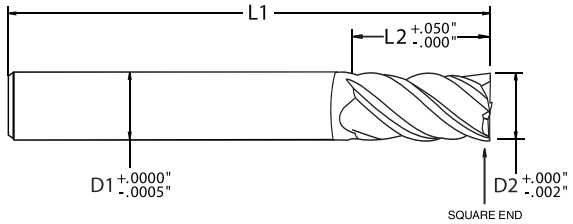
VORTEX4 GLOBAL™

SERIES VX4 - *CARBIDE, 4 FLUTE, ADVANCED VARIABLE GEOMETRY*

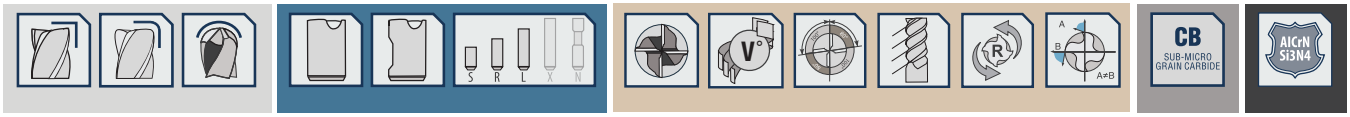
REPLACE YOUR OLD TOOLS

Our Vortex4 end mills demonstrate our history of innovation, through an advanced variable geometry that cannot be matched. These end mills will do more than just replace your old and worn out tools; they will reframe the way you look at machining.

- Square end option to create sharp corners in finishing operations
- Coated for heat resistance, wear resistance and increased lubricity
- Four flute design improves chip evacuation for heavy roughing and slotting operations
- High strength flutes reduce edge chipping, built up edge and extends tool life



TIP & END | SHANK & LENGTH | FLUTE CONFIGURATION | MATERIAL | COATING



SERIES VX4SS - *SQUARE END, STUB LENGTH*

SHANK DIAMETER (D1)		CUTTER DIAMETER (D2)		FLUTE LENGTH (L2)		OVERALL LENGTH (L1)		PLAIN SHANK PART #	PLAIN SHANK EDP #
1/8	0.125	1/8	0.125	3/8	0.375	2	2.000	VX4-0206-SQ	V101S
3/16	0.188	3/16	0.188	3/8	0.375	2	2.000	VX4-0306-SQ	V102S
1/4	0.250	1/4	0.250	3/8	0.375	2	2.000	VX4-0406-SQ	V103S
5/16	0.313	5/16	0.313	1/2	0.500	2	2.000	VX4-0508-SQ	V104S
3/8	0.375	3/8	0.375	5/8	0.625	2	2.000	VX4-0610-SQ	V105S
7/16	0.438	7/16	0.438	5/8	0.625	2 1/2	2.500	VX4-0710-SQ	V106S
1/2	0.500	1/2	0.500	5/8	0.625	2 1/2	2.500	VX4-0810-SQ	V107S
5/8	0.625	5/8	0.625	7/8	0.875	3	3.000	VX4-1014-SQ	V108S
3/4	0.750	3/4	0.750	1 1/8	1.125	3	3.000	VX4-1218-SQ	V109S

SERIES VX4SR - *SQUARE END, REGULAR LENGTH*

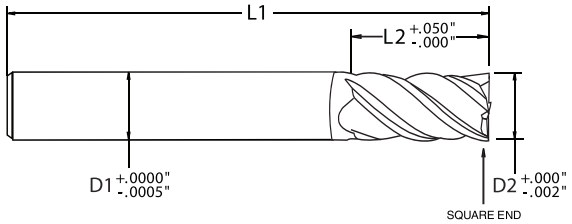
SHANK DIAMETER (D1)		CUTTER DIAMETER (D2)		FLUTE LENGTH (L2)		OVERALL LENGTH (L1)		PLAIN SHANK PART #	PLAIN SHANK EDP #	WELDON SHANK PART #	WELDON SHANK EDP #
1/8	0.125	1/8	0.125	5/8	0.625	2	2.000	VX4-0210-SQ	V201S	—	—
3/16	0.188	3/16	0.188	5/8	0.625	2	2.000	VX4-0310-SQ	V202S	—	—
1/4	0.250	1/4	0.250	7/8	0.875	2 1/2	2.500	VX4-0414-SQ	V203S	—	—
5/16	0.313	5/16	0.313	7/8	0.875	2 1/2	2.500	VX4-0514-SQ	V204S	—	—
3/8	0.375	3/8	0.375	7/8	0.875	2 1/2	2.500	VX4-0614-SQ	V205S	VX4-0614-SQ-W	V215S
				1 3/8	1.375	3	3.000	VX4-0622-SQ	V206S	VX4-0622-SQ-W	V216S
7/16	0.438	7/16	0.438	1 1/8	1.125	3	3.000	VX4-0718-SQ	V207S	VX4-0718-SQ-W	V217S
1/2	0.500	1/2	0.500	1 1/8	1.125	3	3.000	VX4-0818-SQ	V208S	VX4-0818-SQ-W	V218S
				1 3/8	1.375	3	3.000	VX4-0822-SQ	V209S	VX4-0822-SQ-W	V219S
				1 5/8	1.625	3 1/2	3.500	VX4-0826-SQ	V210S	VX4-0826-SQ-W	V220S
				1 7/8	1.875	3 1/2	3.500	VX4-0830-SQ	V211S	VX4-0830-SQ-W	V221S
5/8	0.625	5/8	0.625	1 3/8	1.375	3 1/2	3.500	VX4-1022-SQ	V212S	VX4-1022-SQ-W	V222S
3/4	0.750	3/4	0.750	1 5/8	1.625	4	4.000	VX4-1226-SQ	V213S	VX4-1226-SQ-W	V223S
1	1.000	1	1.000	1 7/8	1.875	4	4.000	VX4-1630-SQ	V214S	VX4-1630-SQ-W	V224S

SERIES VX4 - *CARBIDE, 4 FLUTE, ADVANCED VARIABLE GEOMETRY*

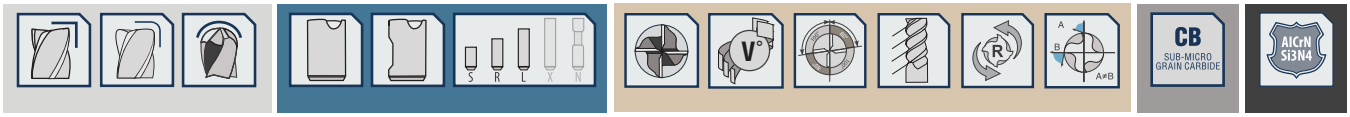
INNOVATIVE ENGINEERING

Featuring an industry leading advanced variable geometry, we combine variable helix and variable index flutes with our innovative engineering. The tool performs silently and flawlessly at incredible feeds & speeds.

- Eccentric relief for improved flute strength
- Ball end option for high performance contour milling in finishing operations
- Corner radius option protects corners in roughing operations and difficult to machine materials by preventing corner chipping and tool failure



TIP & END | SHANK & LENGTH | FLUTE CONFIGURATION | MATERIAL | COATING



SERIES VX4SL - *SQUARE END, LONG LENGTH*

SHANK DIAMETER (D1)		CUTTER DIAMETER (D2)		FLUTE LENGTH (L2)		OVERALL LENGTH (L1)		PLAIN SHANK PART #	PLAIN SHANK EDP #	WELDON SHANK PART #	WELDON SHANK EDP #
1/8	0.125	1/8	0.125	7/8	0.875	2 1/2	2.500	VX4-0214-SQ	V301S	—	—
3/16	0.188	3/16	0.188	7/8	0.875	2 1/2	2.500	VX4-0314-SQ	V302S	—	—
1/4	0.250	1/4	0.250	1 3/8	1.375	3	3.000	VX4-0422-SQ	V303S	—	—
				1 7/8	1.875	3 1/2	3.500	VX4-0430-SQ	V304S	—	—
5/16	0.313	5/16	0.313	1 3/8	1.375	3	3.000	VX4-0522-SQ	V305S	—	—
				2 1/8	2.125	4	4.000	VX4-0534-SQ	V306S	—	—
3/8	0.375	3/8	0.375	2 1/8	2.125	4	4.000	VX4-0634-SQ	V307S	VX4-0634-SQ-W	V322S
				2 5/8	2.625	5	5.000	VX4-0642-SQ	V308S	VX4-0642-SQ-W	V323S
7/16	0.438	7/16	0.438	2 1/8	2.125	4	4.000	VX4-0734-SQ	V309S	VX4-0734-SQ-W	V324S
1/2	0.500	1/2	0.500	2 1/8	2.125	4	4.000	VX4-0834-SQ	V310S	VX4-0834-SQ-W	V325S
				2 5/8	2.625	5	5.000	VX4-0842-SQ	V311S	VX4-0842-SQ-W	V326S
				3 3/8	3.375	6	6.000	VX4-0854-SQ	V312S	VX4-0854-SQ-W	V327S
5/8	0.625	5/8	0.625	2 1/8	2.125	4	4.000	VX4-1034-SQ	V313S	VX4-1034-SQ-W	V328S
				2 5/8	2.625	5	5.000	VX4-1042-SQ	V314S	VX4-1042-SQ-W	V329S
				3 3/8	3.375	6	6.000	VX4-1054-SQ	V315S	VX4-1054-SQ-W	V330S
3/4	0.750	3/4	0.750	2 5/8	2.625	5	5.000	VX4-1242-SQ	V316S	VX4-1242-SQ-W	V331S
				3 3/8	3.375	6	6.000	VX4-1254-SQ	V317S	VX4-1254-SQ-W	V332S
				4 3/8	4.375	7	7.000	VX4-1270-SQ	V318S	VX4-1270-SQ-W	V333S
1	1.000	1	1.000	2 3/8	2.375	5	5.000	VX4-1638-SQ	V319S	VX4-1638-SQ-W	V334S
				3 3/8	3.375	6	6.000	VX4-1654-SQ	V320S	VX4-1654-SQ-W	V335S
				4 3/8	4.375	7	7.000	VX4-1670-SQ	V321S	VX4-1670-SQ-W	V336S

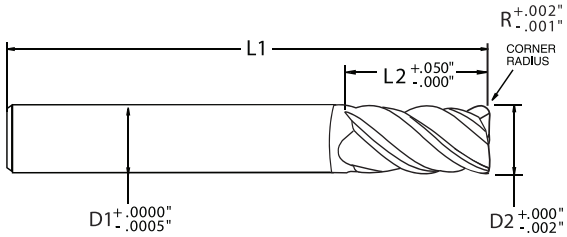
VORTEX4 GLOBAL™

SERIES VX4 - *CARBIDE, 4 FLUTE, ADVANCED VARIABLE GEOMETRY*

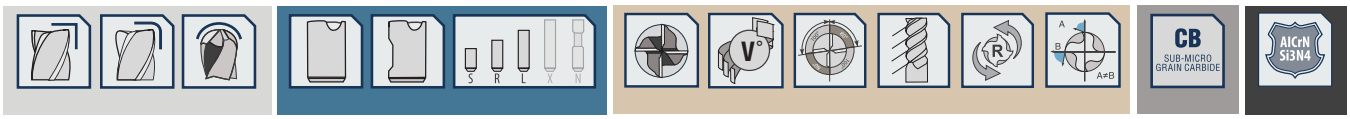
SILENT AND FLAWLESS

The Vortex4 performs silently and flawlessly at incredible feeds & speeds. The Vortex4 performs without exception, which reflects the ideals of Global Cutting Tools.

- Large core design for increased stability; higher speeds & feeds; and reduced tool deflection
- Premium micro-grain carbide substrate resists chipping, tool deflection, and has a high transverse rupture strength for greater feeds and speeds
- Corner radius option protects corners in roughing operations and difficult to machine materials by preventing corner chipping and tool failure



TIP & END | SHANK & LENGTH | FLUTE CONFIGURATION | MATERIAL | COATING



SERIES VX4CS - *CORNER RADIUS, STUB LENGTH*

SHANK DIAMETER (D1)		CUTTER DIAMETER (D2)		FLUTE LENGTH (L2)		OVERALL LENGTH (L1)		CORNER RADIUS (R)	PLAIN SHANK PART #	PLAIN SHANK EDP #
1/8	0.125	1/8	0.125	3/8	0.375	2	2.000	0.015	VX4-0206-R1	V1011
3/16	0.188	3/16	0.188	3/8	0.375	2	2.000	0.015	VX4-0306-R1	V1021
1/4	0.250	1/4	0.250	3/8	0.375	2	2.000	0.020	VX4-0406-R2	V1032
5/16	0.313	5/16	0.313	1/2	0.500	2	2.000	0.030	VX4-0508-R3	V1043
3/8	0.375	3/8	0.375	5/8	0.625	2	2.000	0.030	VX4-0610-R3	V1053
7/16	0.438	7/16	0.438	5/8	0.625	2 1/2	2.500	0.030	VX4-0710-R3	V1063
1/2	0.500	1/2	0.500	5/8	0.625	2 1/2	2.500	0.030	VX4-0810-R3	V1073
5/8	0.625	5/8	0.625	7/8	0.875	3	3.000	0.040	VX4-1014-R4	V1084
3/4	0.750	3/4	0.750	1 1/8	1.125	3	3.000	0.050	VX4-1218-R5	V1095

SERIES VX4CR - *CORNER RADIUS, REGULAR LENGTH*

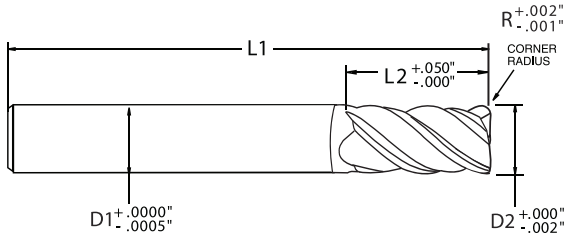
SHANK DIAMETER (D1)		CUTTER DIAMETER (D2)		FLUTE LENGTH (L2)		OVERALL LENGTH (L1)		CORNER RADIUS (R)	PLAIN SHANK PART #	PLAIN SHANK EDP #	WELDON SHANK PART #	WELDON SHANK EDP #
1/8	0.125	1/8	0.125	5/8	0.625	2	2.000	0.015	VX4-0210-R1	V2011	—	—
3/16	0.188	3/16	0.188	5/8	0.625	2	2.000	0.015	VX4-0310-R1	V2021	—	—
1/4	0.250	1/4	0.250	7/8	0.875	2 1/2	2.500	0.020	VX4-0414-R2	V2032	—	—
5/16	0.313	5/16	0.313	7/8	0.875	2 1/2	2.500	0.030	VX4-0514-R3	V2043	—	—
3/8	0.375	3/8	0.375	7/8	0.875	2 1/2	2.500	0.030	VX4-0614-R3	V2053	VX4-0614-R3-W	V2153
				1 3/8	1.375	3	3.000	0.030	VX4-0622-R3	V2063	VX4-0622-R3-W	V2163
7/16	0.438	7/16	0.438	1 1/8	1.125	3	3.000	0.030	VX4-0718-R3	V2073	VX4-0718-R3-W	V2173
1/2	0.500	1/2	0.500	1 1/8	1.125	3	3.000	0.030	VX4-0818-R3	V2083	VX4-0818-R3-W	V2183
				1 3/8	1.375	3	3.000	0.030	VX4-0822-R3	V2093	VX4-0822-R3-W	V2193
				1 5/8	1.625	3 1/2	3.500	0.030	VX4-0826-R3	V2103	VX4-0826-R3-W	V2203
				1 7/8	1.875	3 1/2	3.500	0.030	VX4-0830-R3	V2113	VX4-0830-R3-W	V2213
5/8	0.625	5/8	0.625	1 3/8	1.375	3 1/2	3.500	0.040	VX4-1022-R4	V2124	VX4-1022-R4-W	V2224
3/4	0.750	3/4	0.750	1 5/8	1.625	4	4.000	0.050	VX4-1226-R5	V2135	VX4-1226-R5-W	V2235
1	1.000	1	1.000	1 7/8	1.875	4	4.000	0.060	VX4-1630-R6	V2146	VX4-1630-R6-W	V2246

SERIES VX4 - *CARBIDE, 4 FLUTE, ADVANCED VARIABLE GEOMETRY*

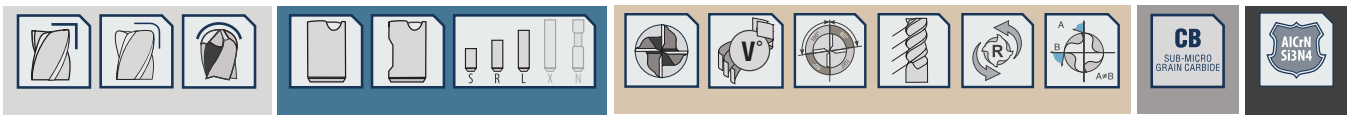
COMBINE OPERATIONS

Combining roughing and finishing operations, the Vortex4 will make your chips disappear with ease, leading to higher productivity and profitability.

- Coated for heat resistance, wear resistance and increased lubricity
- Four flute design improves chip evacuation for heavy roughing and slotting operations
- High strength flutes reduce edge chipping, built up edge and extends tool life
- Eccentric relief for improved flute strength



TIP & END | SHANK & LENGTH | FLUTE CONFIGURATION | MATERIAL | COATING



SERIES VX4CL - *CORNER RADIUS, LONG LENGTH*

SHANK DIAMETER (D1)		CUTTER DIAMETER (D2)		FLUTE LENGTH (L2)		OVERALL LENGTH (L1)		CORNER RADIUS (R)	PLAIN SHANK PART #	PLAIN SHANK EDP #	WELDON SHANK PART #	WELDON SHANK EDP #
1/8	0.125	1/8	0.125	7/8	0.875	2 1/2	2.500	0.015	VX4-0214-R1	V3011	—	—
3/16	0.188	3/16	0.188	7/8	0.875	2 1/2	2.500	0.015	VX4-0314-R1	V3021	—	—
1/4	0.250	1/4	0.250	1 3/8	1.375	3	3.000	0.020	VX4-0422-R2	V3032	—	—
				1 7/8	1.875	3 1/2	3.500	0.020	VX4-0430-R2	V3042	—	—
5/16	0.313	5/16	0.313	1 3/8	1.375	3	3.000	0.030	VX4-0522-R3	V3053	—	—
				2 1/8	2.125	4	4.000	0.030	VX4-0534-R3	V3063	—	—
3/8	0.375	3/8	0.375	2 1/8	2.125	4	4.000	0.030	VX4-0634-R3	V3073	VX4-0634-R3-W	V3223
				2 5/8	2.625	5	5.000	0.030	VX4-0642-R3	V3083	VX4-0642-R3-W	V3233
7/16	0.438	7/16	0.438	2 1/8	2.125	4	4.000	0.030	VX4-0734-R3	V3093	VX4-0734-R3-W	V3243
1/2	0.500	1/2	0.500	2 1/8	2.125	4	4.000	0.030	VX4-0834-R3	V3103	VX4-0834-R3-W	V3253
				2 5/8	2.625	5	5.000	0.030	VX4-0842-R3	V3113	VX4-0842-R3-W	V3263
				3 3/8	3.375	6	6.000	0.030	VX4-0854-R3	V3123	VX4-0854-R3-W	V3273
5/8	0.625	5/8	0.625	2 1/8	2.125	4	4.000	0.040	VX4-1034-R4	V3134	VX4-1034-R4-W	V3284
				2 5/8	2.625	5	5.000	0.040	VX4-1042-R4	V3144	VX4-1042-R4-W	V3294
				3 3/8	3.375	6	6.000	0.040	VX4-1054-R4	V3154	VX4-1054-R4-W	V3304
3/4	0.750	3/4	0.750	2 5/8	2.625	5	5.000	0.050	VX4-1242-R5	V3165	VX4-1242-R5-W	V3315
				3 3/8	3.375	6	6.000	0.050	VX4-1254-R5	V3175	VX4-1254-R5-W	V3325
				4 3/8	4.375	7	7.000	0.050	VX4-1270-R5	V3185	VX4-1270-R5-W	V3335
1	1.000	1	1.000	2 3/8	2.375	5	5.000	0.060	VX4-1638-R6	V3196	VX4-1638-R6-W	V3346
				3 3/8	3.375	6	6.000	0.060	VX4-1654-R6	V3206	VX4-1654-R6-W	V3356
				4 3/8	4.375	7	7.000	0.060	VX4-1670-R6	V3216	VX4-1670-R6-W	V3366

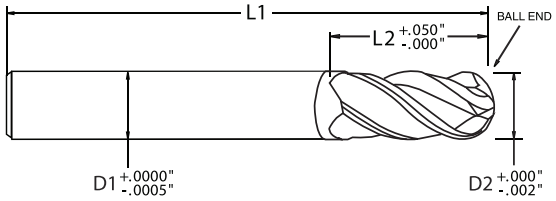
VORTEX4 GLOBAL™

SERIES VX4 - *CARBIDE, 4 FLUTE, ADVANCED VARIABLE GEOMETRY*

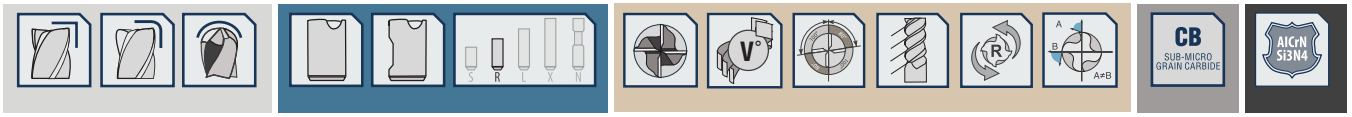
CUT PRODUCTION TIMES

You will dramatically cut production times and have up to five times longer tool life, leading to significantly increased profit per job. The Vortex4 is excellent for pocketing, slotting, roughing and finishing at high feed rates.

- Ball end option for high performance contour milling in finishing operations
- Large core design for increased stability; higher speeds & feeds; and reduced tool deflection
- Premium micro-grain carbide substrate resists chipping, tool deflection, and has a high transverse rupture strength for greater feeds and speeds



TIP & END | SHANK & LENGTH | FLUTE CONFIGURATION | MATERIAL | COATING



SERIES VX4BR - *BALL END, REGULAR LENGTH*

SHANK DIAMETER (D1)		CUTTER DIAMETER (D2)		FLUTE LENGTH (L2)		OVERALL LENGTH (L1)		PLAIN SHANK PART #	PLAIN SHANK EDP #	WELDON SHANK PART #	WELDON SHANK EDP #
1/8	0.125	1/8	0.125	5/8	0.625	2	2.000	VX4-0210-BE	V201B	—	—
3/16	0.188	3/16	0.188	5/8	0.625	2	2.000	VX4-0310-BE	V202B	—	—
1/4	0.250	1/4	0.250	7/8	0.875	2 1/2	2.500	VX4-0414-BE	V203B	—	—
5/16	0.313	5/16	0.313	7/8	0.875	2 1/2	2.500	VX4-0514-BE	V204B	—	—
3/8	0.375	3/8	0.375	7/8	0.875	2 1/2	2.500	VX4-0614-BE	V205B	VX4-0614-BE-W	V211B
7/16	0.438	7/16	0.438	1 1/8	1.125	3	3.000	VX4-0718-BE	V206B	VX4-0718-BE-W	V212B
1/2	0.500	1/2	0.500	1 1/8	1.125	3	3.000	VX4-0818-BE	V207B	VX4-0818-BE-W	V213B
5/8	0.625	5/8	0.625	1 3/8	1.375	3 1/2	3.500	VX4-1022-BE	V208B	VX4-1022-BE-W	V214B
3/4	0.750	3/4	0.750	1 5/8	1.625	4	4.000	VX4-1226-BE	V209B	VX4-1226-BE-W	V215B
1	1.000	1	1.000	2 3/8	2.375	5	5.000	VX4-1638-BE	V210B	VX4-1638-BE-W	V216B

RECONDITIONING PROGRAM

REGRIND ONLY: 1 WEEK; REGRIND & COATING: 2 WEEKS

70 YEARS OF GRINDING EXPERIENCE

RE-SHARPENING SERVICES

Prices vary and are based on coating and diameter size. It does not matter how badly the tool may be damaged, we can regrind most any end mill. We will re-sharpen or recondition any tool, even competitor brands. Most any tool can be re-sharpened, however, when normal re-sharpening is not sufficient, reconditioning may be needed.

SEE PAGES 14 -15 FOR DETAILS

VX4 APPLICATION GUIDE • SPEEDS & FEEDS

WORK MATERIAL		TYPE OF CUT	AXIAL DOC	RADIAL DOC	FLUTES	SPEED (SFM)	FEED (INCHES PER TOOTH) 1/8" (4 FL)	1/4" (4 FL)	3/8" (4 FL)	1/2" (4 FL)	5/8" (4 FL)	3/4" (4 FL)	1" (4 FL)
CARBON STEEL	LOW CARBON STEELS ≤ 38 HRc 10xx; 11xx; 12xx; 12Lxx, 15xx	Slotting	1 x D	1 x D	4	330 - 375	0.0006 - 0.0008	0.0012 - 0.0016	0.0018 - 0.0024	0.0024 - 0.0032	0.0029 - 0.0039	0.0035 - 0.0047	0.0047 - 0.0063
		Roughing	1.5 x D	.5 x D	4	410 - 470	0.0008 - 0.0012	0.0015 - 0.0020	0.0022 - 0.0030	0.0030 - 0.0040	0.0037 - 0.0050	0.0045 - 0.0060	0.0059 - 0.0080
		High Effeciency (HEM)	2 x D	.2 x D	4	515 - 575	0.0015 - 0.0018	0.0030 - 0.0036	0.0044 - 0.0054	0.0058 - 0.0071	0.0073 - 0.0090	0.0088 - 0.0107	0.0117 - 0.0144
		Finishing	1.5 x D	.015 x D	4	475 - 520	0.0009 - 0.0013	0.0017 - 0.0022	0.0026 - 0.0033	0.0034 - 0.0043	0.0042 - 0.0053	0.0050 - 0.0064	0.0067 - 0.0086
	MEDIUM CARBON STEELS ≤ 38 HRc 13xx; 41xx; 43xx; 86xx, 92xx; 93xx; Chromoly	Slotting	1 x D	1 x D	4	305 - 350	0.0006 - 0.0008	0.0011 - 0.0015	0.0017 - 0.0023	0.0022 - 0.0030	0.0027 - 0.0037	0.0033 - 0.0045	0.0044 - 0.0060
		Roughing	1.5 x D	.5 x D	4	375 - 430	0.0008 - 0.0012	0.0014 - 0.0019	0.0021 - 0.0029	0.0028 - 0.0038	0.0035 - 0.0048	0.0042 - 0.0057	0.0055 - 0.0076
		High Effeciency (HEM)	2 x D	.2 x D	4	470 - 525	0.0014 - 0.0017	0.0027 - 0.0033	0.0040 - 0.0050	0.0053 - 0.0066	0.0066 - 0.0083	0.0080 - 0.0099	0.0106 - 0.0133
		Finishing	1.5 x D	.015 x D	4	425 - 465	0.0008 - 0.0012	0.0016 - 0.0021	0.0024 - 0.0031	0.0031 - 0.0040	0.0040 - 0.0051	0.0047 - 0.0061	0.0063 - 0.0082
TOOL STEEL	TOOL & DIE STEELS ≤ 38 HRc A2; A3; D2; H11; H13; M1; O-1; S-7; NAK 55	Slotting	1 x D	1 x D	4	320 - 365	0.0007 - 0.0009	0.0012 - 0.0016	0.0019 - 0.0025	0.0024 - 0.0032	0.0028 - 0.0038	0.0036 - 0.0048	0.0048 - 0.0064
		Roughing	1.5 x D	.5 x D	4	395 - 450	0.0008 - 0.0012	0.0015 - 0.0020	0.0022 - 0.0030	0.0030 - 0.0040	0.0037 - 0.0050	0.0045 - 0.0060	0.0059 - 0.0080
		High Effeciency (HEM)	2 x D	.2 x D	4	495 - 550	0.0013 - 0.0016	0.0025 - 0.0031	0.0037 - 0.0047	0.0048 - 0.0061	0.0060 - 0.0077	0.0074 - 0.0093	0.0098 - 0.0125
		Finishing	1.5 x D	.015 x D	4	450 - 495	0.0008 - 0.0012	0.0015 - 0.0020	0.0023 - 0.0030	0.0031 - 0.0040	0.0038 - 0.0049	0.0047 - 0.0061	0.0062 - 0.0081
	TOOL & DIE STEELS 39 to 48 HRc P20; P21; S-136; PX-5; NAK 80	Slotting	.75 x D	1 x D	4	305 - 350	0.0006 - 0.0008	0.0011 - 0.0015	0.0017 - 0.0023	0.0022 - 0.0030	0.0026 - 0.0036	0.0032 - 0.0044	0.0043 - 0.0059
		Roughing	1.5 x D	.3 x D	4	375 - 430	0.0007 - 0.0011	0.0014 - 0.0019	0.0020 - 0.0028	0.0027 - 0.0037	0.0034 - 0.0047	0.0041 - 0.0056	0.0054 - 0.0075
		High Effeciency (HEM)	2 x D	.15 x D	4	470 - 525	0.0012 - 0.0015	0.0023 - 0.0029	0.0033 - 0.0043	0.0044 - 0.0057	0.0055 - 0.0072	0.0067 - 0.0086	0.0089 - 0.0116
		Finishing	1.5 x D	.015 x D	4	425 - 465	0.0007 - 0.0011	0.0014 - 0.0019	0.0021 - 0.0028	0.0028 - 0.0037	0.0035 - 0.0046	0.0042 - 0.0056	0.0056 - 0.0075
HARDENED STEEL	HARDENED STEELS 48 to 57 HRc	Slotting	1 x D	1 x D	4	225 - 255	0.0006 - 0.0008	0.0011 - 0.0015	0.0017 - 0.0023	0.0022 - 0.0030	0.0027 - 0.0037	0.0033 - 0.0045	0.0044 - 0.0060
		Roughing	1.5 x D	.5 x D	4	265 - 300	0.0007 - 0.0011	0.0013 - 0.0018	0.0019 - 0.0027	0.0026 - 0.0036	0.0032 - 0.0045	0.0039 - 0.0054	0.0051 - 0.0072
		High Effeciency (HEM)	2 x D	.2 x D	4	380 - 425	0.0008 - 0.0011	0.0015 - 0.0021	0.0022 - 0.0032	0.0029 - 0.0042	0.0036 - 0.0053	0.0044 - 0.0063	0.0058 - 0.0085
		Finishing	1.5 x D	.015 x D	4	330 - 360	0.0007 - 0.0011	0.0013 - 0.0018	0.0020 - 0.0027	0.0026 - 0.0035	0.0033 - 0.0044	0.0039 - 0.0053	0.0052 - 0.0071
	HARDENED STEELS 58 to 65HRc	Slotting	.75 x D	1 x D	4	215 - 245	0.0005 - 0.0007	0.0008 - 0.0012	0.0013 - 0.0019	0.0016 - 0.0024	0.0019 - 0.0029	0.0024 - 0.0036	0.0032 - 0.0048
		Roughing	1.5 x D	.3 x D	4	250 - 285	0.0006 - 0.0010	0.0010 - 0.0015	0.0015 - 0.0023	0.0020 - 0.0030	0.0024 - 0.0037	0.0030 - 0.0045	0.0039 - 0.0060
		High Effeciency (HEM)	2 x D	.15 x D	4	360 - 400	0.0006 - 0.0009	0.0010 - 0.0016	0.0015 - 0.0025	0.0019 - 0.0032	0.0023 - 0.0040	0.0029 - 0.0048	0.0038 - 0.0065
		Finishing	1.5 x D	.015 x D	4	305 - 335	0.0006 - 0.0010	0.0010 - 0.0015	0.0015 - 0.0022	0.0020 - 0.0029	0.0025 - 0.0036	0.0030 - 0.0044	0.0040 - 0.0059
STAINLESS STEEL	EASY TO MACHINE 72 - 85 HRb 410; 416; 420; 430F; 440C; 302; 303	Slotting	.75 x D	1 x D	4	305 - 350	0.0006 - 0.0008	0.0011 - 0.0015	0.0017 - 0.0023	0.0022 - 0.0030	0.0026 - 0.0036	0.0032 - 0.0044	0.0043 - 0.0059
		Roughing	1.25 x D	.3 x D	4	375 - 430	0.0007 - 0.0011	0.0014 - 0.0019	0.0020 - 0.0028	0.0027 - 0.0037	0.0034 - 0.0047	0.0041 - 0.0056	0.0054 - 0.0075
		High Effeciency (HEM)	2 x D	.15 x D	4	470 - 525	0.0014 - 0.0017	0.0027 - 0.0033	0.0040 - 0.0050	0.0053 - 0.0066	0.0066 - 0.0083	0.0080 - 0.0099	0.0106 - 0.0133
		Finishing	1.5 x D	.015 x D	4	425 - 465	0.0007 - 0.0011	0.0014 - 0.0019	0.0021 - 0.0028	0.0028 - 0.0037	0.0035 - 0.0046	0.0042 - 0.0056	0.0056 - 0.0075
	MODERATELY DIFFICULT 79 - 85 HRb; 25 - 41 HRc 304; 304L; 316; 316L; 320; 321; 347; Invar 36; Kovar	Slotting	.75 x D	1 x D	4	275 - 315	0.0007 - 0.0009	0.0012 - 0.0016	0.0019 - 0.0025	0.0024 - 0.0032	0.0030 - 0.0040	0.0036 - 0.0048	0.0048 - 0.0064
		Roughing	1.25 x D	.3 x D	4	340 - 390	0.0008 - 0.0012	0.0015 - 0.0020	0.0023 - 0.0031	0.0031 - 0.0041	0.0038 - 0.0051	0.0046 - 0.0061	0.0060 - 0.0081
		High Effeciency (HEM)	2 x D	.1 x D	4	425 - 475	0.0016 - 0.0019	0.0030 - 0.0036	0.0045 - 0.0055	0.0060 - 0.0073	0.0074 - 0.0091	0.0090 - 0.0109	0.0119 - 0.0146
		Finishing	1.5 x D	.01 x D	4	380 - 415	0.0008 - 0.0012	0.0016 - 0.0021	0.0024 - 0.0031	0.0031 - 0.0040	0.0040 - 0.0051	0.0047 - 0.0061	0.0063 - 0.0082
	DIFFICULT TO MACHINE 31 - 50 HRc 13-8 PH; 15-5 PH; 17-4 PH; Carpenter; Custo 465; Invar	Slotting	.5 x D	1 x D	4	260 - 295	0.0005 - 0.0007	0.0009 - 0.0013	0.0014 - 0.0020	0.0018 - 0.0026	0.0022 - 0.0032	0.0027 - 0.0039	0.0036 - 0.0052
		Roughing	1.25 x D	.3 x D	4	320 - 365	0.0006 - 0.0010	0.0012 - 0.0017	0.0017 - 0.0025	0.0023 - 0.0033	0.0028 - 0.0041	0.0035 - 0.0050	0.0045 - 0.0066
		High Effeciency (HEM)	1.5 x D	.1 x D	4	405 - 450	0.0013 - 0.0016	0.0025 - 0.0031	0.0037 - 0.0047	0.0049 - 0.0062	0.0061 - 0.0078	0.0074 - 0.0093	0.0098 - 0.0125
		Finishing	1.5 x D	.01 x D	4	355 - 390	0.0006 - 0.0010	0.0012 - 0.0017	0.0018 - 0.0025	0.0024 - 0.0033	0.0030 - 0.0041	0.0035 - 0.0049	0.0047 - 0.0066
CAST IRON	GRAY 100 - 200 HRb	Slotting	1 x D	1 x D	4	320 - 365	0.0006 - 0.0008	0.0011 - 0.0015	0.0017 - 0.0023	0.0022 - 0.0030	0.0027 - 0.0037	0.0033 - 0.0045	0.0044 - 0.0060
		Roughing	1.5 x D	.5 x D	4	395 - 450	0.0008 - 0.0012	0.0014 - 0.0019	0.0021 - 0.0029	0.0028 - 0.0038	0.0035 - 0.0048	0.0042 - 0.0057	0.0055 - 0.0076
		High Effeciency (HEM)	2 x D	.2 x D	4	495 - 550	0.0013 - 0.0016	0.0025 - 0.0031	0.0037 - 0.0047	0.0050 - 0.0063	0.0062 - 0.0079	0.0075 - 0.0094	0.0099 - 0.0126
		Finishing	1.5 x D	.015 x D	4	450 - 495	0.0008 - 0.0012	0.0016 - 0.0021	0.0024 - 0.0031	0.0031 - 0.0040	0.0040 - 0.0051	0.0047 - 0.0061	0.0063 - 0.0082
	DUCTILE 150 - 300 HRb	Slotting	1 x D	1 x D	4	305 - 350	0.0005 - 0.0007	0.0010 - 0.0014	0.0015 - 0.0021	0.0020 - 0.0028	0.0024 - 0.0034	0.0029 - 0.0041	0.0039 - 0.0055
		Roughing	1.5 x D	.5 x D	4	375 - 430	0.0007 - 0.0011	0.0013 - 0.0018	0.0018 - 0.0026	0.0025 - 0.0035	0.0031 - 0.0044	0.0038 - 0.0053	0.0049 - 0.0070
		High Effeciency (HEM)	2 x D	.2 x D	4	470 - 525	0.0011 - 0.0014	0.0021 - 0.0027	0.0031 - 0.0041	0.0041 - 0.0054	0.0051 - 0.0068	0.0062 - 0.0081	0.0082 - 0.0109
		Finishing	1.5 x D	.015 x D	4	425 - 465	0.0007 - 0.0011	0.0014 - 0.0019	0.0021 - 0.0028	0.0028 - 0.0037	0.0035 - 0.0046	0.0042 - 0.0056	0.0056 - 0.0075
	MALLEABLE 150 - 310 HRb	Slotting	.75 x D	1 x D	4	255 - 290	0.0005 - 0.0007	0.0010 - 0.0014	0.0015 - 0.0021	0.0020 - 0.0028	0.0024 - 0.0034	0.0029 - 0.0041	0.0039 - 0.0055
		Roughing	1.5 x D	.5 x D	4	295 - 335	0.0007 - 0.0011	0.0013 - 0.0018	0.0018 - 0.0026	0.0025 - 0.0035	0.0031 - 0.0044	0.0038 - 0.0053	0.0049 - 0.0070
		High Effeciency (HEM)	2 x D	.2 x D	4	425 - 475	0.0011 - 0.0014	0.0021 - 0.0027	0.0031 - 0.0041	0.0041 - 0.0054	0.0051 - 0.0068	0.0062 - 0.0081	0.0082 - 0.0109
		Finishing	1.5 x D	.015 x D	4	380 - 415	0.0007 - 0.0011	0.0014 - 0.0019	0.0021 - 0.0028	0.0028 - 0.0037	0.0035 - 0.0046	0.0042 - 0.0056	0.0056 - 0.0075
ALLOYS	TITANIUM ALLOYS 70 - 100 HRb; 25 - 36 HRc Ti61AL4V; Grades 5-38	Slotting	.5 x D	1 x D	4	240 - 275	0.0005 - 0.0007	0.0009 - 0.0013	0.0014 - 0.0020	0.0018 - 0.0026	0.0022 - 0.0032	0.0027 - 0.0039	0.0036 - 0.0052
		Roughing	1.25 x D	.3 x D	4	280 - 320	0.0006 - 0.0010	0.0012 - 0.0017	0.0017 - 0.0025	0.0023 - 0.0033	0.0028 - 0.0041	0.0035 - 0.0050	0.0045 - 0.0066
		High Effeciency (HEM)	1.5 x D	.1 x D	4	405 - 450	0.0012 - 0.0015	0.0023 - 0.0029	0.0034 - 0.0044	0.0045 - 0.0058	0.0056 - 0.0073	0.0068 - 0.0087	0.0090 - 0.0117
		Finishing	1.5 x D	.01 x D	4	355 - 390	0.0006 - 0.0010	0.0012 - 0.0017	0.0018 - 0.0025	0.0024 - 0.0033	0.0030 - 0.0041	0.0035 - 0.0049	0.0047 - 0.0066
	HIGH TEMP ALLOYS 83 - 99 HRb; 30 - 52 HRc Inconel; Monel; A286; Rene; Stelite; Haynes; Waspalloy; Hastalloy; etc	Slotting	.25 x D	1 x D	4	70 - 80	0.0005 - 0.0007	0.0010 - 0.0014	0.0015 - 0.0021	0.0019 - 0.0027	0.0024 - 0.0034	0.0029 - 0.0041	0.0038 - 0.0054
		Roughing	1.25 x D	.25 x D	4	90 - 100	0.0007 - 0.0011	0.0012 - 0.0017	0.0018 - 0.0026	0.0025 - 0.0035	0.0030 - 0.0043	0.0037 - 0.0052	0.0048 - 0.0069
		High Effeciency (HEM)	1.5 x D	.1 x D	4	225 - 250	0.0009 - 0.0012	0.0017 - 0.0023	0.0025 - 0.0035	0.0032 - 0.0045	0.0040 - 0.0057	0.0049 - 0.0068	0.0065 - 0.0092
		Finishing	1.5 x D	.01 x D	4	115 - 125	0.0008 - 0.0012	0.0015 - 0.0020	0.0022 - 0.0029	0.0029 - 0.0038	0.0037 - 0.0048	0.0044 - 0.0058	0.0058 - 0.0077

D = tool diameter • Reduce feed rates by 20% when using long length tools • Use reduced neck tooling for long reach slotting • Starting parameters shown

CONICAL™ CUTTING TOOLS

GLOBAL™ CUTTING TOOLS

70 YEARS OF INNOVATION

VORTEX5™
ADVANCED VARIABLE GEOMETRY

UNEQUALED PERFORMANCE

There are "high performance" tools and there are tools that purely perform. Slapping an adjective on a cutting tool does not make it a high performance tool. The way it machines does. The Vortex5 was tested against similarly claimed "high performance" cutting tools and came out on top. We manufacture the Vortex5 with one focus: to be the last time you ever switch cutting tool manufacturers.

The Vortex5 is designed from the substrate up, starting with the highest grade, virgin sub-micron carbide available and finishing with a premium PVD coating. The design is optimized to improve rigidity, reduce harmonics, increase feed rates and leave a tight tolerance surface finish. The five flute design of our Vortex5 end mill offers a 20% increase in performance over four flute designs.

When it's time to finish the job, while decreasing cutting costs and with as little setup or changeover time possible, use the Vortex5.

VISION AND VALUES

Innovation is our past, present and will always be our future. Our loyal customer base is why we are in business and our vision is to provide consistent quality and service as we continue to expand. Simply saying we supply tools to the metalworking industry would leave out a large portion of who we are and what we do. Our aim is to provide our customers with value in everything we do.

Global Cutting Tools
Conical Tool Company

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CHATTER FREE MACHINING

OF FERROUS MATERIALS

FEATURES & BENEFITS

Significantly improve your production rates and finish quality with our Vortex5 premium end mills. By starting with quality materials, our tools last longer, provide performance improvement and reduce costs. Our advanced variable geometry design allows for smooth, chatter free machining and an immediate 20% increase in performance over four flute designs. The five flute design of our Vortex 5 end mill offers higher efficiency through improved tool engagement and increased stability in the cut for tight tolerance applications.

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Custom Tooling:
E: quotes@conicaltool.com
W: conicalendmills.com/custom-tool-ordering

GLOBAL™
CUTTING TOOLS

SERIES: VX5

For high feed rate, chatter-free milling of most ferrous materials to create excellent surface finishes. Slotting, pocketing, light roughing and finishing, wet or dry, low carbon steel to titanium up to 55 HRc.

Square end option to create sharp corners in finishing operations

Coated for heat resistance, wear resistance and increased lubricity

Improved tool engagement through 5 flute design creates a superior surface finish

High strength flutes reduce edge chipping, built up edge and extends tool life

Eccentric relief for enhanced edge strength along the flutes

Vibration dampening geometry: variable helix, variable index, increased core, and odd number of flutes

Corner radius option protects corners in roughing operations and difficult to machine materials by preventing corner chipping and tool failure

Odd number of flutes reduce harmonics by staggering the entry and exit of the cutting edges

Large core design for increased stability; higher speeds & feeds; and reduced tool deflection

Premium micro-grain carbide substrate resists chipping, tool deflection, and has a high transverse rupture strength for greater feeds and speeds

Proprietary design combines roughing and finishing operations into one

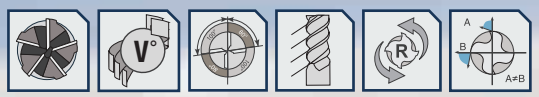
Edge prep drag finishing increases tool life by improving the surface quality in the flute and radiusing the cutting edge of the tool, reducing the potential for premature failure

Post polishing is performed after the tools are coated to remove surface inconsistencies and increase lubricity. This also increases feed rates and allows for smoother operations. The tool runs cooler and performs longer

TIP & END

SHANK & LENGTH

FLUTE CONFIGURATION



MATERIAL

CB
SUB-MICRO GRAIN CARBIDE

COATING

AlCrN Si3N4

RESULTS

The benefits are far reaching with up to five times longer tool life, decreases in work time and engineering you can trust to increase the profit per job. Increased productivity will always lead to greater profitability, when quality is guaranteed and delivered consistently. The Vortex5 will turn any material from low carbon steel to high temp alloys, into easy materials to work with, while yielding superbly machined parts. You will spend less time changing your end mill and have more time for new projects, when you let our experience work for you.

Series VX5: Micro-Grain Carbide, 5 Flute, Advanced Variable Geometry, AlCrN/Si3N4 Coated
SubSeries: VX5SR, VX5SL, VX5CR, VX5CL
Configuration: Varying Diameters; Regular & Long Lengths; 37/39° Variable Helix; Variable Index; Variable Rake; Eccentric Relief; Square End & Corner Radius

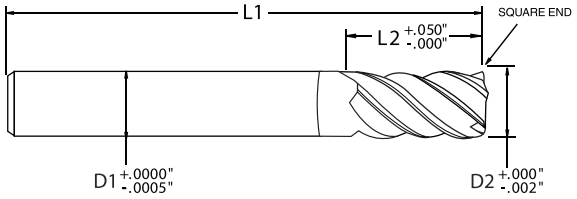
VORTEX5 GLOBAL™

SERIES VX5 - *CARBIDE, 5 FLUTE, ADVANCED VARIABLE GEOMETRY*

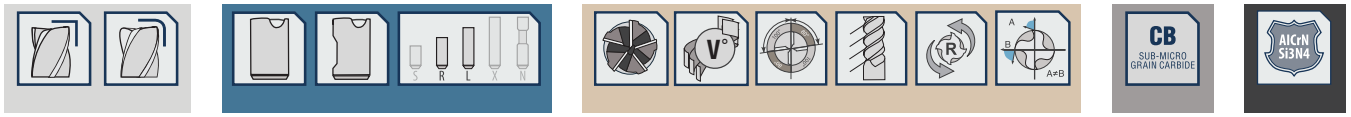
OPTIMIZED DESIGN

The design is optimized to improve rigidity, reduce harmonics, increase feed rates and leave a tight tolerance surface finish. The five flute design of our Vortex5 end mill offers a 20% increase in performance over four flute designs.

- Square end option to create sharp corners in finishing operations
- Coated for heat resistance, wear resistance and increased lubricity
- Improved tool engagement through 5 flute design creates a superior surface finish
- High strength flutes reduce edge chipping, built up edge and extends tool life



TIP & END | SHANK & LENGTH | FLUTE CONFIGURATION | MATERIAL | COATING



SERIES VX5SR - *SQUARE END, REGULAR LENGTH*

SHANK DIAMETER (D1)		CUTTER DIAMETER (D2)		FLUTE LENGTH (L2)		OVERALL LENGTH (L1)		PLAIN SHANK PART #	PLAIN SHANK EDP #	WELDON SHANK PART #	WELDON SHANK EDP #
1/8	0.125	1/8	0.125	5/8	0.625	2	2.000	VX5-0210-SQ	W201S	—	—
3/16	0.188	3/16	0.188	5/8	0.625	2	2.000	VX5-0310-SQ	W202S	—	—
1/4	0.250	1/4	0.250	7/8	0.875	2 1/2	2.500	VX5-0414-SQ	W203S	—	—
5/16	0.313	5/16	0.313	7/8	0.875	2 1/2	2.500	VX5-0514-SQ	W204S	—	—
3/8	0.375	3/8	0.375	7/8	0.875	2 1/2	2.500	VX5-0614-SQ	W205S	VX5-0614-SQ-W	W211S
7/16	0.438	7/16	0.438	1 1/8	1.125	3	3.000	VX5-0718-SQ	W206S	VX5-0718-SQ-W	W212S
1/2	0.500	1/2	0.500	1 3/8	1.375	3	3.000	VX5-0822-SQ	W207S	VX5-0822-SQ-W	W213S
5/8	0.625	5/8	0.625	1 3/8	1.375	3 1/2	3.500	VX5-1022-SQ	W208S	VX5-1022-SQ-W	W214S
3/4	0.750	3/4	0.750	1 5/8	1.625	4	4.000	VX5-1226-SQ	W209S	VX5-1226-SQ-W	W215S
1	1.000	1	1.000	1 7/8	1.875	4	4.000	VX5-1630-SQ	W210S	VX5-1630-SQ-W	W216S

SERIES VX5SL - *SQUARE END, LONG LENGTH*

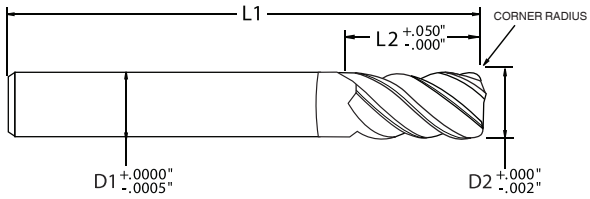
SHANK DIAMETER (D1)		CUTTER DIAMETER (D2)		FLUTE LENGTH (L2)		OVERALL LENGTH (L1)		PLAIN SHANK PART #	PLAIN SHANK EDP #	WELDON SHANK PART #	WELDON SHANK EDP #
1/8	0.125	1/8	0.125	7/8	0.875	2 1/2	2.500	VX5-0214-SQ	W301S	—	—
3/16	0.188	3/16	0.188	7/8	0.875	2 1/2	2.500	VX5-0314-SQ	W302S	—	—
1/4	0.250	1/4	0.250	1 7/8	1.875	3 1/2	3.500	VX5-0430-SQ	W303S	—	—
5/16	0.313	5/16	0.313	2 1/8	2.125	4	4.000	VX5-0534-SQ	W304S	—	—
3/8	0.375	3/8	0.375	2 1/8	2.125	4	4.000	VX5-0634-SQ	W305S	VX5-0634-SQ-W	W311S
7/16	0.438	7/16	0.438	2 1/8	2.125	4	4.000	VX5-0734-SQ	W306S	VX5-0734-SQ-W	W312S
1/2	0.500	1/2	0.500	2 5/8	2.625	5	5.000	VX5-0842-SQ	W307S	VX5-0842-SQ-W	W313S
5/8	0.625	5/8	0.625	2 5/8	2.625	5	5.000	VX5-1042-SQ	W308S	VX5-1042-SQ-W	W314S
3/4	0.750	3/4	0.750	2 5/8	2.625	5	5.000	VX5-1242-SQ	W309S	VX5-1242-SQ-W	W315S
1	1.000	1	1.000	3 3/8	3.375	6	6.000	VX5-1654-SQ	W310S	VX5-1654-SQ-W	W316S

SERIES VX5 - *CARBIDE, 5 FLUTE, ADVANCED VARIABLE GEOMETRY*

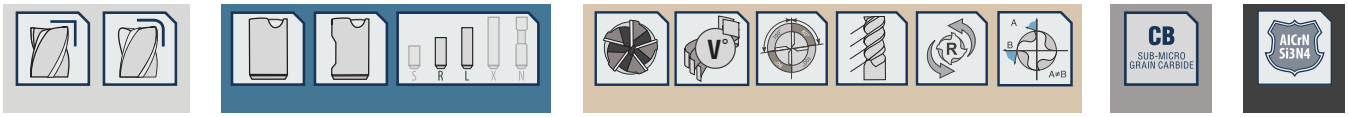
EASY MACHINING

The Vortex5 will turn any material from low carbon steel to high temp alloys, into easy materials to work with, while yielding superbly machined parts.

- Corner radius option protects corners in roughing operations and difficult to machine materials by preventing corner chipping and tool failure
- Eccentric relief for enhanced edge strength along the flutes
- Odd number of flutes reduce harmonics by staggering the entry and exit of the cutting edges
- Large core design for increased stability; higher speeds & feeds; and reduced tool deflection



TIP & END | SHANK & LENGTH | FLUTE CONFIGURATION | MATERIAL | COATINGS



SERIES VX5CR - *CORNER RADIUS, REGULAR LENGTH*

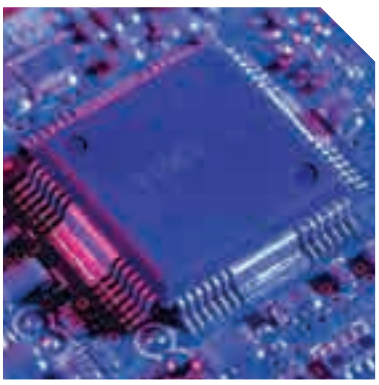
SHANK DIAMETER (D1)		CUTTER DIAMETER (D2)		FLUTE LENGTH (L2)		OVERALL LENGTH (L1)		CORNER RADIUS (R)	PLAIN SHANK PART #	PLAIN SHANK EDP #	WELDON SHANK PART #	WELDON SHANK EDP #
1/8	0.125	1/8	0.125	5/8	0.625	2	2.000	0.015	VX5-0210-R1	W2011	—	—
3/16	0.188	3/16	0.188	5/8	0.625	2	2.000	0.015	VX5-0310-R1	W2021	—	—
1/4	0.250	1/4	0.250	7/8	0.875	2 1/2	2.500	0.020	VX5-0414-R2	W2032	—	—
5/16	0.313	5/16	0.313	7/8	0.875	2 1/2	2.500	0.030	VX5-0514-R3	W2043	—	—
3/8	0.375	3/8	0.375	7/8	0.875	2 1/2	2.500	0.030	VX5-0614-R3	W2053	VX5-0614-R3-W	W2113
7/16	0.438	7/16	0.438	1 1/8	1.125	3	3.000	0.030	VX5-0718-R3	W2063	VX5-0718-R3-W	W2123
1/2	0.500	1/2	0.500	1 3/8	1.375	3	3.000	0.030	VX5-0822-R3	W2073	VX5-0822-R3-W	W2133
5/8	0.625	5/8	0.625	1 3/8	1.375	3 1/2	3.500	0.040	VX5-1022-R4	W2084	VX5-1022-R4-W	W2144
3/4	0.750	3/4	0.750	1 5/8	1.625	4	4.000	0.050	VX5-1226-R5	W2095	VX5-1226-R5-W	W2155
1	1.000	1	1.000	1 7/8	1.875	4	4.000	0.060	VX5-1630-R6	W2106	VX5-1630-R6-W	W2166

SERIES VX5CL - *CORNER RADIUS, LONG LENGTH*

SHANK DIAMETER (D1)		CUTTER DIAMETER (D2)		FLUTE LENGTH (L2)		OVERALL LENGTH (L1)		CORNER RADIUS (R)	PLAIN SHANK PART #	PLAIN SHANK EDP #	WELDON SHANK PART #	WELDON SHANK EDP #
1/8	0.125	1/8	0.125	7/8	0.875	2 1/2	2.500	0.015	VX5-0214-R1	W3011	—	—
3/16	0.188	3/16	0.188	7/8	0.875	2 1/2	2.500	0.015	VX5-0314-R1	W3021	—	—
1/4	0.250	1/4	0.250	1 7/8	1.875	3 1/2	3.500	0.020	VX5-0430-R2	W3032	—	—
5/16	0.313	5/16	0.313	2 1/8	2.125	4	4.000	0.030	VX5-0534-R3	W3043	—	—
3/8	0.375	3/8	0.375	2 1/8	2.125	4	4.000	0.030	VX5-0634-R3	W3053	VX5-0634-R3-W	W3113
7/16	0.438	7/16	0.438	2 1/8	2.125	4	4.000	0.030	VX5-0734-R3	W3063	VX5-0734-R3-W	W3123
1/2	0.500	1/2	0.500	2 5/8	2.625	5	5.000	0.030	VX5-0842-R3	W3073	VX5-0842-R3-W	W3133
5/8	0.625	5/8	0.625	2 5/8	2.625	5	5.000	0.040	VX5-1042-R4	W3084	VX5-1042-R4-W	W3144
3/4	0.750	3/4	0.750	2 5/8	2.625	5	5.000	0.050	VX5-1242-R5	W3095	VX5-1242-R5-W	W3155
1	1.000	1	1.000	3 3/8	3.375	6	6.000	0.060	VX5-1654-R6	W3106	VX5-1654-R6-W	W3166

VX5 APPLICATION GUIDE • SPEED & FEED

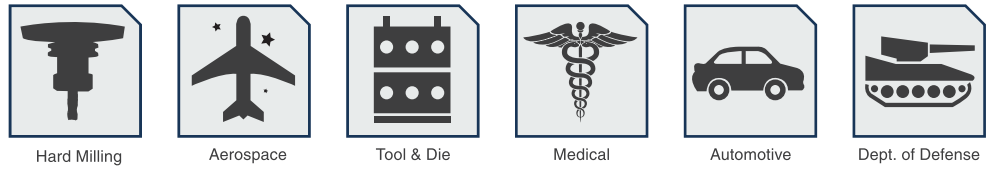
	WORK MATERIAL	TYPE OF CUT	AXIAL DOC	RADIAL DOC	NO. OF FLUTES	SPEED (SFM)	FEED (INCHES PER TOOTH) 1/8" (5 FL)	1/4" (5 FL)	3/8" (5 FL)	1/2" (5 FL)	5/8" (5 FL)	3/4" (5 FL)	1" (5 FL)
CARBON STEEL	LOW CARBON STEELS ≤ 38 HRc 10xx; 11xx; 12xx; 12Lxx, 15xx	Slotting	.5 x D	1 x D	5	330 - 375	0.0006 - 0.0008	0.0011 - 0.0015	0.0017 - 0.0023	0.0022 - 0.0030	0.0027 - 0.0037	0.0033 - 0.0045	0.0044 - 0.0060
		Roughing	1.5 x D	.3 x D	5	410 - 470	0.0008 - 0.0012	0.0014 - 0.0019	0.0021 - 0.0029	0.0028 - 0.0038	0.0034 - 0.0047	0.0042 - 0.0057	0.0055 - 0.0076
		High Effeciency (HEM)	2 x D	.15 x D	5	515 - 575	0.0008 - 0.0011	0.0014 - 0.0020	0.0021 - 0.0031	0.0027 - 0.0040	0.0033 - 0.0050	0.0041 - 0.0060	0.0054 - 0.0081
		Finishing	1.5 x D	.015 x D	5	475 - 520	0.0008 - 0.0012	0.0015 - 0.0020	0.0023 - 0.0030	0.0030 - 0.0039	0.0038 - 0.0049	0.0045 - 0.0059	0.0060 - 0.0079
	MEDIUM CARBON STEELS ≤ 38 HRc 13xx; 41xx; 43xx; 86xx, 92xx; 93xx; Chromoly	Slotting	.5 x D	1 x D	5	305 - 350	0.0006 - 0.0008	0.0010 - 0.0014	0.0016 - 0.0022	0.0020 - 0.0028	0.0024 - 0.0034	0.0030 - 0.0042	0.0040 - 0.0056
		Roughing	1.5 x D	.3 x D	5	375 - 430	0.0007 - 0.0011	0.0013 - 0.0018	0.0019 - 0.0027	0.0026 - 0.0036	0.0032 - 0.0045	0.0039 - 0.0054	0.0051 - 0.0072
		High Effeciency (HEM)	2 x D	.15 x D	5	470 - 525	0.0007 - 0.0010	0.0013 - 0.0019	0.0019 - 0.0029	0.0025 - 0.0038	0.0031 - 0.0048	0.0038 - 0.0057	0.0050 - 0.0077
		Finishing	1.5 x D	.015 x D	5	425 - 465	0.0008 - 0.0012	0.0014 - 0.0019	0.0021 - 0.0028	0.0028 - 0.0037	0.0035 - 0.0046	0.0042 - 0.0056	0.0056 - 0.0075
TOOL STEEL	TOOL & DIE STEELS ≤ 38 HRc A2; A3; D2; H11; H13; M1; O-1; S-7; NAK 55	Slotting	.5 x D	1 x D	5	320 - 365	0.0007 - 0.0009	0.0013 - 0.0017	0.0020 - 0.0026	0.0026 - 0.0034	0.0032 - 0.0042	0.0039 - 0.0051	0.0052 - 0.0068
		Roughing	1.5 x D	.3 x D	5	395 - 450	0.0008 - 0.0012	0.0015 - 0.0020	0.0022 - 0.0030	0.0030 - 0.0040	0.0037 - 0.0050	0.0045 - 0.0060	0.0059 - 0.0080
		High Effeciency (HEM)	2 x D	.15 x D	5	495 - 550	0.0008 - 0.0011	0.0015 - 0.0021	0.0022 - 0.0032	0.0029 - 0.0042	0.0036 - 0.0053	0.0044 - 0.0063	0.0058 - 0.0085
		Finishing	1.5 x D	.015 x D	5	450 - 495	0.0008 - 0.0012	0.0015 - 0.0020	0.0023 - 0.0030	0.0030 - 0.0039	0.0038 - 0.0049	0.0045 - 0.0059	0.0060 - 0.0079
	TOOL & DIE STEELS 39 to 48 HRc P20; P21; S-136; PX-5; NAK 80	Slotting	.5 x D	1 x D	5	305 - 350	0.0005 - 0.0007	0.0009 - 0.0013	0.0014 - 0.0020	0.0018 - 0.0026	0.0022 - 0.0032	0.0027 - 0.0039	0.0036 - 0.0052
		Roughing	1.5 x D	.3 x D	5	375 - 430	0.0007 - 0.0011	0.0012 - 0.0017	0.0018 - 0.0026	0.0024 - 0.0034	0.0029 - 0.0042	0.0036 - 0.0051	0.0047 - 0.0068
		High Effeciency (HEM)	2 x D	.15 x D	5	470 - 525	0.0007 - 0.0010	0.0012 - 0.0018	0.0018 - 0.0028	0.0023 - 0.0036	0.0028 - 0.0045	0.0035 - 0.0054	0.0046 - 0.0073
		Finishing	1.5 x D	.015 x D	5	425 - 465	0.0007 - 0.0011	0.0012 - 0.0017	0.0018 - 0.0025	0.0024 - 0.0033	0.0030 - 0.0041	0.0036 - 0.0050	0.0048 - 0.0067
HARDENED STEEL	HARDENED STEELS 48 to 57 HRc	Slotting	.5 x D	1 x D	5	225 - 255	0.0005 - 0.0007	0.0008 - 0.0012	0.0013 - 0.0019	0.0016 - 0.0024	0.0019 - 0.0029	0.0024 - 0.0036	0.0032 - 0.0048
		Roughing	1.5 x D	.3 x D	5	265 - 300	0.0006 - 0.0010	0.0010 - 0.0015	0.0015 - 0.0023	0.0020 - 0.0030	0.0024 - 0.0037	0.0030 - 0.0045	0.0039 - 0.0060
		High Effeciency (HEM)	2 x D	.15 x D	5	380 - 425	0.0006 - 0.0009	0.0010 - 0.0016	0.0015 - 0.0025	0.0019 - 0.0032	0.0023 - 0.0040	0.0029 - 0.0048	0.0038 - 0.0065
		Finishing	1.5 x D	.015 x D	5	330 - 360	0.0006 - 0.0010	0.0010 - 0.0015	0.0015 - 0.0022	0.0020 - 0.0029	0.0025 - 0.0036	0.0030 - 0.0044	0.0040 - 0.0059
	HARDENED STEELS 58 to 65HRc	Slotting	.5 x D	1 x D	5	225 - 255	0.0005 - 0.0007	0.0008 - 0.0012	0.0013 - 0.0019	0.0016 - 0.0024	0.0019 - 0.0029	0.0024 - 0.0036	0.0032 - 0.0048
		Roughing	1.5 x D	.3 x D	5	265 - 300	0.0006 - 0.0010	0.0010 - 0.0015	0.0015 - 0.0023	0.0020 - 0.0030	0.0024 - 0.0037	0.0030 - 0.0045	0.0039 - 0.0060
		High Effeciency (HEM)	2 x D	.15 x D	5	380 - 425	0.0006 - 0.0009	0.0010 - 0.0016	0.0015 - 0.0025	0.0019 - 0.0032	0.0023 - 0.0040	0.0029 - 0.0048	0.0038 - 0.0065
		Finishing	1.5 x D	.015 x D	5	355 - 390	0.0006 - 0.0010	0.0010 - 0.0015	0.0015 - 0.0022	0.0020 - 0.0029	0.0025 - 0.0036	0.0030 - 0.0044	0.0040 - 0.0059
STAINLESS STEEL	EASY TO MACHINE 72 - 85 HRb 410; 416; 420; 430F; 440C; 302; 303	Slotting	.5 x D	1 x D	5	305 - 350	0.0005 - 0.0007	0.0009 - 0.0013	0.0014 - 0.0020	0.0018 - 0.0026	0.0022 - 0.0032	0.0027 - 0.0039	0.0036 - 0.0052
		Roughing	1.25 x D	.3 x D	5	375 - 430	0.0007 - 0.0011	0.0012 - 0.0017	0.0018 - 0.0026	0.0024 - 0.0034	0.0029 - 0.0042	0.0036 - 0.0051	0.0047 - 0.0068
		High Effeciency (HEM)	2 x D	.15 x D	5	470 - 525	0.0007 - 0.0010	0.0012 - 0.0018	0.0018 - 0.0028	0.0023 - 0.0036	0.0028 - 0.0045	0.0035 - 0.0054	0.0046 - 0.0073
		Finishing	1.5 x D	.015 x D	5	425 - 465	0.0007 - 0.0011	0.0012 - 0.0017	0.0018 - 0.0025	0.0024 - 0.0033	0.0030 - 0.0041	0.0036 - 0.0050	0.0048 - 0.0067
	MODERATELY DIFFICULT 79 - 85 HRb; 25 - 41 HRc 304; 304L; 316; 316L; 320; 321; 347; Invar 36; Kovar	Slotting	.5 x D	1 x D	5	275 - 315	0.0006 - 0.0008	0.0011 - 0.0015	0.0017 - 0.0023	0.0022 - 0.0030	0.0027 - 0.0037	0.0033 - 0.0045	0.0044 - 0.0060
		Roughing	1.25 x D	.3 x D	5	340 - 390	0.0008 - 0.0012	0.0014 - 0.0019	0.0021 - 0.0029	0.0028 - 0.0038	0.0034 - 0.0047	0.0042 - 0.0057	0.0055 - 0.0076
		High Effeciency (HEM)	2 x D	.1 x D	5	425 - 475	0.0008 - 0.0011	0.0014 - 0.0020	0.0021 - 0.0031	0.0027 - 0.0040	0.0033 - 0.0050	0.0041 - 0.0060	0.0054 - 0.0081
		Finishing	1.5 x D	.01 x D	5	380 - 415	0.0008 - 0.0012	0.0014 - 0.0019	0.0021 - 0.0028	0.0028 - 0.0037	0.0035 - 0.0046	0.0042 - 0.0056	0.0056 - 0.0075
	DIFFICULT TO MACHINE 31 - 50 HRc 13-8 PH; 15-5 PH; 17-4 PH; Carpenter; Custo 465; Invar	Slotting	.5 x D	1 x D	5	260 - 295	0.0004 - 0.0006	0.0007 - 0.0011	0.0011 - 0.0017	0.0014 - 0.0022	0.0017 - 0.0027	0.0021 - 0.0033	0.0028 - 0.0044
		Roughing	1.25 x D	.3 x D	5	320 - 365	0.0005 - 0.0009	0.0009 - 0.0014	0.0013 - 0.0021	0.0018 - 0.0028	0.0022 - 0.0035	0.0027 - 0.0042	0.0035 - 0.0056
		High Effeciency (HEM)	1.5 x D	.1 x D	5	405 - 450	0.0005 - 0.0008	0.0009 - 0.0015	0.0013 - 0.0023	0.0017 - 0.0030	0.0021 - 0.0038	0.0026 - 0.0045	0.0034 - 0.0061
		Finishing	1.5 x D	.01 x D	5	355 - 390	0.0006 - 0.0010	0.0010 - 0.0015	0.0015 - 0.0022	0.0020 - 0.0029	0.0025 - 0.0036	0.0030 - 0.0044	0.0040 - 0.0059
CAST IRON	GRAY 100 - 200 HRb	Slotting	.5 x D	1 x D	5	320 - 365	0.0006 - 0.0008	0.0010 - 0.0014	0.0016 - 0.0022	0.0020 - 0.0028	0.0024 - 0.0034	0.0030 - 0.0042	0.0040 - 0.0056
		Roughing	1.5 x D	.3 x D	5	395 - 450	0.0007 - 0.0011	0.0013 - 0.0018	0.0019 - 0.0027	0.0026 - 0.0036	0.0032 - 0.0045	0.0039 - 0.0054	0.0051 - 0.0072
		High Effeciency (HEM)	2 x D	.15 x D	5	495 - 550	0.0007 - 0.0010	0.0013 - 0.0019	0.0019 - 0.0029	0.0025 - 0.0038	0.0031 - 0.0048	0.0038 - 0.0057	0.0050 - 0.0077
		Finishing	1.5 x D	.015 x D	5	450 - 495	0.0008 - 0.0012	0.0014 - 0.0019	0.0021 - 0.0028	0.0028 - 0.0037	0.0035 - 0.0046	0.0042 - 0.0056	0.0056 - 0.0075
	DUCTILE 150 - 300 HRb	Slotting	.5 x D	1 x D	5	305 - 350	0.0005 - 0.0007	0.0009 - 0.0013	0.0014 - 0.0020	0.0018 - 0.0026	0.0022 - 0.0032	0.0027 - 0.0039	0.0036 - 0.0052
		Roughing	1.5 x D	.3 x D	5	375 - 430	0.0006 - 0.0010	0.0011 - 0.0016	0.0016 - 0.0024	0.0022 - 0.0032	0.0027 - 0.0040	0.0033 - 0.0048	0.0043 - 0.0064
		High Effeciency (HEM)	2 x D	.15 x D	5	470 - 525	0.0006 - 0.0009	0.0011 - 0.0017	0.0016 - 0.0026	0.0021 - 0.0034	0.0026 - 0.0043	0.0032 - 0.0051	0.0042 - 0.0069
		Finishing	1.5 x D	.015 x D	5	425 - 465	0.0007 - 0.0011	0.0012 - 0.0017	0.0018 - 0.0025	0.0024 - 0.0033	0.0030 - 0.0041	0.0036 - 0.0050	0.0048 - 0.0067
	MALLEABLE 150 - 310 HRb	Slotting	.5 x D	1 x D	5	255 - 290	0.0005 - 0.0007	0.0009 - 0.0013	0.0014 - 0.0020	0.0018 - 0.0026	0.0022 - 0.0032	0.0027 - 0.0039	0.0036 - 0.0052
		Roughing	1.5 x D	.3 x D	5	295 - 335	0.0006 - 0.0010	0.0011 - 0.0016	0.0016 - 0.0024	0.0022 - 0.0032	0.0027 - 0.0040	0.0033 - 0.0048	0.0043 - 0.0064
		High Effeciency (HEM)	2 x D	.15 x D	5	425 - 475	0.0006 - 0.0009	0.0011 - 0.0017	0.0016 - 0.0026	0.0021 - 0.0034	0.0026 - 0.0043	0.0032 - 0.0051	0.0042 - 0.0069
		Finishing	1.5 x D	.015 x D	5	380 - 415	0.0007 - 0.0011	0.0012 - 0.0017	0.0018 - 0.0025	0.0024 - 0.0033	0.0030 - 0.0041	0.0036 - 0.0050	0.0048 - 0.0067
ALLOYS	TITANIUM ALLOYS 70 - 100 HRb; 25 - 36 HRc Ti61AL4V; Grades 5-38	Slotting	.5 x D	1 x D	5	240 - 275	0.0005 - 0.0007	0.0008 - 0.0012	0.0013 - 0.0019	0.0016 - 0.0024	0.0019 - 0.0029	0.0024 - 0.0036	0.0032 - 0.0048
		Roughing	1.25 x D	.3 x D	5	280 - 320	0.0006 - 0.0010	0.0010 - 0.0015	0.0015 - 0.0023	0.0020 - 0.0030	0.0024 - 0.0037	0.0030 - 0.0045	0.0039 - 0.0060
		High Effeciency (HEM)	1.5 x D	.1 x D	5	405 - 450	0.0006 - 0.0009	0.0010 - 0.0016	0.0015 - 0.0025	0.0019 - 0.0032	0.0023 - 0.0040	0.0029 - 0.0048	0.0038 - 0.0065
		Finishing	1.5 x D	.01 x D	5	355 - 390	0.0006 - 0.0010	0.0010 - 0.0015	0.0015 - 0.0022	0.0020 - 0.0029	0.0025 - 0.0036	0.0030 - 0.0044	0.0040 - 0.0059
	HIGH TEMP ALLOYS 83 - 99 HRb; 30 - 52 HRc Inconel; Monel; A286; Rene; Stelite; Haynes; Waspalloy; Hastalloy; etc	Slotting	.25 x D	1 x D	5	70 - 80	0.0005 - 0.0007	0.0008 - 0.0012	0.0013 - 0.0019	0.0016 - 0.0024	0.0019 - 0.0029	0.0024 - 0.0036	0.0032 - 0.0048
		Roughing	1.25 x D	.25 x D	5	90 - 100	0.0006 - 0.0010	0.0011 - 0.0016	0.0016 - 0.0024	0.0022 - 0.0032	0.0027 - 0.0040	0.0033 - 0.0048	0.0043 - 0.0064
		High Effeciency (HEM)	1.5 x D	.1 x D	5	225 - 250	0.0006 - 0.0009	0.0011 - 0.0017	0.0016 - 0.0026	0.0021 - 0.0034	0.0026 - 0.0043	0.0032 - 0.0051	0.0042 - 0.0069
		Finishing	1.5 x D	.01 x D	5	115 - 125	0.0007 - 0.0011	0.0013 - 0.0018	0.0020 - 0.0027	0.0026 - 0.0035	0.0033 - 0.0044	0.0039 - 0.0053	0.0052 - 0.0071



OUR INDUSTRIES

The original tapered end mill manufacturer, Conical Tool's industry expertise runs deep and we have maintained exceptional relationships with some of the world's largest companies. Our commitment to the industry as hands-on technical experts cross many sectors and geographies. Our 70 year history coupled with analytical, innovative thinking allows us to provide our customers with the most practical and efficient solutions to their tooling needs.

Our industry foresight is based on identifying the key issues our customers face, and developing rigorous programs to provide the most appropriate and beneficial solutions. These are only a small percentage of the industries we serve, contact us today for more information and to find out what we can do for you.



NEARLY 7,000 DISTRIBUTORS WORLDWIDE & HUNDREDS OF THOUSANDS OF END USERS CAN'T BE WRONG

The manufacturing and materials industry is changing at an unprecedented pace and simply saying we supply tools to the metalworking industry would leave out a large portion of our customer base. Our tools have been used in every application imaginable, from sculptural ice carving to precision manufacturing of custom nuclear reactor parts.

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CYCLONE MX™

HIGH FEED & HIGH HARDNESS MILLING

UNMATCHED ABILITY

The Cyclone MX is a natural choice, for any ferrous or high hardness material milling, where increased feed rates are desired. Its staged, multi-flute design and AlTiN/Si3N4 Nano coating, gives you the aggressive cutting needed for hardened tool steels, stainless steels, high temp alloys and titanium.

When searching for an end mill with unmatched performance, search no more. The unique design balances tool engagement and chip evacuation to dramatically improve machine times and tool life.

Market demands continually shorten lead times and increase quality expectations for customers in the metalworking industry. The importance of doing the job right and doing it fast was the focus of the Cyclone MX's design. Engineered for precision machining of hard and difficult to machine materials, while minimizing tool deflection and taking heavy cuts, the Cyclone MX simply performs.

END MILL PIONEERS

We have been filing patents and manufacturing end mills for worldwide distribution since the 1940's. New inventions of the 1970's increased production levels to meet the demands of the global marketplace, but we kept innovating, essentially creating the first CNC machine process capable of grinding complex shapes. Our innovations are still being employed today, as the most effective methods know in the industry.

Global Cutting Tools
Conical Tool Company

3890 Buchanan Ave SW
Grand Rapids, MI 49548

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HIGH PERFORMANCE END MILLS

FOR AGGRESSIVE MACHINING OF FERROUS AND HARDENED MATERIALS

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CYCLONE MX™

HIGH FEED & HIGH HARDNESS MILLING

AGRESSIVE MACHINING

OF FERROUS & HARDENED MATERIALS

FEATURES & BENEFITS

The Cyclone MX exceeds at milling difficult to machine materials. The massive core increases stability and reduces tool deflection, while the rugged high strength six and eight flute design, maximizes the relationship between flute engagement and chip evacuation. Engineered with an advanced variable geometry, the Cyclone MX performs high speed, high efficiency machining of light to medium cuts. Its versatility allows the tool to be used either wet or dry.

General Inquiries:
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GLOBAL™ CUTTING TOOLS

SERIES: CMX

For high performance milling of difficult to machine materials to improve chip evacuation while light to medium roughing or finishing; wet or dry; hardened tool steel > 48 HRc; stainless steel; high temp alloys; and titanium < 65HRc.

Square end option to create sharp corners in finishing operations

Coated for heat resistance, wear resistance and increased lubricity

Improved tool stability through multi-flute flute design keeps more cutting edges engaged, creating a superior surface finish

High helix angle reduces cutting forces by creating a higher shearing plane for better efficiencies, chip management and longer tool life

High strength flutes reduce edge chipping, built up edge and extends tool life

Corner radius protects corners during tool entry and roughing operations in difficult to machine materials by preventing corner chipping and tool failure

Engineered flute relief allows for superior chip evacuation without compromising flute integrity

Reduced neck option increases stability and reduces tool deflection while maintaining overall reach

Premium micro-grain carbide substrate resists chipping, tool deflection, and has a high transverse rupture strength for greater feeds and speeds

Edge prep drag finishing increases tool life by improving the surface quality in the flute and radiusing the cutting edge of the tool, reducing the potential for premature failure

Post polishing is performed after the tools are coated to remove surface inconsistencies and increase lubricity. This also increases feed rates and allows for smoother operations. The tool runs cooler and performs longer

TIP & END

SHANK & LENGTH

FLUTE CONFIGURATION

MATERIAL

COATING

RESULTS

At the end of the day, you will have relied on the quality of the tool to do the work for you and maintain profitability. The Cyclone MX ensures reductions in edge chipping, built up edge and guarantees extended tool life. A higher helix angle reduces cutting forces by creating a higher shearing plane, which again results in efficiencies and even longer tool life. The advantage of using a few quality end mills, instead of many less expensive ones, is more than just added profit; its quality you can trust.

Series CMX: Micro-Grain Carbide, 6 & 8 Flute, Advanced Variable Geometry, AlTiN/Si3N4
Coated SubSeries: CMXSR, CMXSL, CMXSN, CMXCR, CMXCL, CMXCN
Configuration: Varying Diameters; Regular, Long, Extra-Long and Reduced Neck Lengths; 44/45/46° Variable Helix; Square End & Corner Radius

CYCLONE MX

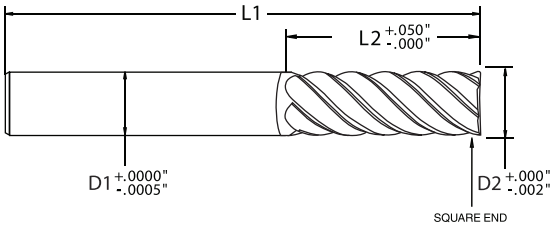
GLOBAL™

SERIES CMX - *CARBIDE, 6 & 8 FLUTE, 44/45/46° VARIABLE HELIX*

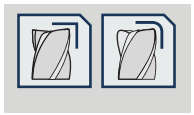
AGGRESIVE CUTTING

The Cyclone MX has a staged, multi-flute design and AlTiN/Si3N4 coating, to give you the aggressive cutting needed for hardened tool steels, stainless steels, high temp alloys and titanium.

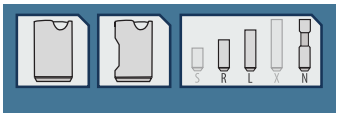
- Square end option to create sharp corners in finishing operations
- Coated for heat resistance, wear resistance and increased lubricity
- Improved tool stability through multi-flute flute design keeps more cutting edges engaged, creating a superior surface finish
- High helix angle reduces cutting forces by creating a higher shearing plane for better efficiencies, chip management and longer tool life



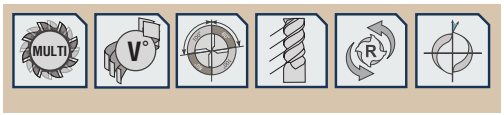
TIP & END



SHANK & LENGTH



FLUTE CONFIGURATION



MATERIAL

COATING

SERIES CMXSR - *SQUARE END, REGULAR LENGTH*

SHANK DIAMETER (D1)		CUTTER DIAMETER (D2)		FLUTE LENGTH (L2)		OVERALL LENGTH (L1)		# OF FLUTES	PLAIN SHANK PART #	PLAIN SHANK EDP #	WELDON SHANK PART #	WELDON SHANK EDP #
1/8	0.125	1/8	0.125	5/8	0.625	2 1/2	2.500	6	CMX-0210-SQ	C201S	—	—
3/16	0.188	3/16	0.188	5/8	0.625	2 1/2	2.500	6	CMX-0310-SQ	C202S	—	—
1/4	0.250	1/4	0.250	5/8	0.625	2 1/2	2.500	6	CMX-0410-SQ	C203S	—	—
5/16	0.313	5/16	0.313	7/8	0.875	3	3.000	6	CMX-0514-SQ	C204S	—	—
3/8	0.375	3/8	0.375	5/8	0.625	2 1/2	2.500	6	CMX-0610-SQ	C205S	CMX-0610-SQ-W	C214S
				7/8	0.875	3	3.000	6	CMX-0614-SQ	C206S	CMX-0614-SQ-W	C215S
7/16	0.438	7/16	0.438	1 1/8	1.125	3	3.000	6	CMX-0718-SQ	C207S	CMX-0718-SQ-W	C216S
1/2	0.500	1/2	0.500	7/8	0.875	3 1/2	3.500	6	CMX-0814-SQ	C208S	CMX-0814-SQ-W	C217S
				1 3/8	1.375	3 1/2	3.500	6	CMX-0822-SQ	C209S	CMX-0822-SQ-W	C218S
5/8	0.625	5/8	0.625	7/8	0.875	3	3.000	6	CMX-1014-SQ	C210S	CMX-1014-SQ-W	C219S
				1 3/8	1.375	3 1/2	3.500	6	CMX-1022-SQ	C211S	CMX-1022-SQ-W	C220S
3/4	0.750	3/4	0.750	1 5/8	1.625	4	4.000	8	CMX-1226-SQ	C212S	CMX-1226-SQ-W	C221S
1	1.000	1	1.000	1 7/8	1.875	4	4.000	8	CMX-1630-SQ	C213S	CMX-1630-SQ-W	C222S

SERIES CMXSL - *SQUARE END, LONG LENGTH*

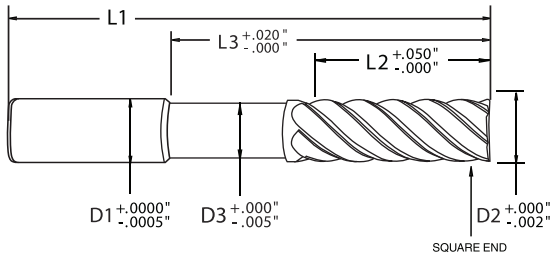
SHANK DIAMETER (D1)		CUTTER DIAMETER (D2)		FLUTE LENGTH (L2)		OVERALL LENGTH (L1)		# OF FLUTES	PLAIN SHANK PART #	PLAIN SHANK EDP #	WELDON SHANK PART #	WELDON SHANK EDP #
1/8	0.125	1/8	0.125	7/8	0.875	3	3.000	6	CMX-0214-SQ	C301S	—	—
3/16	0.188	3/16	0.188	7/8	0.875	3	3.000	6	CMX-0314-SQ	C302S	—	—
1/4	0.250	1/4	0.250	1 1/8	1.125	4	4.000	6	CMX-0418-SQ	C303S	—	—
5/16	0.313	5/16	0.313	1 5/8	1.625	4	4.000	6	CMX-0526-SQ	C304S	—	—
3/8	0.375	3/8	0.375	1 7/8	1.875	4	4.000	6	CMX-0630-SQ	C305S	CMX-0630-SQ-W	C313S
7/16	0.438	7/16	0.438	2 1/8	2.125	4	4.000	6	CMX-0734-SQ	C306S	CMX-0734-SQ-W	C314S
1/2	0.500	1/2	0.500	2 1/8	2.125	4	4.000	6	CMX-0834-SQ	C307S	CMX-0834-SQ-W	C315S
5/8	0.625	5/8	0.625	2 5/8	2.625	5	5.000	6	CMX-1042-SQ	C308S	CMX-1042-SQ-W	C316S
3/4	0.750	3/4	0.750	2 5/8	2.625	5	5.000	8	CMX-1242-SQ	C309S	CMX-1242-SQ-W	C317S
				3 3/8	3.375	6	6.000	8	CMX-1254-SQ	C310S	CMX-1254-SQ-W	C318S
				4 3/8	4.375	7	7.000	8	CMX-1270-SQ	C311S	CMX-1270-SQ-W	C319S
1	1.000	1	1.000	4 3/8	4.375	7	7.000	8	CMX-1670-SQ	C312S	CMX-1670-SQ-W	C320S

SERIES CMX - *CARBIDE, 6 & 8 FLUTE, 44/45/46° VARIABLE HELIX*

UNMATCHED PERFORMANCE

When searching for an end mill with unmatched performance, search no more. The unique design balances tool engagement and chip evacuation to dramatically improve machine times and tool life.

- Reduced neck option increases stability and reduces tool deflection while maintaining overall reach
- High strength flutes reduce edge chipping, built up edge and extends tool life
- Engineered flute relief allows for superior chip evacuation without compromising flute integrity



TIP & END | SHANK & LENGTH | FLUTE CONFIGURATION | MATERIAL | COATING

SERIES CMXSN - *SQUARE END, REDUCED NECK*

SHANK DIAMETER (D1)		CUTTER DIAMETER (D2)		FLUTE LENGTH (L2)		OVERALL LENGTH (L1)		NECK LBS (L3)		NECK DIAMETER (D3)	# OF FLUTES	PLAIN SHANK PART #	PLAIN SHANK EDP #	WELDON SHANK PART #	WELDON SHANK EDP #
1/8	0.125	1/8	0.125	1/4	0.250	2	2.000	1/2	0.500	0.118	6	CMX-0204-RN1-SQ	C501S	—	—
						3	3.000	1 1/2	1.500			CMX-0204-RN2-SQ	C502S	—	—
3/16	0.188	3/16	0.188	5/16	0.313	2	2.000	9/16	0.563	0.176		CMX-0305-RN1-SQ	C503S	—	—
						3	3.000	1 9/16	1.563			CMX-0305-RN2-SQ	C504S	—	—
1/4	0.250	1/4	0.250	3/8	0.375	2 1/2	2.500	1 1/8	1.125	0.235		CMX-0406-RN1-SQ	C505S	—	—
						3 1/2	3.500	2 1/8	2.125			CMX-0406-RN2-SQ	C506S	—	—
5/16	0.313	5/16	0.313	1/2	0.500	3	3.000	1 1/8	1.125	0.298		CMX-0508-RN1-SQ	C507S	—	—
						4	4.000	2 1/8	2.125			CMX-0508-RN2-SQ	C508S	—	—
3/8	0.375	3/8	0.375	1/2	0.500	3	3.000	1 1/8	1.125	0.355		CMX-0608-RN1-SQ	C509S	CMX-0608-RN1-SQ-W	C521S
						4	4.000	2 1/8	2.125			CMX-0608-RN2-SQ	C510S	CMX-0608-RN2-SQ-W	C522S
7/16	0.438	7/16	0.438	5/8	0.625	3	3.000	1 3/8	1.375	0.418		CMX-0710-RN1-SQ	C511S	CMX-0710-RN1-SQ-W	C523S
						4	4.000	2 3/8	2.375			CMX-0710-RN2-SQ	C512S	CMX-0710-RN2-SQ-W	C524S
1/2	0.500	1/2	0.500	5/8	0.625	3 1/2	3.500	1 3/8	1.375	0.475		CMX-0810-RN1-SQ	C513S	CMX-0810-RN1-SQ-W	C525S
						4 1/2	4.500	2 3/8	2.375			CMX-0810-RN2-SQ	C514S	CMX-0810-RN2-SQ-W	C526S
5/8	0.625	5/8	0.625	3/4	0.750	3 1/2	3.500	1 1/2	1.500	0.590		CMX-1012-RN1-SQ	C515S	CMX-1012-RN1-SQ-W	C527S
						5	5.000	2 1/2	2.500			CMX-1012-RN2-SQ	C516S	CMX-1012-RN2-SQ-W	C528S
3/4	0.750	3/4	0.750	1	1.000	4	4.000	1 3/4	1.750	0.715	8	CMX-1216-RN1-SQ	C517S	CMX-1216-RN1-SQ-W	C529S
						5	5.000	2 3/4	2.750			CMX-1216-RN2-SQ	C518S	CMX-1216-RN2-SQ-W	C530S
						6	6.000	3 3/4	3.750			CMX-1216-RN3-SQ	C519S	CMX-1216-RN3-SQ-W	C533S
1	1.000	1	1.000	1 1/8	1.125	4	4.000	1 7/8	1.875	0.960		CMX-1618-RN1-SQ	C519S	CMX-1618-RN1-SQ-W	C531S
						5	5.000	2 7/8	2.875			CMX-1618-RN2-SQ	C520S	CMX-1618-RN2-SQ-W	C532S
						6	6.000	3 7/8	3.875			CMX-1618-RN3-SQ	C522S	CMX-1618-RN3-SQ-W	C536S

CYCLONE MX

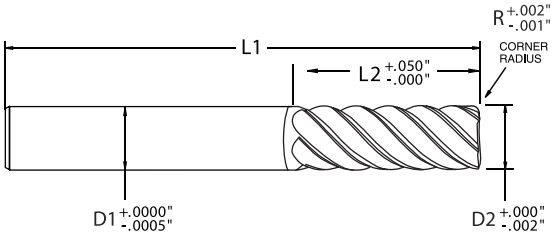
GLOBAL™

SERIES CMX - *CARBIDE, 6 & 8 FLUTE, 44/45/46° VARIABLE HELIX*

PRECISION MACHINING

Engineered for precision machining of hard and difficult to machine materials, while minimizing tool deflection and taking heavy cuts, the Cyclone MX simply performs.

- Corner radius protects corners during tool entry and roughing operations in difficult to machine materials by preventing corner chipping and tool failure
- Premium micro-grain carbide substrate resists chipping, tool deflection, and has a high transverse rupture strength for greater feeds and speeds
- Large core design for increased stability; higher speeds & feeds; and reduced tool deflection in difficult to machine materials



TIP & END | SHANK & LENGTH | FLUTE CONFIGURATION | MATERIAL | COATING

SERIES CMXCR - *CORNER RADIUS, REGULAR LENGTH*

SHANK DIAMETER (D1)		CUTTER DIAMETER (D2)		FLUTE LENGTH (L2)		OVERALL LENGTH (L1)		# OF FLUTES	CORNER RADIUS (R)	PLAIN SHANK PART #	PLAIN SHANK EDP #	WELDON SHANK PART #	WELDON SHANK EDP #
1/8	0.125	1/8	0.125	5/8	0.625	2 1/2	2.500	6	0.015	CMX-0210-R1	C2011	—	—
3/16	0.188	3/16	0.188	5/8	0.625	2 1/2	2.500	6	0.015	CMX-0310-R1	C2021	—	—
1/4	0.250	1/4	0.250	5/8	0.625	2 1/2	2.500	6	0.020	CMX-0410-R2	C2032	—	—
5/16	0.313	5/16	0.313	7/8	0.875	3	3.000	6	0.030	CMX-0514-R3	C2043	—	—
3/8	0.375	3/8	0.375	5/8	0.625	2 1/2	2.500	6	0.030	CMX-0610-R3	C2053	CMX-0610-R3-W	C2143
				7/8	0.875	3	3.000	6	0.030	CMX-0614-R3	C2063	CMX-0614-R3-W	C2153
7/16	0.438	7/16	0.438	1 1/8	1.125	3	3.000	6	0.030	CMX-0718-R3	C2073	CMX-0718-R3-W	C2163
1/2	0.500	1/2	0.500	7/8	0.875	3 1/2	3.500	6	0.030	CMX-0814-R3	C2083	CMX-0814-R3-W	C2173
				1 3/8	1.375	3 1/2	3.500	6	0.030	CMX-0822-R3	C2093	CMX-0822-R3-W	C2183
5/8	0.625	5/8	0.625	7/8	0.875	3	3.000	6	0.040	CMX-1014-R4	C2104	CMX-1014-R4-W	C2194
				1 3/8	1.375	3 1/2	3.500	6	0.040	CMX-1022-R4	C2114	CMX-1022-R4-W	C2204
3/4	0.750	3/4	0.750	1 5/8	1.625	4	4.000	8	0.050	CMX-1226-R5	C2125	CMX-1226-R5-W	C2215
1	1.000	1	1.000	1 7/8	1.875	4	4.000	8	0.060	CMX-1630-R6	C2136	CMX-1630-R6-W	C2226

SERIES CMXCL - *CORNER RADIUS, LONG LENGTH*

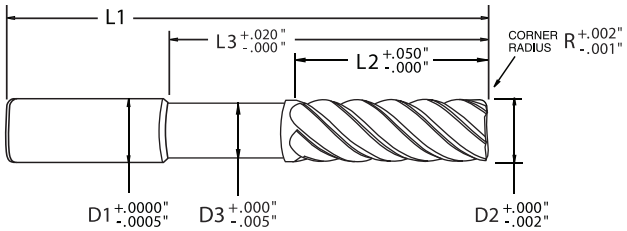
SHANK DIAMETER (D1)		CUTTER DIAMETER (D2)		FLUTE LENGTH (L2)		OVERALL LENGTH (L1)		# OF FLUTES	CORNER RADIUS (R)	PLAIN SHANK PART #	PLAIN SHANK EDP #	WELDON SHANK PART #	WELDON SHANK EDP #
1/8	0.125	1/8	0.125	7/8	0.875	3	3.000	6	0.015	CMX-0214-R1	C3011	—	—
3/16	0.188	3/16	0.188	7/8	0.875	3	3.000	6	0.015	CMX-0314-R1	C3021	—	—
1/4	0.250	1/4	0.250	1 1/8	1.125	4	4.000	6	0.020	CMX-0418-R2	C3032	—	—
5/16	0.313	5/16	0.313	1 5/8	1.625	4	4.000	6	0.030	CMX-0526-R3	C3043	—	—
3/8	0.375	3/8	0.375	1 7/8	1.875	4	4.000	6	0.030	CMX-0630-R3	C3053	CMX-0630-R3-W	C3133
7/16	0.438	7/16	0.438	2 1/8	2.125	4	4.000	6	0.030	CMX-0734-R3	C3063	CMX-0734-R3-W	C3143
1/2	0.500	1/2	0.500	2 1/8	2.125	4	4.000	6	0.030	CMX-0834-R3	C3073	CMX-0834-R3-W	C3153
5/8	0.625	5/8	0.625	2 5/8	2.625	5	5.000	6	0.040	CMX-1042-R4	C3084	CMX-1042-R4-W	C3164
3/4	0.750	3/4	0.750	2 5/8	2.625	5	5.000	8	0.050	CMX-1242-R5	C3095	CMX-1242-R5-W	C3175
				3 3/8	3.375	6	6.000	8	0.050	CMX-1254-R5	C3105	CMX-1254-R5-W	C3185
				4 3/8	4.375	7	7.000	8	0.050	CMX-1270-R5	C3115	CMX-1270-R5-W	C3195
1	1.000	1	1.000	4 3/8	4.375	7	7.000	8	0.060	CMX-1670-R6	C3126	CMX-1670-R6-W	C3206

SERIES CMX - *CARBIDE, 6 & 8 FLUTE, 44/45/46° VARIABLE HELIX*

INCREASED STABILITY

The massive core increases stability and reduces tool deflection, while the rugged high strength six and eight flute design, maximizes the relationship between flute engagement and chip evacuation.

- Reduced neck option increases stability and reduces tool deflection while maintaining overall reach
- High strength flutes reduce edge chipping, built up edge and extends tool life
- Engineered flute relief allows for superior chip evacuation without compromising flute integrity



TIP & END | SHANK & LENGTH | FLUTE CONFIGURATION | MATERIAL | COATING

SERIES CMXCN - *CORNER RADIUS, REDUCED NECK*

SHANK DIAMETER (D1)	CUTTER DIAMETER (D2)	FLUTE LENGTH (L2)	OVERALL LENGTH (L1)	NECK LBS (L3)	NECK DIAMETER (L3)	# OF FLUTES	CORNER RADIUS (R)	PLAIN SHANK PART #	PLAIN SHANK EDP #	WELDON SHANK PART #	WELDON SHANK EDP #
1/8 0.125	1/8 0.125	1/4 0.250	2 2.000	1/2 0.500	0.118	6	0.015	CMX-0204-RN1-R1	C5011	—	—
			3 3.000	1 1/2 1.500				CMX-0204-RN2-R1	C5021	—	—
3/16 0.188	3/16 0.188	5/16 0.313	2 2.000	9/16 0.563	0.176		0.015	CMX-0305-RN1-R1	C5031	—	—
			3 3.000	1 9/16 1.563				CMX-0305-RN2-R1	C5041	—	—
1/4 0.250	1/4 0.250	3/8 0.375	2 1/2 2.500	1 1/8 1.125	0.235		0.020	CMX-0406-RN1-R2	C5052	—	—
			3 1/2 3.500	2 1/8 2.125				CMX-0406-RN2-R2	C5062	—	—
5/16 0.313	5/16 0.313	1/2 0.500	3 3.000	1 1/8 1.125	0.298		0.030	CMX-0508-RN1-R3	C5073	—	—
			4 4.000	2 1/8 2.125				CMX-0508-RN2-R3	C5083	—	—
3/8 0.375	3/8 0.375	1/2 0.500	3 3.000	1 1/8 1.125	0.355		0.030	CMX-0608-RN1-R3	C5093	CMX-0608-RN1-R3-W	C5213
			4 4.000	2 1/8 2.125				CMX-0608-RN2-R3	C5103	CMX-0608-RN2-R3-W	C5223
7/16 0.438	7/16 0.438	5/8 0.625	3 3.000	1 3/8 1.375	0.418		0.030	CMX-0710-RN1-R3	C5113	CMX-0710-RN1-R3-W	C5233
			4 4.000	2 3/8 2.375				CMX-0710-RN2-R3	C5123	CMX-0710-RN2-R3-W	C5243
1/2 0.500	1/2 0.500	5/8 0.625	3 1/2 3.500	1 3/8 1.375	0.475		0.030	CMX-0810-RN1-R3	C5133	CMX-0810-RN1-R3-W	C5253
			4 1/2 4.500	2 3/8 2.375				CMX-0810-RN2-R3	C5143	CMX-0810-RN2-R3-W	C5263
5/8 0.625	5/8 0.625	3/4 0.750	3 1/2 3.500	1 1/2 1.500	0.590		0.040	CMX-1012-RN1-R4	C5154	CMX-1012-RN1-R4-W	C5274
			5 5.000	2 1/2 2.500				CMX-1012-RN2-R4	C5164	CMX-1012-RN2-R4-W	C5284
3/4 0.750	3/4 0.750	1 1.000	4 4.000	1 3/4 1.750	0.715	8	0.050	CMX-1216-RN1-R5	C5175	CMX-1216-RN1-R5-W	C5295
			5 5.000	2 3/4 2.750				CMX-1216-RN2-R5	C5185	CMX-1216-RN2-R5-W	C5305
			6 6.000	3 3/4 3.750				CMX-1216-RN3-R5	C5195	CMX-1216-RN3-R5-W	C5335
1 1.000	1 1.000	1 1/8 1.125	4 4.000	1 7/8 1.875	0.960		0.060	CMX-1618-RN1-R6	C5196	CMX-1618-RN1-R6-W	C5316
			5 5.000	2 7/8 2.875				CMX-1618-RN2-R6	C5206	CMX-1618-RN2-R6-W	C5326
			6 6.000	3 7/8 3.875				CMX-1618-RN3-R6	C5226	CMX-1618-RN3-R6-W	C5366

CMX APPLICATION GUIDE • SPEEDS & FEEDS

	WORK MATERIAL	TYPE OF CUT	AXIAL DOC	RADIAL DOC	NO. OF FLUTES	SPEED (SFM)	FEED (INCHES PER TOOTH) 1/8" (6 FL)	1/4" (6 FL)	3/8" (6 FL)	1/2" (6 FL)	5/8" (6 FL)	3/4" (8 FL)	1" (8 FL)
CARBON STEEL	LOW CARBON STEELS ≤ 38 HRc 10xx; 11xx; 12xx; 12Lxx, 15xx	Slotting	1 x D	1 x D	6 / 8	255 - 290	0.0005 - 0.0007	0.0009 - 0.0013	0.0014 - 0.0020	0.0018 - 0.0026	0.0022 - 0.0032	0.0027 - 0.0039	0.0036 - 0.0052
		Roughing	1.5 x D	.5 x D	6 / 8	295 - 335	0.0006 - 0.0010	0.0011 - 0.0016	0.0016 - 0.0024	0.0022 - 0.0032	0.0027 - 0.0040	0.0033 - 0.0048	0.0043 - 0.0064
		High Effeciency (HEM)	2 x D	.2 x D	6 / 8	425 - 475	0.0009 - 0.0012	0.0017 - 0.0023	0.0025 - 0.0035	0.0033 - 0.0046	0.0041 - 0.0058	0.0050 - 0.0069	0.0066 - 0.0093
		Finishing	1.5 x D	.015 x D	6 / 8	400 - 440	0.0008 - 0.0012	0.0015 - 0.0020	0.0023 - 0.0030	0.0030 - 0.0039	0.0038 - 0.0049	0.0045 - 0.0059	0.0060 - 0.0079
	MEDIUM CARBON STEELS ≤ 38 HRc 13xx; 41xx; 43xx; 86xx, 92xx; 93xx; Chromoly	Slotting	1 x D	1 x D	6 / 8	260 - 295	0.0005 - 0.0007	0.0009 - 0.0013	0.0014 - 0.0020	0.0018 - 0.0026	0.0022 - 0.0032	0.0027 - 0.0039	0.0036 - 0.0052
		Roughing	1.5 x D	.5 x D	6 / 8	280 - 320	0.0006 - 0.0010	0.0011 - 0.0016	0.0016 - 0.0024	0.0022 - 0.0032	0.0027 - 0.0040	0.0033 - 0.0048	0.0043 - 0.0064
		High Effeciency (HEM)	2 x D	.2 x D	6 / 8	405 - 450	0.0009 - 0.0012	0.0017 - 0.0023	0.0025 - 0.0035	0.0033 - 0.0046	0.0041 - 0.0058	0.0050 - 0.0069	0.0066 - 0.0093
		Finishing	1.5 x D	.015 x D	6 / 8	380 - 415	0.0008 - 0.0012	0.0015 - 0.0020	0.0023 - 0.0030	0.0030 - 0.0039	0.0038 - 0.0049	0.0045 - 0.0059	0.0060 - 0.0079
TOOL STEEL	TOOL & DIE STEELS ≤ 38 HRc A2; A3; D2; H11; H13; M1; O-1; S-7; NAK 55	Slotting	1 x D	1 x D	6 / 8	200 - 230	0.0006 - 0.0008	0.0010 - 0.0014	0.0016 - 0.0022	0.0020 - 0.0028	0.0024 - 0.0034	0.0030 - 0.0042	0.0040 - 0.0056
		Roughing	1.5 x D	.5 x D	6 / 8	335 - 385	0.0006 - 0.0010	0.0011 - 0.0016	0.0016 - 0.0024	0.0022 - 0.0032	0.0027 - 0.0040	0.0033 - 0.0048	0.0043 - 0.0064
		High Effeciency (HEM)	2 x D	.2 x D	6 / 8	450 - 500	0.0009 - 0.0012	0.0017 - 0.0023	0.0025 - 0.0035	0.0033 - 0.0046	0.0041 - 0.0058	0.0050 - 0.0069	0.0066 - 0.0093
		Finishing	1.5 x D	.015 x D	6 / 8	425 - 465	0.0008 - 0.0012	0.0015 - 0.0020	0.0023 - 0.0030	0.0030 - 0.0039	0.0038 - 0.0049	0.0045 - 0.0059	0.0060 - 0.0079
	TOOL & DIE STEELS 39 to 48 HRc P20; P21; S-136; PX-5; NAK 80	Slotting	.75 x D	1 x D	6 / 8	190 - 215	0.0005 - 0.0007	0.0009 - 0.0013	0.0014 - 0.0020	0.0018 - 0.0026	0.0022 - 0.0032	0.0027 - 0.0039	0.0036 - 0.0052
		Roughing	1.5 x D	.3 x D	6 / 8	295 - 335	0.0006 - 0.0010	0.0011 - 0.0016	0.0016 - 0.0024	0.0022 - 0.0032	0.0027 - 0.0040	0.0033 - 0.0048	0.0043 - 0.0064
		High Effeciency (HEM)	2 x D	.15 x D	6 / 8	425 - 475	0.0008 - 0.0011	0.0015 - 0.0021	0.0022 - 0.0032	0.0029 - 0.0042	0.0036 - 0.0053	0.0044 - 0.0063	0.0058 - 0.0085
		Finishing	1.5 x D	.015 x D	6 / 8	400 - 440	0.0007 - 0.0011	0.0013 - 0.0018	0.0020 - 0.0027	0.0026 - 0.0035	0.0033 - 0.0044	0.0039 - 0.0053	0.0052 - 0.0071
HARDENED STEEL	HARDENED STEELS 48 to 57 HRc	Slotting	1 x D	1 x D	6 / 8	100 - 115	0.0004 - 0.0006	0.0007 - 0.0011	0.0011 - 0.0017	0.0014 - 0.0022	0.0017 - 0.0027	0.0021 - 0.0033	0.0028 - 0.0044
		Roughing	1.5 x D	.5 x D	6 / 8	170 - 195	0.0005 - 0.0009	0.0009 - 0.0014	0.0013 - 0.0021	0.0018 - 0.0028	0.0022 - 0.0035	0.0027 - 0.0042	0.0035 - 0.0056
		High Effeciency (HEM)	2 x D	.2 x D	6 / 8	345 - 385	0.0006 - 0.0009	0.0011 - 0.0017	0.0016 - 0.0026	0.0021 - 0.0034	0.0026 - 0.0043	0.0032 - 0.0051	0.0042 - 0.0069
		Finishing	1.5 x D	.015 x D	6 / 8	330 - 360	0.0005 - 0.0009	0.0009 - 0.0014	0.0014 - 0.0021	0.0018 - 0.0027	0.0023 - 0.0034	0.0027 - 0.0041	0.0036 - 0.0055
	HARDENED STEELS 58 to 65HRc	Slotting	.75 x D	1 x D	6 / 8	90 - 100	0.0004 - 0.0006	0.0007 - 0.0011	0.0011 - 0.0017	0.0014 - 0.0022	0.0017 - 0.0027	0.0021 - 0.0033	0.0028 - 0.0044
		Roughing	1.5 x D	.3 x D	6 / 8	160 - 180	0.0005 - 0.0009	0.0009 - 0.0014	0.0013 - 0.0021	0.0018 - 0.0028	0.0022 - 0.0035	0.0027 - 0.0042	0.0035 - 0.0056
		High Effeciency (HEM)	2 x D	.15 x D	6 / 8	365 - 410	0.0005 - 0.0008	0.0009 - 0.0015	0.0013 - 0.0023	0.0017 - 0.0030	0.0021 - 0.0038	0.0026 - 0.0045	0.0034 - 0.0061
		Finishing	1.5 x D	.015 x D	6 / 8	330 - 360	0.0005 - 0.0009	0.0009 - 0.0014	0.0014 - 0.0021	0.0018 - 0.0027	0.0023 - 0.0034	0.0027 - 0.0041	0.0036 - 0.0055
STAINLESS STEEL	EASY TO MACHINE 72 - 85 HRb 410; 416; 420; 430F; 440C; 302; 303	Slotting	.75 x D	1 x D	6 / 8	190 - 215	0.0004 - 0.0006	0.0007 - 0.0011	0.0011 - 0.0017	0.0014 - 0.0022	0.0017 - 0.0027	0.0021 - 0.0033	0.0028 - 0.0044
		Roughing	1.25 x D	.3 x D	6 / 8	265 - 300	0.0005 - 0.0009	0.0009 - 0.0014	0.0013 - 0.0021	0.0018 - 0.0028	0.0022 - 0.0035	0.0027 - 0.0042	0.0035 - 0.0056
		High Effeciency (HEM)	2 x D	.15 x D	6 / 8	410 - 460	0.0006 - 0.0009	0.0011 - 0.0017	0.0016 - 0.0026	0.0021 - 0.0034	0.0026 - 0.0043	0.0032 - 0.0051	0.0042 - 0.0069
		Finishing	1.5 x D	.015 x D	6 / 8	400 - 440	0.0006 - 0.0010	0.0011 - 0.0016	0.0017 - 0.0024	0.0022 - 0.0031	0.0028 - 0.0039	0.0033 - 0.0047	0.0044 - 0.0063
	MODERATELY DIFFICULT 79 - 85 HRb; 25 - 41 HRc 304; 304L; 316; 316L; 320; 321; 347; Invar 36; Kovar	Slotting	.75 x D	1 x D	6 / 8	190 - 215	0.0005 - 0.0007	0.0009 - 0.0013	0.0014 - 0.0020	0.0018 - 0.0026	0.0022 - 0.0032	0.0027 - 0.0039	0.0036 - 0.0052
		Roughing	1.25 x D	.3 x D	6 / 8	220 - 250	0.0007 - 0.0011	0.0013 - 0.0018	0.0019 - 0.0027	0.0026 - 0.0036	0.0032 - 0.0045	0.0039 - 0.0054	0.0051 - 0.0072
		High Effeciency (HEM)	2 x D	.1 x D	6 / 8	320 - 360	0.0010 - 0.0013	0.0019 - 0.0025	0.0028 - 0.0038	0.0037 - 0.0050	0.0046 - 0.0063	0.0056 - 0.0075	0.0074 - 0.0101
		Finishing	1.5 x D	.01 x D	6 / 8	305 - 335	0.0008 - 0.0012	0.0015 - 0.0020	0.0023 - 0.0030	0.0030 - 0.0039	0.0038 - 0.0049	0.0045 - 0.0059	0.0060 - 0.0079
	DIFFICULT TO MACHINE 31 - 50 HRc 13-8 PH; 15-5 PH; 17-4 PH; Carpenter; Custo 465; Invar	Slotting	.5 x D	1 x D	6 / 8	185 - 210	0.0005 - 0.0007	0.0009 - 0.0013	0.0014 - 0.0020	0.0018 - 0.0026	0.0022 - 0.0032	0.0027 - 0.0039	0.0036 - 0.0052
		Roughing	1.25 x D	.3 x D	6 / 8	235 - 270	0.0006 - 0.0010	0.0011 - 0.0016	0.0016 - 0.0024	0.0022 - 0.0032	0.0027 - 0.0040	0.0033 - 0.0048	0.0043 - 0.0064
		High Effeciency (HEM)	1.5 x D	.1 x D	6 / 8	315 - 350	0.0011 - 0.0014	0.0021 - 0.0027	0.0031 - 0.0041	0.0041 - 0.0054	0.0051 - 0.0068	0.0062 - 0.0081	0.0082 - 0.0109
		Finishing	1.5 x D	.01 x D	6 / 8	285 - 310	0.0007 - 0.0011	0.0013 - 0.0018	0.0020 - 0.0027	0.0026 - 0.0035	0.0033 - 0.0044	0.0039 - 0.0053	0.0052 - 0.0071
CAST IRON	GRAY 100 - 200 HRb	Slotting	1 x D	1 x D	6 / 8	275 - 315	0.0006 - 0.0008	0.0011 - 0.0015	0.0017 - 0.0023	0.0022 - 0.0030	0.0027 - 0.0037	0.0033 - 0.0045	0.0044 - 0.0060
		Roughing	1.5 x D	.5 x D	6 / 8	340 - 390	0.0007 - 0.0011	0.0013 - 0.0018	0.0019 - 0.0027	0.0026 - 0.0036	0.0032 - 0.0045	0.0039 - 0.0054	0.0051 - 0.0072
		High Effeciency (HEM)	2 x D	.2 x D	6 / 8	425 - 475	0.0009 - 0.0012	0.0017 - 0.0023	0.0025 - 0.0035	0.0033 - 0.0046	0.0041 - 0.0058	0.0050 - 0.0069	0.0066 - 0.0093
		Finishing	1.5 x D	.015 x D	6 / 8	400 - 440	0.0009 - 0.0013	0.0017 - 0.0022	0.0026 - 0.0033	0.0034 - 0.0043	0.0043 - 0.0054	0.0051 - 0.0065	0.0068 - 0.0087
	DUCTILE 150 - 300 HRb	Slotting	1 x D	1 x D	6 / 8	275 - 315	0.0006 - 0.0008	0.0011 - 0.0015	0.0017 - 0.0023	0.0022 - 0.0030	0.0027 - 0.0037	0.0033 - 0.0045	0.0044 - 0.0060
		Roughing	1.5 x D	.5 x D	6 / 8	340 - 390	0.0007 - 0.0011	0.0013 - 0.0018	0.0019 - 0.0027	0.0026 - 0.0036	0.0032 - 0.0045	0.0039 - 0.0054	0.0051 - 0.0072
		High Effeciency (HEM)	2 x D	.2 x D	6 / 8	425 - 475	0.0009 - 0.0012	0.0017 - 0.0023	0.0025 - 0.0035	0.0033 - 0.0046	0.0041 - 0.0058	0.0050 - 0.0069	0.0066 - 0.0093
		Finishing	1.5 x D	.015 x D	6 / 8	400 - 440	0.0009 - 0.0013	0.0017 - 0.0022	0.0026 - 0.0033	0.0034 - 0.0043	0.0043 - 0.0054	0.0051 - 0.0065	0.0068 - 0.0087
	MALLEABLE 150 - 310 HRb	Slotting	.75 x D	1 x D	6 / 8	240 - 275	0.0005 - 0.0007	0.0009 - 0.0013	0.0014 - 0.0020	0.0018 - 0.0026	0.0022 - 0.0032	0.0027 - 0.0039	0.0036 - 0.0052
		Roughing	1.5 x D	.5 x D	6 / 8	280 - 320	0.0007 - 0.0011	0.0013 - 0.0018	0.0019 - 0.0027	0.0026 - 0.0036	0.0032 - 0.0045	0.0039 - 0.0054	0.0051 - 0.0072
		High Effeciency (HEM)	2 x D	.2 x D	6 / 8	405 - 450	0.0009 - 0.0012	0.0017 - 0.0023	0.0025 - 0.0035	0.0033 - 0.0046	0.0041 - 0.0058	0.0050 - 0.0069	0.0066 - 0.0093
		Finishing	1.5 x D	.015 x D	6 / 8	380 - 415	0.0008 - 0.0012	0.0015 - 0.0020	0.0023 - 0.0030	0.0030 - 0.0039	0.0038 - 0.0049	0.0045 - 0.0059	0.0060 - 0.0079
ALLOYS	TITANIUM ALLOYS 70 - 100 HRb; 25 - 36 HRc Ti61AL4V; Grades 5-38	Slotting	.5 x D	1 x D	6 / 8	170 - 195	0.0004 - 0.0006	0.0007 - 0.0011	0.0011 - 0.0017	0.0014 - 0.0022	0.0017 - 0.0027	0.0021 - 0.0033	0.0028 - 0.0044
		Roughing	1.25 x D	.3 x D	6 / 8	220 - 250	0.0006 - 0.0010	0.0011 - 0.0016	0.0016 - 0.0024	0.0022 - 0.0032	0.0027 - 0.0040	0.0033 - 0.0048	0.0043 - 0.0064
		High Effeciency (HEM)	1.5 x D	.1 x D	6 / 8	315 - 350	0.0011 - 0.0014	0.0021 - 0.0027	0.0031 - 0.0041	0.0041 - 0.0054	0.0051 - 0.0068	0.0062 - 0.0081	0.0082 - 0.0109
		Finishing	1.5 x D	.01 x D	6 / 8	235 - 255	0.0007 - 0.0011	0.0013 - 0.0018	0.0020 - 0.0027	0.0026 - 0.0035	0.0033 - 0.0044	0.0039 - 0.0053	0.0052 - 0.0071
	HIGH TEMP ALLOYS 83 - 99 HRb; 30 - 52 HRc Inconel; Monel; A286; Rene; Stelite; Haynes; Waspalloy; Hastalloy; etc	Slotting	.25 x D	1 x D	6 / 8	60 - 65	0.0004 - 0.0006	0.0007 - 0.0011	0.0011 - 0.0017	0.0014 - 0.0022	0.0017 - 0.0027	0.0021 - 0.0033	0.0028 - 0.0044
		Roughing	1.25 x D	.25 x D	6 / 8	75 - 85	0.0005 - 0.0009	0.0009 - 0.0014	0.0013 - 0.0021	0.0018 - 0.0028	0.0022 - 0.0035	0.0027 - 0.0042	0.0035 - 0.0056
		High Effeciency (HEM)	1.5 x D	.1 x D	6 / 8	155 - 175	0.0005 - 0.0008	0.0009 - 0.0015	0.0013 - 0.0023	0.0017 - 0.0030	0.0021 - 0.0038	0.0026 - 0.0045	0.0034 - 0.0061
		Finishing	1.5 x D	.01 x D	6 / 8	115 - 125	0.0005 - 0.0009	0.0009 - 0.0014	0.0014 - 0.0021	0.0018 - 0.0027	0.0023 - 0.0034	0.0027 - 0.0041	0.0036 - 0.0055

D = tool diameter • Reduce feed rates by 20% when using long length tools • Use reduced neck tooling for long reach slotting • Starting parameters shown

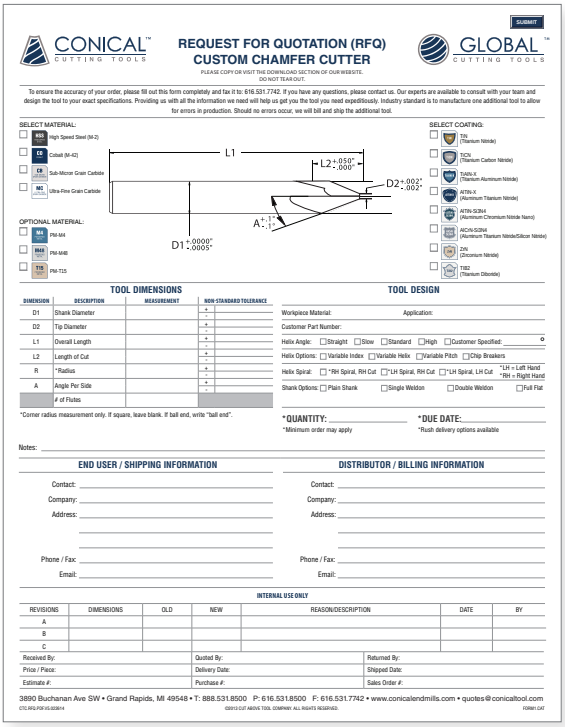
CUSTOM TOOL ORDERING

TO SOLVE MACHINING CHALLENGES

"JUST IN TIME" AVAILABILITY

WE'LL HELP YOU FIND THE SOLUTION

Along with our standard tool offerings, Conical Tool Company manufactures custom carbide and high speed steel end mills and cutters. Whether a variation of a standard tool or specialized tool meant to combine multiple processes into one pass, our custom tools improve performance and reduce cycle time at the best value in the industry.



CONICAL™ CUTTING TOOLS

REQUEST FOR QUOTATION (RFQ)
CUSTOM CHAMFER CUTTER

GLOBAL™ CUTTING TOOLS

PLEASE COPY OR VISIT THE DOWNLOAD SECTION OF OUR WEBSITE.
DO NOT TEAR OUT.

To ensure the accuracy of your order, please fill out this form completely and fax it to: 616.531.7742. If you have any questions, please contact us. Our experts are available to consult with your team and design the tool to your exact specifications. Providing us with all the information we need will help us get you the tool you need expeditiously. Industry standard is to manufacture one additional tool to allow for errors in production. Should no errors occur, we will bill and ship the additional tool.

SELECT MATERIAL:
HSS High Speed Steel (M-2)
CO Cobalt (M-42)
CB Sub-Micron Grain Carbide
MG Ultra-Fine Grain Carbide

OPTIONAL MATERIAL:
PM-M4
PM-M48
PM-T15

L1
L2 +.050" -.000"
D2 +.002" -.002"
A ±.1°
D1 +.0000" -.0005"

SELECT COATING:
TiN (Titanium Nitride)
TiCN (Titanium Carbon Nitride)
TiAlN-X (Titanium Aluminum Nitride)
AlTiN-X (Aluminum Titanium Nitride)
AlTiN-SUN4 (Aluminum Chromium Nitride Nano)
AlCrN-SUN4 (Aluminum Titanium Nitride/Silicon Nitride)
ZrN (Zirconium Nitride)
TiB2 (Titanium Diboride)

TOOL DIMENSIONS

DIMENSION	DESCRIPTION	MEASUREMENT	NON-STANDARD TOLERANCE
D1	Shank Diameter		+ -
D2	Tip Diameter		+ -
L1	Overall Length		+ -
L2	Length of Cut		+ -
R	*Radius		+ -
A	Angle Per Side		+ -
	# of Flutes		

*Corner radius measurement only. If square, leave blank. If ball end, write "ball end".

TOOL DESIGN

Workpiece Material: Application:
Customer Part Number:
Helix Angle: Straight Slow Standard High Customer Specified: °
Helix Options: Variable Index Variable Helix Variable Pitch Chip Breakers
Helix Spiral: *RH Spiral, RH Cut *LH Spiral, RH Cut *LH Spiral, LH Cut *LH = Left Hand *RH = Right Hand
Shank Options: Plain Shank Single Weldon Double Weldon Full Flat

*QUANTITY: *Minimum order may apply
*DUE DATE: *Rush delivery options available

Notes:

END USER / SHIPPING INFORMATION
Contact:
Company:
Address:
Phone / Fax:
Email:

DISTRIBUTOR / BILLING INFORMATION
Contact:
Company:
Address:
Phone / Fax:
Email:

INTERNAL USE ONLY

REVISIONS	DIMENSIONS	OLD	NEW	REASON/DESCRIPTION	DATE	BY
A						
B						
C						

Received By:	Quoted By:	Returned By:
Price / Piece:	Delivery Date:	Shipped Date:
Estimate #:	Purchase #:	Sales Order #:

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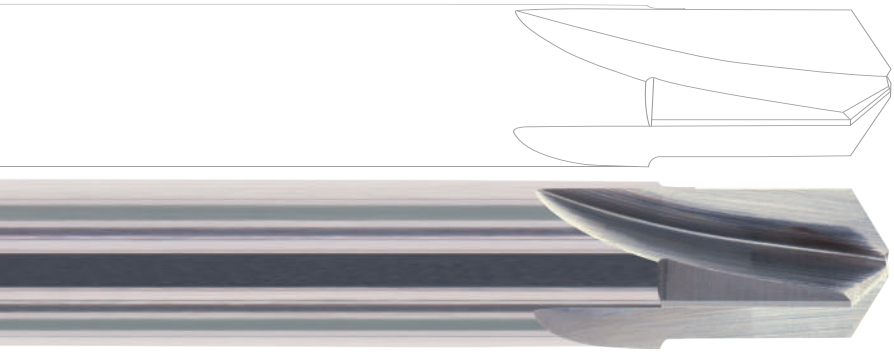

SEE PAGES 27-36 FOR DETAILS

VISIT CONICALENDMILLS.COM

OR CALL (888) 531-8500

CONICAL™ CUTTING TOOLS

GLOBAL™ CUTTING TOOLS

REQUEST FOR QUOTE

We can modify our standard tools or manufacture a highly specialized tool to your exact specifications. Request for Quote documents for custom tools are on the following pages. We cannot process your quote without this form. RFQ's are typically returned within 24 hours. A full list of definitions and acronyms can be found on pages 80-81. If you need assistance with your custom tool design or have any questions, please contact us.

CONICAL TOOL COMPANY 70 YEARS IN BUSINESS 1944 - 2014

CONICAL™ CUTTING TOOLS

GLOBAL™ CUTTING TOOLS

70 YEARS OF INNOVATION

HYDRA FX™
PERFORMANCE FINISHING

UNRIVALED QUALITY

The Hydra FX keeps the tight tolerance finishing of ferrous materials under control. This high performance end mill is fashioned from micro-grain carbide, with a multilayer AlCrN/Si3N4 coating.

The staged multi-flute design maximizes core diameter and keeps the highest number of flutes engaged possible. When flawless surface finishes are critical; this end mill delivers impressive results, wet or dry.

Smooth, chatterless cutting and high feed finishing is only possible with a stable, engaged tool.

There are many inferior solutions, but when finish quality is critical, the Hydra FX is the only choice. Its advanced variable geometry staggers the entry and exit of the flutes reducing vibration and creates a fluid machining environment.

EXPERIENCE THAT COUNTS

We spend thousands of hours each year creating custom, complex geometries and additional time testing and refining those designs based on customer feedback. That experience is poured right back into every new tool line we design. Multiple designs are tested in a multitude of materials, in a never ending quest for the highest performing end mills in the industry.

Global Cutting Tools
Conical Tool Company

3890 Buchanan Ave SW
Grand Rapids, MI 49548

T: 888.531.8500 | **P:** 616.531.8500
F: 616.531.7742 | **E:** info@conicaltool.com

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AMERICAN MADE

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HIGH PERFORMANCE END MILLS

FOR TIGHT TOLERANCE FINISHING OF FERROUS MATERIALS

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HYDRA FX™

PERFORMANCE FINISHING

TIGHT TOLERANCE FINISHING

OF FERROUS MATERIALS

FEATURES & BENEFITS

Welcome to the 21st century of metalworking and the Hydra FX line of high performance finishing end mills. Imagine high speed, tight tolerance milling that produces a remarkable surface finish. Our HydraFX line is offered in 5, 7, 9 and 11 flute configurations to meet any and all of your surface finish challenges. The odd number of flutes design is engineered for strength and endurance, as well as to resist many common machining problems. Consistent and smooth tool engagement was the motivation behind our engineering philosophy.

General Inquiries:
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Grand Rapids, MI 49548

P: (616) 531-8500
F: (616) 531-7742
E: info@conicaltool.com

Sales & Distribution:
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E: sales@conicaltool.com

Custom Tooling:
E: quotes@conicaltool.com
W: conicalendmills.com/custom-tool-ordering

GLOBAL™ CUTTING TOOLS

SERIES: HFX

For high feed finishing and tight tolerance milling of most ferrous materials where excellent surface finishes are critical. Higher flute counts promote smoother cutting actions, increased tool life, improved productivity and performance; wet or dry; low carbon steel to titanium up to 65 HRc.

Square end option to create sharp corners in finishing operations

Coated for heat resistance, wear resistance and increased lubricity

Improved tool stability through multi-flute flute design keeps more cutting edges engaged, creating a superior surface finish

High strength flutes reduce edge chipping, built up edge and extends tool life

Large core design for increased stability; higher speeds & feeds; and reduced tool deflection in difficult to machine materials

Corner radius option protects corners in difficult to machine materials by preventing corner chipping and tool failure

Premium micro-grain carbide substrate resists chipping, tool deflection, and has a high transverse rupture strength for greater feeds and speeds

Helix angle allows for proper chip management and longer tool life

Odd number of flutes reduce harmonics by staggering the entry and exit of the cutting edges

Engineered flute relief allows for superior chip evacuation without compromising flute integrity

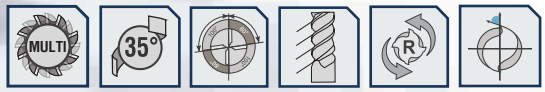
Edge prep drag finishing increases tool life by improving the surface quality in the flute and radiusing the cutting edge of the tool, reducing the potential for premature failure

Post polishing is performed after the tools are coated to remove surface inconsistencies and increase lubricity. This also increases feed rates and allows for smoother operations. The tool runs cooler and performs longer

TIP & END

SHANK & LENGTH

FLUTE CONFIGURATION



MATERIAL

CB
SUB-MICRO GRAIN CARBIDE

COATING

AlCrN Si3N4

RESULTS

The Hydra FX is designed with a 35 degree constant helix and is coated for heat resistance and added lubricity. Available in 5, 7, 9 & 11 flute designs, the odd number of flutes create quiet machining, while more cutting edges engaged enables superior stability and chip management.

The Hydra FX end mill is available in square end and corner radius options, to make sharp corners in finishing operations, or protect corners in difficult to machine materials. Every HydraFX end mill will leave your work piece with a near polished shine, while ensuring your future in the industry does the same.

Series HFX: Micro-Grain Carbide, Multi-Flute Configuration, Vibration Dampening Geometry, AlCrN/Si3N4 Coated
Subseries: HFXSR, HFXCR
Configuration: Varying Diameters; Regular Lengths; 35° Constant Helix; 5 Flutes (1/8" - 3/16"); 7 Flutes (1/4" - 3/8"); 9 Flutes (7/16" - 5/8"); 11 Flutes (3/4" - 1"); Square End & Corner Radius

HYDRA FX

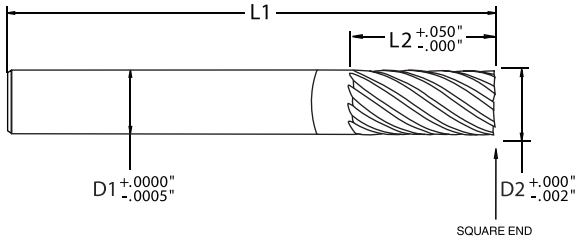
GLOBAL™

SERIES HFX - *CARBIDE, 5, 7, 9, & 11 FLUTE, 35° CONSTANT HELIX*

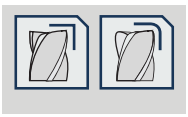
TIGHT TOLERANCE FINISHING

The Hydra FX keeps the tight tolerance finishing of ferrous materials under control. This high performance end mill is fashioned from micro-grain carbide, with a multilayer AlTiN/Si3N4 coating.

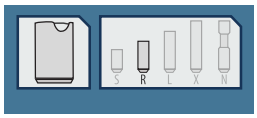
- Square end option to create sharp corners in finishing operations
- Improved tool stability through multi-flute flute design keeps more cutting edges engaged, creating a superior surface finish
- High strength flutes reduce edge chipping, built up edge and extends tool life
- Helix angle allows for proper chip management and longer tool life



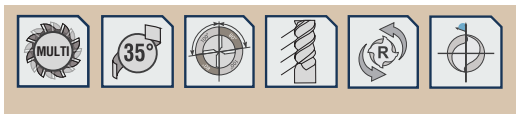
TIP & END



SHANK & LENGTH



FLUTE CONFIGURATION



MATERIAL

COATING

SERIES HFXSR - *SQUARE END, REGULAR LENGTH*

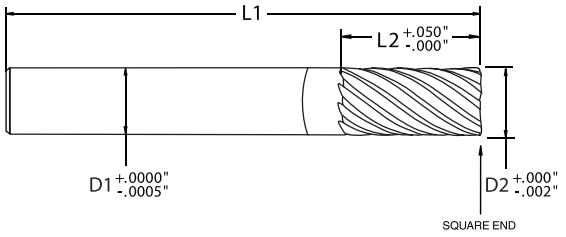
SHANK DIAMETER (D1)		CUTTER DIAMETER (D2)		FLUTE LENGTH (L2)		OVERALL LENGTH (L1)		# OF FLUTES	PLAIN SHANK PART #	PLAIN SHANK EDP #
1/8	0.125	1/8	0.125	5/8	0.625	2	2.000	5	HFX-0210-SQ	H201S
3/16	0.188	3/16	0.188	5/8	0.625	2	2.000		HFX-0310-SQ	H202S
1/4	0.250	1/4	0.250	7/8	0.875	2 1/2	2.500	7	HFX-0414-SQ	H203S
5/16	0.313	5/16	0.313	7/8	0.875	2 1/2	2.500		HFX-0514-SQ	H204S
3/8	0.375	3/8	0.375	1 1/8	1.125	3	3.000		HFX-0618-SQ	H205S
7/16	0.438	7/16	0.438	1 1/8	1.125	3	3.000	9	HFX-0718-SQ	H206S
1/2	0.500	1/2	0.500	1 3/8	1.375	3	3.000		HFX-0822-SQ	H207S
5/8	0.625	5/8	0.625	1 5/8	1.625	3 1/2	3.500		HFX-1026-SQ	H208S
3/4	0.750	3/4	0.750	1 5/8	1.625	4	4.000	11	HFX-1226-SQ	H209S
1	1.000	1	1.000	2 1/8	2.125	5	5.000		HFX-1634-SQ	H210S

SERIES HFX - *CARBIDE, 5, 7, 9, & 11 FLUTE, 35° CONSTANT HELIX*

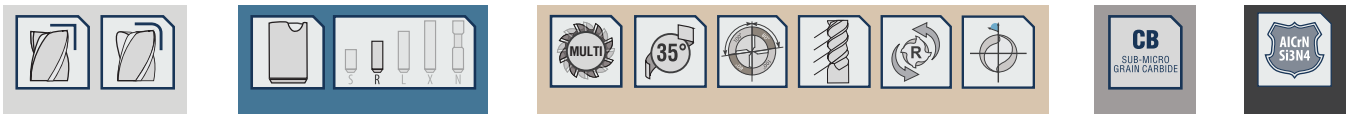
IMPRESSIVE RESULTS

The staged multi-flute design maximizes core diameter and keeps the highest number of flutes engaged possible. When flawless surface finishes are critical; this end mill delivers impressive results, wet or dry.

- Corner radius option protects corners in difficult to machine materials by preventing corner chipping and tool failure
- Large core design for increased stability; higher speeds & feeds; and reduced tool deflection in difficult to machine materials
- Odd number of flutes reduce harmonics by staggering the entry and exit of the cutting edges
- Superior chip evacuation without compromising flute integrity



TIP & END | SHANK & LENGTH | FLUTE CONFIGURATION | MATERIAL | COATING



SERIES HFXCR - *CORNER RADIUS, REGULAR LENGTH*

SHANK DIAMETER (D1)		CUTTER DIAMETER (D2)		FLUTE LENGTH (L2)		OVERALL LENGTH (L1)		# OF FLUTES	CORNER RADIUS (R)	PLAIN SHANK PART #	PLAIN SHANK EDP #
1/8	0.125	1/8	0.125	5/8	0.625	2	2.000	5	0.015	HFX-0210-R1	H2011
3/16	0.188	3/16	0.188	5/8	0.625	2	2.000		0.015	HFX-0310-R1	H2021
1/4	0.250	1/4	0.250	7/8	0.875	2 1/2	2.500	7	0.020	HFX-0414-R2	H2032
5/16	0.313	5/16	0.313	7/8	0.875	2 1/2	2.500		0.030	HFX-0514-R3	H2043
3/8	0.375	3/8	0.375	1 1/8	1.125	3	3.000		0.030	HFX-0618-R3	H2053
7/16	0.438	7/16	0.438	1 1/8	1.125	3	3.000	9	0.030	HFX-0718-R3	H2063
1/2	0.500	1/2	0.500	1 3/8	1.375	3	3.000		0.030	HFX-0822-R3	H2073
				1 3/8	1.375	3	3.000		0.090	HFX-0822-R9	H2087
				1 3/8	1.375	3	3.000		0.120	HFX-0822-R12	H2098
5/8	0.625	5/8	0.625	1 5/8	1.625	3 1/2	3.500		0.030	HFX-1026-R3	H2103
				1 5/8	1.625	3 1/2	3.500		0.090	HFX-1026-R9	H2117
				1 5/8	1.625	3 1/2	3.500		0.120	HFX-1026-R12	H2128
3/4	0.750	3/4	0.750	1 5/8	1.625	4	4.000	11	0.030	HFX-1226-R3	H2133
				1 5/8	1.625	4	4.000		0.090	HFX-1226-R9	H2147
				1 5/8	1.625	4	4.000		0.120	HFX-1226-R12	H2158
1	1.000	1	1.000	2 1/8	2.125	5	5.000		0.030	HFX-1634-R3	H2163
				2 1/8	2.125	5	5.000		0.090	HFX-1634-R9	H2177
				2 1/8	2.125	5	5.000		0.120	HFX-1634-R12	H2188

HFX APPLICATION GUIDE • SPEED & FEED

	WORK MATERIAL	TYPE OF CUT	AXIAL DOC	RADIAL DOC	NO. OF FLUTES	SPEED (SFM)	FEED (INCHES PER TOOTH) 1/8" (5 FL)	1/4" (7 FL)	3/8" (7 FL)	1/2" (9 FL)	5/8" (9 FL)	3/4" (11 FL)	1" (11 FL)
CARBON STEEL	LOW CARBON STEELS ≤ 38 HRc	Profiling	1 x D	.1 x D	5 / 7 / 9 / 11	535 - 595	0.0005 - 0.0007	0.0009 - 0.0011	0.0015 - 0.0018	0.0021 - 0.0025	0.0022 - 0.0026	0.0027 - 0.0033	0.0030 - 0.0038
		Finishing	1 x D	.05 x D	5 / 7 / 9 / 11	680 - 745	0.0006 - 0.0009	0.0011 - 0.0015	0.0020 - 0.0024	0.0027 - 0.0033	0.0031 - 0.0038	0.0035 - 0.0044	0.0040 - 0.0051
	MEDIUM CARBON STEELS ≤ 38 HRc	Profiling	1 x D	.1 x D	5 / 7 / 9 / 11	465 - 520	0.0005 - 0.0007	0.0009 - 0.0011	0.0015 - 0.0018	0.0021 - 0.0025	0.0022 - 0.0026	0.0027 - 0.0033	0.0030 - 0.0038
		Finishing	1 x D	.05 x D	5 / 7 / 9 / 11	595 - 650	0.0006 - 0.0009	0.0011 - 0.0015	0.0020 - 0.0024	0.0027 - 0.0033	0.0031 - 0.0038	0.0035 - 0.0044	0.0040 - 0.0051
TOOL STEEL	TOOL & DIE STEELS ≤ 38 HRc	Profiling	1 x D	.1 x D	5 / 7 / 9 / 11	395 - 440	0.0003 - 0.0005	0.0006 - 0.0008	0.0010 - 0.0013	0.0014 - 0.0018	0.0014 - 0.0018	0.0018 - 0.0024	0.0020 - 0.0027
		Finishing	1 x D	.05 x D	5 / 7 / 9 / 11	500 - 550	0.0005 - 0.0008	0.0008 - 0.0012	0.0014 - 0.0019	0.0020 - 0.0026	0.0023 - 0.0030	0.0025 - 0.0034	0.0029 - 0.0041
	TOOL & DIE STEELS 39 to 48 HRc	Profiling	1 x D	.1 x D	5 / 7 / 9 / 11	355 - 395	0.0003 - 0.0005	0.0006 - 0.0008	0.0010 - 0.0013	0.0014 - 0.0018	0.0014 - 0.0018	0.0018 - 0.0024	0.0020 - 0.0027
		Finishing	1 x D	.05 x D	5 / 7 / 9 / 11	445 - 485	0.0004 - 0.0007	0.0007 - 0.0010	0.0012 - 0.0016	0.0016 - 0.0022	0.0019 - 0.0026	0.0021 - 0.0030	0.0024 - 0.0035
HARDENED STEEL	HARDENED STEELS 48 to 57 HRc	Profiling	1 x D	.1 x D	5 / 7 / 9 / 11	275 - 310	0.0003 - 0.0005	0.0006 - 0.0008	0.0010 - 0.0013	0.0014 - 0.0018	0.0014 - 0.0018	0.0018 - 0.0024	0.0020 - 0.0027
		Finishing	1 x D	.05 x D	5 / 7 / 9 / 11	340 - 370	0.0005 - 0.0008	0.0008 - 0.0012	0.0014 - 0.0019	0.0020 - 0.0026	0.0023 - 0.0030	0.0025 - 0.0034	0.0029 - 0.0041
	HARDENED STEELS 58 to 65HRc	Profiling	1 x D	.1 x D	5 / 7 / 9 / 11	225 - 255	0.0002 - 0.0004	0.0004 - 0.0007	0.0007 - 0.0010	0.0010 - 0.0014	0.0009 - 0.0014	0.0013 - 0.0019	0.0014 - 0.0022
		Finishing	1 x D	.05 x D	5 / 7 / 9 / 11	275 - 300	0.0003 - 0.0006	0.0005 - 0.0009	0.0009 - 0.0014	0.0013 - 0.0019	0.0015 - 0.0022	0.0016 - 0.0025	0.0019 - 0.0030
STAINLESS STEEL	EASY TO MACHINE 72 - 85 HRb	Profiling	1 x D	.1 x D	5 / 7 / 9 / 11	405 - 455	0.0003 - 0.0005	0.0006 - 0.0008	0.0010 - 0.0013	0.0014 - 0.0018	0.0014 - 0.0018	0.0018 - 0.0024	0.0020 - 0.0027
		Finishing	1 x D	.05 x D	5 / 7 / 9 / 11	530 - 580	0.0005 - 0.0008	0.0008 - 0.0012	0.0014 - 0.0019	0.0020 - 0.0026	0.0023 - 0.0030	0.0025 - 0.0034	0.0029 - 0.0041
	MODERATELY DIFFICULT 79 - 85 HRb; 25 - 41 HRc	Profiling	1 x D	.1 x D	5 / 7 / 9 / 11	295 - 330	0.0003 - 0.0005	0.0006 - 0.0008	0.0010 - 0.0013	0.0014 - 0.0018	0.0014 - 0.0018	0.0018 - 0.0024	0.0020 - 0.0027
		Finishing	1 x D	.05 x D	5 / 7 / 9 / 11	365 - 400	0.0004 - 0.0007	0.0007 - 0.0010	0.0012 - 0.0016	0.0016 - 0.0022	0.0019 - 0.0026	0.0021 - 0.0030	0.0024 - 0.0035
	DIFFICULT TO MACHINE 31 - 50 HRc	Profiling	1 x D	.1 x D	5 / 7 / 9 / 11	270 - 305	0.0003 - 0.0005	0.0006 - 0.0008	0.0010 - 0.0013	0.0014 - 0.0018	0.0014 - 0.0018	0.0018 - 0.0024	0.0020 - 0.0027
		Finishing	1 x D	.05 x D	5 / 7 / 9 / 11	335 - 365	0.0004 - 0.0007	0.0007 - 0.0010	0.0012 - 0.0016	0.0016 - 0.0022	0.0019 - 0.0026	0.0021 - 0.0030	0.0024 - 0.0035
CAST IRON	GRAY 100 - 200 HRb	Profiling	1 x D	.1 x D	5 / 7 / 9 / 11	535 - 595	0.0005 - 0.0007	0.0009 - 0.0011	0.0015 - 0.0018	0.0021 - 0.0025	0.0022 - 0.0026	0.0027 - 0.0033	0.0030 - 0.0038
		Finishing	1 x D	.05 x D	5 / 7 / 9 / 11	680 - 745	0.0006 - 0.0009	0.0011 - 0.0015	0.0020 - 0.0024	0.0027 - 0.0033	0.0031 - 0.0038	0.0035 - 0.0044	0.0040 - 0.0051
	DUCTILE 150 - 300 HRb	Profiling	1 x D	.1 x D	5 / 7 / 9 / 11	520 - 580	0.0005 - 0.0007	0.0009 - 0.0011	0.0015 - 0.0018	0.0021 - 0.0025	0.0022 - 0.0026	0.0027 - 0.0033	0.0030 - 0.0038
		Finishing	1 x D	.05 x D	5 / 7 / 9 / 11	665 - 730	0.0006 - 0.0009	0.0011 - 0.0015	0.0020 - 0.0024	0.0027 - 0.0033	0.0031 - 0.0038	0.0035 - 0.0044	0.0040 - 0.0051
	MALLEABLE 150 - 310 HRb	Profiling	1 x D	.1 x D	5 / 7 / 9 / 11	395 - 440	0.0005 - 0.0007	0.0009 - 0.0011	0.0015 - 0.0018	0.0021 - 0.0025	0.0022 - 0.0026	0.0027 - 0.0033	0.0030 - 0.0038
		Finishing	1 x D	.05 x D	5 / 7 / 9 / 11	495 - 540	0.0006 - 0.0009	0.0011 - 0.0015	0.0020 - 0.0024	0.0027 - 0.0033	0.0031 - 0.0038	0.0035 - 0.0044	0.0040 - 0.0051
ALLOYS	TITANIUM ALLOYS 70 - 100 HRb; 25 - 36 HRc	Profiling	1 x D	.1 x D	5 / 7 / 9 / 11	295 - 330	0.0003 - 0.0005	0.0006 - 0.0008	0.0010 - 0.0013	0.0014 - 0.0018	0.0014 - 0.0018	0.0018 - 0.0024	0.0020 - 0.0027
		Finishing	1 x D	.05 x D	5 / 7 / 9 / 11	370 - 405	0.0004 - 0.0007	0.0007 - 0.0010	0.0012 - 0.0016	0.0016 - 0.0022	0.0019 - 0.0026	0.0021 - 0.0030	0.0024 - 0.0035
	HIGH TEMP ALLOYS 83 - 99 HRb; 30 - 52 HRc	Profiling	1 x D	.1 x D	5 / 7 / 9 / 11	95 - 110	0.0003 - 0.0005	0.0006 - 0.0008	0.0010 - 0.0013	0.0014 - 0.0018	0.0014 - 0.0018	0.0018 - 0.0024	0.0020 - 0.0027
		Finishing	1 x D	.05 x D	5 / 7 / 9 / 11	95 - 100	0.0004 - 0.0007	0.0007 - 0.0010	0.0012 - 0.0016	0.0016 - 0.0022	0.0019 - 0.0026	0.0021 - 0.0030	0.0024 - 0.0035

D = tool diameter • Reduce feed rates by 20% when using long length tools • Use reduced neck tooling for long reach slotting • Starting parameters shown

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FOR SLOTTING & FINISHING

OF DIFFICULT TO MACHINE MATERIALS

FEATURES & BENEFITS

The 30-48 degree variable pitch helix of our Xterra3 end mill is “the” solution to impossible operations in difficult to machine materials. The industry’s only variable pitch and tapered core design permits an exceptional material removal rate, making the Xterra3 perfect for maximum chip evacuation when ramping, pocketing or slotting. The odd numbers of flutes and advanced variable design minimize chatter creating smooth machining, a high shearing plane and controlled chip management.

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GLOBAL™ CUTTING TOOLS

SERIES: XT3

For high feed / material removal rate of difficult to machine materials to improve chip evacuation while ramping, pocketing or slotting; wet or dry; hardened steel, stainless steel, titanium and inconel.

Coated for heat resistance, wear resistance and increased lubricity

Three flute design improves chip formation and evacuation

Odd number of flutes reduce harmonics by staggering the entry and exit of the cutting edges

High helix angle reduces cutting forces by creating a higher shearing plane for better efficiencies, chip management and longer tool life

Corner radius option protects corners in roughing operations and difficult to machine materials by preventing corner chipping and tool failure

Eccentric relief for enhanced edge strength along the flutes

Large tapered core design for increased stability; higher speeds & feeds; and reduced tool deflection in heavy roughing operations

Premium micro-grain carbide substrate resists chipping, tool deflection, and has a high transverse rupture strength for greater feeds and speeds

Edge prep drag finishing increases tool life by improving the surface quality in the flute and radiusing the cutting edge of the tool, reducing the potential for premature failure

Post polishing is performed after the tools are coated to remove surface inconsistencies and increase lubricity. This also increases feed rates and allows for smoother operations. The tool runs cooler and performs longer

Variable pitch helix angle reduces cutting forces by creating a higher shearing plane for better efficiencies, chip management and longer tool life

TIP & END

SHANK & LENGTH

FLUTE CONFIGURATION

MATERIAL

COATING

RESULTS

Through a focused engineering approach, the Xterra3 combines aggressive cutting with strength and stability for the most demanding operations in the most demanding materials. Operators historically had to choose between performance and tool life, but that was before the Xterra3.

Now, performance can be achieved without sacrificing tool life, part finish or machine time. The Xterra3 end mill creates opportunities to maximize productivity; where none had previously existed.

Series XT3: Micro-Grain Carbide, 3 Flute, Advanced Variable Geometry, AlTiN/Si3N4 Coated
Subseries: XT3CR
Configuration: Varying Diameters; Regular Lengths; 30-48° Variable Pitch Helix; Corner Radius

XTERRA3

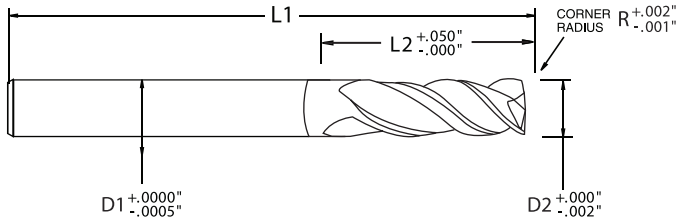
GLOBAL™

SERIES XT3 - *CARBIDE, 3 FLUTE, 30-48° VARIABLE PITCH HELIX*

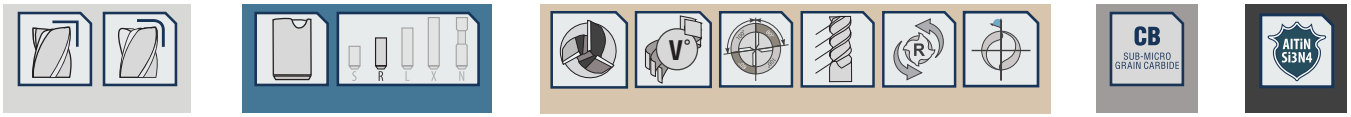
EXCEPTIONAL REMOVAL RATES

The industry's only variable pitch and tapered core design permits an exceptional material removal rate, making the Xterra3 perfect for maximum chip evacuation when ramping, pocketing or slotting.

- Three flute design improves chip formation and evacuation
- High helix angle reduces cutting forces by creating a higher shearing plane for better efficiencies, chip management and longer tool life
- Corner radius option protects corners in roughing operations and difficult to machine materials by preventing corner chipping and tool failure



TIP & END | SHANK & LENGTH | FLUTE CONFIGURATION | MATERIAL | COATING



SERIES XT3CR - *CORNER RADIUS, REGULAR LENGTH*

SHANK DIAMETER (D1)		CUTTER DIAMETER (D2)		FLUTE LENGTH (L2)		OVERALL LENGTH (L1)		CORNER RADIUS (R)	PLAIN SHANK PART #	PLAIN SHANK EDP #
1/8	0.125	1/8	0.125	3/8	0.375	2 1/2	2.500	0.015	XT3-0206-R1	X2011
3/16	0.188	3/16	0.188	5/8	0.625	2 1/2	2.500	0.015	XT3-0310-R1	X2021
1/4	0.250	1/4	0.250	7/8	0.875	2 1/2	2.500	0.020	XT3-0414-R2	X2032
5/16	0.313	5/16	0.313	7/8	0.875	2 1/2	2.500	0.030	XT3-0514-R3	X2043
3/8	0.375	3/8	0.375	1 1/8	1.125	3	3.000	0.030	XT3-0618-R3	X2053
7/16	0.438	7/16	0.438	1 1/8	1.125	3	3.000	0.030	XT3-0718-R3	X2063
1/2	0.500	1/2	0.500	1 3/8	1.375	3 1/2	3.500	0.030	XT3-0822-R3	X2073
5/8	0.625	5/8	0.625	1 5/8	1.625	3 1/2	3.500	0.040	XT3-1026-R4	X2084
3/4	0.750	3/4	0.750	1 7/8	1.875	4	4.000	0.050	XT3-1230-R5	X2095
1	1.000	1	1.000	2 3/8	2.375	5	5.000	0.060	XT3-1638-R6	X2106

SURFACE TREATMENTS & COATINGS

SELECT ADVANCED SPECIALTY COATING

SELECTING YOUR COATING

Certain applications, materials or performances simply require the enhancement of a specialty coating and knowledge of the properties of the coatings available. Temperature, friction resistance, hardness, lubricity, toughness and cohesion of the resulting process must be examined prior to the selection.

UNC	TiN	TiCN	TiAlN-X	AlTiN-X	AlTiN Si3N4	AlCrN Si3N4	ZrN	TiB2	DIA
UNCOATED	TITANIUM NITRIDE	TITANIUM CARBON NITRIDE	TITANIUM ALUMINUM NITRIDE NANO	ALUMINUM TITANIUM NITRIDE NANO	ALUMINUM TITANIUM NITRIDE/ SILICON NITRIDE	ALUMINUM CHROMIUM NITRIDE NANO	ZIRCONIUM NITRIDE	TITANIUM DIBORIDE	AMORPHOUS DIAMOND & CVD

SEE PAGES 42 - 44 FOR DETAILS

XT3 APPLICATION GUIDE • SPEED & FEED

	WORK MATERIAL	TYPE OF CUT	AXIAL DOC	RADIAL DOC	NO. OF FLUTES	SPEED (SFM)	FEED (INCHES PER TOOTH) 1/8" (3 FL)	1/4" (3 FL)	3/8" (3 FL)	1/2" (3 FL)	5/8" (3 FL)	3/4" (3 FL)	1" (3 FL)
CARBON STEEL	LOW CARBON STEELS ≤ 38 HRc 10xx; 11xx; 12xx; 12Lxx, 15xx	Slotting	1 x D	1 x D	3	410 - 490	0.0004 - 0.0006	0.0007 - 0.0011	0.0011 - 0.0017	0.0015 - 0.0023	0.0017 - 0.0027	0.0022 - 0.0034	0.0029 - 0.0045
		Roughing	1.5 x D	.5 x D	3	505 - 580	0.0005 - 0.0009	0.0008 - 0.0013	0.0012 - 0.0020	0.0016 - 0.0026	0.0020 - 0.0033	0.0024 - 0.0039	0.0031 - 0.0052
		High Effeciency (HEM)	2 x D	.2 x D	3	635 - 710	0.0007 - 0.0010	0.0013 - 0.0019	0.0019 - 0.0029	0.0024 - 0.0037	0.0030 - 0.0047	0.0037 - 0.0056	0.0049 - 0.0076
		Finishing	1.5 x D	.015 x D	3	455 - 500	0.0005 - 0.0009	0.0008 - 0.0013	0.0012 - 0.0019	0.0016 - 0.0025	0.0021 - 0.0032	0.0025 - 0.0039	0.0032 - 0.0051
	MEDIUM CARBON STEELS ≤ 38 HRc 13xx; 41xx; 43xx; 86xx, 92xx; 93xx; Chromoly	Slotting	1 x D	1 x D	3	340 - 405	0.0003 - 0.0005	0.0005 - 0.0009	0.0008 - 0.0014	0.0010 - 0.0018	0.0012 - 0.0022	0.0015 - 0.0027	0.0020 - 0.0036
		Roughing	1.5 x D	.5 x D	3	420 - 480	0.0003 - 0.0007	0.0005 - 0.0010	0.0008 - 0.0016	0.0012 - 0.0022	0.0014 - 0.0027	0.0017 - 0.0032	0.0022 - 0.0043
		High Effeciency (HEM)	2 x D	.2 x D	3	530 - 590	0.0005 - 0.0008	0.0009 - 0.0015	0.0013 - 0.0023	0.0017 - 0.0030	0.0021 - 0.0038	0.0026 - 0.0045	0.0034 - 0.0061
		Finishing	1.5 x D	.015 x D	3	305 - 335	0.0003 - 0.0007	0.0005 - 0.0010	0.0009 - 0.0016	0.0011 - 0.0020	0.0015 - 0.0026	0.0017 - 0.0031	0.0023 - 0.0042
TOOL STEEL	TOOL & DIE STEELS ≤ 38 HRc A2; A3; D2; H11; H13; M1; O-1; S-7; NAK 55	Slotting	1 x D	1 x D	3	220 - 260	0.0003 - 0.0005	0.0005 - 0.0009	0.0008 - 0.0014	0.0010 - 0.0018	0.0012 - 0.0022	0.0015 - 0.0027	0.0020 - 0.0036
		Roughing	1.5 x D	.5 x D	3	270 - 310	0.0003 - 0.0007	0.0005 - 0.0010	0.0008 - 0.0016	0.0012 - 0.0022	0.0014 - 0.0027	0.0017 - 0.0032	0.0022 - 0.0043
		High Effeciency (HEM)	2 x D	.2 x D	3	340 - 380	0.0005 - 0.0008	0.0009 - 0.0015	0.0013 - 0.0023	0.0017 - 0.0030	0.0021 - 0.0038	0.0026 - 0.0045	0.0034 - 0.0061
		Finishing	1.5 x D	.015 x D	3	225 - 245	0.0003 - 0.0007	0.0005 - 0.0010	0.0009 - 0.0016	0.0011 - 0.0020	0.0015 - 0.0026	0.0017 - 0.0031	0.0023 - 0.0042
	TOOL & DIE STEELS 39 to 48 HRc P20; P21; S-136; PX-5; NAK 80	Slotting	.75 x D	1 x D	3	205 - 245	0.0003 - 0.0005	0.0004 - 0.0008	0.0007 - 0.0013	0.0009 - 0.0017	0.0010 - 0.0020	0.0013 - 0.0025	0.0018 - 0.0034
		Roughing	1.5 x D	.3 x D	3	255 - 290	0.0003 - 0.0007	0.0005 - 0.0010	0.0007 - 0.0015	0.0010 - 0.0020	0.0012 - 0.0025	0.0015 - 0.0030	0.0019 - 0.0040
		High Effeciency (HEM)	2 x D	.15 x D	3	320 - 358	0.0005 - 0.0008	0.0008 - 0.0014	0.0012 - 0.0022	0.0015 - 0.0028	0.0018 - 0.0035	0.0023 - 0.0042	0.0030 - 0.0057
		Finishing	1.5 x D	.015 x D	3	210 - 230	0.0004 - 0.0008	0.0006 - 0.0011	0.0010 - 0.0017	0.0012 - 0.0021	0.0016 - 0.0027	0.0019 - 0.0033	0.0025 - 0.0044
HARDENED STEEL	HARDENED STEELS 48 to 57 HRc	Slotting	1 x D	1 x D	3	195 - 230	0.0003 - 0.0005	0.0004 - 0.0008	0.0007 - 0.0013	0.0009 - 0.0017	0.0010 - 0.0020	0.0013 - 0.0025	0.0018 - 0.0034
		Roughing	1.5 x D	.5 x D	3	240 - 275	0.0003 - 0.0007	0.0005 - 0.0010	0.0007 - 0.0015	0.0010 - 0.0020	0.0012 - 0.0025	0.0015 - 0.0030	0.0019 - 0.0040
		High Effeciency (HEM)	2 x D	.2 x D	3	300 - 336	0.0005 - 0.0008	0.0008 - 0.0014	0.0012 - 0.0022	0.0015 - 0.0028	0.0018 - 0.0035	0.0023 - 0.0042	0.0030 - 0.0057
		Finishing	1.5 x D	.015 x D	3	195 - 210	0.0003 - 0.0007	0.0005 - 0.0010	0.0008 - 0.0015	0.0010 - 0.0019	0.0013 - 0.0024	0.0015 - 0.0029	0.0020 - 0.0039
	HARDENED STEELS 58 to 65HRc	Slotting	.75 x D	1 x D	3	180 - 215	0.0002 - 0.0004	0.0004 - 0.0008	0.0006 - 0.0012	0.0007 - 0.0015	0.0008 - 0.0018	0.0011 - 0.0023	0.0014 - 0.0030
		Roughing	1.5 x D	.3 x D	3	220 - 250	0.0003 - 0.0007	0.0004 - 0.0009	0.0006 - 0.0014	0.0008 - 0.0018	0.0009 - 0.0022	0.0012 - 0.0027	0.0015 - 0.0036
		High Effeciency (HEM)	2 x D	.15 x D	3	280 - 314	0.0004 - 0.0007	0.0007 - 0.0013	0.0009 - 0.0019	0.0012 - 0.0025	0.0014 - 0.0031	0.0018 - 0.0037	0.0024 - 0.0051
		Finishing	1.5 x D	.015 x D	3	180 - 195	0.0003 - 0.0007	0.0004 - 0.0009	0.0006 - 0.0013	0.0008 - 0.0017	0.0010 - 0.0021	0.0012 - 0.0026	0.0016 - 0.0035
STAINLESS STEEL	EASY TO MACHINE 72 - 85 HRb 410; 416; 420; 430F; 440C; 302; 303	Slotting	.75 x D	1 x D	3	315 - 375	0.0003 - 0.0005	0.0006 - 0.0010	0.0009 - 0.0015	0.0011 - 0.0019	0.0013 - 0.0023	0.0017 - 0.0029	0.0023 - 0.0039
		Roughing	1.25 x D	.3 x D	3	390 - 445	0.0004 - 0.0008	0.0006 - 0.0011	0.0009 - 0.0017	0.0013 - 0.0023	0.0015 - 0.0028	0.0019 - 0.0034	0.0024 - 0.0045
		High Effeciency (HEM)	2 x D	.15 x D	3	490 - 545	0.0006 - 0.0009	0.0010 - 0.0016	0.0015 - 0.0025	0.0019 - 0.0032	0.0023 - 0.0040	0.0029 - 0.0048	0.0038 - 0.0065
		Finishing	1.5 x D	.015 x D	3	340 - 370	0.0004 - 0.0008	0.0006 - 0.0011	0.0010 - 0.0017	0.0012 - 0.0021	0.0016 - 0.0027	0.0019 - 0.0033	0.0025 - 0.0044
	MODERATELY DIFFICULT 79 - 85 HRb; 25 - 41 HRc 304; 304L; 316; 316L; 320; 321; 347; Invar 36; Kovar	Slotting	.75 x D	1 x D	3	285 - 340	0.0003 - 0.0005	0.0004 - 0.0008	0.0007 - 0.0013	0.0009 - 0.0017	0.0010 - 0.0020	0.0013 - 0.0025	0.0018 - 0.0034
		Roughing	1.25 x D	.3 x D	3	350 - 400	0.0003 - 0.0007	0.0005 - 0.0010	0.0007 - 0.0015	0.0010 - 0.0020	0.0012 - 0.0025	0.0015 - 0.0030	0.0019 - 0.0040
		High Effeciency (HEM)	2 x D	.1 x D	3	440 - 490	0.0005 - 0.0008	0.0008 - 0.0014	0.0012 - 0.0022	0.0015 - 0.0028	0.0018 - 0.0035	0.0023 - 0.0042	0.0030 - 0.0057
		Finishing	1.5 x D	.01 x D	3	305 - 335	0.0003 - 0.0007	0.0005 - 0.0010	0.0008 - 0.0015	0.0010 - 0.0019	0.0013 - 0.0024	0.0015 - 0.0029	0.0020 - 0.0039
	DIFFICULT TO MACHINE 31 - 50 HRc 13-8 PH; 15-5 PH; 17-4 PH; Carpenter; Custo 465; Invar	Slotting	.5 x D	1 x D	3	225 - 270	0.0003 - 0.0005	0.0004 - 0.0008	0.0007 - 0.0013	0.0009 - 0.0017	0.0010 - 0.0020	0.0013 - 0.0025	0.0018 - 0.0034
		Roughing	1.25 x D	.3 x D	3	280 - 320	0.0003 - 0.0007	0.0005 - 0.0010	0.0007 - 0.0015	0.0010 - 0.0020	0.0012 - 0.0025	0.0015 - 0.0030	0.0019 - 0.0040
		High Effeciency (HEM)	1.5 x D	.1 x D	3	350 - 391	0.0005 - 0.0008	0.0008 - 0.0014	0.0012 - 0.0022	0.0015 - 0.0028	0.0018 - 0.0035	0.0023 - 0.0042	0.0030 - 0.0057
		Finishing	1.5 x D	.01 x D	3	235 - 255	0.0003 - 0.0007	0.0005 - 0.0010	0.0008 - 0.0015	0.0010 - 0.0019	0.0013 - 0.0024	0.0015 - 0.0029	0.0020 - 0.0039
CAST IRON	GRAY 100 - 200 HRb	Slotting	1 x D	1 x D	3	315 - 360	0.0003 - 0.0005	0.0005 - 0.0009	0.0007 - 0.0013	0.0009 - 0.0017	0.0010 - 0.0020	0.0014 - 0.0026	0.0018 - 0.0034
		Roughing	1.5 x D	.5 x D	3	390 - 445	0.0003 - 0.0007	0.0005 - 0.0010	0.0007 - 0.0015	0.0010 - 0.0020	0.0012 - 0.0025	0.0015 - 0.0030	0.0019 - 0.0040
		High Effeciency (HEM)	2 x D	.2 x D	3	490 - 545	0.0005 - 0.0008	0.0008 - 0.0014	0.0012 - 0.0022	0.0015 - 0.0028	0.0019 - 0.0036	0.0023 - 0.0042	0.0031 - 0.0058
		Finishing	1.5 x D	.015 x D	3	380 - 415	0.0003 - 0.0007	0.0005 - 0.0010	0.0008 - 0.0015	0.0010 - 0.0019	0.0013 - 0.0024	0.0016 - 0.0030	0.0020 - 0.0039
	DUCTILE 150 - 300 HRb	Slotting	1 x D	1 x D	3	300 - 345	0.0002 - 0.0004	0.0004 - 0.0008	0.0006 - 0.0012	0.0007 - 0.0015	0.0008 - 0.0018	0.0011 - 0.0023	0.0014 - 0.0030
		Roughing	1.5 x D	.5 x D	3	370 - 425	0.0003 - 0.0007	0.0004 - 0.0009	0.0006 - 0.0014	0.0008 - 0.0018	0.0009 - 0.0022	0.0012 - 0.0027	0.0015 - 0.0036
		High Effeciency (HEM)	2 x D	.2 x D	3	465 - 520	0.0004 - 0.0007	0.0007 - 0.0013	0.0009 - 0.0019	0.0012 - 0.0025	0.0014 - 0.0031	0.0018 - 0.0037	0.0024 - 0.0051
		Finishing	1.5 x D	.015 x D	3	360 - 395	0.0003 - 0.0007	0.0004 - 0.0009	0.0006 - 0.0013	0.0008 - 0.0017	0.0010 - 0.0021	0.0012 - 0.0026	0.0016 - 0.0035
	MALLEABLE 150 - 310 HRb	Slotting	.75 x D	1 x D	3	220 - 260	0.0002 - 0.0004	0.0004 - 0.0008	0.0006 - 0.0012	0.0007 - 0.0015	0.0008 - 0.0018	0.0011 - 0.0023	0.0014 - 0.0030
		Roughing	1.5 x D	.5 x D	3	270 - 310	0.0003 - 0.0007	0.0004 - 0.0009	0.0006 - 0.0014	0.0008 - 0.0018	0.0009 - 0.0022	0.0012 - 0.0027	0.0015 - 0.0036
		High Effeciency (HEM)	2 x D	.2 x D	3	340 - 380	0.0004 - 0.0007	0.0007 - 0.0013	0.0009 - 0.0019	0.0012 - 0.0025	0.0014 - 0.0031	0.0018 - 0.0037	0.0024 - 0.0051
		Finishing	1.5 x D	.015 x D	3	225 - 245	0.0003 - 0.0007	0.0004 - 0.0009	0.0006 - 0.0013	0.0008 - 0.0017	0.0010 - 0.0021	0.0012 - 0.0026	0.0016 - 0.0035
ALLOYS	TITANIUM ALLOYS 70 - 100 HRb; 25 - 36 HRc Ti61AL4V; Grades 5-38	Slotting	.5 x D	1 x D	3	120 - 160	0.0003 - 0.0005	0.0004 - 0.0008	0.0007 - 0.0013	0.0009 - 0.0017	0.0010 - 0.0020	0.0013 - 0.0025	0.0018 - 0.0034
		Roughing	1.25 x D	.3 x D	3	205 - 275	0.0003 - 0.0007	0.0005 - 0.0010	0.0007 - 0.0015	0.0010 - 0.0020	0.0012 - 0.0025	0.0015 - 0.0030	0.0019 - 0.0040
		High Effeciency (HEM)	1.5 x D	.1 x D	3	275 - 310	0.0005 - 0.0008	0.0008 - 0.0014	0.0012 - 0.0022	0.0015 - 0.0028	0.0018 - 0.0035	0.0023 - 0.0042	0.0030 - 0.0057
		Finishing	1.5 x D	.01 x D	3	200 - 240	0.0003 - 0.0007	0.0005 - 0.0010	0.0008 - 0.0015	0.0010 - 0.0019	0.0013 - 0.0024	0.0015 - 0.0029	0.0020 - 0.0039
	HIGH TEMP ALLOYS 83 - 99 HRb; 30 - 52 HRc Inconel; Monel; A286; Rene; Stelite; Haynes; Waspalloy; Hastalloy; etc	Slotting	.25 x D	1 x D	3	50 - 65	0.0002 - 0.0004	0.0003 - 0.0007	0.0004 - 0.0010	0.0005 - 0.0013	0.0006 - 0.0016	0.0008 - 0.0020	0.0010 - 0.0026
		Roughing	1.25 x D	.25 x D	3	80 - 105	0.0002 - 0.0006	0.0003 - 0.0008	0.0004 - 0.0012	0.0006 - 0.0016	0.0007 - 0.0020	0.0009 - 0.0024	0.0011 - 0.0032
		High Effeciency (HEM)	1.5 x D	.1 x D	3	120 - 135	0.0003 - 0.0006	0.0005 - 0.0011	0.0007 - 0.0017	0.0009 - 0.0022	0.0011 - 0.0028	0.0014 - 0.0033	0.0018 - 0.0045
		Finishing	1.5 x D	.01 x D	3	60 - 70	0.0002 - 0.0006	0.0003 - 0.0008	0.0005 - 0.0012	0.0006 - 0.0015	0.0008 - 0.0019	0.0009 - 0.0023	0.0012 - 0.0031

D = tool diameter • Reduce feed rates by 20% when using long length tools • Use reduced neck tooling for long reach slotting • Starting parameters shown

CONICAL™ CUTTING TOOLS

GLOBAL™ CUTTING TOOLS

70 YEARS OF INNOVATION

EXTREME3™
ADVANCED VARIABLE GEOMETRY

INCOMPARABLE INNOVATION

The benefits of a higher helix angle are well known. Traditionally, those benefits were limited by weakened end configurations and thin, fragile flutes. Our Extreme 3 end mill has an advanced variable design, coupled with the only transitional fluting design in the industry.

A maximum core diameter ensures rigidity while high efficiency machining and the eccentrically relieved flutes add the strength to perform, and keep performing.

This end mill is perfect for high feed material removal rates in easy to machine ferrous material. The strength of the design improves performances in low horsepower and spindle speed machines, giving older machines new life.

It's simple; Global Cutting Tools designed a performance end mill for your standard performance machine tools. Relying on our Extreme 3 will keep your machines in use and your operations effective. The increased tool life guarantees your old and tired machines will finally see some run time.

PRINCIPLES AND COMMITMENTS

We are committed to excellence in our business practices, and our products share the same goal; to provide the best technologies, processes and tools possible for our customers. We are in the business of providing solutions, experience, options and quality products. Our principles are based on the ethical foundations, laid by our company founders, almost 70 years ago.

Global Cutting Tools
Conical Tool Company

3890 Buchanan Ave SW
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GLOBALLY RENOWNED

HIGH PERFORMANCE END MILLS

FOR HIGH FEED MACHINING & EXTREME MATERIAL REMOVAL RATES

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EXTREME3™

ADVANCED VARIABLE GEOMETRY

HIGH FEED MACHINING

EXTREME MATERIAL REMOVAL RATES

FEATURES & BENEFITS

The Extreme3 end mill will perform exceptionally well in easy to machine materials. It is designed with a large core diameter for increased stability and a multi stage, transitional variable pitch helix to protect fragile corners and allow for extreme helix angles. The Extreme3 performs rapid material removal rates and makes quick work of easy work, which results in robust profits all around.

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GLOBAL™ CUTTING TOOLS

SERIES: EX3

For high feed / material removal rate of easy to machine materials to improve chip evacuation while ramping, pocketing, roughing or slotting; wet or dry; low carbon steel to stainless steel < 48 HRc.

Square end to create sharp corners in finishing operations

Coated for heat resistance, wear resistance and increased lubricity

Three flute design improves chip formation and evacuation

Odd number of flutes reduce harmonics by staggering the entry and exit of the cutting edges

Vibration Dampening Geometry: Variable Helix, Variable Index, Increased Core and Cutting Flute Engagement

Corner radius option protects corners in roughing operations and difficult to machine materials by preventing corner chipping and tool failure

Eccentric relief for enhanced edge strength along the flutes

High helix angle reduces cutting forces by creating a higher shearing plane for better efficiencies, chip management and longer tool life

Premium micro-grain carbide substrate resists chipping, tool deflection, and has a high transverse rupture strength for greater feeds and speeds

Edge prep drag finishing increases tool life by improving the surface quality in the flute and radiusing the cutting edge of the tool, reducing the potential for premature failure

Post polishing is performed after the tools are coated to remove surface inconsistencies and increase lubricity. This also increases feed rates and allows for smoother operations. The tool runs cooler and performs longer

TIP & END

SHANK & LENGTH

FLUTE CONFIGURATION

MATERIAL

COATING

RESULTS

Extreme3 end mills are intended for high feed material removal rates of easy to machine ferrous materials. Best used in profiling operations, the Extreme3 is engineered with an eccentric relief to improve cutting flute strength and withstand the forces of high speed machining. The 3 flute design maintains stability and manages chip formation and evacuation, to make high speed machining possible.

Series EX3: Micro-Grain Carbide, 3 Flute, Advanced Variable Geometry, AlTiN/Si3N4 Coated
Subseries: EX3SR, EX3CR,
Configuration: Varying Diameters; Regular Length; 45/60° Transitional Variable Helix; Variable Index; 58/59/60° Variable Helix; Square End & Corner Radius

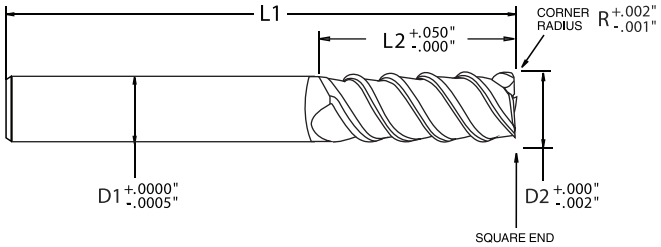
EXTREME3 GLOBAL™

SERIES EX3 - *CARBIDE, 3 FLUTE, 45/60° TRANSITIONAL VARIABLE HELIX*

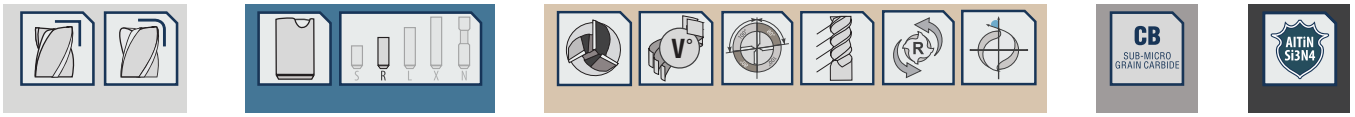
EXTREME TOOL DESIGN

The Extreme3 is designed with a large core diameter for increased stability and a multi stage, transitional variable pitch helix to protect fragile corners and allow for extreme helix angles

- Three flute design improves chip formation and evacuation
- Eccentric relief for enhanced edge strength along the flutes
- Odd number of flutes reduce harmonics by staggering the entry and exit of the cutting edges
- Square end to create sharp corners in finishing operations



TIP & END | SHANK & LENGTH | FLUTE CONFIGURATION | MATERIAL | COATING



SERIES EX3 - SQUARE END, *REGULAR LENGTH*

SHANK DIAMETER (D1)		CUTTER DIAMETER (D2)		FLUTE LENGTH (L2)		OVERALL LENGTH (L1)		PLAIN SHANK PART #	PLAIN SHANK EDP #
1/8	0.125	1/8	0.125	5/8	0.625	2	2.000	EX3-0210-SQ	E201S
3/16	0.188	3/16	0.188	5/8	0.625	2	2.000	EX3-0310-SQ	E202S
1/4	0.250	1/4	0.250	7/8	0.875	2 1/2	2.500	EX3-0414-SQ	E203S
5/16	0.313	5/16	0.313	7/8	0.875	2 1/2	2.500	EX3-0514-SQ	E204S
3/8	0.375	3/8	0.375	1 1/8	1.125	3	3.000	EX3-0618-SQ	E205S
7/16	0.438	7/16	0.438	1 1/8	1.125	3	3.000	EX3-0718-SQ	E206S
1/2	0.500	1/2	0.500	1 3/8	1.375	3	3.000	EX3-0822-SQ	E207S
5/8	0.625	5/8	0.625	1 5/8	1.625	3 1/2	3.500	EX3-1026-SQ	E208S
3/4	0.750	3/4	0.750	1 5/8	1.625	4	4.000	EX3-1226-SQ	E209S
1	1.000	1	1.000	2 1/8	2.125	5	5.000	EX3-1634-SQ	E210S

SERIES EX3 - CORNER RADIUS, *REGULAR LENGTH*

SHANK DIAMETER (D1)		CUTTER DIAMETER (D2)		FLUTE LENGTH (L2)		OVERALL LENGTH (L1)		CORNER RADIUS (R)	PLAIN SHANK PART #	PLAIN SHANK EDP #
1/8	0.125	1/8	0.125	5/8	0.625	2	2.000	0.015	EX3-0210-R1	E2011
3/16	0.188	3/16	0.188	5/8	0.625	2	2.000	0.015	EX3-0310-R1	E2021
1/4	0.250	1/4	0.250	7/8	0.875	2 1/2	2.500	0.020	EX3-0414-R2	E2032
5/16	0.313	5/16	0.313	7/8	0.875	2 1/2	2.500	0.030	EX3-0514-R3	E2043
3/8	0.375	3/8	0.375	1 1/8	1.125	3	3.000	0.030	EX3-0618-R3	E2053
7/16	0.438	7/16	0.438	1 1/8	1.125	3	3.000	0.030	EX3-0718-R3	E2063
1/2	0.500	1/2	0.500	1 3/8	1.375	3	3.000	0.030	EX3-0822-R3	E2073
5/8	0.625	5/8	0.625	1 5/8	1.625	3 1/2	3.500	0.040	EX3-1026-R4	E2084
3/4	0.750	3/4	0.750	1 5/8	1.625	4	4.000	0.050	EX3-1226-R5	E2095
1	1.000	1	1.000	2 1/8	2.125	5	5.000	0.060	EX3-1634-R6	E2106

EX3 APPLICATION GUIDE • SPEED & FEED

	WORK MATERIAL	TYPE OF CUT	AXIAL DOC	RADIAL DOC	NO. OF FLUTES	SPEED (SFM)	FEED (INCHES PER TOOTH) 1/8" (3 FL)	1/4" (3 FL)	3/8" (3 FL)	1/2" (3 FL)	5/8" (3 FL)	3/4" (3 FL)	1" (3 FL)
CARBON STEEL	LOW CARBON STEELS ≤ 38 HRc 10xx; 11xx; 12xx; 12Lxx, 15xx	Slotting	.5 x D	1 x D	3	260 - 295	0.0012 - 0.0014	0.0017 - 0.0021	0.0023 - 0.0029	0.0028 - 0.0036	0.0033 - 0.0043	0.0039 - 0.0051	0.0044 - 0.0060
		Roughing	1 x D	.5 x D	3	305 - 350	0.0014 - 0.0018	0.0020 - 0.0025	0.0026 - 0.0034	0.0033 - 0.0043	0.0039 - 0.0052	0.0046 - 0.0061	0.0051 - 0.0072
		Finishing	1.5 x D	.015 x D	3	355 - 390	0.0014 - 0.0018	0.0020 - 0.0025	0.0027 - 0.0034	0.0033 - 0.0042	0.0040 - 0.0051	0.0046 - 0.0060	0.0052 - 0.0071
	MEDIUM CARBON STEELS ≤ 38 HRc 13xx; 41xx; 43xx; 86xx, 92xx; 93xx; Chromoly	Slotting	.5 x D	1 x D	3	260 - 295	0.0010 - 0.0012	0.0014 - 0.0018	0.0019 - 0.0025	0.0023 - 0.0031	0.0027 - 0.0037	0.0032 - 0.0044	0.0036 - 0.0052
		Roughing	1 x D	.5 x D	3	305 - 350	0.0012 - 0.0016	0.0017 - 0.0022	0.0022 - 0.0030	0.0028 - 0.0038	0.0033 - 0.0046	0.0039 - 0.0054	0.0043 - 0.0064
		Finishing	1.5 x D	.015 x D	3	355 - 390	0.0012 - 0.0016	0.0017 - 0.0022	0.0023 - 0.0030	0.0028 - 0.0037	0.0034 - 0.0045	0.0039 - 0.0053	0.0044 - 0.0063
TOOL STEEL	TOOL & DIE STEELS ≤ 38 HRc A2; A3; D2; H11; H13; M1; O-1; S-7; NAK 55	Slotting	.5 x D	1 x D	3	210 - 240	0.0007 - 0.0009	0.0010 - 0.0014	0.0013 - 0.0019	0.0016 - 0.0024	0.0018 - 0.0028	0.0022 - 0.0034	0.0024 - 0.0040
		Roughing	1 x D	.5 x D	3	260 - 295	0.0008 - 0.0012	0.0011 - 0.0016	0.0014 - 0.0022	0.0018 - 0.0028	0.0021 - 0.0034	0.0025 - 0.0040	0.0027 - 0.0048
		Finishing	1.5 x D	.015 x D	3	305 - 335	0.0008 - 0.0012	0.0011 - 0.0016	0.0015 - 0.0022	0.0018 - 0.0027	0.0022 - 0.0033	0.0025 - 0.0039	0.0028 - 0.0047
	TOOL & DIE STEELS 39 to 48 HRc P20; P21; S-136; PX-5; NAK 80	Slotting	.5 x D	1 x D	3	190 - 215	0.0006 - 0.0008	0.0008 - 0.0012	0.0011 - 0.0017	0.0013 - 0.0021	0.0015 - 0.0025	0.0018 - 0.0030	0.0020 - 0.0036
		Roughing	1 x D	.5 x D	3	235 - 270	0.0008 - 0.0012	0.0011 - 0.0016	0.0014 - 0.0022	0.0018 - 0.0028	0.0021 - 0.0034	0.0025 - 0.0040	0.0027 - 0.0048
		Finishing	1.5 x D	.015 x D	3	285 - 310	0.0008 - 0.0012	0.0011 - 0.0016	0.0015 - 0.0022	0.0018 - 0.0027	0.0022 - 0.0033	0.0025 - 0.0039	0.0028 - 0.0047
STAINLESS STEEL	EASY TO MACHINE 72 - 85 HRb 410; 416; 420; 430F; 440C; 302; 303	Slotting	.5 x D	1 x D	3	235 - 270	0.0010 - 0.0012	0.0014 - 0.0018	0.0019 - 0.0025	0.0023 - 0.0031	0.0027 - 0.0037	0.0032 - 0.0044	0.0036 - 0.0052
		Roughing	1 x D	.5 x D	3	285 - 325	0.0013 - 0.0017	0.0018 - 0.0023	0.0024 - 0.0032	0.0031 - 0.0041	0.0036 - 0.0049	0.0042 - 0.0057	0.0047 - 0.0068
		Finishing	1.5 x D	.015 x D	3	330 - 360	0.0014 - 0.0018	0.0020 - 0.0025	0.0027 - 0.0034	0.0033 - 0.0042	0.0040 - 0.0051	0.0046 - 0.0060	0.0052 - 0.0071
	MODERATELY DIFFICULT 79 - 85 HRb; 25 - 41 HRc 304; 304L; 316; 316L; 320; 321; 347; Invar 36; Kovar	Slotting	.5 x D	1 x D	3	235 - 270	0.0007 - 0.0009	0.0010 - 0.0014	0.0013 - 0.0019	0.0016 - 0.0024	0.0018 - 0.0028	0.0022 - 0.0034	0.0024 - 0.0040
		Roughing	1 x D	.5 x D	3	260 - 295	0.0011 - 0.0015	0.0015 - 0.0020	0.0020 - 0.0028	0.0026 - 0.0036	0.0030 - 0.0043	0.0035 - 0.0050	0.0039 - 0.0060
		Finishing	1.5 x D	.015 x D	3	305 - 335	0.0012 - 0.0016	0.0017 - 0.0022	0.0023 - 0.0030	0.0028 - 0.0037	0.0034 - 0.0045	0.0039 - 0.0053	0.0044 - 0.0063
	DIFFICULT TO MACHINE 31 - 50 HRc 13-8 PH; 15-5 PH; 17-4 PH; Carpenter; Custo 465; Invar	Slotting	.5 x D	1 x D	3	210 - 240	0.0006 - 0.0008	0.0008 - 0.0012	0.0011 - 0.0017	0.0013 - 0.0021	0.0015 - 0.0025	0.0018 - 0.0030	0.0020 - 0.0036
		Roughing	1 x D	.5 x D	3	260 - 295	0.0007 - 0.0011	0.0009 - 0.0014	0.0012 - 0.0020	0.0016 - 0.0026	0.0018 - 0.0031	0.0021 - 0.0036	0.0023 - 0.0044
		Finishing	1.5 x D	.015 x D	3	305 - 335	0.0011 - 0.0015	0.0015 - 0.0020	0.0021 - 0.0028	0.0025 - 0.0034	0.0031 - 0.0042	0.0036 - 0.0050	0.0040 - 0.0059
CAST IRON	GRAY 100 - 200 HRb	Slotting	.5 x D	1 x D	3	260 - 295	0.0012 - 0.0014	0.0017 - 0.0021	0.0023 - 0.0029	0.0028 - 0.0036	0.0033 - 0.0043	0.0039 - 0.0051	0.0044 - 0.0060
		Roughing	1 x D	.5 x D	3	305 - 350	0.0014 - 0.0018	0.0020 - 0.0025	0.0026 - 0.0034	0.0033 - 0.0043	0.0039 - 0.0052	0.0046 - 0.0061	0.0051 - 0.0072
		Finishing	1.5 x D	.015 x D	3	355 - 390	0.0014 - 0.0018	0.0020 - 0.0025	0.0027 - 0.0034	0.0033 - 0.0042	0.0040 - 0.0051	0.0046 - 0.0060	0.0052 - 0.0071
	DUCTILE 150 - 300 HRb	Slotting	.5 x D	1 x D	3	260 - 295	0.0012 - 0.0014	0.0017 - 0.0021	0.0023 - 0.0029	0.0028 - 0.0036	0.0033 - 0.0043	0.0039 - 0.0051	0.0044 - 0.0060
		Roughing	1 x D	.5 x D	3	305 - 350	0.0014 - 0.0018	0.0020 - 0.0025	0.0026 - 0.0034	0.0033 - 0.0043	0.0039 - 0.0052	0.0046 - 0.0061	0.0051 - 0.0072
		Finishing	1.5 x D	.015 x D	3	355 - 390	0.0014 - 0.0018	0.0020 - 0.0025	0.0027 - 0.0034	0.0033 - 0.0042	0.0040 - 0.0051	0.0046 - 0.0060	0.0052 - 0.0071
	MALLEABLE 150 - 310 HRb	Slotting	.5 x D	1 x D	3	235 - 270	0.0010 - 0.0012	0.0014 - 0.0018	0.0019 - 0.0025	0.0023 - 0.0031	0.0027 - 0.0037	0.0032 - 0.0044	0.0036 - 0.0052
		Roughing	1 x D	.5 x D	3	285 - 325	0.0013 - 0.0017	0.0018 - 0.0023	0.0024 - 0.0032	0.0031 - 0.0041	0.0036 - 0.0049	0.0042 - 0.0057	0.0047 - 0.0068
		Finishing	1.5 x D	.015 x D	3	330 - 360	0.0014 - 0.0018	0.0020 - 0.0025	0.0027 - 0.0034	0.0033 - 0.0042	0.0040 - 0.0051	0.0046 - 0.0060	0.0052 - 0.0071

D = tool diameter • Reduce feed rates by 20% when using long length tools • Use reduced neck tooling for long reach slotting • Starting parameters shown

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ZEPHYR3™
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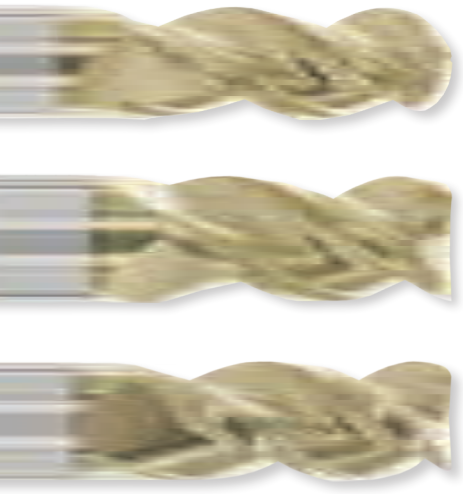

UNQUESTIONABLE RESULTS

Achieving an average performance improvement of over 50% in field tests, our customers swear by the Zephyr3. Our proprietary design uses the most advanced machining and coating processes, combined with an innovative advanced variable geometry, to create the ultimate aluminum and non-ferrous material end mill.

Engineered for unquestionable results, the Zephyr3 was designed for high speeds and feeds. A variable pitch, variable index, variable core design combines with the strength of our eccentric relief, to create an exceptional performing tool, in all non-ferrous materials.

Whether cutting copper, magnesium or any grade of aluminum, the Zephyr3 has incredible material removal rates. Rather than adding additional shifts, machines or personnel, use the right tool for the job and increase your machining capacity.

A TRUSTED INDUSTRY LEADER

We encourage customers to test our end mills for performance and production enhancements against any manufacturer. For over 70 years, we've been creating and innovating the best specialty and performance cutting tools in the market. It is never easy staying ahead of the competition, but having the experience and investing in the latest technologies gives us an edge in the market today.

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FOR CHATTER-FREE MACHINING OF NON-FERROUS MATERIALS

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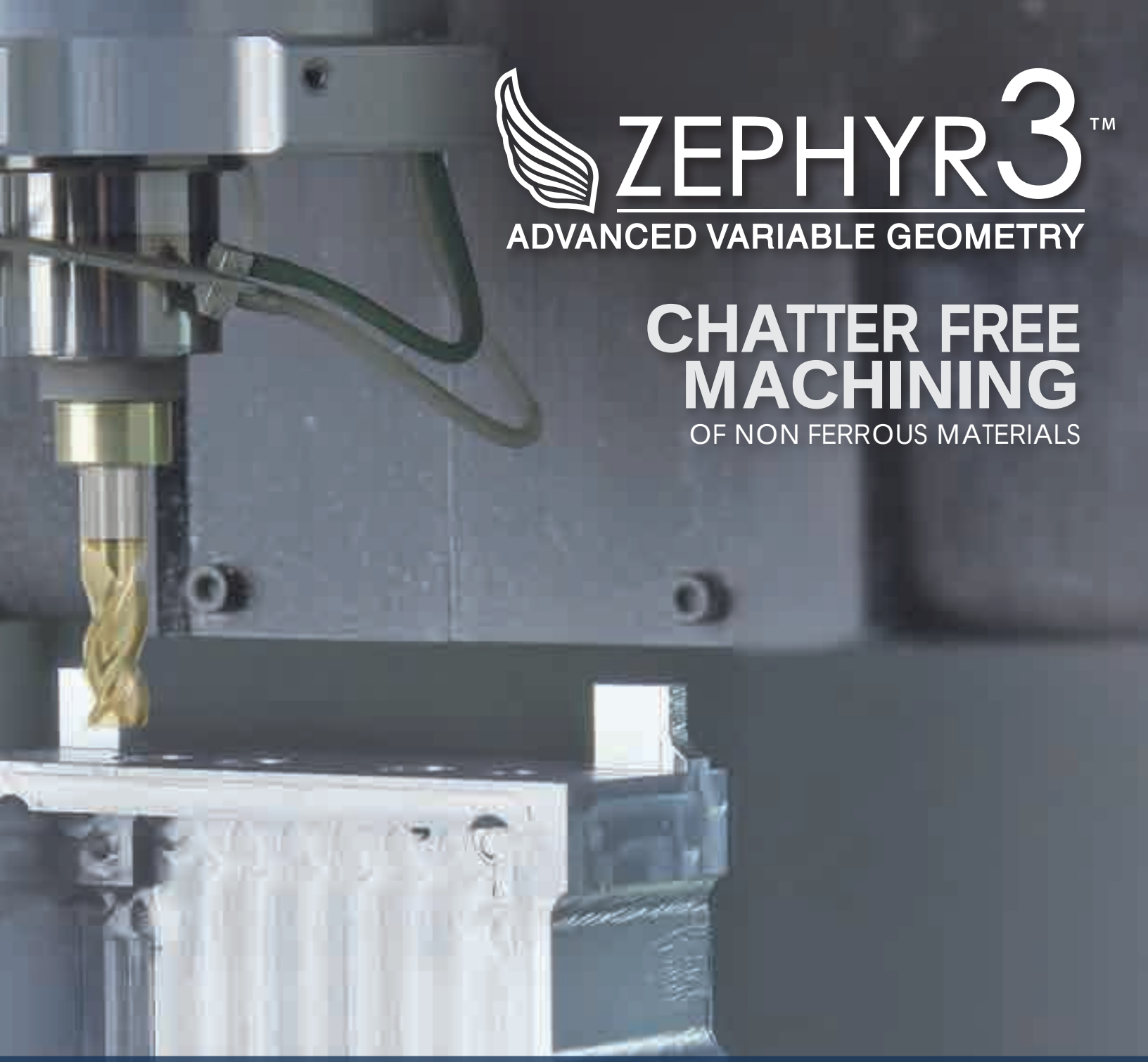

ZEPHYR3™

ADVANCED VARIABLE GEOMETRY

CHATTER FREE MACHINING

OF NON FERROUS MATERIALS

FEATURES & BENEFITS

The Zephyr3 3 flute is yet another testament to the adaptability of Global Cutting Tools. We are proud to boast about the fact this tool increased performance in tests by over 50%, while leaving exemplary surface finishes. The Zephyr3 is a trifecta of strength, endurance and rapid material removal. The eccentric relief and variable pitch design of this end mill enable operations at vastly improved speeds and feeds. This tool has standard ZrN coating for added lubricity and hardness, giving the tool a pale gold coloration.

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GLOBAL™
CUTTING TOOLS

SERIES: AVX

For high feed / material removal rate of aluminum and non-ferrous materials to maximize productivity and surface finish while roughing, slotting, pocketing and finishing ; wet or dry; aluminum, magnesium, and copper alloys, composites, plastics and fiberglass.

Square end option to create sharp corners in finishing operations

Coated for heat resistance, wear resistance and increased lubricity

Three flute design improves chip formation and evacuation

Variable pitch helix angle reduces cutting forces by creating a higher shearing plane for better efficiencies, chip management and longer tool life

Eccentric relief for enhanced edge strength along the flutes

Corner radius option protects corners in roughing operations and difficult to machine materials by preventing corner chipping and tool failure

Ball end option for high performance contour milling in finishing operations

Premium micro-grain carbide substrate resists chipping, tool deflection, and has a high transverse rupture strength for greater feeds and speeds

Vibration Dampening Geometry: Variable Pitch, Variable Index, Increased Core and Cutting Flute Engagement

Edge prep drag finishing increases tool life by improving the surface quality in the flute and radiusing the cutting edge of the tool, reducing the potential for premature failure.

Odd number of flutes reduce harmonics by staggering the entry and exit of the cutting edges. Immediate 50% increase in performance over 2 flute designs

Post polishing is performed after the tools are coated to remove surface inconsistencies and increase lubricity. This also increases feed rates and allows for smoother operations. The tool runs cooler and performs longer

TIP OPTIONS

SHANK OPTIONS

FLUTE OPTIONS

MATERIALS

CB
SUB-MICRO GRAIN CARBIDE

COATING

ZrN

RESULTS

At Global we know results are all that matter. The Zephyr3 offers multiple end, shank and length configurations, to turn materials like copper, magnesium and any grade of aluminum into a job well done. The advantage of a better tool is never taken for granted by our end users. The Zephyr3 end mills increase machine time utilization and lower tooling costs by increasing rigidity, stability, and chip evacuation at high speeds, or when the cutter is fully engaged. Run this end mill with any plastics, or fiberglass, but be prepared to get the work done a little quicker than usual.

Series AVX: Micro-Grain Carbide, 3 Flute, Advanced Variable Geometry, ZrN Coated
Subseries: AVXSR, AVXCR, AVXBR
Configuration: Variable Pitch 30-48°; Stub, Regular & Long Lengths;
Variable Helix; Square End, Corner Radius & Ball End

ZEPHYR3

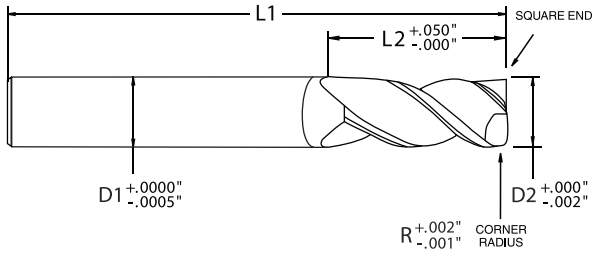
GLOBAL™

SERIES AVX - *CARBIDE, 3 FLUTE, ADVANCED VARIABLE GEOMETRY*

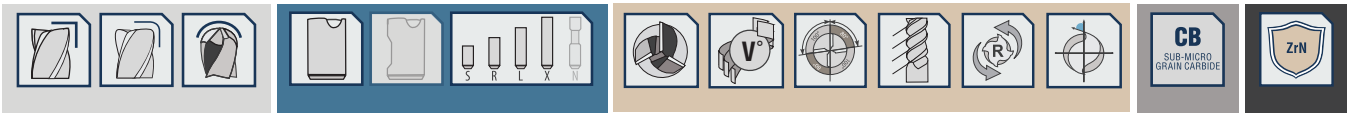
ADVANCED MACHINING

Our proprietary design uses the most advanced machining and coating processes, combined with an innovative advanced variable geometry, to create the ultimate aluminum and non-ferrous material end mill.

- Square end option to create sharp corners in finishing operations
- Three flute design improves chip formation and evacuation
- Cylindrical land for excellent surface finishes
- High strength flutes reduce edge chipping, built up edge and extends tool life



TIP & END | SHANK & LENGTH | FLUTE CONFIGURATION | MATERIAL | COATING



SERIES AVX - *SQUARE END & CORNER RADIUS, PLAIN SHANK*

SHANK DIAMETER (D1)		CUTTER DIAMETER (D2)		FLUTE LENGTH (L2)		OVERALL LENGTH (L1)		SQUARE END		CORNER RADIUS .015 (R)		.030 (R)		.060 (R)		.090 (R)	
								PART #	EDP #	PART #	EDP #	PART #	EDP #	PART #	EDP #	PART #	EDP #
1/8	0.125	1/8	0.125	3/8	0.375	2	2.000	AVX-0206-SQ	A001S	AVX-0206-R1	A0011	—	—	—	—	—	—
				5/8	0.625	2	2.000	AVX-0210-SQ	A002S	AVX-0210-R1	A0021	—	—	—	—	—	—
3/16	0.188	3/16	0.188	3/8	0.375	2	2.000	AVX-0306-SQ	A003S	AVX-0306-R1	A0031	AVX-0306-R3	A0013	—	—	—	—
				5/8	0.625	2	2.000	AVX-0310-SQ	A004S	AVX-0310-R1	A0041	AVX-0310-R3	A0023	—	—	—	—
1/4	0.250	1/4	0.250	3/8	0.375	2	2.000	AVX-0406-SQ	A005S	AVX-0406-R1	A0051	AVX-0406-R3	A0033	AVX-0406-R6	A0016	—	—
				7/8	0.875	2 1/2	2.500	AVX-0414-SQ	A006S	AVX-0414-R1	A0061	AVX-0414-R3	A0043	AVX-0414-R6	A0026	—	—
				1 3/8	1.375	3	3.000	AVX-0422-SQ	A007S	AVX-0422-R1	A0071	AVX-0422-R3	A0053	AVX-0422-R6	A0036	—	—
5/16	0.313	5/16	0.313	1/2	0.500	2	2.000	AVX-0508-SQ	A008S	AVX-0508-R1	A0081	AVX-0508-R3	A0063	AVX-0508-R6	A0046	—	—
				7/8	0.875	2 1/2	2.500	AVX-0514-SQ	A009S	AVX-0514-R1	A0091	AVX-0514-R3	A0073	AVX-0514-R6	A0056	—	—
				1 3/8	1.375	3	3.000	AVX-0522-SQ	A010S	AVX-0522-R1	A0101	AVX-0522-R3	A0083	AVX-0522-R6	A0066	—	—
3/8	0.375	3/8	0.375	5/8	0.625	2	2.000	AVX-0610-SQ	A011S	AVX-0610-R1	A0111	AVX-0610-R3	A0093	AVX-0610-R6	A0076	AVX-0610-R9	A0017
				7/8	0.875	2 1/2	2.500	AVX-0614-SQ	A012S	AVX-0614-R1	A0121	AVX-0614-R3	A0103	AVX-0614-R6	A0086	AVX-0614-R9	A0027
				1 3/8	1.375	3	3.000	AVX-0622-SQ	A013S	AVX-0622-R1	A0131	AVX-0622-R3	A0113	AVX-0622-R6	A0096	AVX-0622-R9	A0037
				1 7/8	1.875	3 1/2	3.500	AVX-0630-SQ	A014S	AVX-0630-R1	A0141	AVX-0630-R3	A0123	AVX-0630-R6	A0106	AVX-0630-R9	A0047
				2 1/8	2.125	4	4.000	AVX-0634-SQ	A015S	AVX-0634-R1	A0151	AVX-0634-R3	A0133	AVX-0634-R6	A0116	AVX-0634-R9	A0057
7/16	0.438	7/16	0.438	5/8	0.625	2 1/2	2.500	AVX-0710-SQ	A016S	AVX-0710-R1	A0161	AVX-0710-R3	A0143	AVX-0710-R6	A0126	AVX-0710-R9	A0067
				1 1/8	1.125	3	3.000	AVX-0718-SQ	A017S	AVX-0718-R1	A0171	AVX-0718-R3	A0153	AVX-0718-R6	A0136	AVX-0718-R9	A0077
				2 1/8	2.125	4	4.000	AVX-0734-SQ	A018S	AVX-0734-R1	A0181	AVX-0734-R3	A0163	AVX-0734-R6	A0146	AVX-0734-R9	A0087
1/2	0.500	1/2	0.500	5/8	0.625	2 1/2	2.500	AVX-0810-SQ	A019S	AVX-0810-R1	A0191	AVX-0810-R3	A0173	AVX-0810-R6	A0156	AVX-0810-R9	A0097
				1 1/8	1.125	3	3.000	AVX-0818-SQ	A020S	AVX-0818-R1	A0201	AVX-0818-R3	A0183	AVX-0818-R6	A0166	AVX-0818-R9	A0107
				1 5/8	1.625	3 1/2	3.500	AVX-0826-SQ	A021S	AVX-0826-R1	A0211	AVX-0826-R3	A0193	AVX-0826-R6	A0176	AVX-0826-R9	A0117
				2 1/8	2.125	4	4.000	AVX-0834-SQ	A022S	AVX-0834-R1	A0221	AVX-0834-R3	A0203	AVX-0834-R6	A0186	AVX-0834-R9	A0127
				2 5/8	2.625	5	5.000	AVX-0842-SQ	A023S	AVX-0842-R1	A0231	AVX-0842-R3	A0213	AVX-0842-R6	A0196	AVX-0842-R9	A0137
				3 3/8	3.375	6	6.000	AVX-0854-SQ	A024S	AVX-0854-R1	A0241	AVX-0854-R3	A0223	AVX-0854-R6	A0206	AVX-0854-R9	A0147
5/8	0.625	5/8	0.625	7/8	0.875	3	3.000	AVX-1014-SQ	A025S	—	—	AVX-1014-R3	A0233	AVX-1014-R6	A0216	AVX-1014-R9	A0157
				1 5/8	1.625	3 1/2	3.500	AVX-1026-SQ	A026S	—	—	AVX-1026-R3	A0243	AVX-1026-R6	A0226	AVX-1026-R9	A0167
				2 1/8	2.125	4	4.000	AVX-1034-SQ	A027S	—	—	AVX-1034-R3	A0253	AVX-1034-R6	A0236	AVX-1034-R9	A0177
				2 5/8	2.625	5	5.000	AVX-1042-SQ	A028S	—	—	AVX-1042-R3	A0263	AVX-1042-R6	A0246	AVX-1042-R9	A0187
				3 3/8	3.375	6	6.000	AVX-1054-SQ	A029S	—	—	AVX-1054-R3	A0273	AVX-1054-R6	A0256	AVX-1054-R9	A0197
3/4	0.750	3/4	0.750	1 1/8	1.125	3	3.000	AVX-1218-SQ	A030S	—	—	AVX-1218-R3	A0283	AVX-1218-R6	A0266	AVX-1218-R9	A0207
				1 5/8	1.625	4	4.000	AVX-1226-SQ	A031S	—	—	AVX-1226-R3	A0293	AVX-1226-R6	A0276	AVX-1226-R9	A0217
				2 5/8	2.625	5	5.000	AVX-1242-SQ	A032S	—	—	AVX-1242-R3	A0303	AVX-1242-R6	A0286	AVX-1242-R9	A0227
				3 3/8	3.375	6	6.000	AVX-1254-SQ	A033S	—	—	AVX-1254-R3	A0313	AVX-1254-R6	A0296	AVX-1254-R9	A0237
				4 1/8	4.125	7	7.000	AVX-1266-SQ	A034S	—	—	AVX-1266-R3	A0323	AVX-1266-R6	A0306	AVX-1266-R9	A0247
1	1.000	1	1.000	1 5/8	1.625	4	4.000	AVX-1626-SQ	A035S	—	—	AVX-1626-R3	A0333	AVX-1626-R6	A0316	AVX-1626-R9	A0257
				2 1/8	2.125	4	4.000	AVX-1634-SQ	A036S	—	—	AVX-1634-R3	A0343	AVX-1634-R6	A0326	AVX-1634-R9	A0267
				2 5/8	2.625	5	5.000	AVX-1642-SQ	A037S	—	—	AVX-1642-R3	A0353	AVX-1642-R6	A0336	AVX-1642-R9	A0277
				3 3/8	3.375	6	6.000	AVX-1654-SQ	A038S	—	—	AVX-1654-R3	A0363	AVX-1654-R6	A0346	AVX-1654-R9	A0287
				4 3/8	4.375	7	7.000	AVX-1670-SQ	A039S	—	—	AVX-1670-R3	A0613	AVX-1670-R6	A0356	AVX-1670-R9	A0297

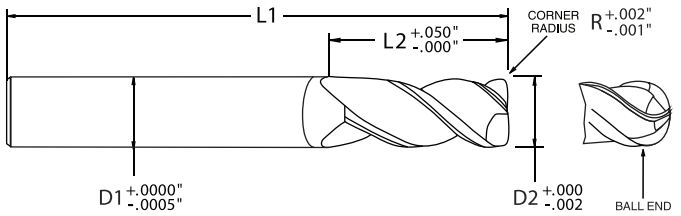
(continued)

SERIES AVX - *CARBIDE, 3 FLUTE, ADVANCED VARIABLE GEOMETRY*

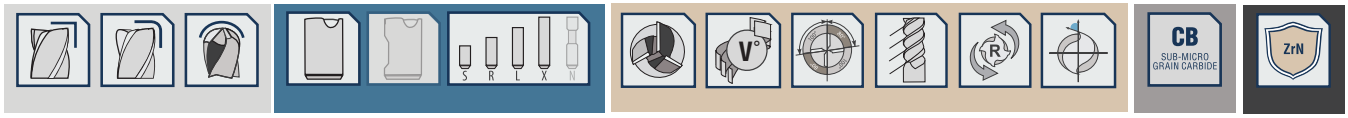
EXCEPTIONAL PERFORMANCE

A variable pitch, variable index, variable core design combines with the strength of our eccentric relief, to create an exceptional performing tool, in all non-ferrous materials.

- Corner radius option protects corners in roughing operations and difficult to machine materials by preventing corner chipping and tool failure
- Ball end option for high performance contour milling in finishing operations
- Odd number of flutes reduce harmonics by staggering the entry and exit of the cutting edges



TIP & END | SHANK & LENGTH | FLUTE CONFIGURATION | MATERIAL | COATING



SERIES AVX - *CORNER RADIUS & BALL END, PLAIN SHANK*

SHANK DIAMETER (D1)		CUTTER DIAMETER (D2)		FLUTE LENGTH (L2)		OVERALL LENGTH (L1)		CORNER RADIUS .125 (R) PART #	.125 (R) EDP #	.156 (R) PART #	.156 (R) EDP #	.190 (R) PART #	.190 (R) EDP #	.250 (R) PART #	.250 (R) EDP #	BALL END PART #	BALL END EDP #
1/8	0.125	1/8	0.125	3/8	0.375	2	2.000	—	—	—	—	—	—	—	—	—	—
				5/8	0.625	2	2.000	—	—	—	—	—	—	—	—	AVX-0210-BE	A201B
3/16	0.188	3/16	0.188	3/8	0.375	2	2.000	—	—	—	—	—	—	—	—	—	—
				5/8	0.625	2	2.000	—	—	—	—	—	—	—	—	AVX-0310-BE	A202B
1/4	0.250	1/4	0.250	3/8	0.375	2	2.000	—	—	—	—	—	—	—	—	—	—
				7/8	0.875	2 1/2	2.500	—	—	—	—	—	—	—	—	AVX-0414-BE	A203B
				1 3/8	1.375	3	3.000	—	—	—	—	—	—	—	—	—	—
5/16	0.313	5/16	0.313	1/2	0.500	2	2.000	—	—	—	—	—	—	—	—	—	—
				7/8	0.875	2 1/2	2.500	—	—	—	—	—	—	—	—	AVX-0514-BE	A204B
				1 3/8	1.375	3	3.000	—	—	—	—	—	—	—	—	—	—
3/8	0.375	3/8	0.375	5/8	0.625	2	2.000	—	—	—	—	—	—	—	—	—	—
				7/8	0.875	2 1/2	2.500	—	—	—	—	—	—	—	—	AVX-0614-BE	A205B
				1 3/8	1.375	3	3.000	—	—	—	—	—	—	—	—	—	—
				1 7/8	1.875	3 1/2	3.500	—	—	—	—	—	—	—	—	—	—
				2 1/8	2.125	4	4.000	—	—	—	—	—	—	—	—	—	—
7/16	0.438	7/16	0.438	5/8	0.625	2 1/2	2.500	—	—	—	—	—	—	—	—	—	—
				1 1/8	1.125	3	3.000	—	—	—	—	—	—	—	—	AVX-0718-BE	A206B
				2 1/8	2.125	4	4.000	—	—	—	—	—	—	—	—	—	—
1/2	0.500	1/2	0.500	5/8	0.625	2 1/2	2.500	AVX-0810-R12	A0018	—	—	—	—	—	—	—	—
				1 1/8	1.125	3	3.000	AVX-0818-R12	A0028	—	—	—	—	—	—	AVX-0818-BE	A207B
				1 5/8	1.625	3 1/2	3.500	AVX-0826-R12	A0038	—	—	—	—	—	—	—	—
				2 1/8	2.125	4	4.000	AVX-0834-R12	A0048	—	—	—	—	—	—	—	—
				2 5/8	2.625	5	5.000	AVX-0842-R12	A0058	—	—	—	—	—	—	—	—
				3 3/8	3.375	6	6.000	AVX-0854-R12	A0068	—	—	—	—	—	—	—	—
5/8	0.625	5/8	0.625	7/8	0.875	3	3.000	AVX-1014-R12	A0078	—	—	—	—	—	—	—	—
				1 5/8	1.625	3 1/2	3.500	AVX-1026-R12	A0088	—	—	—	—	—	—	AVX-1026-BE	A208B
				2 1/8	2.125	4	4.000	AVX-1034-R12	A0098	—	—	—	—	—	—	—	—
				2 5/8	2.625	5	5.000	AVX-1042-R12	A0108	—	—	—	—	—	—	—	—
				3 3/8	3.375	6	6.000	AVX-1054-R12	A0118	—	—	—	—	—	—	—	—
3/4	0.750	3/4	0.750	1 1/8	1.125	3	3.000	AVX-1218-R12	A0128	AVX-1218-R15	A0019	AVX-1218-R19	A0010	—	—	—	—
				1 5/8	1.625	4	4.000	AVX-1226-R12	A0138	AVX-1226-R15	A0029	AVX-1226-R19	A0020	—	—	AVX-1226-BE	A209B
				2 5/8	2.625	5	5.000	AVX-1242-R12	A0148	AVX-1242-R15	A0039	AVX-1242-R19	A0030	—	—	—	—
				3 3/8	3.375	6	6.000	AVX-1254-R12	A0158	AVX-1254-R15	A0049	AVX-1254-R19	A0040	—	—	—	—
				4 1/8	4.125	7	7.000	AVX-1266-R12	A0168	AVX-1266-R15	A0059	AVX-1266-R19	A0050	—	—	—	—
1	1.000	1	1.000	1 5/8	1.625	4	4.000	AVX-1626-R12	A0178	AVX-1626-R15	A0069	AVX-1626-R19	A0060	AVX-1626-R25	A0110	—	—
				2 1/8	2.125	4	4.000	AVX-1634-R12	A0188	AVX-1634-R15	A0079	AVX-1634-R19	A0070	AVX-1634-R25	A0120	AVX-1634-BE	A210B
				2 5/8	2.625	5	5.000	AVX-1642-R12	A0198	AVX-1642-R15	A0089	AVX-1642-R19	A0080	AVX-1642-R25	A0130	—	—
				3 3/8	3.375	6	6.000	AVX-1654-R12	A0208	AVX-1654-R15	A0099	AVX-1654-R19	A0090	AVX-1654-R25	A0140	—	—
				4 3/8	4.375	7	7.000	AVX-1670-R12	A0218	AVX-1670-R15	A0109	AVX-1670-R19	A0100	AVX-1670-R25	A0150	—	—

AVX APPLICATION GUIDE • SPEED & FEED

	WORK MATERIAL	TYPE OF CUT	AXIAL DOC	RADIAL DOC	NO. OF FLUTES	SPEED (SFM)	FEED (INCHES PER TOOTH) 1/8" (2 & 3 FL)	1/4" (2 & 3 FL)	3/8" (2 & 3 FL)	1/2" (2 & 3 FL)	5/8" (2 & 3 FL)	3/4" (2 & 3 FL)	1" (2 & 3 FL)
ALUMINUM	ALUMINUM ALLOYS Low Silicon Content 20xx; 50xx; 60xx; 70xx	Slotting	1 x D	1 x D	3	905 - 1040	0.0014 - 0.0016	0.0027 - 0.0031	0.0041 - 0.0047	0.0054 - 0.0062	0.0067 - 0.0077	0.0081 - 0.0093	0.0108 - 0.0124
		Roughing	1 x D	.75 x D	3	1115 - 1280	0.0017 - 0.0021	0.0033 - 0.0038	0.0049 - 0.0057	0.0066 - 0.0076	0.0082 - 0.0095	0.0099 - 0.0114	0.0131 - 0.0152
		High Effeciency (HEM)	2 x D	.2 x D	3	1395 - 1550	0.0031 - 0.0034	0.0061 - 0.0067	0.0091 - 0.0101	0.0121 - 0.0134	0.0151 - 0.0168	0.0182 - 0.0201	0.0242 - 0.0269
		Finishing	1.5 x D	.01 x D	3	1330 - 1460	0.0020 - 0.0024	0.0039 - 0.0044	0.0059 - 0.0066	0.0078 - 0.0087	0.0098 - 0.0109	0.0117 - 0.0131	0.0156 - 0.0175
	ALUMINUM DIE CAST ALLOY High Silicon Content A-38x; A-39x; B39x	Slotting	.75 x D	1 x D	3	760 - 870	0.0012 - 0.0014	0.0023 - 0.0027	0.0035 - 0.0041	0.0046 - 0.0054	0.0057 - 0.0067	0.0069 - 0.0081	0.0092 - 0.0108
		Roughing	1 x D	.5 x D	3	935 - 1075	0.0015 - 0.0019	0.0029 - 0.0034	0.0043 - 0.0051	0.0058 - 0.0068	0.0072 - 0.0085	0.0087 - 0.0102	0.0115 - 0.0136
		High Effeciency (HEM)	2 x D	.15 x D	3	1170 - 1300	0.0024 - 0.0027	0.0048 - 0.0054	0.0071 - 0.0081	0.0094 - 0.0107	0.0117 - 0.0134	0.0141 - 0.0160	0.0188 - 0.0215
		Finishing	1.5 x D	.01 x D	3	1140 - 1250	0.0018 - 0.0022	0.0035 - 0.0040	0.0053 - 0.0060	0.0070 - 0.0079	0.0088 - 0.0099	0.0105 - 0.0119	0.0140 - 0.0159
NONFERROUS	MAGNESIUM ALLOYS ≤ 38 HRc	Slotting	1 x D	1 x D	3	905 - 1040	0.0014 - 0.0016	0.0027 - 0.0031	0.0041 - 0.0047	0.0054 - 0.0062	0.0067 - 0.0077	0.0081 - 0.0093	0.0108 - 0.0124
		Roughing	1 x D	.75 x D	3	1115 - 1280	0.0017 - 0.0021	0.0033 - 0.0038	0.0049 - 0.0057	0.0066 - 0.0076	0.0082 - 0.0095	0.0099 - 0.0114	0.0131 - 0.0152
		High Effeciency (HEM)	2 x D	.2 x D	3	1395 - 1550	0.0033 - 0.0036	0.0064 - 0.0070	0.0096 - 0.0106	0.0127 - 0.0140	0.0158 - 0.0175	0.0191 - 0.0210	0.0254 - 0.0281
		Finishing	1.5 x D	.01 x D	3	1330 - 1460	0.0021 - 0.0025	0.0041 - 0.0046	0.0062 - 0.0069	0.0082 - 0.0091	0.0103 - 0.0114	0.0123 - 0.0137	0.0164 - 0.0183
	COPPER ALLOYS, BRASS & BRONZE 39 to 48 HRc Manganese Bronze, Tin Bronze, Beryllium	Slotting	1 x D	1 x D	3	760 - 870	0.0012 - 0.0014	0.0023 - 0.0027	0.0035 - 0.0041	0.0046 - 0.0054	0.0057 - 0.0067	0.0069 - 0.0081	0.0092 - 0.0108
		Roughing	1 x D	.75 x D	3	935 - 1075	0.0015 - 0.0019	0.0029 - 0.0034	0.0043 - 0.0051	0.0058 - 0.0068	0.0072 - 0.0085	0.0087 - 0.0102	0.0115 - 0.0136
		High Effeciency (HEM)	2 x D	.2 x D	3	1170 - 1300	0.0028 - 0.0031	0.0055 - 0.0061	0.0082 - 0.0092	0.0108 - 0.0121	0.0135 - 0.0152	0.0163 - 0.0182	0.0217 - 0.0244
		Finishing	1.5 x D	.01 x D	3	1140 - 1250	0.0018 - 0.0022	0.0035 - 0.0040	0.0053 - 0.0060	0.0070 - 0.0079	0.0088 - 0.0099	0.0105 - 0.0119	0.0140 - 0.0159
	COMPOSITES, PLASTICS & FIBERGLASS 48 to 57 HRc ABS, Polycarbonate, PVC, Polypropylene	Slotting	1 x D	1 x D	3	760 - 870	0.0012 - 0.0014	0.0023 - 0.0027	0.0035 - 0.0041	0.0046 - 0.0054	0.0057 - 0.0067	0.0069 - 0.0081	0.0092 - 0.0108
		Roughing	1 x D	.75 x D	3	935 - 1075	0.0015 - 0.0019	0.0029 - 0.0034	0.0043 - 0.0051	0.0058 - 0.0068	0.0072 - 0.0085	0.0087 - 0.0102	0.0115 - 0.0136
		High Effeciency (HEM)	2 x D	.2 x D	3	1170 - 1300	0.0028 - 0.0031	0.0055 - 0.0061	0.0082 - 0.0092	0.0108 - 0.0121	0.0135 - 0.0152	0.0163 - 0.0182	0.0217 - 0.0244
		Finishing	1.5 x D	.01 x D	3	1140 - 1250	0.0018 - 0.0022	0.0035 - 0.0040	0.0053 - 0.0060	0.0070 - 0.0079	0.0088 - 0.0099	0.0105 - 0.0119	0.0140 - 0.0159

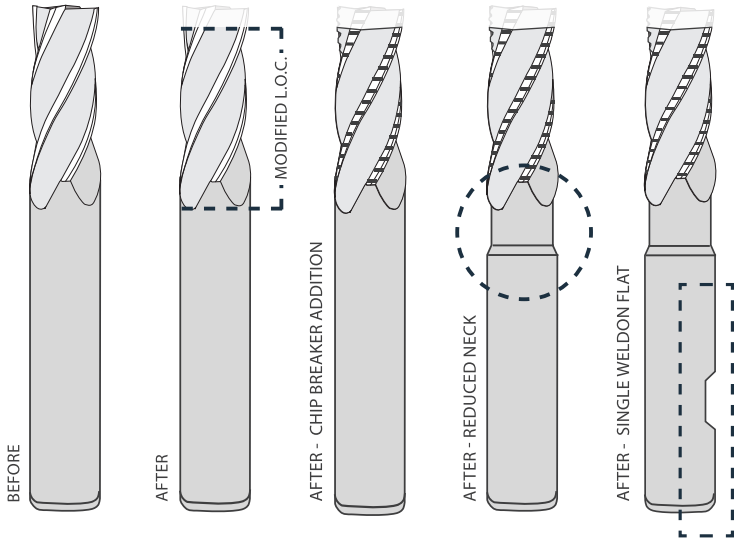
MODIFICATION PROGRAM

MODIFICATION OF IN-STOCK TOOLS

WE CAN MODIFY MOST ANY TOOL

We can modify our standard tools or manufacture a highly specialized tool to your exact specifications. Modifications ensure fast delivery of your tool (subject to availability) and decrease costs on small batch runs. Most modifications ship within 2 - 3 business days. Please allow additional time when adding coatings. If you need assistance with modification selection or have any questions, please contact us.

SEE PAGE 16 - 21 FOR DETAILS



NEW PREMIUM TOOL LINE!

ALUMINUM 2&3™

HIGH PERFORMANCE MILLING

AMERICAN MADE

GLOBALLY RENOWNED

HIGH PERFORMANCE END MILLS

HIGH FEED AND REMOVAL RATES OF NON-FERROUS MATERIALS

GLOBAL™ CUTTING TOOLS

www.conicalendmills.com | www.globalcuttingtools.com

ALUMINUM 2&3™

HIGH PERFORMANCE MILLING

HIGH FEED & REMOVAL RATES

FOR FERROUS MATERIALS

FEATURES & BENEFITS

The Aluminum 2&3 is no exception to the Global commitment for continuous improvement. These end mills offer multi-functionality and cost effectiveness, rarely attained in an end mill. Premium micro-grain carbide substrate resists chipping, tool deflection, and has a high transverse rupture strength, for greater feeds and speeds. The numerous combinations of tip, shank, flute and coating options, make this end mill popular among users who have a diversity of materials they need to process.

General Inquiries:
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Custom Tooling:
E: quotes@conicaltool.com
W: conicalendmills.com/custom-tool-ordering

GLOBAL™
CUTTING TOOLS

SERIES: AL2 & AL3

For high feed / material removal rate of aluminum and non-ferrous materials to maximize productivity and surface finish while roughing, slotting, pocketing and finishing ; wet or dry; aluminum, magnesium, and copper alloys, composites, plastics and fiberglass.

Square end option to create sharp corners in finishing operations

Ball end option for high performance contour milling in finishing operations

Two flute design permits maximum chip evacuation while high performance milling in heavy roughing or slotting operations at increased depths

Cylindrical land for excellent surface finishes

Cylindrical flute grind / relief for enhanced chip formation and improved chip evacuation

Corner radius option protects corners in roughing operations and difficult to machine materials by preventing corner chipping and tool failure

Odd number of flutes reduce harmonics by staggering the entry and exit of the cutting edges

Improved tool engagement through 3 flute design creates more stability in the cut and a superior surface finish

Secondary flute polish creates an internal chip breaker, improving chip management and evacuation.

Premium micro-grain carbide substrate resists chipping, tool deflection, and has a high transverse rupture strength for greater feeds and speeds

Proper chip evacuation allows for increased material removal rates at lower horsepower

Immediate 50% increase in performance over 2 flute designs

Chip evacuation reduces spindle drag to maximize the horsepower available for increased feed rates

TIP OPTIONS | **SHANK OPTIONS** | **FLUTE OPTIONS** | **MATERIALS** | **COATINGS**

STANDARD | OPTIONAL | OPTIONAL

RESULTS

These end mills breeze through non-ferrous materials like brass, bronze, copper, plastics, and of course aluminum. Their performance leaves little to question about its effectiveness or value. Coatings are optional to fine tune the end mill to your application and material, yet this tool still produces increased material removal rates even with lower horsepower machines. This tool gives you solutions to complex machining challenges, while simplifying the process and delivering consistent results with measurable success.

Series AL2 & AL3: Micro-Grain Carbide, 2 & 3 Flute, 45° Constant Helix
Subseries: AL2SR, AL2CR, AL2BR, AL2SS, AL2CS, AL2BS, AL2SL, AL2CL, AL2BL, AL3SR, AL3CR, AL3BR, AL3SS, AL3CS, AL3BS, AL3SL, AL3CL, AL3BL
Configuration: Varying Diameters; Stub, Regular & Long Lengths;
45° Constant Helix; Square End, Corner Radius & Ball End (2 Flute only)

ALUMINUM 2 FLUTE

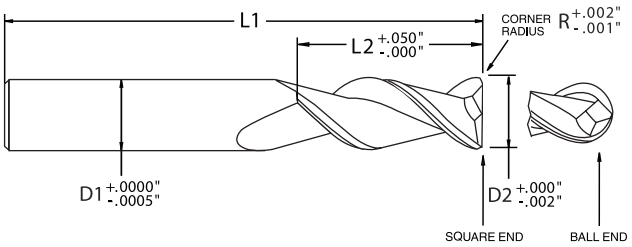
GLOBAL™

SERIES AL2 - *CARBIDE, 2 FLUTE, 45° CONSTANT HELIX*

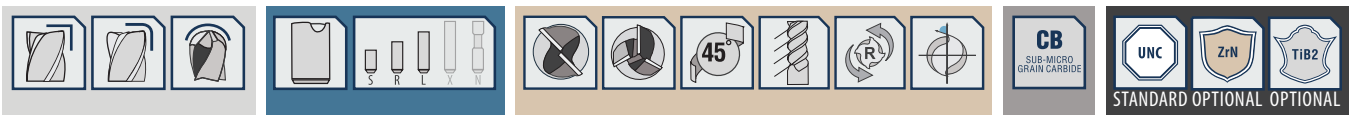
FOR USE IN DIVERSE MATERIALS

The numerous combinations of tip, shank, flute and coating options, make this end mill popular among users who have a diversity of materials they need to process.

- Square end option to create sharp corners in finishing operations
- Two flute design permits maximum chip evacuation while high performance milling in heavy roughing or slotting operations at increased depths
- Cylindrical land for excellent surface finishes• Cylindrical flute grind / relief for enhanced chip formation and improved chip evacuation



TIP & END | SHANK & LENGTH | FLUTE CONFIGURATION | MATERIAL | COATINGS



SERIES AL2SR - *SQUARE END & CORNER RADIUS, PLAIN SHANK*

SHANK DIAMETER (D1)		CUTTER DIAMETER (D2)		FLUTE LENGTH (L2)		OVERALL LENGTH (L1)		SQUARE END		CORNER RADIUS .015 (R)		.030 (R)		.060 (R)		.090 (R)	
								PART #	EDP #	PART #	EDP #	PART #	EDP #	PART #	EDP #	PART #	EDP #
1/8	0.125	1/8	0.125	3/8	0.375	2	2.000	AL2-0206-SQ	B001S	AL2-0206-R1	B0011	—	—	—	—	—	—
				5/8	0.625	2	2.000	AL2-0210-SQ	B002S	AL2-0210-R1	B0021	—	—	—	—	—	—
3/16	0.188	3/16	0.188	3/8	0.375	2	2.000	AL2-0306-SQ	B003S	AL2-0306-R1	B0031	AL2-0306-R3	B0013	—	—	—	—
				5/8	0.625	2	2.000	AL2-0310-SQ	B004S	AL2-0310-R1	B0041	AL2-0310-R3	B0023	—	—	—	—
1/4	0.250	1/4	0.250	3/8	0.375	2	2.000	AL2-0406-SQ	B005S	AL2-0406-R1	B0051	AL2-0406-R3	B0033	AL2-0406-R6	B0016	—	—
				7/8	0.875	2 1/2	2.500	AL2-0414-SQ	B006S	AL2-0414-R1	B0061	AL2-0414-R3	B0043	AL2-0414-R6	B0026	—	—
				1 3/8	1.375	3	3.000	AL2-0422-SQ	B007S	AL2-0422-R1	B0071	AL2-0422-R3	B0053	AL2-0422-R6	B0036	—	—
5/16	0.313	5/16	0.313	1/2	0.500	2	2.000	AL2-0508-SQ	B008S	AL2-0508-R1	B0081	AL2-0508-R3	B0063	AL2-0508-R6	B0046	—	—
				7/8	0.875	2 1/2	2.500	AL2-0514-SQ	B009S	AL2-0514-R1	B0091	AL2-0514-R3	B0073	AL2-0514-R6	B0056	—	—
				1 3/8	1.375	3	3.000	AL2-0522-SQ	B010S	AL2-0522-R1	B0101	AL2-0522-R3	B0083	AL2-0522-R6	B0066	—	—
3/8	0.375	3/8	0.375	5/8	0.625	2	2.000	AL2-0610-SQ	B011S	AL2-0610-R1	B0111	AL2-0610-R3	B0093	AL2-0610-R6	B0076	AL2-0610-R9	B0017
				7/8	0.875	2 1/2	2.500	AL2-0614-SQ	B012S	AL2-0614-R1	B0121	AL2-0614-R3	B0103	AL2-0614-R6	B0086	AL2-0614-R9	B0027
				1 3/8	1.375	3	3.000	AL2-0622-SQ	B013S	AL2-0622-R1	B0131	AL2-0622-R3	B0113	AL2-0622-R6	B0096	AL2-0622-R9	B0037
				1 7/8	1.875	3 1/2	3.500	AL2-0630-SQ	B014S	AL2-0630-R1	B0141	AL2-0630-R3	B0123	AL2-0630-R6	B0106	AL2-0630-R9	B0047
				2 1/8	2.125	4	4.000	AL2-0634-SQ	B015S	AL2-0634-R1	B0151	AL2-0634-R3	B0133	AL2-0634-R6	B0116	AL2-0634-R9	B0057
7/16	0.438	7/16	0.438	5/8	0.625	2 1/2	2.500	AL2-0710-SQ	B016S	AL2-0710-R1	B0161	AL2-0710-R3	B0143	AL2-0710-R6	B0126	AL2-0710-R9	B0067
				1 1/8	1.125	3	3.000	AL2-0718-SQ	B017S	AL2-0718-R1	B0171	AL2-0718-R3	B0153	AL2-0718-R6	B0136	AL2-0718-R9	B0077
				2 1/8	2.125	4	4.000	AL2-0734-SQ	B018S	AL2-0734-R1	B0181	AL2-0734-R3	B0163	AL2-0734-R6	B0146	AL2-0734-R9	B0087
1/2	0.500	1/2	0.500	5/8	0.625	2 1/2	2.500	AL2-0810-SQ	B019S	AL2-0810-R1	B0191	AL2-0810-R3	B0173	AL2-0810-R6	B0156	AL2-0810-R9	B0097
				1 1/8	1.125	3	3.000	AL2-0818-SQ	B020S	AL2-0818-R1	B0201	AL2-0818-R3	B0183	AL2-0818-R6	B0166	AL2-0818-R9	B0107
				1 5/8	1.625	3 1/2	3.500	AL2-0826-SQ	B021S	AL2-0826-R1	B0211	AL2-0826-R3	B0193	AL2-0826-R6	B0176	AL2-0826-R9	B0117
				2 1/8	2.125	4	4.000	AL2-0834-SQ	B022S	AL2-0834-R1	B0221	AL2-0834-R3	B0203	AL2-0834-R6	B0186	AL2-0834-R9	B0127
				2 5/8	2.625	5	5.000	AL2-0842-SQ	B023S	AL2-0842-R1	B0231	AL2-0842-R3	B0213	AL2-0842-R6	B0196	AL2-0842-R9	B0137
				3 3/8	3.375	6	6.000	AL2-0854-SQ	B024S	AL2-0854-R1	B0241	AL2-0854-R3	B0223	AL2-0854-R6	B0206	AL2-0854-R9	B0147
5/8	0.625	5/8	0.625	7/8	0.875	3	3.000	AL2-1014-SQ	B025S	—	—	AL2-1014-R3	B0233	AL2-1014-R6	B0216	AL2-1014-R9	B0157
				1 5/8	1.625	3 1/2	3.500	AL2-1026-SQ	B026S	—	—	AL2-1026-R3	B0243	AL2-1026-R6	B0226	AL2-1026-R9	B0167
				2 1/8	2.125	4	4.000	AL2-1034-SQ	B027S	—	—	AL2-1034-R3	B0253	AL2-1034-R6	B0236	AL2-1034-R9	B0177
				2 5/8	2.625	5	5.000	AL2-1042-SQ	B028S	—	—	AL2-1042-R3	B0263	AL2-1042-R6	B0246	AL2-1042-R9	B0187
				3 3/8	3.375	6	6.000	AL2-1054-SQ	B029S	—	—	AL2-1054-R3	B0273	AL2-1054-R6	B0256	AL2-1054-R9	B0197
3/4	0.750	3/4	0.750	1 1/8	1.125	3	3.000	AL2-1218-SQ	B030S	—	—	AL2-1218-R3	B0283	AL2-1218-R6	B0266	AL2-1218-R9	B0207
				1 5/8	1.625	4	4.000	AL2-1226-SQ	B031S	—	—	AL2-1226-R3	B0293	AL2-1226-R6	B0276	AL2-1226-R9	B0217
				2 5/8	2.625	5	5.000	AL2-1242-SQ	B032S	—	—	AL2-1242-R3	B0303	AL2-1242-R6	B0286	AL2-1242-R9	B0227
				3 3/8	3.375	6	6.000	AL2-1254-SQ	B033S	—	—	AL2-1254-R3	B0313	AL2-1254-R6	B0296	AL2-1254-R9	B0237
				4 1/8	4.125	7	7.000	AL2-1266-SQ	B034S	—	—	AL2-1266-R3	B0323	AL2-1266-R6	B0306	AL2-1266-R9	B0247
1	1.000	1	1.000	1 5/8	1.625	4	4.000	AL2-1626-SQ	B035S	—	—	AL2-1626-R3	B0333	AL2-1626-R6	B0316	AL2-1626-R9	B0257
				2 1/8	2.125	4	4.000	AL2-1634-SQ	B036S	—	—	AL2-1634-R3	B0343	AL2-1634-R6	B0326	AL2-1634-R9	B0267
				2 5/8	2.625	5	5.000	AL2-1642-SQ	B037S	—	—	AL2-1642-R3	B0353	AL2-1642-R6	B0336	AL2-1642-R9	B0277
				3 3/8	3.375	6	6.000	AL2-1654-SQ	B038S	—	—	AL2-1654-R3	B0363	AL2-1654-R6	B0346	AL2-1654-R9	B0287
				4 3/8	4.375	7	7.000	AL2-1670-SQ	B039S	—	—	AL2-1670-R3	B0373	AL2-1670-R6	B0356	AL2-1670-R9	B0297

ALUMINUM 2 FLUTE

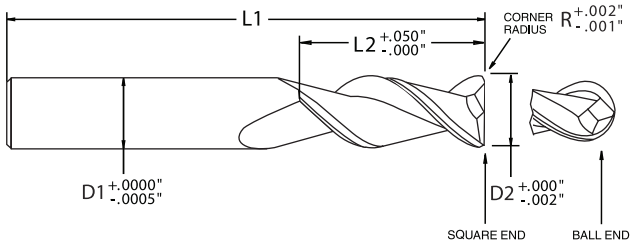
GLOBAL™

SERIES AL2 - *CARBIDE, 2 FLUTE, 45° CONSTANT HELIX*

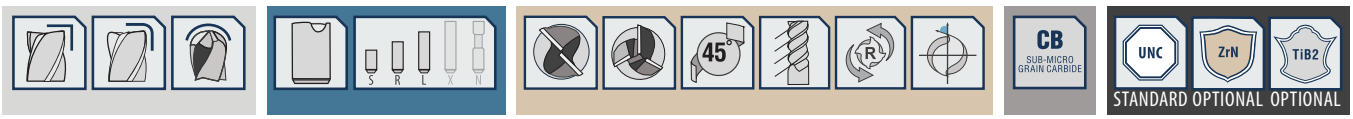
GREATER FEEDS AND SPEEDS

These end mills offer multi- functionality and cost effectiveness, rarely attained in an end mill. Premium micro-grain carbide substrate resists chipping, tool deflection, and has a high transverse rupture strength, for greater feeds and speeds.

- Cylindrical flute grind / relief for enhanced chip formation and improved chip evacuation
- Odd number of flutes reduce harmonics by staggering the entry and exit of the cutting edges
- Premium micro-grain carbide substrate resists chipping, tool ..... deflection, and has a high transverse rupture strength for greater feeds and speeds



TIP & END | SHANK & LENGTH | FLUTE CONFIGURATION | MATERIAL | COATINGS



SERIES AL2SL - *CORNER RADIUS & BALL END, PLAIN SHANK*

SHANK DIAMETER (D1)		CUTTER DIAMETER (D2)		FLUTE LENGTH (L2)		OVERALL LENGTH (L1)		CORNER RADIUS .125 (R) PART #	.125 (R) EDP #	.156 (R) PART #	.156 (R) EDP #	.190 (R) PART #	.190 (R) EDP #	.250 (R) PART #	.250 (R) EDP #	BALL END PART #	BALL END EDP #
1/8	0.125	1/8	0.125	3/8	0.375	2	2.000	—	—	—	—	—	—	—	—	—	—
				5/8	0.625	2	2.000	—	—	—	—	—	—	—	—	AL2-0210-BE	B201B
3/16	0.188	3/16	0.188	3/8	0.375	2	2.000	—	—	—	—	—	—	—	—	—	—
				5/8	0.625	2	2.000	—	—	—	—	—	—	—	—	AL2-0310-BE	B202B
1/4	0.250	1/4	0.250	3/8	0.375	2	2.000	—	—	—	—	—	—	—	—	—	—
				7/8	0.875	2 1/2	2.500	—	—	—	—	—	—	—	—	AL2-0414-BE	B203B
				1 3/8	1.375	3	3.000	—	—	—	—	—	—	—	—	—	—
5/16	0.313	5/16	0.313	1/2	0.500	2	2.000	—	—	—	—	—	—	—	—	—	—
				7/8	0.875	2 1/2	2.500	—	—	—	—	—	—	—	—	AL2-0514-BE	B204B
				1 3/8	1.375	3	3.000	—	—	—	—	—	—	—	—	—	—
3/8	0.375	3/8	0.375	5/8	0.625	2	2.000	—	—	—	—	—	—	—	—	—	—
				7/8	0.875	2 1/2	2.500	—	—	—	—	—	—	—	—	AL2-0614-BE	B205B
				1 3/8	1.375	3	3.000	—	—	—	—	—	—	—	—	—	—
				1 7/8	1.875	3 1/2	3.500	—	—	—	—	—	—	—	—	—	—
				2 1/8	2.125	4	4.000	—	—	—	—	—	—	—	—	—	—
7/16	0.438	7/16	0.438	5/8	0.625	2 1/2	2.500	—	—	—	—	—	—	—	—	—	—
				1 1/8	1.125	3	3.000	—	—	—	—	—	—	—	—	AL2-0718-BE	B206B
				2 1/8	2.125	4	4.000	—	—	—	—	—	—	—	—	—	—
1/2	0.500	1/2	0.500	5/8	0.625	2 1/2	2.500	AL2-0810-R12	B0018	—	—	—	—	—	—	—	—
				1 1/8	1.125	3	3.000	AL2-0818-R12	B0028	—	—	—	—	—	—	AL2-0818-BE	B207B
				1 5/8	1.625	3 1/2	3.500	AL2-0826-R12	B0038	—	—	—	—	—	—	—	—
				2 1/8	2.125	4	4.000	AL2-0834-R12	B0048	—	—	—	—	—	—	—	—
				2 5/8	2.625	5	5.000	AL2-0842-R12	B0058	—	—	—	—	—	—	—	—
				3 3/8	3.375	6	6.000	AL2-0854-R12	B0068	—	—	—	—	—	—	—	—
5/8	0.625	5/8	0.625	7/8	0.875	3	3.000	AL2-1014-R12	B0078	—	—	—	—	—	—	—	—
				1 5/8	1.625	3 1/2	3.500	AL2-1026-R12	B0088	—	—	—	—	—	—	AL2-1026-BE	B208B
				2 1/8	2.125	4	4.000	AL2-1034-R12	B0098	—	—	—	—	—	—	—	—
				2 5/8	2.625	5	5.000	AL2-1042-R12	B0108	—	—	—	—	—	—	—	—
				3 3/8	3.375	6	6.000	AL2-1054-R12	B0118	—	—	—	—	—	—	—	—
3/4	0.750	3/4	0.750	1 1/8	1.125	3	3.000	AL2-1218-R12	B0128	AL2-1218-R15	B0019	AL2-1218-R19	B0010	—	—	—	—
				1 5/8	1.625	4	4.000	AL2-1226-R12	B0138	AL2-1226-R15	B0029	AL2-1226-R19	B0020	—	—	AL2-1226-BE	B209B
				2 5/8	2.625	5	5.000	AL2-1242-R12	B0148	AL2-1242-R15	B0039	AL2-1242-R19	B0030	—	—	—	—
				3 3/8	3.375	6	6.000	AL2-1254-R12	B0158	AL2-1254-R15	B0049	AL2-1254-R19	B0040	—	—	—	—
				4 1/8	4.125	7	7.000	AL2-1266-R12	B0168	AL2-1266-R15	B0059	AL2-1266-R19	B0050	—	—	—	—
1	1.000	1	1.000	1 5/8	1.625	4	4.000	AL2-1626-R12	B0178	AL2-1626-R15	B0069	AL2-1626-R19	B0060	AL2-1626-R25	B0110	—	—
				2 1/8	2.125	4	4.000	AL2-1634-R12	B0188	AL2-1634-R15	B0079	AL2-1634-R19	B0070	AL2-1634-R25	B0120	AL2-1634-BE	B210B
				2 5/8	2.625	5	5.000	AL2-1642-R12	B0198	AL2-1642-R15	B0089	AL2-1642-R19	B0080	AL2-1642-R25	B0130	—	—
				3 3/8	3.375	6	6.000	AL2-1654-R12	B0208	AL2-1654-R15	B0099	AL2-1654-R19	B0090	AL2-1654-R25	B0140	—	—
				4 3/8	4.375	7	7.000	AL2-1670-R12	B0218	AL2-1670-R15	B0109	AL2-1670-R19	B0100	AL2-1670-R25	B0150	—	—

ALUMINUM 3 FLUTE

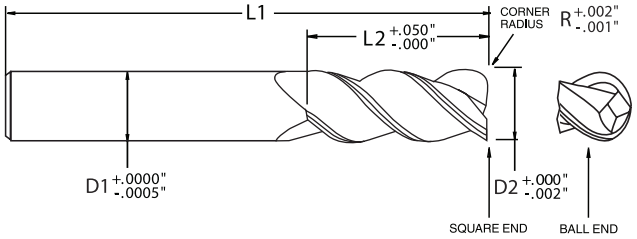
GLOBAL™

SERIES AL3 - *CARBIDE, 3 FLUTE, 45° CONSTANT HELIX*

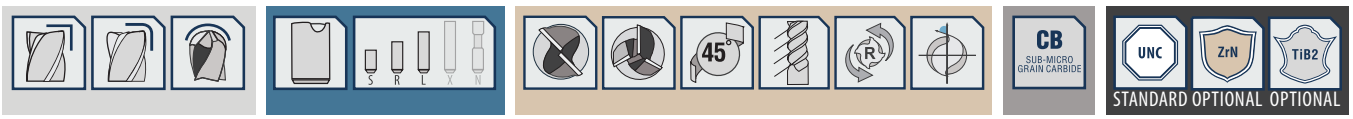
EFFECTIVENESS AND VALUE

These end mills breeze through non-ferrous materials like brass, bronze, copper, plastics, and of course aluminum. Their performance leaves little to question about its effectiveness or value.

- Corner radius option protects corners in roughing operations and difficult to machine materials by preventing corner chipping and tool failure
- Immediate 50% increase in performance over 2 flute designs
- Premium micro-grain carbide substrate resists chipping, tool deflection, and has a high transverse rupture strength for greater feeds and speeds



TIP & END | SHANK & LENGTH | FLUTE CONFIGURATION | MATERIAL | COATINGS



SERIES AL3SR - *SQUARE END & CORNER RADIUS, PLAIN SHANK*

SHANK DIAMETER (D1)		CUTTER DIAMETER (D2)		FLUTE LENGTH (L2)		OVERALL LENGTH (L1)		SQUARE END		CORNER RADIUS .015 (R)		.030 (R)		.060 (R)		.090 (R)	
								PART #	EDP #	PART #	EDP #	PART #	EDP #	PART #	EDP #	PART #	EDP #
1/8	0.125	1/8	0.125	3/8	0.375	2	2.000	AL3-0206-SQ	C001S	AL3-0206-R1	C0011	—	—	—	—	—	—
				5/8	0.625	2	2.000	AL3-0210-SQ	C002S	AL3-0210-R1	C0021	—	—	—	—	—	—
3/16	0.188	3/16	0.188	3/8	0.375	2	2.000	AL3-0306-SQ	C003S	AL3-0306-R1	C0031	AL3-0306-R3	C0013	—	—	—	—
				5/8	0.625	2	2.000	AL3-0310-SQ	C004S	AL3-0310-R1	C0041	AL3-0310-R3	C0023	—	—	—	—
1/4	0.250	1/4	0.250	3/8	0.375	2	2.000	AL3-0406-SQ	C005S	AL3-0406-R1	C0051	AL3-0406-R3	C0033	AL3-0406-R6	C0016	—	—
				7/8	0.875	2 1/2	2.500	AL3-0414-SQ	C006S	AL3-0414-R1	C0061	AL3-0414-R3	C0043	AL3-0414-R6	C0026	—	—
				1 3/8	1.375	3	3.000	AL3-0422-SQ	C007S	AL3-0422-R1	C0071	AL3-0422-R3	C0053	AL3-0422-R6	C0036	—	—
5/16	0.313	5/16	0.313	1/2	0.500	2	2.000	AL3-0508-SQ	C008S	AL3-0508-R1	C0081	AL3-0508-R3	C0063	AL3-0508-R6	C0046	—	—
				7/8	0.875	2 1/2	2.500	AL3-0514-SQ	C009S	AL3-0514-R1	C0091	AL3-0514-R3	C0073	AL3-0514-R6	C0056	—	—
				1 3/8	1.375	3	3.000	AL3-0522-SQ	C010S	AL3-0522-R1	C0101	AL3-0522-R3	C0083	AL3-0522-R6	C0066	—	—
3/8	0.375	3/8	0.375	5/8	0.625	2	2.000	AL3-0610-SQ	C011S	AL3-0610-R1	C0111	AL3-0610-R3	C0093	AL3-0610-R6	C0076	AL3-0610-R9	C0017
				7/8	0.875	2 1/2	2.500	AL3-0614-SQ	C012S	AL3-0614-R1	C0121	AL3-0614-R3	C0103	AL3-0614-R6	C0086	AL3-0614-R9	C0027
				1 3/8	1.375	3	3.000	AL3-0622-SQ	C013S	AL3-0622-R1	C0131	AL3-0622-R3	C0113	AL3-0622-R6	C0096	AL3-0622-R9	C0037
				1 7/8	1.875	3 1/2	3.500	AL3-0630-SQ	C014S	AL3-0630-R1	C0141	AL3-0630-R3	C0123	AL3-0630-R6	C0106	AL3-0630-R9	C0047
				2 1/8	2.125	4	4.000	AL3-0634-SQ	C015S	AL3-0634-R1	C0151	AL3-0634-R3	C0133	AL3-0634-R6	C0116	AL3-0634-R9	C0057
7/16	0.438	7/16	0.438	5/8	0.625	2 1/2	2.500	AL3-0710-SQ	C016S	AL3-0710-R1	C0161	AL3-0710-R3	C0143	AL3-0710-R6	C0126	AL3-0710-R9	C0067
				1 1/8	1.125	3	3.000	AL3-0718-SQ	C017S	AL3-0718-R1	C0171	AL3-0718-R3	C0153	AL3-0718-R6	C0136	AL3-0718-R9	C0077
				2 1/8	2.125	4	4.000	AL3-0734-SQ	C018S	AL3-0734-R1	C0181	AL3-0734-R3	C0163	AL3-0734-R6	C0146	AL3-0734-R9	C0087
1/2	0.500	1/2	0.500	5/8	0.625	2 1/2	2.500	AL3-0810-SQ	C019S	AL3-0810-R1	C0191	AL3-0810-R3	C0173	AL3-0810-R6	C0156	AL3-0810-R9	C0097
				1 1/8	1.125	3	3.000	AL3-0818-SQ	C020S	AL3-0818-R1	C0201	AL3-0818-R3	C0183	AL3-0818-R6	C0166	AL3-0818-R9	C0107
				1 5/8	1.625	3 1/2	3.500	AL3-0826-SQ	C021S	AL3-0826-R1	C0211	AL3-0826-R3	C0193	AL3-0826-R6	C0176	AL3-0826-R9	C0117
				2 1/8	2.125	4	4.000	AL3-0834-SQ	C022S	AL3-0834-R1	C0221	AL3-0834-R3	C0203	AL3-0834-R6	C0186	AL3-0834-R9	C0127
				2 5/8	2.625	5	5.000	AL3-0842-SQ	C023S	AL3-0842-R1	C0231	AL3-0842-R3	C0213	AL3-0842-R6	C0196	AL3-0842-R9	C0137
				3 3/8	3.375	6	6.000	AL3-0854-SQ	C024S	AL3-0854-R1	C0241	AL3-0854-R3	C0223	AL3-0854-R6	C0206	AL3-0854-R9	C0147
5/8	0.625	5/8	0.625	7/8	0.875	3	3.000	AL3-1014-SQ	C025S	—	—	AL3-1014-R3	C0233	AL3-1014-R6	C0216	AL3-1014-R9	C0157
				1 5/8	1.625	3 1/2	3.500	AL3-1026-SQ	C026S	—	—	AL3-1026-R3	C0243	AL3-1026-R6	C0226	AL3-1026-R9	C0167
				2 1/8	2.125	4	4.000	AL3-1034-SQ	C027S	—	—	AL3-1034-R3	C0253	AL3-1034-R6	C0236	AL3-1034-R9	C0177
				2 5/8	2.625	5	5.000	AL3-1042-SQ	C028S	—	—	AL3-1042-R3	C0263	AL3-1042-R6	C0246	AL3-1042-R9	C0187
				3 3/8	3.375	6	6.000	AL3-1054-SQ	C029S	—	—	AL3-1054-R3	C0273	AL3-1054-R6	C0256	AL3-1054-R9	C0197
3/4	0.750	3/4	0.750	1 1/8	1.125	3	3.000	AL3-1218-SQ	C030S	—	—	AL3-1218-R3	C0283	AL3-1218-R6	C0266	AL3-1218-R9	C0207
				1 5/8	1.625	4	4.000	AL3-1226-SQ	C031S	—	—	AL3-1226-R3	C0293	AL3-1226-R6	C0276	AL3-1226-R9	C0217
				2 5/8	2.625	5	5.000	AL3-1242-SQ	C032S	—	—	AL3-1242-R3	C0303	AL3-1242-R6	C0286	AL3-1242-R9	C0227
				3 3/8	3.375	6	6.000	AL3-1254-SQ	C033S	—	—	AL3-1254-R3	C0313	AL3-1254-R6	C0296	AL3-1254-R9	C0237
				4 1/8	4.125	7	7.000	AL3-1266-SQ	C034S	—	—	AL3-1266-R3	C0323	AL3-1266-R6	C0306	AL3-1266-R9	C0247
1	1.000	1	1.000	1 5/8	1.625	4	4.000	AL3-1626-SQ	C035S	—	—	AL3-1626-R3	C0333	AL3-1626-R6	C0316	AL3-1626-R9	C0257
				2 1/8	2.125	4	4.000	AL3-1634-SQ	C036S	—	—	AL3-1634-R3	C0343	AL3-1634-R6	C0326	AL3-1634-R9	C0267
				2 5/8	2.625	5	5.000	AL3-1642-SQ	C037S	—	—	AL3-1642-R3	C0353	AL3-1642-R6	C0336	AL3-1642-R9	C0277
				3 3/8	3.375	6	6.000	AL3-1654-SQ	C038S	—	—	AL3-1654-R3	C0363	AL3-1654-R6	C0346	AL3-1654-R9	C0287
				4 3/8	4.375	7	7.000	AL3-1670-SQ	C039S	—	—	AL3-1670-R3	C0373	AL3-1670-R6	C0356	AL3-1670-R9	C0297

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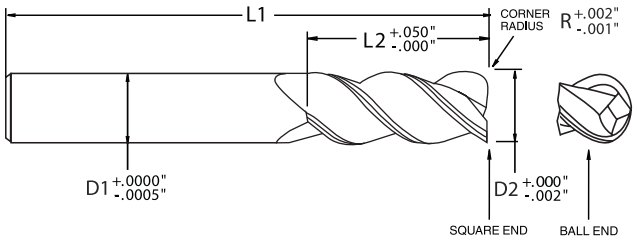
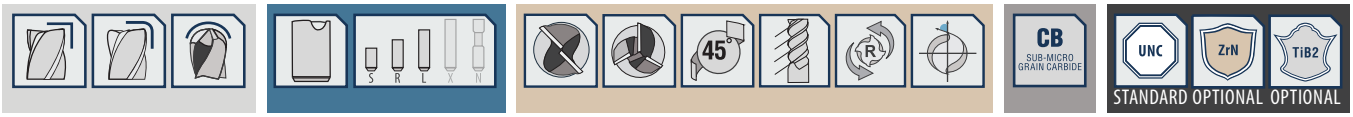
- Odd number of flutes reduce harmonics by staggering the entry and exit of the cutting edges
- Improved tool engagement through 3 flute design creates more stability in the cut and a superior surface finish



TIP & END | SHANK & LENGTH | FLUTE CONFIGURATION | MATERIAL | COATINGS



SERIES AL3SL - *CORNER RADIUS & BALL END, PLAIN SHANK*

SHANK DIAMETER (D1)		CUTTER DIAMETER (D2)		FLUTE LENGTH (L2)		OVERALL LENGTH (L1)		CORNER RADIUS .0125 (R) PART #	.0125 (R) EDP #	.156 (R) PART #	.156 (R) EDP #	.190 (R) PART #	.190 (R) EDP #	.250 (R) PART #	.250 (R) EDP #	BALL END PART #	BALL END EDP #
1/8	0.125	1/8	0.125	3/8	0.375	2	2.000	—	—	—	—	—	—	—	—	—	—
				5/8	0.625	2	2.000	—	—	—	—	—	—	—	—	AL3-0210-BE	C201B
3/16	0.188	3/16	0.188	3/8	0.375	2	2.000	—	—	—	—	—	—	—	—	—	—
				5/8	0.625	2	2.000	—	—	—	—	—	—	—	—	AL3-0310-BE	C202B
1/4	0.250	1/4	0.250	3/8	0.375	2	2.000	—	—	—	—	—	—	—	—	—	—
				7/8	0.875	2 1/2	2.500	—	—	—	—	—	—	—	—	AL3-0414-BE	C203B
				1 3/8	1.375	3	3.000	—	—	—	—	—	—	—	—	—	—
5/16	0.313	5/16	0.313	1/2	0.500	2	2.000	—	—	—	—	—	—	—	—	—	—
				7/8	0.875	2 1/2	2.500	—	—	—	—	—	—	—	—	AL3-0514-BE	C204B
				1 3/8	1.375	3	3.000	—	—	—	—	—	—	—	—	—	—
3/8	0.375	3/8	0.375	5/8	0.625	2	2.000	—	—	—	—	—	—	—	—	—	—
				7/8	0.875	2 1/2	2.500	—	—	—	—	—	—	—	—	AL3-0614-BE	C205B
				1 3/8	1.375	3	3.000	—	—	—	—	—	—	—	—	—	—
				1 7/8	1.875	3 1/2	3.500	—	—	—	—	—	—	—	—	—	—
				2 1/8	2.125	4	4.000	—	—	—	—	—	—	—	—	—	—
7/16	0.438	7/16	0.438	5/8	0.625	2 1/2	2.500	—	—	—	—	—	—	—	—	—	—
				1 1/8	1.125	3	3.000	—	—	—	—	—	—	—	—	AL3-0718-BE	C206B
				2 1/8	2.125	4	4.000	—	—	—	—	—	—	—	—	—	—
1/2	0.500	1/2	0.500	5/8	0.625	2 1/2	2.500	AL3-0810-R12	C0018	—	—	—	—	—	—	—	—
				1 1/8	1.125	3	3.000	AL3-0818-R12	C0028	—	—	—	—	—	—	AL3-0818-BE	C207B
				1 5/8	1.625	3 1/2	3.500	AL3-0826-R12	C0038	—	—	—	—	—	—	—	—
				2 1/8	2.125	4	4.000	AL3-0834-R12	C0048	—	—	—	—	—	—	—	—
				2 5/8	2.625	5	5.000	AL3-0842-R12	C0058	—	—	—	—	—	—	—	—
				3 3/8	3.375	6	6.000	AL3-0854-R12	C0068	—	—	—	—	—	—	—	—
5/8	0.625	5/8	0.625	7/8	0.875	3	3.000	AL3-1014-R12	C0078	—	—	—	—	—	—	—	—
				1 5/8	1.625	3 1/2	3.500	AL3-1026-R12	C0088	—	—	—	—	—	—	AL3-1026-BE	C208B
				2 1/8	2.125	4	4.000	AL3-1034-R12	C0098	—	—	—	—	—	—	—	—
				2 5/8	2.625	5	5.000	AL3-1042-R12	C0108	—	—	—	—	—	—	—	—
				3 3/8	3.375	6	6.000	AL3-1054-R12	C0118	—	—	—	—	—	—	—	—
3/4	0.750	3/4	0.750	1 1/8	1.125	3	3.000	AL3-1218-R12	C0128	AL3-1218-R15	C0019	AL3-1218-R19	C0010	—	—	—	—
				1 5/8	1.625	4	4.000	AL3-1226-R12	C0138	AL3-1226-R15	C0029	AL3-1226-R19	C0020	—	—	AL3-1226-BE	C209B
				2 5/8	2.625	5	5.000	AL3-1242-R12	C0148	AL3-1242-R15	C0039	AL3-1242-R19	C0030	—	—	—	—
				3 3/8	3.375	6	6.000	AL3-1254-R12	C0158	AL3-1254-R15	C0049	AL3-1254-R19	C0040	—	—	—	—
				4 1/8	4.125	7	7.000	AL3-1266-R12	C0168	AL3-1266-R15	C0059	AL3-1266-R19	C0050	—	—	—	—
1	1.000	1	1.000	1 5/8	1.625	4	4.000	AL3-1626-R12	C0178	AL3-1626-R15	C0069	AL3-1626-R19	C0060	AL3-1626-R25	C0110	—	—
				2 1/8	2.125	4	4.000	AL3-1634-R12	C0188	AL3-1634-R15	C0079	AL3-1634-R19	C0070	AL3-1634-R25	C0120	AL3-1634-BE	C210B
				2 5/8	2.625	5	5.000	AL3-1642-R12	C0198	AL3-1642-R15	C0089	AL3-1642-R19	C0080	AL3-1642-R25	C0130	—	—
				3 3/8	3.375	6	6.000	AL3-1654-R12	C0208	AL3-1654-R15	C0099	AL3-1654-R19	C0090	AL3-1654-R25	C0140	—	—
				4 3/8	4.375	7	7.000	AL3-1670-R12	C0218	AL3-1670-R15	C0109	AL3-1670-R19	C0100	AL3-1670-R25	C0150	—	—

AL 2 & 3 APPLICATION GUIDE • SPEED & FEED

WORK MATERIAL		TYPE OF CUT	AXIAL DOC	RADIAL DOC	NO. OF FLUTES	SPEED (SFM)	FEED (INCHES PER TOOTH) 1/8" (2 & 3 FL)	1/4" (2 & 3 FL)	3/8" (2 & 3 FL)	1/2" (2 & 3 FL)	5/8" (2 & 3 FL)	3/4" (2 & 3 FL)	1" (2 & 3 FL)
ALUMINUM	ALUMINUM ALLOYS Low Silicon Content 20xx; 50xx; 60xx; 70xx	Slotting	1 x D	1 x D	2 / 3	815 - 935	0.0011 - 0.0013	0.0021 - 0.0025	0.0032 - 0.0038	0.0042 - 0.0050	0.0052 - 0.0062	0.0063 - 0.0075	0.0084 - 0.010
		Roughing	1 x D	.5 x D	2 / 3	1005 - 1155	0.0014 - 0.0018	0.0027 - 0.0032	0.0040 - 0.0048	0.0054 - 0.0064	0.0067 - 0.0080	0.0081 - 0.0096	0.0107 - 0.0128
		High Effeciency (HEM)	2 x D	.2 x D	2 / 3	1260 - 1400	0.0027 - 0.0030	0.0053 - 0.0059	0.0079 - 0.0089	0.0105 - 0.0118	0.0131 - 0.0148	0.0158 - 0.0177	0.0210 - 0.0237
		Finishing	1.5 x D	.01 x D	2 / 3	1045 - 1145	0.0017 - 0.0021	0.0033 - 0.0038	0.0050 - 0.0057	0.0066 - 0.0075	0.0083 - 0.0094	0.0099 - 0.0113	0.0132 - 0.0151
	ALUMINUM DIE CAST ALLOY High Silicon Content A-38x; A-39x; B39x	Slotting	.75 x D	1 x D	2 / 3	670 - 770	0.0090 - 0.0092	0.0179 - 0.0183	0.0269 - 0.0275	0.0358 - 0.0366	0.0447 - 0.0457	0.0537 - 0.0549	0.0716 - 0.0732
		Roughing	1 x D	.5 x D	2 / 3	825 - 945	0.0012 - 0.0016	0.0023 - 0.0028	0.0034 - 0.0042	0.0046 - 0.0056	0.0057 - 0.0070	0.0069 - 0.0084	0.0091 - 0.0112
		High Effeciency (HEM)	2 x D	.15 x D	2 / 3	1035 - 1150	0.0021 - 0.0024	0.0041 - 0.0047	0.0061 - 0.0071	0.0081 - 0.0094	0.0101 - 0.0118	0.0122 - 0.0141	0.0162 - 0.0189
		Finishing	1.5 x D	.01 x D	2 / 3	900 - 990	0.0015 - 0.0019	0.0029 - 0.0034	0.0044 - 0.0051	0.0058 - 0.0067	0.0073 - 0.0084	0.0087 - 0.0101	0.0116 - 0.0135
NONFERROUS	MAGNESIUM ALLOYS ≤ 38 HRc	Slotting	1 x D	1 x D	2 / 3	845 - 970	0.0011 - 0.0013	0.0021 - 0.0025	0.0032 - 0.0038	0.0042 - 0.0050	0.0052 - 0.0062	0.0063 - 0.0075	0.0084 - 0.010
		Roughing	1 x D	.75 x D	2 / 3	1040 - 1195	0.0014 - 0.0018	0.0027 - 0.0032	0.0040 - 0.0048	0.0054 - 0.0064	0.0067 - 0.0080	0.0081 - 0.0096	0.0107 - 0.0128
		High Effeciency (HEM)	2 x D	.2 x D	2 / 3	1305 - 1450	0.0030 - 0.0033	0.0059 - 0.0065	0.0088 - 0.0098	0.0117 - 0.0130	0.0146 - 0.0163	0.0176 - 0.0195	0.0234 - 0.0261
		Finishing	1.5 x D	.01 x D	2 / 3	1185 - 1300	0.0018 - 0.0022	0.0035 - 0.0040	0.0053 - 0.0060	0.0070 - 0.0079	0.0088 - 0.0099	0.0105 - 0.0119	0.0140 - 0.0159
	COPPER ALLOYS, BRASS & BRONZE 39 to 48 HRc Manganese Bronze, Tin Bronze, Beryllium	Slotting	1 x D	1 x D	2 / 3	670 - 770	0.0009 - 0.0011	0.0017 - 0.0021	0.0026 - 0.0032	0.0034 - 0.0042	0.0042 - 0.0052	0.0051 - 0.0063	0.0068 - 0.0084
		Roughing	1 x D	.75 x D	2 / 3	825 - 945	0.0012 - 0.0016	0.0023 - 0.0028	0.0034 - 0.0042	0.0046 - 0.0056	0.0057 - 0.0070	0.0069 - 0.0084	0.0091 - 0.0112
		High Effeciency (HEM)	2 x D	.2 x D	2 / 3	1035 - 1150	0.0025 - 0.0028	0.0049 - 0.0055	0.0073 - 0.0083	0.0097 - 0.0110	0.0121 - 0.0138	0.0146 - 0.0165	0.0194 - 0.0221
		Finishing	1.5 x D	.01 x D	2 / 3	995 - 1090	0.0015 - 0.0019	0.0029 - 0.0034	0.0044 - 0.0051	0.0058 - 0.0067	0.0073 - 0.0084	0.0087 - 0.0101	0.0116 - 0.0135
	COMPOSITES, PLASTICS & FIBERGLASS 48 to 57 HRc ABS, Polycarbonate, PVC, Polypropylene	Slotting	1 x D	1 x D	2 / 3	670 - 770	0.0009 - 0.0011	0.0017 - 0.0021	0.0026 - 0.0032	0.0034 - 0.0042	0.0042 - 0.0052	0.0051 - 0.0063	0.0068 - 0.0084
		Roughing	1 x D	.75 x D	2 / 3	825 - 945	0.0012 - 0.0016	0.0023 - 0.0028	0.0034 - 0.0042	0.0046 - 0.0056	0.0057 - 0.0070	0.0069 - 0.0084	0.0091 - 0.0112
		High Effeciency (HEM)	2 x D	.2 x D	2 / 3	1035 - 1150	0.0025 - 0.0028	0.0049 - 0.0055	0.0073 - 0.0083	0.0097 - 0.0110	0.0121 - 0.0138	0.0146 - 0.0165	0.0194 - 0.0221
		Finishing	1.5 x D	.01 x D	2 / 3	995 - 1090	0.0015 - 0.0019	0.0029 - 0.0034	0.0044 - 0.0051	0.0058 - 0.0067	0.0073 - 0.0084	0.0087 - 0.0101	0.0116 - 0.0135

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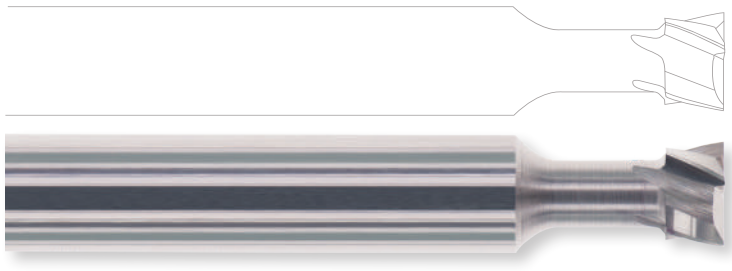
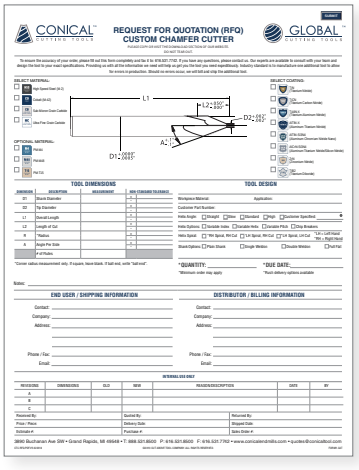
Along with our standard tool offerings, Conical Tool Company manufactures custom carbide and high speed steel end mills and cutters. Whether a variation of a standard tool or specialized tool meant to combine multiple processes into one pass, our custom tools improve performance and reduce cycle time at the best value in the industry.




CONICAL
REQUEST FOR QUOTATION (RFQ)
CUSTOM CHAMFER CUTTER
GLOBAL

SEE PAGES 27-36 FOR DETAILS, VISIT CONICALENDMILLS.COM, OR CALL (888) 531-8500

8 DIE & MOLD

DIFFICULT JOBS REQUIRE
EXTRAORDINARY TOOLS

There are differences in the demands of many industries, but we are always on the cutting edge of the latest technology.

We appreciate the opportunity to demonstrate the ability of our tools, right before your eyes, every time you run them on your machines.

DIVERSITY

We offer a massive assortment of carbide cutting tools designed specifically for the Die and Mold industry. Whether milling parts large or small, we have the right tool to achieve maximum performance. Enhance your production with our Die and Mold end mills. Let our experience go to work for you.

RESULTS

These Die and Mold end mills are designed to run at faster speeds and feeds resulting in reduced cycle times. Many are standard with the most advanced coatings available, which allows for dry machining and extends the life of the tool. These solid carbide end mills are made from sub micron and ultra fine carbide grades for longer tool life and exceptional efficiency all around.

(888) 531.8500 | info@conicaltool.com | www.conicalendmills.com

CONICAL™ CUTTING TOOLS

GLOBAL™ CUTTING TOOLS

MANUFACTURING FOR OVER 70 YEARS 1944 - 2014

CONICAL™ CUTTING TOOLS

GLOBAL™ CUTTING TOOLS

70 YEARS OF INNOVATION

GLOBAL™ DIE & MOLD CUTTERS

UNPARALLELED EXCELLENCE

The Global Die & Mold Cutters are the best choice for high feed finishing of ferrous materials when speed and surface finish are critical. Tool steels and exotic alloys demand the most rugged carbide end mills on the market and that's where we come in. Our Global Die & Mold end mills stand up to difficult to machine material without showing immediate signs of wear. Hardened tool steels need end mills with the ability to perform. With an AlTiN/ Si3N4 coating for added lubricity and heat resistance, these tools reach new levels of performance and incredible tool longevity. These end mills deliver, beyond expectations.

Always consider three important factors when choosing your end mills: application, material and performance. When machining detail features and cavities in ferrous materials, the Global Die & Mold Cutters perform. We will continue to expand this product offering over the upcoming months, if there is a standard tool you desire, please don't hesitate to call.

CHANGING DEMANDS

We strive to remain at the forefront of progress, while building lasting partnerships throughout the supply chain. We work every day to better understand the changing demands of the industry and anticipate them whenever possible. We like to imagine our customers proudly placing our tools in their machine holders, confident they have the longest lasting and most efficient end mill available on the market.

Global Cutting Tools
Conical Tool Company

3890 Buchanan Ave SW
Grand Rapids, MI 49548

T: 888.531.8500 | **P:** 616.531.8500
F: 616.531.7742 | **E:** info@conicaltool.com

W: www.conicalendmills.com
W: www.globalcuttingtools.com

MANUFACTURING FOR OVER 70 YEARS 1944 - 2014

SEAL OF QUALITY ASSURANCE

Global Cutting Tools are distributed by:

OVER 7,000
DISTRIBUTORS WORLDWIDE

Made in the U.S.A.

GLOBAL™
DIE & MOLD CUTTERS

AMERICAN MADE

GLOBALLY RENOWNED

DIE & MOLD END MILLS
FOR HIGH FEED RATE FINISHING OF FERROUS MATERIALS

GLOBAL™ CUTTING TOOLS

GLOBAL™
DIE & MOLD CUTTERS

HIGH FEED RATE FINISHING

OF FERROUS MATERIALS

FEATURES & BENEFITS

These tools are ideal for contour machining of mold and die cavities. Premium AlTiN/Si3N4 coating protects the tool from tool steel and hardened materials, while a larger core design adds stability, rigidity and reduces run out. The high strength flutes were engineered for any difficult to machine material, including hardened tool steels, stainless steels, and high temp alloys. Running at higher speeds and feeds with vibration dampening geometry, our Die and Mold cutters can eliminate the need for expensive hand finishing operations.

General Inquiries:
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Grand Rapids, MI 49548

P: (616) 531-8500
F: (616) 531-7742
E: info@conicaltool.com

Sales & Distribution:
T: (888) 531-8500
E: sales@conicaltool.com

Custom Tooling:
E: quotes@conicaltool.com
W: conicalendmills.com/custom-tool-ordering

GLOBAL™
CUTTING TOOLS

SERIES: DMX

For high feed rate finishing of high hardness ferrous materials to maximize productivity and surface finish while roughing, slotting, pocketing, contouring and finishing; wet or dry; mold & tools steels, alloy steels and high hardness materials.

Square end option to create sharp corners in finishing operations

Coated for heat resistance, wear resistance and increased lubricity

Two high strength flute design improves chip formation and evacuation for increased feed rates

30° constant helix provides added rigidity to the flutes for cutting hardened materials

Large core design for increased stability; higher speeds & feeds; and reduced tool deflection

Corner radius option protects corners in roughing operations and difficult to machine materials by preventing corner chipping and tool failure

Ball end option for high performance contour milling in finishing operations

For high feed rate finishing of high hardness ferrous materials

Premium micro-grain carbide substrate resists chipping, tool deflection, and has a high transverse rupture strength for greater feeds and speeds

Eccentric relief for enhanced edge strength along the flutes

Edge prep drag finishing increases tool life by improving the surface quality in the flute and radiusing the cutting edge of the tool, reducing the potential for premature failure.

Post polishing is performed after the tools are coated to remove surface inconsistencies and increase lubricity. This also increases feed rates and allows for smoother operations. The tool runs cooler and performs longer

TIP & END

OPTIONAL OPTIONAL OPTIONAL

SHANK & LENGTH

STANDARD OPTIONAL

FLUTE CONFIGURATION

MATERIAL

CB SUB-MICRO GRAIN CARBIDE

COATING

AlTiN Si3N4

RESULTS

Removing material is only part of the battle, to be truly effective, a Die & Mold cutter must speed up slow finishing and contouring operations. The option to use wet or dry, in roughing and finishing, will make your set-up time one of the easiest parts of your day. Our Die and Mold cutters will leave your finishing operations, finished in record time. These tools have incredible longevity and versatility, making them a staple in most tools rooms and vending machines.

Series DMX: Micro-Grain Carbide, 2 Flutes, 30° Constant Helix, AlTiN/Si3N4 Coated
Subseries: DM2SS, DM2SR, DM2SL, DM2CS, DM2CR, DM2CL, DM2BS, DM2BR, DM2BL
Configuration: Varying Diameters; Stub, Regular & Long Lengths;
30° Constant Helix; Square End, Corner Radius & Ball End

DIE & MOLD CUTTERS

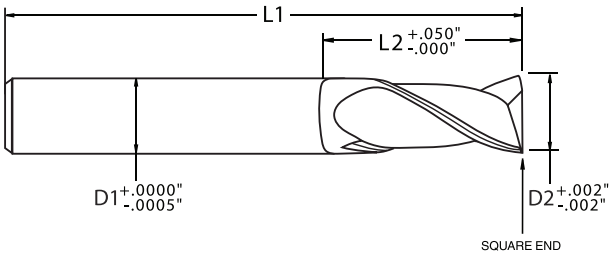
GLOBAL™

SERIES DMX - *CARBIDE, 2 FLUTE, 30° CONSTANT HELIX*

NEW LEVELS OF PERFORMANCE

With an AlTiN/Si3N4 coating for added lubricity and heat resistance, these tools reach new levels of performance and incredible tool longevity. These end mills deliver, beyond expectations.

- Square end option to create sharp corners in finishing operations
- Coated for heat resistance, wear resistance and increased lubricity
- Two high strength flute design improves chip formation and evacuation for increased feed rates
- For high feed rate finishing of high hardness ferrous materials

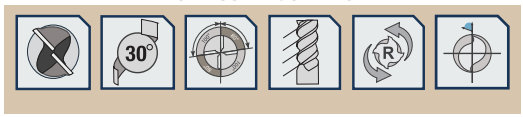


To order a corner radius, use code "CR" & actual radius in the part number. For example, a standard AX-203 would be ordered as AX-203-CR-015, with "015" being the radius.

TIP & END

SHANK & LENGTH

FLUTE CONFIGURATION



MATERIAL

COATINGS

SERIES DM2SS - *SQUARE END, STUB LENGTH*

SHANK DIAMETER (D1)		CUTTER DIAMETER (D2)		FLUTE LENGTH (L2)		OVERALL LENGTH (L1)		PLAIN SHANK PART #	EDP #
1/8	0.125	1/8	0.125	1/4	0.250	2	2.000	DM2-0204-SQ	D001S
3/16	0.188	3/16	0.188	5/16	0.313	2 1/2	2.500	DM2-0305-SQ	D002S
1/4	0.250	1/4	0.250	3/8	0.375	3	3.000	DM2-0406-SQ	D003S
5/16	0.313	5/16	0.313	7/16	0.438	3	3.000	DM2-0507-SQ	D004S
3/8	0.375	3/8	0.375	1/2	0.500	3 1/2	3.500	DM2-0608-SQ	D005S
1/2	0.500	1/2	0.500	5/8	0.625	3 1/2	3.500	DM2-0810-SQ	D006S

SERIES DM2SR - *SQUARE END, REGULAR LENGTH*

SHANK DIAMETER (D1)		CUTTER DIAMETER (D2)		FLUTE LENGTH (L2)		OVERALL LENGTH (L1)		PLAIN SHANK PART #	EDP #
1/8	0.125	1/8	0.125	5/8	0.625	2 1/2	2.500	DM2-0210-SQ	D101S
3/16	0.188	3/16	0.188	5/8	0.625	2 1/2	2.500	DM2-0310-SQ	D102S
1/4	0.250	1/4	0.250	7/8	0.875	2 1/2	2.500	DM2-0414-SQ	D103S
5/16	0.313	5/16	0.313	7/8	0.875	2 1/2	2.500	DM2-0514-SQ	D104S
3/8	0.375	3/8	0.375	1 1/8	1.125	3	3.000	DM2-0618-SQ	D105S
7/16	0.438	7/16	0.438	1 1/8	1.125	3	3.000	DM2-0718-SQ	D106S
1/2	0.500	1/2	0.500	1 3/8	1.375	3 1/2	3.500	DM2-0822-SQ	D107S
5/8	0.625	5/8	0.625	1 3/8	1.375	3 1/2	3.500	DM2-1022-SQ	D108S
3/4	0.750	3/4	0.750	1 5/8	1.625	4	4.000	DM2-1226-SQ	D109S
1	1.000	1	1.000	1 5/8	1.625	4	4.000	DM2-1626-SQ	D110S

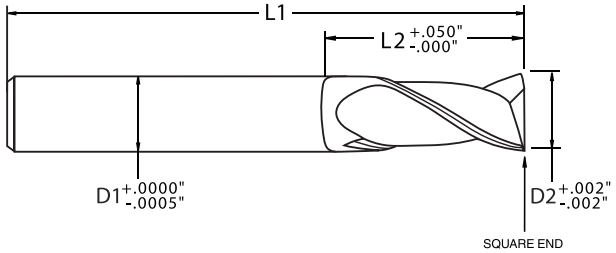
DIE & MOLD CUTTERS GLOBAL™

SERIES DMX - *CARBIDE, 2 FLUTE, 30° CONSTANT HELIX*

CONSIDER IMPORTANT FACTORS

Always consider three important factors when choosing your end mills: application, material and performance. When machining detail features and cavities in ferrous materials, the Global Die & Mold Cutters perform.

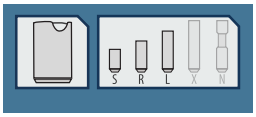
- 30° constant helix provides added rigidity to the flutes for cutting hardened materials
- Ball end option for high performance contour milling in finishing operations
- Corner radius option protects corners in roughing operations and difficult to machine materials by preventing corner chipping and tool failure



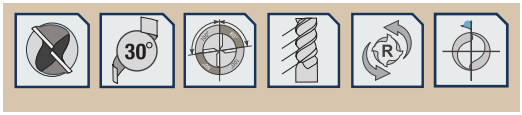
To order a corner radius, use code "CR" & actual radius in the part number. For example, a standard AX-203 would be ordered as AX-203-CR-015, with "015" being the radius.

TIP & END

SHANK & LENGTH



FLUTE CONFIGURATION



MATERIAL

COATINGS

SERIES DM2SL - *SQUARE END, LONG LENGTH*

SHANK DIAMETER (D1)		CUTTER DIAMETER (D2)		FLUTE LENGTH (L2)		OVERALL LENGTH (L1)		PLAIN SHANK PART #	PLAIN SHANK EDP #
1/8	0.125	1/8	0.125	7/8	0.875	2 1/2	2.500	DM2-0214-SQ	D201S
3/16	0.188	3/16	0.188	7/8	0.875	2 1/2	2.500	DM2-0314-SQ	D202S
1/4	0.250	1/4	0.250	1 3/8	1.375	3	3.000	DM2-0422-SQ	D203S
5/16	0.313	5/16	0.313	1 3/8	1.375	3	3.000	DM2-0522-SQ	D204S
3/8	0.375	3/8	0.375	1 7/8	1.875	3 1/2	3.500	DM2-0630-SQ	D205S
7/16	0.438	7/16	0.438	1 7/8	1.875	3 1/2	3.500	DM2-0730-SQ	D206S
1/2	0.500	1/2	0.500	2 1/8	2.125	4	4.000	DM2-0834-SQ	D207S
5/8	0.625	5/8	0.625	2 1/8	2.125	4	4.000	DM2-1034-SQ	D208S
3/4	0.750	3/4	0.750	2 3/8	2.375	5	5.000	DM2-1238-SQ	D209S
1	1.000	1	1.000	2 3/8	2.375	5	5.000	DM2-1638-SQ	D210S

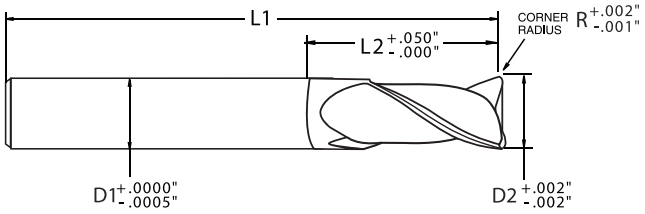
DIE & MOLD CUTTERS GLOBAL™

SERIES DMX - *CARBIDE, 2 FLUTE, 30° CONSTANT HELIX*

IMPROVED RIGIDITY

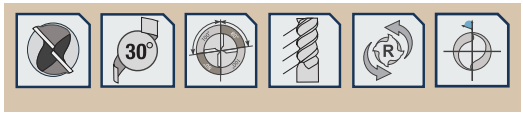
These tools are ideal for contour machining of mold and die cavities. Premium AlTiN-X Nano coating protects the tool from tool steel and hardened materials, while a larger core design adds stability, rigidity and reduces run out.

- Premium micro-grain carbide substrate resists chipping, tool deflection, and has a high transverse rupture strength for greater feeds and speeds
- Large core design for increased stability; higher speeds & feeds; and reduced tool deflection
- Eccentric relief for enhanced edge strength along the flutes



To order a corner radius, use code "CR" & actual radius in the part number. For example, a standard AX-203 would be ordered as AX-203-CR-015, with "015" being the radius.

TIP & END | SHANK & LENGTH | FLUTE CONFIGURATION | MATERIAL | COATINGS

SERIES DM2CS - *CORNER RADIUS, STUB LENGTH*

SHANK DIAMETER (D1)		CUTTER DIAMETER (D2)		FLUTE LENGTH (L2)		OVERALL LENGTH (L1)		CORNER RADIUS (R)	PLAIN SHANK PART #	PLAIN SHANK EDP #
1/8	0.125	1/8	0.125	1/4	0.250	2	2.000	0.010	DM2-0204-R1	D0011
								0.020	DM2-0204-R2	D0022
								0.030	DM2-0204-R3	D0033
3/16	0.188	3/16	0.188	5/16	0.313	2 1/2	2.500	0.010	DM2-0305-R1	D0041
								0.020	DM2-0305-R2	D0052
								0.030	DM2-0305-R3	D0063
1/4	0.250	1/4	0.250	3/8	0.375	3	3.000	0.010	DM2-0406-R1	D0071
								0.020	DM2-0406-R2	D0082
								0.030	DM2-0406-R3	D0093
5/16	0.313	5/16	0.313	7/16	0.438	3	3.000	0.020	DM2-0507-R2	D0102
								0.030	DM2-0507-R3	D0113
								0.060	DM2-0507-R6	D0126
								0.090	DM2-0507-R9	D0137
3/8	0.375	3/8	0.375	1/2	0.500	3 1/2	3.500	0.020	DM2-0608-R2	D0142
								0.030	DM2-0608-R3	D0153
								0.060	DM2-0608-R6	D0166
								0.090	DM2-0608-R9	D0177
1/2	0.500	1/2	0.500	5/8	0.625	3 1/2	3.500	0.020	DM2-0810-R2	D0182
								0.030	DM2-0810-R3	D0193
								0.060	DM2-0810-R6	D0206
								0.090	DM2-0810-R9	D0217

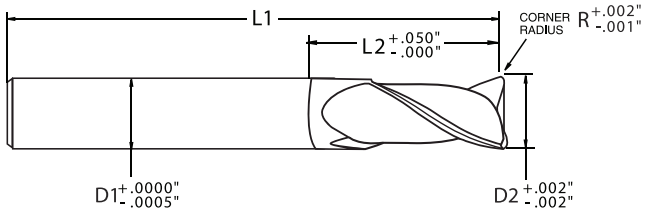
DIE & MOLD CUTTERS GLOBAL™

SERIES DMX - *CARBIDE, 2 FLUTE, 30° CONSTANT HELIX*

HIGHER SPEEDS AND FEEDS

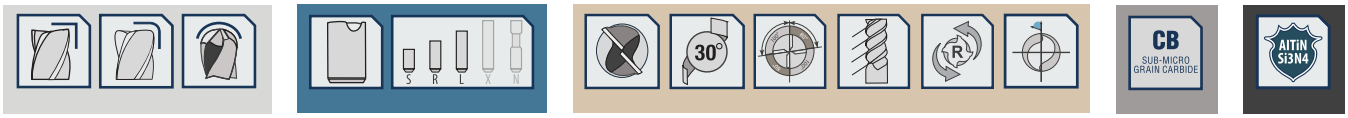
Running at higher speeds and feeds with vibration dampening geometry, our Die and Mold cutters can eliminate the need for expensive hand finishing operations.

- Square end option to create sharp corners in finishing operations
- Coated for heat resistance, wear resistance and increased lubricity
- Two high strength flute design improves chip formation and evacuation for increased feed rates
- For high feed rate finishing of high hardness ferrous materials



To order a corner radius, use code "CR" & actual radius in the part number. For example, a standard AX-203 would be ordered as AX-203-CR-015, with "015" being the radius.

TIP & END | SHANK & LENGTH | FLUTE CONFIGURATION | MATERIAL | COATINGS



SERIES DM2CR - *CORNER RADIUS, REGULAR LENGTH*

SHANK DIAMETER (D1)		CUTTER DIAMETER (D2)		FLUTE LENGTH (L2)		OVERALL LENGTH (L1)		CORNER RADIUS (R)	PLAIN SHANK PART #	PLAIN SHANK EDP #
1/8	0.125	1/8	0.125	5/8	0.625	2 1/2	2.500	0.010	DM2-0210-R1	D1011
								0.020	DM2-0210-R2	D1022
								0.030	DM2-0210-R3	D1033
3/16	0.188	3/16	0.188	5/8	0.625	2 1/2	2.500	0.010	DM2-0310-R1	D1041
								0.020	DM2-0310-R2	D1052
								0.030	DM2-0310-R3	D1063
1/4	0.250	1/4	0.250	7/8	0.875	2 1/2	2.500	0.010	DM2-0414-R1	D1071
								0.020	DM2-0414-R2	D1082
								0.030	DM2-0414-R3	D1093
5/16	0.313	5/16	0.313	7/8	0.875	2 1/2	2.500	0.020	DM2-0514-R2	D1102
								0.030	DM2-0514-R3	D1113
								0.060	DM2-0514-R6	D1126
								0.090	DM2-0514-R9	D1137
3/8	0.375	3/8	0.375	1 1/8	1.125	3	3.000	0.020	DM2-0618-R2	D1142
								0.030	DM2-0618-R3	D1153
								0.060	DM2-0618-R6	D1166
								0.090	DM2-0618-R9	D1177
7/16	0.438	7/16	0.438	1 1/8	1.125	3	3.000	0.030	DM2-0718-R3	D1183
								0.060	DM2-0718-R6	D1196
1/2	0.500	1/2	0.500	1 3/8	1.375	3 1/2	3.500	0.020	DM2-0822-R2	D1202
								0.030	DM2-0822-R3	D1213
								0.060	DM2-0822-R6	D1226
								0.090	DM2-0822-R9	D1237

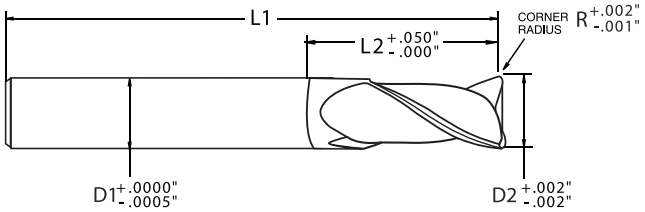
DIE & MOLD CUTTERS GLOBAL™

SERIES DMX - *CARBIDE, 2 FLUTE, 30° CONSTANT HELIX*

COMPLETED IN RECORD TIME

The option to use wet or dry, in roughing and finishing, will make your setup time one of the easiest parts of your day. Our Die and Mold cutters will have your finishing operations completed in record time.

- 30° constant helix provides added rigidity to the flutes for cutting hardened materials
- Ball end option for high performance contour milling in finishing operations
- Corner radius option protects corners in roughing operations and difficult to machine materials by preventing corner chipping and tool failure



To order a corner radius, use code "CR" & actual radius in the part number. For example, a standard AX-203 would be ordered as AX-203-CR-015, with "015" being the radius.

TIP & END | SHANK & LENGTH | FLUTE CONFIGURATION | MATERIAL | COATINGS

SERIES DM2CL - *CORNER RADIUS, LONG LENGTH*

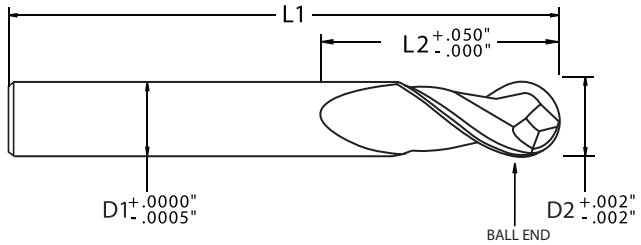
SHANK DIAMETER (D1)		CUTTER DIAMETER (D2)		FLUTE LENGTH (L2)		OVERALL LENGTH (L1)		CORNER RADIUS (R)	PLAIN SHANK PART #	PLAIN SHANK EDP #
1/8	0.125	1/8	0.125	7/8	0.875	3	3.000	0.010	DM2-0214-R1	D2011
								0.020	DM2-0214-R2	D2022
								0.030	DM2-0214-R3	D2033
3/16	0.188	3/16	0.188	7/8	0.875	3	3.000	0.010	DM2-0314-R1	D2041
								0.020	DM2-0314-R2	D2052
								0.030	DM2-0314-R3	D2063
1/4	0.250	1/4	0.250	1 3/8	1.375	3	3.000	0.010	DM2-0422-R1	D2071
								0.020	DM2-0422-R2	D2082
								0.030	DM2-0422-R3	D2093
5/16	0.313	5/16	0.313	1 3/8	1.375	3	3.000	0.020	DM2-0522-R2	D2102
								0.030	DM2-0522-R3	D2113
								0.060	DM2-0522-R6	D2126
								0.090	DM2-0522-R9	D2137
3/8	0.375	3/8	0.375	1 7/8	1.875	3 1/2	3.500	0.020	DM2-0630-R2	D2142
								0.030	DM2-0630-R3	D2153
								0.060	DM2-0630-R6	D2166
								0.090	DM2-0630-R9	D2177
7/16	0.438	7/16	0.438	1 7/8	1.875	3 1/2	3.500	0.030	DM2-0730-R3	D2183
								0.060	DM2-0730-R6	D2196
1/2	0.500	1/2	0.500	2 1/8	2.125	4	4.000	0.020	DM2-0834-R2	D2202
								0.030	DM2-0834-R3	D2213
								0.060	DM2-0834-R6	D2226
								0.090	DM2-0834-R9	D2237

SERIES DMX - *CARBIDE, 2 FLUTE, 30° CONSTANT HELIX*

HIGH STRENGTH FLUTES

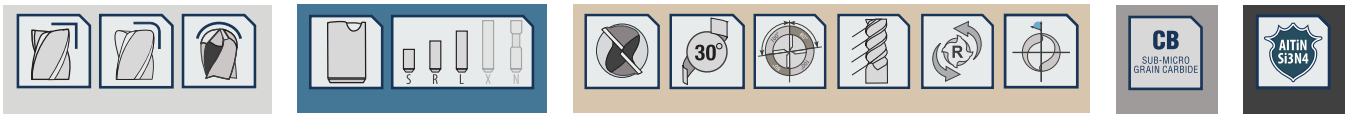
The high strength flutes were engineered for any difficult to machine material, including hardened tool steel, stainless steel, and high temp alloys.

- Premium micro-grain carbide substrate resists chipping, tool deflection, and has a high transverse rupture strength for greater feeds and speeds
- Large core design for increased stability; higher speeds & feeds; and reduced tool deflection
- Eccentric relief for enhanced edge strength along the flutes



To order a corner radius, use code "CR" & actual radius in the part number. For example, a standard AX-203 would be ordered as AX-203-CR-015, with "015" being the radius.

TIP & END | SHANK & LENGTH | FLUTE CONFIGURATION | MATERIAL | COATINGS



SERIES DM2BS - *BALL END, STUB LENGTH*

SHANK DIAMETER (D1)		CUTTER DIAMETER (D2)		FLUTE LENGTH (L2)		OVERALL LENGTH (L1)		PLAIN SHANK PART #	EDP #
1/8	0.125	1/8	0.125	1/4	0.250	2	2.000	DM2-0204-BE	D001B
3/16	0.188	3/16	0.188	5/16	0.313	2 1/2	2.500	DM2-0305-BE	D002B
1/4	0.250	1/4	0.250	3/8	0.375	3	3.000	DM2-0406-BE	D003B
5/16	0.313	5/16	0.313	7/16	0.438	3	3.000	DM2-0507-BE	D004B
3/8	0.375	3/8	0.375	1/2	0.500	3 1/2	3.500	DM2-0608-BE	D005B
1/2	0.500	1/2	0.500	5/8	0.625	3 1/2	3.500	DM2-0810-BE	D006B

SERIES DM2BR - *BALL END, REGULAR LENGTH*

SHANK DIAMETER (D1)		CUTTER DIAMETER (D2)		FLUTE LENGTH (L2)		OVERALL LENGTH (L1)		PLAIN SHANK PART #	EDP #
1/8	0.125	1/8	0.125	5/8	0.625	2 1/2	2.500	DM2-0210-BE	D101B
3/16	0.188	3/16	0.188	5/8	0.625	2 1/2	2.500	DM2-0310-BE	D102B
1/4	0.250	1/4	0.250	7/8	0.875	2 1/2	2.500	DM2-0414-BE	D103B
5/16	0.313	5/16	0.313	7/8	0.875	2 1/2	2.500	DM2-0514-BE	D104B
3/8	0.375	3/8	0.375	1 1/8	1.125	3	3.000	DM2-0618-BE	D105B
7/16	0.438	7/16	0.438	1 1/8	1.125	3	3.000	DM2-0718-BE	D106B
1/2	0.500	1/2	0.500	1 3/8	1.375	3 1/2	3.500	DM2-0822-BE	D107B
5/8	0.625	5/8	0.625	1 3/8	1.375	3 1/2	3.500	DM2-1022-BE	D108B
3/4	0.750	3/4	0.750	1 5/8	1.625	4	4.000	DM2-1226-BE	D109B
1	1.000	1	1.000	1 5/8	1.625	4	4.000	DM2-1626-BE	D110B

SERIES DM2BL - *BALL END, LONG LENGTH*

SHANK DIAMETER (D1)		CUTTER DIAMETER (D2)		FLUTE LENGTH (L2)		OVERALL LENGTH (L1)		PLAIN SHANK PART #	EDP #
1/8	0.125	1/8	0.125	7/8	0.875	2 1/2	2.500	DM2-0214-BE	D201B
3/16	0.188	3/16	0.188	7/8	0.875	2 1/2	2.500	DM2-0314-BE	D202B
1/4	0.250	1/4	0.250	1 3/8	1.375	3	3.000	DM2-0422-BE	D203B
5/16	0.313	5/16	0.313	1 3/8	1.375	3	3.000	DM2-0522-BE	D204B
3/8	0.375	3/8	0.375	1 7/8	1.875	3 1/2	3.500	DM2-0630-BE	D205B
7/16	0.438	7/16	0.438	1 7/8	1.875	3 1/2	3.500	DM2-0730-BE	D206B
1/2	0.500	1/2	0.500	2 1/8	2.125	4	4.000	DM2-0834-BE	D207B
5/8	0.625	5/8	0.625	2 1/8	2.125	4	4.000	DM2-1034-BE	D208B
3/4	0.750	3/4	0.750	2 3/8	2.375	5	5.000	DM2-1238-BE	D209B
1	1.000	1	1.000	2 3/8	2.375	5	5.000	DM2-1638-BE	D210B

DM APPLICATION GUIDE • SPEED & FEED

WORK MATERIAL		TYPE OF CUT	AXIAL DOC	RADIAL DOC	NO. OF FLUTES	SPEED (SFM)	FEED (INCHES PER TOOTH) 1/8" (2 FL)	1/4" (2 FL)	3/8" (2 FL)	1/2" (2 FL)	5/8" (2 FL)	3/4" (2 FL)	1" (2FL)
HARDENED & TOOL STEEL	PRE-HARDENED STEELS 25 to 48 HRc	Roughing	.06 x D	.30 x D	2	140 - 185	0.0020 - 0.0022	0.0039 - 0.0043	0.0059 - 0.0065	0.0078 - 0.0086	0.0097 - 0.0107	0.0117 - 0.0129	0.0156 - 0.0172
		High Effeciency (HEM)	.06 x D	.30 x D	2	265 - 345	0.0020 - 0.0024	0.0039 - 0.0044	0.0058 - 0.0066	0.0078 - 0.0088	0.0097 - 0.0110	0.0117 - 0.0132	0.0155 - 0.0176
		Finishing	.07 x D	.01 5 x D	2	170 - 220	0.0030 - 0.0034	0.0059 - 0.0064	0.0089 - 0.0096	0.0118 - 0.0127	0.0148 - 0.0159	0.0177 - 0.0191	0.0236 - 0.0255
	HARDENED STEELS Less than 48 HRc	Roughing	.06 x D	.30 x D	2	140 - 185	0.0020 - 0.0022	0.0039 - 0.0043	0.0059 - 0.0065	0.0078 - 0.0086	0.0097 - 0.0107	0.0117 - 0.0129	0.0156 - 0.0172
		High Effeciency (HEM)	.06 x D	.30 x D	2	265 - 345	0.0020 - 0.0024	0.0039 - 0.0044	0.0058 - 0.0066	0.0078 - 0.0088	0.0097 - 0.0110	0.0117 - 0.0132	0.0155 - 0.0176
		Finishing	.07 x D	.01 5 x D	2	170 - 220	0.0030 - 0.0034	0.0059 - 0.0064	0.0089 - 0.0096	0.0118 - 0.0127	0.0148 - 0.0159	0.0177 - 0.0191	0.0236 - 0.0255
	HARDENED STEELS 48 to 57 HRc	Roughing	.05 x D	.25 x D	2	110 - 140	0.0020 - 0.0022	0.0039 - 0.0043	0.0059 - 0.0065	0.0078 - 0.0086	0.0097 - 0.0107	0.0117 - 0.0129	0.0156 - 0.0172
		High Effeciency (HEM)	.05 x D	.25 x D	2	225 - 295	0.0020 - 0.0024	0.0039 - 0.0044	0.0058 - 0.0066	0.0078 - 0.0088	0.0097 - 0.0110	0.0117 - 0.0132	0.0155 - 0.0176
		Finishing	.06 x D	.015 x D	2	115 - 150	0.0030 - 0.0034	0.0059 - 0.0064	0.0089 - 0.0096	0.0118 - 0.0127	0.0148 - 0.0159	0.0177 - 0.0191	0.0236 - 0.0255
	HARDENED STEELS 58 to 65 HRc	Roughing	.04 x D	.25 x D	2	90 - 120	0.0020 - 0.0022	0.0039 - 0.0043	0.0059 - 0.0065	0.0078 - 0.0086	0.0097 - 0.0107	0.0117 - 0.0129	0.0156 - 0.0172
		High Effeciency (HEM)	.04 x D	.25 x D	2	185 - 240	0.0020 - 0.0024	0.0039 - 0.0044	0.0058 - 0.0066	0.0078 - 0.0088	0.0097 - 0.0110	0.0117 - 0.0132	0.0155 - 0.0176
		Finishing	.03 x D	.01 x D	2	115 - 150	0.0020 - 0.0024	0.0039 - 0.0044	0.0059 - 0.0066	0.0078 - 0.0087	0.0098 - 0.0109	0.0117 - 0.0131	0.0156 - 0.0175
	HARDENED STEELS Greater than 65 HRc	Roughing	.025 x D	.20 x D	2	55 - 75	0.0010 - 0.0012	0.0019 - 0.0023	0.0029 - 0.0035	0.0038 - 0.0046	0.0047 - 0.0057	0.0057 - 0.0069	0.0076 - 0.0092
		High Effeciency (HEM)	.025 x D	.20 x D	2	125 - 165	0.0020 - 0.0024	0.0039 - 0.0044	0.0058 - 0.0066	0.0078 - 0.0088	0.0097 - 0.0110	0.0117 - 0.0132	0.0155 - 0.0176
		Finishing	.02 x D	.01 x D	2	90 - 120	0.0020 - 0.0024	0.0039 - 0.0044	0.0059 - 0.0066	0.0078 - 0.0087	0.0098 - 0.0109	0.0117 - 0.0131	0.0156 - 0.0175

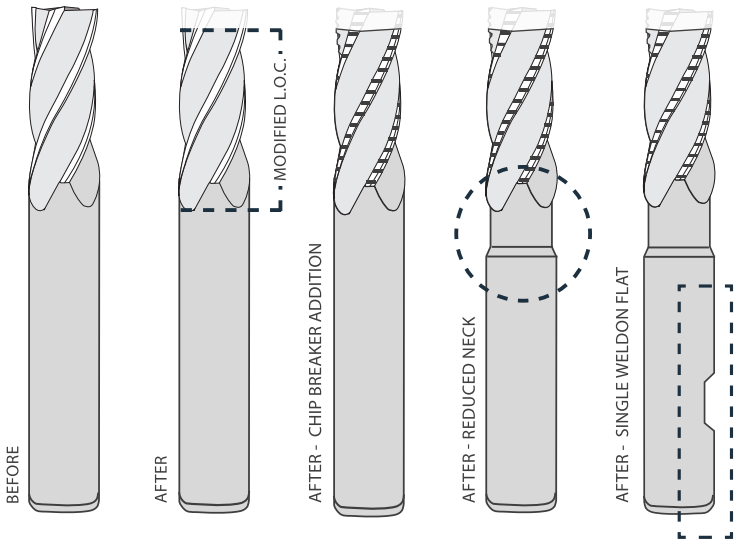
MODIFICATION PROGRAM

MODIFICATION OF IN-STOCK TOOLS

WE CAN MODIFY MOST ANY TOOL

We can modify our standard tools or manufacture a highly specialized tool to your exact specifications. Modifications ensure fast delivery of your tool (subject to availability) and decrease costs on small batch runs. Most modifications ship within 2 - 3 business days. Please allow additional time when adding coatings. If you need assistance with modification selection or have any questions, please contact us.

SEE PAGE 16 - 21 FOR DETAILS



GUARANTEED TEST TOOL

*TEST OUR STANDARD END MILLS

CARBIDE | HSS | COBALT

SELECTING YOUR END MILL

We realize that selecting the optimal end mill for your particular job can be confusing. That's why our team of experts are here to help. Our outstanding customer service can help you select the best end mill for your job, as well as the expertise needed to choose the most advantageous tool for your machining needs.

VISIT OUR WEBSITE OR CALL FOR YOUR TOOL TODAY!

CONICAL™ CUTTING TOOLS

GLOBAL™ CUTTING TOOLS

TOOL PERFORMANCE REPORT

In order to serve you better, please print out our "tool performance report" on pg. 272. Fill in the information completely and fax it to: (616) 531-7742. We are always striving for excellence in everything we do. By filling out this form, we will continue to do everything we can to make your experience with Conical Tool as efficient and effective as possible.

MANUFACTURING FOR OVER 70 YEARS 1944 - 2014

*not applicable to specials

CONICAL™ CUTTING TOOLS

GLOBAL™ CUTTING TOOLS

70 YEARS OF INNOVATION

CONICAL™
PROFILE RIB CUTTERS

SOPHISTICATED ENGINEERING

The Conical Profile Rib Cutters are fabricated from ultra-fine grain carbide and finished with a premium, multi-layer PVD AlTiN/Si3N4 coating.

These end mills provide the necessary precision required for machining finished features and ribs in a huge array of materials and operations. It has varying angles, diameters, lengths and end configurations that work in combination to maximize smooth surface finish and maintain high levels of productivity.

Perfect features are cut in the workpiece through our proprietary design which combines tool engagement with vibration dampening geometries.

The Conical Profile Rib Cutters elegant and detailed performance is showcased in the finished products it creates. Maximum core diameters are still a focal point on these tools, as an increase in even a few thousandths on a small diameter tool can have vast impacts on the rigidity and speeds generated.

PROCESS ENGINEERING

Our company has the talent to troubleshoot even the most challenging machining problems in the industry today. We know there are more ways to accomplish cost saving efficiencies than just having a quality tool. We provide machining recommendation and process improvements to maximize the goals of our customers, whether that be speed, finish or cost. Our engineering strategy goes beyond the tools we manufacture.

Global Cutting Tools
Conical Tool Company

3890 Buchanan Ave SW
Grand Rapids, MI 49548

T: 888.531.8500 | **P:** 616.531.8500
F: 616.531.7742 | **E:** info@conicaltool.com

W: www.conicalendmills.com
W: www.globalcuttingtools.com

MANUFACTURING FOR OVER 70 YEARS 1944 - 2014

SEAL OF QUALITY ASSURANCE

Global Cutting Tools are distributed by:

OVER 7,000
DISTRIBUTORS WORLDWIDE

Made in the U.S.A.

CONICAL™
PROFILE RIB CUTTERS

AMERICAN MADE

GLOBALLY RENOWNED

DIE & MOLD END MILLS
FOR PRECISION FINISHING OF RIBS & FEATURES IN FERROUS MATERIALS

CONICAL™ CUTTING TOOLS

CONICAL™
PROFILE RIB CUTTERS

PRECISION FINISHING
OF FEATURES IN FERROUS MATERIALS

FEATURES & BENEFITS

Our expertise and proprietary designs are once again combined to create our Conical Profile Rib Cutters. These tools have multiple configurations of angle, tip size and offer an optional extra-long length. The Profile Rib Cutters are capable of precision machining mold ribs and performance finishing profile walls in a wide range of materials from low carbon steel to titanium. They turn hardened die steels into finished products with the exact specifications you demand. Every tool is built to create consistency, reliability and performance for our customers.

General Inquiries:
3890 Buchanann Ave SW
Grand Rapids, MI 49548

P: (616) 531-8500
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Sales & Distribution:
T: (888) 531-8500
E: sales@conicaltool.com

Custom Tooling:
E: quotes@conicaltool.com
W: conicalendmills.com/custom-tool-ordering

CONICAL™
CUTTING TOOLS

SERIES: PRX

For precision finishing of high hardness ferrous materials to maximize productivity and surface finish while detail machining features and ribs in ferrous material; wet or dry; mold & tools steels, alloy steels and high hardness materials

Square end option to create sharp corners in finishing operations

Coated for heat resistance, wear resistance and increased lubricity

Improved tool engagement through four flute design creates a superior surface finish

Variable lead helix provides increased tool engagement and rigidity

Ball end option for high performance contour milling, and radius forming in finishing operations

Corner radius option protects corners in rib cutting operations and difficult to machine materials by preventing corner chipping and tool failure

Variable Core Design maximizes chip evacuation and provides increased rigidity when the cutter is fully engaged

Premium micro-grain carbide substrate resists chipping, tool deflection, and has a high transverse rupture strength for greater feeds and speeds

TIP & END

NON STOCK

SHANK & LENGTH

S R L X N

FLUTE CONFIGURATION

25°-30°

MATERIAL

CB SUB-MICRO GRAIN CARBIDE

COATING

AlTiN Si3N4

RESULTS

Combining an eccentric relief, AlTiN/Si3N4 coating and proprietary flute design gives the tool greater strength, rigidity and added longevity. This structure also enables a high feed/material removal rate and chatter-free milling, for most ferrous materials. Don't spend unnecessary time with set-ups when you can count on our experience to make things easier for you, by ensuring you have the knowledge and proper tools to get the job done right.

Series PRX: Ultra-Fine Grain Carbide, 4 Flute; Variable Lead Helix
Subseries: PR00R, PR0XR, PR01R, PR1XR, PR02R, PR03R, PR05R, PR07R, PR10R
Subseries: PR00B, PR0XB, PR01B, PR1XB, PR02B, PR03B, PR05B, PR07B, PR10B
Configuration: Varying Angles; Varying Diameters; 7 x D Length & 14 x D Lengths; 25 - 30° Variable Lead Helix; Square End, Corner Radius & Ball End

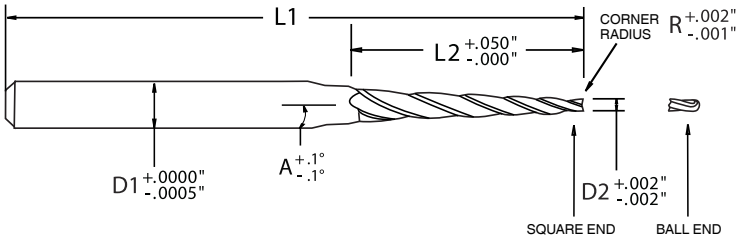
PROFILE RIB CUTTERS CONICAL™

SERIES PRX - *CARBIDE, 4 FLUTE, PRECISION MACHINING*

REQUIRED PRECISION

These end mills provide the necessary precision required for machining finishing features and ribs in a huge array of materials and operations.

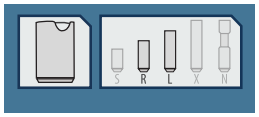
- Square end option to create sharp corners in finishing operations
- Coated for heat resistance, wear resistance and increased lubricity
- Improved tool engagement through four flute design creates a superior surface finish



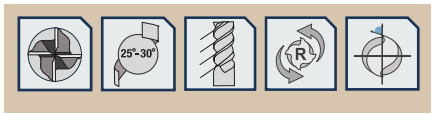
To order a corner radius, use code "CR" & actual radius in the part number. For example, a standard AX-203 would be ordered as AX-203-CR-015, with "015" being the radius.

TIP & END

SHANK & LENGTH



FLUTE CONFIGURATION



MATERIAL

COATINGS

SERIES PR00R & PR00B - *0 DEGREE, 7xD, REGULAR LENGTH*

ANGLE PER SIDE (A)	TIP DIAMETER (D2)	SHANK DIAMETER (D1)		FLUTE LENGTH (L2)	OVERALL LENGTH (L1)	# OF FLUTES	CORNER RADIUS (R)		BALL END PART #	BALL END EDP #
0°	0.030	3/16	0.188	0.210	3.000	4	SL01.030R	5S011	SL01.030B	5S01B
	0.040			0.280			SL01.040R	5S021	SL01.040B	5S02B
	0.050			0.350			SL01.050R	5S031	SL01.050B	5S03B
	0.060			0.420			SL01.060R	5S041	SL01.060B	5S04B
	0.070			0.490			SL01.070R	5S051	SL01.070B	5S05B
	0.080			0.560			SL01.080R	5S061	SL01.080B	5S06B
	0.090			0.630			SL01.090R	5S071	SL01.090B	5S07B
	0.100			0.700			SL01.100R	5S081	SL01.100B	5S08B

SERIES PR00R & PR00B - *0 DEGREE, 14xD, LONG LENGTH*

ANGLE PER SIDE (A)	TIP DIAMETER (D2)	SHANK DIAMETER (D1)		FLUTE LENGTH (L2)	OVERALL LENGTH (L1)	# OF FLUTES	CORNER RADIUS (R)		BALL END PART #	BALL END EDP #
0°	0.030	3/16	0.188	0.188	3.000	4	SL02.030R	5S091	SL02.030B	5S09B
	0.040			0.560			SL02.040R	5S101	SL02.040B	5S10B
	0.050			0.700			SL02.050R	5S111	SL02.050B	5S11B
	0.060			0.840			SL02.060R	5S121	SL02.060B	5S12B
	0.070			0.980			SL02.070R	5S131	SL02.070B	5S13B
	0.080			1.120			SL02.080R	5S141	SL02.080B	5S14B
	0.090			1.260			SL02.090R	5S151	SL02.090B	5S15B
	0.100			1.400			SL02.100R	5S161	SL02.100B	5S16B

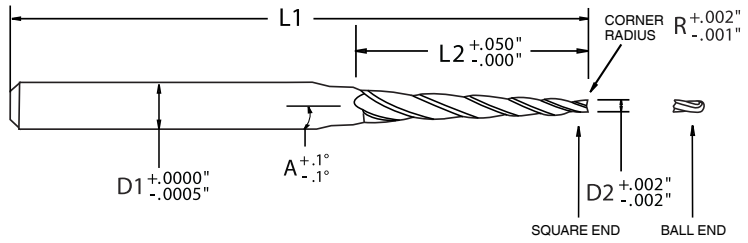
PROFILE RIB CUTTERS CONICAL™

SERIES PRX - *CARBIDE, 4 FLUTE, PRECISION MACHINING*

THE BEST MATERIALS AND COATINGS

The Conical Profile Rib Cutters are fabricated from ultra-fine grain carbide and finished with a premium, AlTiN/Si3N4 coating.

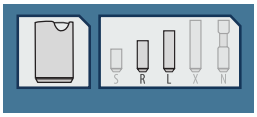
- Variable lead helix provides increased tool engagement and rigidity
- Eccentric relief for enhanced edge strength along the flutes
- Ball end option for high performance contour milling, and radius forming in finishing operations



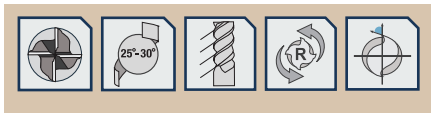
To order a corner radius, use code "CR" & actual radius in the part number. For example, a standard AX-203 would be ordered as AX-203-CR-015, with "015" being the radius.

TIP & END

SHANK & LENGTH



FLUTE CONFIGURATIONS



MATERIAL

COATINGS

SERIES PR0XR & PR0XB - *½ DEGREE, 7xD, STUB LENGTH*

ANGLE PER SIDE (A)	TIP DIAMETER (D2)	SHANK DIAMETER (D1)		FLUTE LENGTH (L2)	OVERALL LENGTH (L1)	# OF FLUTES	CORNER RADIUS (R)		BALL END PART #	BALL END EDP #
.5°	0.030	3/16	0.188	0.210	3.000	4	AX01.030R	5Y011	AX01.030B	5Y01B
	0.040			0.280			AX01.040R	5Y021	AX01.040B	5Y02B
	0.050			0.350			AX01.050R	5Y031	AX01.050B	5Y03B
	0.060			0.420			AX01.060R	5Y041	AX01.060B	5Y04B
	0.070			0.490			AX01.070R	5Y051	AX01.070B	5Y05B
	0.080			0.560			AX01.080R	5Y061	AX01.080B	5Y06B
	0.090			0.630			AX01.090R	5Y071	AX01.090B	5Y07B
	0.100			0.700			AX01.100R	5Y081	AX01.100B	5Y08B

SERIES PR0XR & PR0XB - *½ DEGREE, 14xD, STUB & REGULAR*

ANGLE PER SIDE (A)	TIP DIAMETER (D2)	SHANK DIAMETER (D1)		FLUTE LENGTH (L2)	OVERALL LENGTH (L1)	# OF FLUTES	CORNER RADIUS (R)		BALL END PART #	BALL END EDP #
.5°	0.030	3/16	0.188	0.188	3.000	4	AX02.030R	5Y091	AX02.030B	5Y09B
	0.040			0.560			AX02.040R	5Y101	AX02.040B	5Y10B
	0.050			0.700			AX02.050R	5Y111	AX02.050B	5Y11B
	0.060			0.840			AX02.060R	5Y121	AX02.060B	5Y12B
	0.070			0.980			AX02.070R	5Y131	AX02.070B	5Y13B
	0.080			1.120			AX02.080R	5Y141	AX02.080B	5Y14B
	0.090			1.260			AX02.090R	5Y151	AX02.090B	5Y15B
	0.100			1.400			AX02.100R	5Y161	AX02.100B	5Y16B

PROFILE RIB CUTTERS

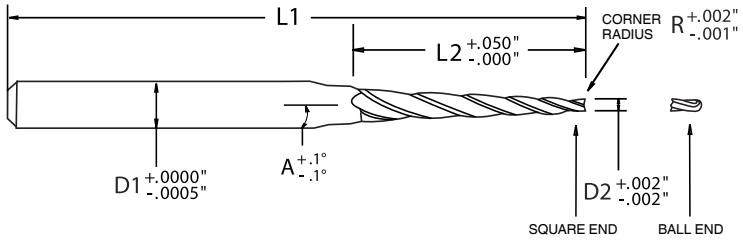
CONICAL™

SERIES PRX - *CARBIDE, 4 FLUTE, PRECISION MACHINING*

MAXIMIZE PRODUCTIVITY AND PERFORMANCE

Our Profile Rib Cutters have varying angles, diameters, lengths and end configurations that work in conjunction to maximize smooth surface finish and maintain high levels of productivity.

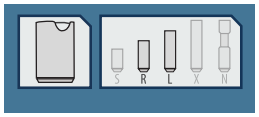
- Corner radius option protects corners in rib cutting operations and difficult to machine materials by preventing corner chipping and tool failure
- Variable Core Design maximizes chip evacuation and provides increased rigidity when the cutter is fully engaged
- Improved tool engagement through four flute design creates a superior surface finish



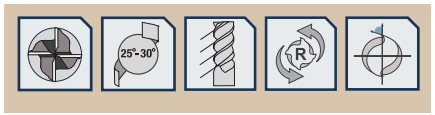
To order a corner radius, use code "CR" & actual radius in the part number. For example, a standard AX-203 would be ordered as AX-203-CR-015, with "015" being the radius.

TIP & END

SHANK & LENGTH



FLUTE CONFIGURATIONS



MATERIAL

COATINGS

SERIES PR01R & PR01B - *1 DEGREE, 7xD, REGULAR LENGTH*

ANGLE PER SIDE (A)	TIP DIAMETER (D2)	SHANK DIAMETER (D1)		FLUTE LENGTH (L2)	OVERALL LENGTH (L1)	# OF FLUTES	CORNER RADIUS (R)		BALL END PART #	BALL END EDP #
1°	0.030	3/16	0.188	0.210	3.000	4	A01.030R	5A011	A01.030B	5A01B
	0.040			0.280			A01.040R	5A021	A01.040B	5A02B
	0.050			0.350			A01.050R	5A031	A01.050B	5A03B
	0.060			0.420			A01.060R	5A041	A01.060B	5A04B
	0.070			0.490			A01.070R	5A051	A01.070B	5A05B
	0.080			0.560			A01.080R	5A061	A01.080B	5A06B
	0.090			0.630			A01.090R	5A071	A01.090B	5A07B
	0.100			0.700			A01.100R	5A081	A01.100B	5A08B

SERIES PR01R & PR01B - *1 DEGREE, 14xD, LONG LENGTH*

ANGLE PER SIDE (A)	TIP DIAMETER (D2)	SHANK DIAMETER (D1)		FLUTE LENGTH (L2)	OVERALL LENGTH (L1)	# OF FLUTES	CORNER RADIUS (R)		BALL END PART #	BALL END EDP #
1°	0.030	3/16	0.188	0.188	3.000	4	A02.030R	5A091	A02.030B	5A09B
	0.040			0.560			A02.040R	5A101	A02.040B	5A10B
	0.050			0.700			A02.050R	5A111	A02.050B	5A11B
	0.060			0.840			A02.060R	5A121	A02.060B	5A12B
	0.070			0.980			A02.070R	5A131	A02.070B	5A13B
	0.080			1.120			A02.080R	5A141	A02.080B	5A14B
	0.090			1.260			A02.090R	5A151	A02.090B	5A15B
	0.100			1.400			A02.100R	5A161	A02.100B	5A16B

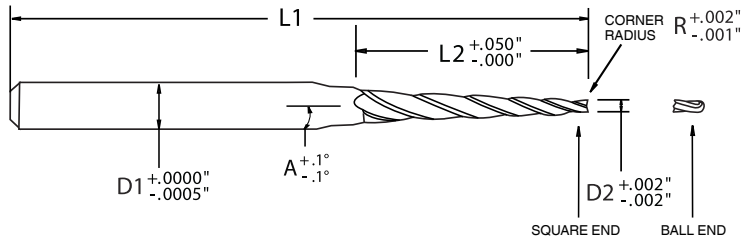
PROFILE RIB CUTTERS CONICAL™

SERIES PRX - *CARBIDE, 4 FLUTE, PRECISION MACHINING*

COMBINING FEATURES

Perfect features are cut in the workpiece through our proprietary design which combines tool engagement with vibration dampening geometries.

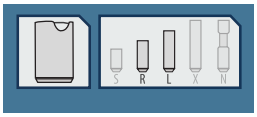
- Square end option to create sharp corners in finishing operations
- Coated for heat resistance, wear resistance and increased lubricity
- Premium micro-grain carbide substrate resists chipping, tool deflection, and has a high transverse rupture strength for greater feeds and speeds



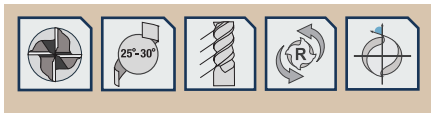
To order a corner radius, use code "CR" & actual radius in the part number. For example, a standard AX-203 would be ordered as AX-203-CR-015, with "015" being the radius.

TIP & END

SHANK & LENGTH



FLUTE CONFIGURATIONS



MATERIAL

COATINGS

SERIES PR1XR & PR1XB - *1 ½ DEGREE, 7xD, REGULAR LENGTH*

ANGLE PER SIDE (A)	TIP DIAMETER (D2)	SHANK DIAMETER (D1)	FLUTE LENGTH (L2)	OVERALL LENGTH (L1)	# OF FLUTES	CORNER RADIUS (R)		BALL END PART #	BALL END EDP #
1.5°	0.030	3/16 0.188	0.210	3.000	4	AAX01.030R	5X011	AAX01.030B	5X01B
	0.040		0.280			AAX01.040R	5X021	AAX01.040B	5X02B
	0.050		0.350			AAX01.050R	5X031	AAX01.050B	5X03B
	0.060		0.420			AAX01.060R	5X041	AAX01.060B	5X04B
	0.070		0.490			AAX01.070R	5X051	AAX01.070B	5X05B
	0.080		0.560			AAX01.080R	5X061	AAX01.080B	5X06B
	0.090		0.630			AAX01.090R	5X071	AAX01.090B	5X07B
	0.100		0.700			AAX01.100R	5X081	AAX01.100B	5X08B

SERIES PR1XR & PR1XB - *1 ½ DEGREE, 14xD, LONG LENGTH*

ANGLE PER SIDE (A)	TIP DIAMETER (D2)	SHANK DIAMETER (D1)	FLUTE LENGTH (L2)	OVERALL LENGTH (L1)	# OF FLUTES	CORNER RADIUS (R)		BALL END PART #	BALL END EDP #
1.5°	0.030	3/16 0.188	0.188	3.000	4	AAX02.030R	5X091	AAX02.030B	5X09B
	0.040		0.560			AAX02.040R	5X101	AAX02.040B	5X10B
	0.050		0.700			AAX02.050R	5X111	AAX02.050B	5X11B
	0.060		0.840			AAX02.060R	5X121	AAX02.060B	5X12B
	0.070		0.980			AAX02.070R	5X131	AAX02.070B	5X13B
	0.080		1.120			AAX02.080R	5X141	AAX02.080B	5X14B
	0.090		1.260			AAX02.090R	5X151	AAX02.090B	5X15B
	0.100		1.400			AAX02.100R	5X161	AAX02.100B	5X16B

PROFILE RIB CUTTERS

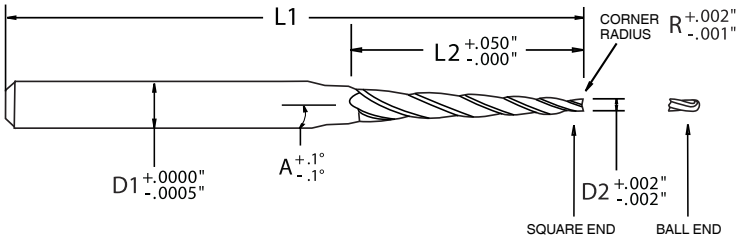
CONICAL™

SERIES PRX - *CARBIDE, 4 FLUTE, PRECISION MACHINING*

MULTIPLE CONFIGURATIONS

Our Profile Rib Cutters have multiple configurations of angle, tip size and offer an optional extra-long length. No matter what your application demands, we have the specifications you need.

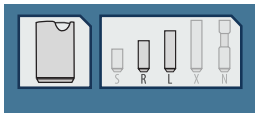
- Constant spiral helix provides increased tool engagement and rigidity
- Eccentric relief for enhanced edge strength along the flutes
- Ball end option for high performance contour milling, and radius forming in finishing operations



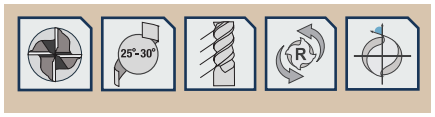
To order a corner radius, use code "CR" & actual radius in the part number. For example, a standard AX-203 would be ordered as AX-203-CR-015, with "015" being the radius.

TIP & END

SHANK & LENGTH



FLUTE CONFIGURATIONS



MATERIAL

COATINGS

SERIES PR02R & PR02B - *2 DEGREE, 7xD, REGULAR LENGTH*

ANGLE PER SIDE (A)	TIP DIAMETER (D2)	SHANK DIAMETER (D1)		FLUTE LENGTH (L2)	OVERALL LENGTH (L1)	# OF FLUTES	CORNER RADIUS (R)		BALL END PART #	BALL END EDP #
2°	0.030	3/16	0.188	0.210	3.000	4	B01.030R	5B011	B01.030B	5B01B
	0.040			0.280			B01.040R	5B021	B01.040B	5B02B
	0.050			0.350			B01.050R	5B031	B01.050B	5B03B
	0.060			0.420			B01.060R	5B041	B01.060B	5B04B
	0.070			0.490			B01.070R	5B051	B01.070B	5B05B
	0.080			0.560			B01.080R	5B061	B01.080B	5B06B
	0.090			0.630			B01.090R	5B071	B01.090B	5B07B
	0.100			0.700			B01.100R	5B081	B01.100B	5B08B

SERIES PR02R & PR02B - *2 DEGREE, 14xD, LONG LENGTH*

ANGLE PER SIDE (A)	TIP DIAMETER (D2)	SHANK DIAMETER (D1)		FLUTE LENGTH (L2)	OVERALL LENGTH (L1)	# OF FLUTES	CORNER RADIUS (R)		BALL END PART #	BALL END EDP #
2°	0.030	3/16	0.188	0.188	3.000	4	B02.030R	5B091	B02.030B	5B09B
	0.040			0.560			B02.040R	5B101	B02.040B	5B10B
	0.050			0.700			B02.050R	5B111	B02.050B	5B11B
	0.060			0.840			B02.060R	5B121	B02.060B	5B12B
	0.070			0.980			B02.070R	5B131	B02.070B	5B13B
	0.080			1.120			B02.080R	5B141	B02.080B	5B14B
	0.090			1.260			B02.090R	5B151	B02.090B	5B15B
	0.100	1/4	0.250	1.400			B02.100R	5B161	B02.100B	5B16B

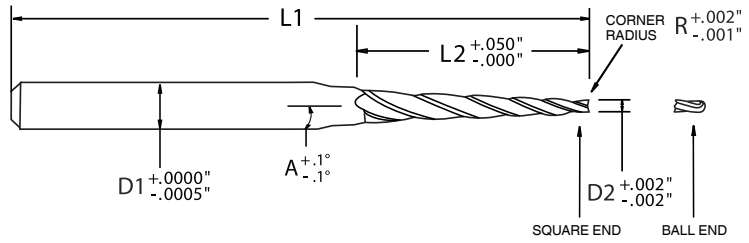
PROFILE RIB CUTTERS CONICAL™

SERIES PRX - *CARBIDE, 4 FLUTE, PRECISION MACHINING*

CONSISTENCY, RELIABILITY & PERFORMANCE

Our Profile Rib Cutters turn hardened die steels into finished products with the exact specifications you demand. Every tool is built to create consistency, reliability and performance for our customers.

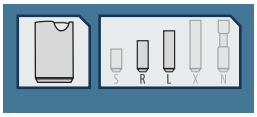
- Corner radius option protects corners in rib cutting operations and difficult to machine materials by preventing corner chipping and tool failure
- Variable Core Design maximizes chip evacuation and provides increased rigidity when the cutter is fully engaged
- Improved tool engagement through four flute design creates a superior surface finish



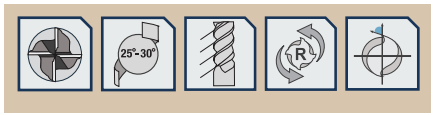
To order a corner radius, use code "CR" & actual radius in the part number. For example, a standard AX-203 would be ordered as AX-203-CR-015, with "015" being the radius.

TIP & END

SHANK & LENGTH



FLUTE CONFIGURATIONS



MATERIAL

COATINGS

SERIES PR03R & PR03B - *3 DEGREE, 7xD, REGULAR LENGTH*

ANGLE PER SIDE (A)	TIP DIAMETER (D2)	SHANK DIAMETER (D1)	FLUTE LENGTH (L2)	OVERALL LENGTH (L1)	# OF FLUTES	CORNER RADIUS (R)		BALL END PART #	BALL END EDP #
3°	0.030	3/16 0.188	0.210	3.000	4	C01.030R	5C011	C01.030B	5C01B
	0.040		0.280			C01.040R	5C021	C01.040B	5C02B
	0.050		0.350			C01.050R	5C031	C01.050B	5C03B
	0.060		0.420			C01.060R	5C041	C01.060B	5C04B
	0.070		0.490			C01.070R	5C051	C01.070B	5C05B
	0.080		0.560			C01.080R	5C061	C01.080B	5C06B
	0.090		0.630			C01.090R	5C071	C01.090B	5C07B
	0.100		0.700			C01.100R	5C081	C01.100B	5C08B

SERIES PR03R & PR03B - *3 DEGREE, 14xD, LONG LENGTH*

ANGLE PER SIDE (A)	TIP DIAMETER (D2)	SHANK DIAMETER (D1)	FLUTE LENGTH (L2)	OVERALL LENGTH (L1)	# OF FLUTES	CORNER RADIUS (R)		BALL END PART #	BALL END EDP #
3°	0.030	3/16 0.188	0.188	3.000	4	C02.030R	5C091	C02.030B	5C09B
	0.040		0.560			C02.040R	5C101	C02.040B	5C10B
	0.050		0.700			C02.050R	5C111	C02.050B	5C11B
	0.060		0.840			C02.060R	5C121	C02.060B	5C12B
	0.070		0.980			C02.070R	5C131	C02.070B	5C13B
	0.080	1/4 0.250	0.250			C02.080R	5C141	C02.080B	5C14B
	0.090		1.260			C02.090R	5C151	C02.090B	5C15B
	0.100		1.400			C02.100R	5C161	C02.100B	5C16B

PROFILE RIB CUTTERS

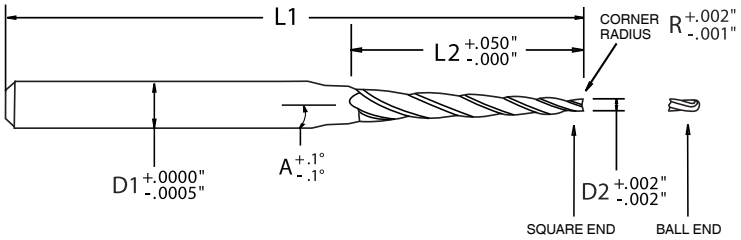
CONICAL™

SERIES PRX - *CARBIDE, 4 FLUTE, PRECISION MACHINING*

STRENGTH, RIGIDITY AND LONGEVITY

Our Profile Rib Cutters combine an eccentric relief, AlTiN-X Nano coating and proprietary flute design to give the tool greater strength, rigidity and added longevity.

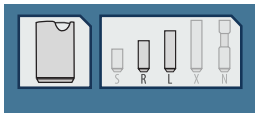
- Square end option to create sharp corners in finishing operations
- Coated for heat resistance, wear resistance and increased lubricity
- Improved tool engagement through four flute design creates a superior surface finish



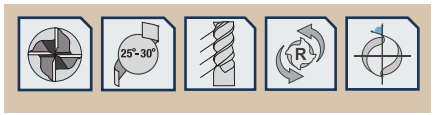
To order a corner radius, use code "CR" & actual radius in the part number. For example, a standard AX-203 would be ordered as AX-203-CR-015, with "015" being the radius.

TIP & END

SHANK & LENGTH



FLUTE CONFIGURATIONS



MATERIAL

COATINGS

SERIES PR05R & PR05B - *5 DEGREE, 7xD, REGULAR LENGTH*

ANGLE PER SIDE (A)	TIP DIAMETER (D2)	SHANK DIAMETER (D1)		FLUTE LENGTH (L2)	OVERALL LENGTH (L1)	# OF FLUTES	CORNER RADIUS (R)		BALL END PART #	BALL END EDP #
5°	0.030	3/16	0.188	0.210	3.000	4	E01.030R	5E011	E01.030B	5E01B
	0.040			0.280			E01.040R	5E021	E01.040B	5E02B
	0.050			0.350			E01.050R	5E031	E01.050B	5E03B
	0.060			0.420			E01.060R	5E041	E01.060B	5E04B
	0.070			0.490			E01.070R	5E051	E01.070B	5E05B
	0.080			0.560			E01.080R	5E061	E01.080B	5E06B
	0.090	1/4	0.250	0.630			E01.090R	5E071	E01.090B	5E07B
	0.100			0.700			E01.100R	5E081	E01.100B	5E08B

SERIES PR05R & PR05B - *5 DEGREE, 14xD, LONG LENGTH*

ANGLE PER SIDE (A)	TIP DIAMETER (D2)	SHANK DIAMETER (D1)		FLUTE LENGTH (L2)	OVERALL LENGTH (L1)	# OF FLUTES	CORNER RADIUS (R)		BALL END PART #	BALL END EDP #
5°	0.030	3/16	0.188	0.188	3.000	4	E02.030R	5E091	E02.030B	5E09B
	0.040			0.560			E02.040R	5E101	E02.040B	5E10B
	0.050			0.700			E02.050R	5E111	E02.050B	5E11B
	0.060	1/4	0.250	0.250			E02.060R	5E121	E02.060B	5E12B
	0.070			0.980			E02.070R	5E131	E02.070B	5E13B
	0.080	3/8	0.375	0.375			E02.080R	5E141	E02.080B	5E14B
	0.090			1.260			E02.090R	5E151	E02.090B	5E15B
	0.100			1.400			E02.100R	5E161	E02.100B	5E16B

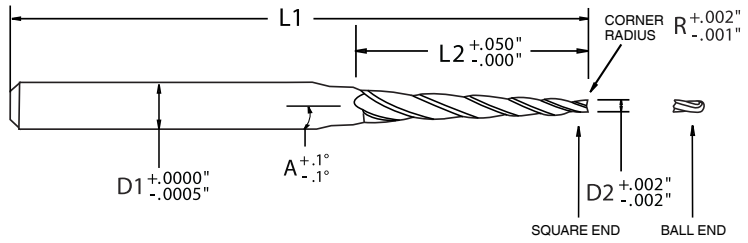
PROFILE RIB CUTTERS CONICAL™

SERIES PRX - *CARBIDE, 4 FLUTE, PRECISION MACHINING*

WIDE RANGE OF APPLICATIONS

Our Profile Rib Cutters enable high feed/material removal rates and chatter-free milling, for most ferrous materials. The Profile Rib Cutters are capable of precision machining mold ribs and performance finishing profile walls in a wide range of materials.

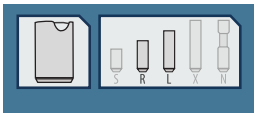
- Constant spiral helix provides increased tool engagement and rigidity
- Eccentric relief for enhanced edge strength along the flutes
- Ball end option for high performance contour milling, and radius forming in finishing operations



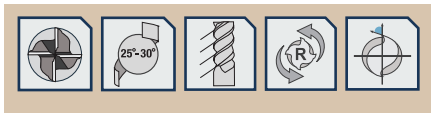
To order a corner radius, use code "CR" & actual radius in the part number. For example, a standard AX-203 would be ordered as AX-203-CR-015, with "015" being the radius.

TIP & END

SHANK & LENGTH



FLUTE CONFIGURATIONS



MATERIAL

COATINGS

SERIES PR07R & PR07B - *7 DEGREE, 7xD, REGULAR LENGTH*

ANGLE PER SIDE (A)	TIP DIAMETER (D2)	SHANK DIAMETER (D1)		FLUTE LENGTH (L2)	OVERALL LENGTH (L1)	# OF FLUTES	CORNER RADIUS (R)		BALL END PART #	BALL END EDP #
7°	0.030	3/16	0.188	0.210	3.000	4	G01.030R	5G011	G01.030B	5G01B
	0.040			0.280			G01.040R	5G021	G01.040B	5G02B
	0.050			0.350			G01.050R	5G031	G01.050B	5G03B
	0.060			0.420			G01.060R	5G041	G01.060B	5G04B
	0.070	1/4	0.250	0.490			G01.070R	5G051	G01.070B	5G05B
	0.080			0.560			G01.080R	5G061	G01.080B	5G06B
	0.090			0.630			G01.090R	5G071	G01.090B	5G07B

SERIES PR07R & PR07B - *7 DEGREE, 14xD, LONG LENGTH*

ANGLE PER SIDE (A)	TIP DIAMETER (D2)	SHANK DIAMETER (D1)		FLUTE LENGTH (L2)	OVERALL LENGTH (L1)	# OF FLUTES	CORNER RADIUS (R)		BALL END PART #	BALL END EDP #
7°	0.030	3/16	0.188	0.188	3.000	4	G02.030R	5G081	G02.030B	5G08B
	0.040			0.560			G02.040R	5G091	G02.040B	5G09B
	0.050	1/4	0.250	0.700			G02.050R	5G101	G02.050B	5G10B
	0.060	3/8	0.375	0.375			G02.060R	5G111	G02.060B	5G11B
	0.070			0.980			G02.070R	5G121	G02.070B	5G12B
	0.080			1.120			G02.080R	5G131	G02.080B	5G13B
	0.090	1/2	0.500	1.260			G02.090R	5G141	G02.090B	5G14B

PROFILE RIB CUTTERS

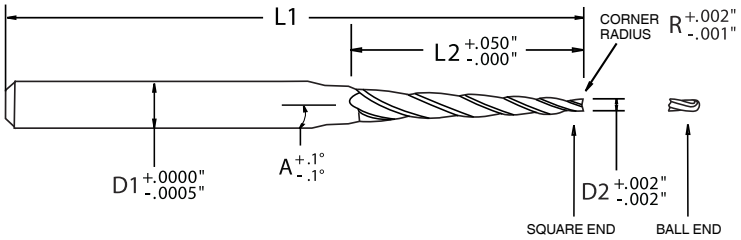
CONICAL™

SERIES PRX - *CARBIDE, 4 FLUTE, PRECISION MACHINING*

REQUIRED PRECISION

These end mills provide the necessary precision required for machining finishing features and ribs in a huge array of materials and operations.

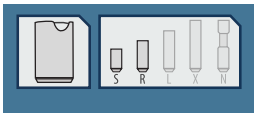
- Corner radius option protects corners in rib cutting operations and difficult to machine materials by preventing corner chipping and tool failure
- Variable Core Design maximizes chip evacuation and provides increased rigidity when the cutter is fully engaged
- Improved tool engagement through four flute design creates a superior surface finish



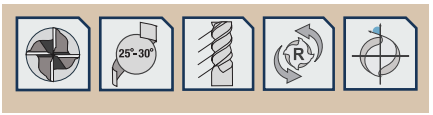
To order a corner radius, use code "CR" & actual radius in the part number. For example, a standard AX-203 would be ordered as AX-203-CR-015, with "015" being the radius.

TIP & END

SHANK & LENGTH



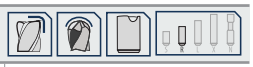
FLUTE CONFIGURATIONS



MATERIAL

COATINGS

SERIES PR10R & PR10B - *10 DEGREE, 7xD, REGULAR LENGTH*



ANGLE PER SIDE (A)	TIP DIAMETER (D2)	SHANK DIAMETER (D1)		FLUTE LENGTH (L2)	OVERALL LENGTH (L1)	# OF FLUTES	CORNER RADIUS (R)		BALL END PART #	BALL END EDP #
10°	0.030	3/16	0.188	0.210	3.000	4	J01.030R	5J011	J01.030B	5J01B
	0.040			0.280			J01.040R	5J021	J01.040B	5J02B
	0.050			0.350			J01.050R	5J031	J01.050B	5J03B
	0.060	1/4	0.250	0.420			J01.060R	5J041	J01.060B	5J04B
	0.070			0.490			J01.070R	5J051	J01.070B	5J05B

SERIES PR10R & PR10B - *10 DEGREE, 14xD, LONG LENGTH*

ANGLE PER SIDE (A)	TIP DIAMETER (D2)	SHANK DIAMETER (D1)		FLUTE LENGTH (L2)	OVERALL LENGTH (L1)	# OF FLUTES	CORNER RADIUS (R)		BALL END PART #	BALL END EDP #
10°	0.030	3/16	0.188	0.188	3.000	4	J02.030R	5J061	J02.030B	5J06B
	0.040	1/4	0.250	0.250			J02.040R	5J071	J02.040B	5J07B
	0.050	3/8	0.375	0.375			J02.050R	5J081	J02.050B	5J08B
	0.060			0.840			J02.060R	5J091	J02.060B	5J09B
	0.070	1/2	0.500	0.980			J02.070R	5J101	J02.070B	5J10B

PRX APPLICATION GUIDE • SPEED & FEED

	WORK MATERIAL	TYPE OF CUT	AXIAL DOC	RADIAL DOC	NO. OF FLUTES	SPEED (SFM)	FEED (INCHES PER TOOTH) BASED ON EFFECTIVE CUTTING DIAMETER							
							.030 (4 FL)	.040 (4 FL)	.050 (4 FL)	.060 (4 FL)	.070 (4 FL)	.080 (4 FL)	.090 (4 FL)	.100 (4 FL)
ALUMINUM	ALUMINUM ALLOYS Low Silicon Content	Finishing	7 x D	.05 x D	4	850 - 1100	0.00009 - 0.00012	0.00011 - 0.00014	0.00013 - 0.00016	0.00016 - 0.00019	0.00019 - 0.00022	0.00023 - 0.00026	0.00028 - 0.00031	0.00034 - 0.00037
		Finishing	14 x D	.03 x D	4	850 - 1100	0.00009 - 0.00012	0.00011 - 0.00014	0.00014 - 0.00017	0.00018 - 0.00021	0.00023 - 0.00026	0.00029 - 0.00032	0.00037 - 0.00040	0.00046 - 0.00049
	ALUMINUM DIE CAST ALLOY High Silicon Content	Finishing	7 x D	.05 x D	4	635 - 825	0.00008 - 0.00011	0.00010 - 0.00013	0.00013 - 0.00016	0.00016 - 0.00019	0.00020 - 0.00023	0.00026 - 0.00029	0.00033 - 0.00036	0.00041 - 0.00044
		Finishing	14 x D	.03 x D	4	635 - 825	0.00008 - 0.00011	0.00010 - 0.00013	0.00013 - 0.00016	0.00016 - 0.00019	0.00020 - 0.00023	0.00026 - 0.00029	0.00033 - 0.00036	0.00041 - 0.00044
NONFERROUS	MAGNESIUM ALLOYS ≤ 38 HRc	Finishing	7 x D	.05 x D	4	1275 - 1650	0.00009 - 0.00012	0.00011 - 0.00014	0.00014 - 0.00017	0.00018 - 0.00021	0.00023 - 0.00026	0.00029 - 0.00032	0.00037 - 0.00040	0.00046 - 0.00049
		Finishing	14 x D	.03 x D	4	1275 - 1650	0.00009 - 0.00012	0.00011 - 0.00014	0.00014 - 0.00017	0.00018 - 0.00021	0.00023 - 0.00026	0.00029 - 0.00032	0.00037 - 0.00040	0.00046 - 0.00049
	COPPER ALLOYS, BRASS & BRONZE 39 to 48 HRc	Finishing	7 x D	.05 x D	4	340 - 440	0.00007 - 0.00010	0.00009 - 0.00012	0.00011 - 0.00014	0.00014 - 0.00017	0.00018 - 0.00021	0.00023 - 0.00026	0.00029 - 0.00032	0.00037 - 0.00040
		Finishing	14 x D	.03 x D	4	340 - 440	0.00007 - 0.00010	0.00009 - 0.00012	0.00011 - 0.00014	0.00014 - 0.00017	0.00018 - 0.00021	0.00023 - 0.00026	0.00029 - 0.00032	0.00037 - 0.00040
	COMPOSITES, PLASTICS & FIBERGLASS ABS, Polycarbonate, PVC	Finishing	7 x D	.05 x D	4	550 - 715	0.00079 - 0.00082	0.00099 - 0.00102	0.00124 - 0.00127	0.00155 - 0.00158	0.00194 - 0.00197	0.00243 - 0.00246	0.00304 - 0.00307	0.00380 - 0.00383
		Finishing	14 x D	.03 x D	4	550 - 715	0.00079 - 0.00082	0.00099 - 0.00102	0.00124 - 0.00127	0.00155 - 0.00158	0.00194 - 0.00197	0.00243 - 0.00246	0.00304 - 0.00307	0.00380 - 0.00383
CARBON STEEL	LOW CARBON STEELS ≤ 38 HRc	Finishing	7 x D	.05 x D	4	510 - 660	0.00002 - 0.00005	0.00002 - 0.00005	0.00003 - 0.00006	0.00004 - 0.00007	0.00005 - 0.00008	0.00006 - 0.00009	0.00007 - 0.00010	0.00009 - 0.00012
		Finishing	14 x D	.03 x D	4	510 - 660	0.00002 - 0.00005	0.00002 - 0.00005	0.00003 - 0.00006	0.00004 - 0.00007	0.00005 - 0.00008	0.00006 - 0.00009	0.00007 - 0.00010	0.00009 - 0.00012
	MEDIUM CARBON STEELS ≤ 38 HRc	Finishing	7 x D	.05 x D	4	170 - 220	0.00002 - 0.00005	0.00002 - 0.00005	0.00003 - 0.00006	0.00004 - 0.00007	0.00005 - 0.00008	0.00006 - 0.00009	0.00007 - 0.00010	0.00009 - 0.00012
		Finishing	14 x D	.03 x D	4	170 - 220	0.00002 - 0.00005	0.00002 - 0.00005	0.00003 - 0.00006	0.00004 - 0.00007	0.00005 - 0.00008	0.00006 - 0.00009	0.00007 - 0.00010	0.00009 - 0.00012
TOOL STEEL	TOOL & DIE STEELS ≤ 38 HRc	Finishing	7 x D	.05 x D	4	170 - 220	0.00002 - 0.00005	0.00002 - 0.00005	0.00003 - 0.00006	0.00004 - 0.00007	0.00005 - 0.00008	0.00006 - 0.00009	0.00007 - 0.00010	0.00009 - 0.00012
		Finishing	14 x D	.03 x D	4	170 - 220	0.00002 - 0.00005	0.00002 - 0.00005	0.00003 - 0.00006	0.00004 - 0.00007	0.00005 - 0.00008	0.00006 - 0.00009	0.00007 - 0.00010	0.00009 - 0.00012
	TOOL & DIE STEELS 39 to 48 HRc	Finishing	7 x D	.05 x D	4	125 - 165	0.00001 - 0.00004	0.00001 - 0.00004	0.00001 - 0.00004	0.00002 - 0.00005	0.00003 - 0.00006	0.00003 - 0.00006	0.00004 - 0.00007	0.00006 - 0.00009
		Finishing	14 x D	.03 x D	4	125 - 165	0.00001 - 0.00004	0.00001 - 0.00004	0.00001 - 0.00004	0.00002 - 0.00005	0.00003 - 0.00006	0.00003 - 0.00006	0.00004 - 0.00007	0.00006 - 0.00009
HARDENED STEEL	HARDENED STEELS 48 to 57 HRc	Finishing	7 x D	.05 x D	4	85 - 110	0.00001 - 0.00004	0.00001 - 0.00004	0.00001 - 0.00004	0.00001 - 0.00004	0.00001 - 0.00004	0.00001 - 0.00004	0.00001 - 0.00004	0.00002 - 0.00005
		Finishing	14 x D	.03 x D	4	85 - 110	0.00001 - 0.00004	0.00001 - 0.00004	0.00001 - 0.00004	0.00001 - 0.00004	0.00001 - 0.00004	0.00001 - 0.00004	0.00001 - 0.00004	0.00002 - 0.00005
	HARDENED STEELS 58 to 65HRc	Finishing	7 x D	.05 x D	4	75 - 95	0.00001 - 0.00004	0.00001 - 0.00004	0.00001 - 0.00004	0.00001 - 0.00004	0.00001 - 0.00004	0.00001 - 0.00004	0.00001 - 0.00004	0.00002 - 0.00005
		Finishing	14 x D	.03 x D	4	75 - 95	0.00001 - 0.00004	0.00001 - 0.00004	0.00001 - 0.00004	0.00001 - 0.00004	0.00001 - 0.00004	0.00001 - 0.00004	0.00001 - 0.00004	0.00002 - 0.00005
STAINLESS STEEL	EASY TO MACHINE 72 - 85 HRb	Finishing	7 x D	.05 x D	4	380 - 495	0.00002 - 0.00005	0.00002 - 0.00005	0.00003 - 0.00006	0.00004 - 0.00007	0.00005 - 0.00008	0.00006 - 0.00009	0.00007 - 0.00010	0.00009 - 0.00012
		Finishing	14 x D	.03 x D	4	380 - 495	0.00002 - 0.00005	0.00002 - 0.00005	0.00003 - 0.00006	0.00004 - 0.00007	0.00005 - 0.00008	0.00006 - 0.00009	0.00007 - 0.00010	0.00009 - 0.00012
	MODERATELY DIFFICULT 79 - 85 HRb; 25 - 41 HRc	Finishing	7 x D	.05 x D	4	170 - 220	0.00002 - 0.00005	0.00002 - 0.00005	0.00003 - 0.00006	0.00004 - 0.00007	0.00005 - 0.00008	0.00006 - 0.00009	0.00007 - 0.00010	0.00009 - 0.00012
		Finishing	14 x D	.03 x D	4	170 - 220	0.00002 - 0.00005	0.00002 - 0.00005	0.00003 - 0.00006	0.00004 - 0.00007	0.00005 - 0.00008	0.00006 - 0.00009	0.00007 - 0.00010	0.00009 - 0.00012
	DIFFICULT TO MACHINE 31 - 50 HRc	Finishing	7 x D	.05 x D	4	125 - 165	0.00001 - 0.00004	0.00001 - 0.00004	0.00001 - 0.00004	0.00002 - 0.00005	0.00003 - 0.00006	0.00003 - 0.00006	0.00004 - 0.00007	0.00006 - 0.00009
		Finishing	14 x D	.03 x D	4	125 - 165	0.00001 - 0.00004	0.00001 - 0.00004	0.00001 - 0.00004	0.00002 - 0.00005	0.00003 - 0.00006	0.00003 - 0.00006	0.00004 - 0.00007	0.00006 - 0.00009
CAST IRON	GRAY 100 - 200 HRb	Finishing	7 x D	.05 x D	4	465 - 605	0.00002 - 0.00005	0.00002 - 0.00005	0.00003 - 0.00006	0.00004 - 0.00007	0.00005 - 0.00008	0.00006 - 0.00009	0.00007 - 0.00010	0.00009 - 0.00012
		Finishing	14 x D	.03 x D	4	465 - 605	0.00002 - 0.00005	0.00002 - 0.00005	0.00003 - 0.00006	0.00004 - 0.00007	0.00005 - 0.00008	0.00006 - 0.00009	0.00007 - 0.00010	0.00009 - 0.00012
	DUCTILE 150 - 300 HRb	Finishing	7 x D	.05 x D	4	425 - 550	0.00002 - 0.00005	0.00002 - 0.00005	0.00003 - 0.00006	0.00004 - 0.00007	0.00005 - 0.00008	0.00006 - 0.00009	0.00007 - 0.00010	0.00009 - 0.00012
		Finishing	14 x D	.03 x D	4	425 - 550	0.00002 - 0.00005	0.00002 - 0.00005	0.00003 - 0.00006	0.00004 - 0.00007	0.00005 - 0.00008	0.00006 - 0.00009	0.00007 - 0.00010	0.00009 - 0.00012
	MALLEABLE 150 - 310 HRb	Finishing	7 x D	.05 x D	4	340 - 440	0.00002 - 0.00005	0.00002 - 0.00005	0.00003 - 0.00006	0.00004 - 0.00007	0.00005 - 0.00008	0.00006 - 0.00009	0.00007 - 0.00010	0.00009 - 0.00012
		Finishing	14 x D	.03 x D	4	340 - 440	0.00002 - 0.00005	0.00002 - 0.00005	0.00003 - 0.00006	0.00004 - 0.00007	0.00005 - 0.00008	0.00006 - 0.00009	0.00007 - 0.00010	0.00009 - 0.00012
ALLOYS	TITANIUM ALLOYS 70 - 100 HRb; 25 - 36 HRc	Finishing	7 x D	.05 x D	4	110 - 145	0.00001 - 0.00004	0.00001 - 0.00004	0.00001 - 0.00004	0.00002 - 0.00005	0.00003 - 0.00006	0.00003 - 0.00006	0.00004 - 0.00007	0.00006 - 0.00009
		Finishing	14 x D	.03 x D	4	110 - 145	0.00001 - 0.00004	0.00001 - 0.00004	0.00001 - 0.00004	0.00002 - 0.00005	0.00003 - 0.00006	0.00003 - 0.00006	0.00004 - 0.00007	0.00006 - 0.00009
	HIGH TEMP ALLOYS 83 - 99 HRb; 30 - 52 HRc	Finishing	7 x D	.05 x D	4	55 - 75	0.00001 - 0.00004	0.00001 - 0.00004	0.00001 - 0.00004	0.00002 - 0.00005	0.00003 - 0.00006	0.00003 - 0.00006	0.00004 - 0.00007	0.00006 - 0.00009
		Finishing	14 x D	.03 x D	4	55 - 75	0.00001 - 0.00004	0.00001 - 0.00004	0.00001 - 0.00004	0.00002 - 0.00005	0.00003 - 0.00006	0.00003 - 0.00006	0.00004 - 0.00007	0.00006 - 0.00009

CONICAL™ CUTTING TOOLS

GLOBAL™ CUTTING TOOLS

70 YEARS OF INNOVATION

GLOBAL™ RUNNER CUTTERS

UNQUESTIONABLE RESOURCES

Our Global Runner Cutters are an essential part of any mold maker's tool room. High performance slotting a perfect modified trapezoidal runner in record time, these tools let mold makers design for minimum waste and maximum mold performance.

With a huge tapered core, staged eccentric relief, slight positive rake, 12 degree helix and premium AlTiN/Si3N4 coating, they perform in all ferrous materials, whether the work piece is easily machinable, hardened or exotic.

Applications may include: mold and tool steels, alloy steels and high hardness materials, for use wet or dry. The true efficiencies of this tool may not even be possible to determine as they improve the performance of the mold and efficiencies of the supply chain. Its high strength flute design improves chip formation and evacuation, to such a high degree, our tools will become a standard practice in our customers' operations. We request customers let us know their results and always keep our experience in mind.

GROWING SPEED

We design our tools for exceptional machining characteristics, and design our operations for exceptional turnarounds. Whether our customers need a modification or custom tool, we can perform many in as little as 24 hours. The performance of a tool won't matter, if it doesn't arrive before the job is complete. You can rely on us for thousands of in-stock items, and thousands of available modifications.

Global Cutting Tools
Conical Tool Company

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DIE & MOLD END MILLS
FOR SLOTTING MODIFIED TRAPEZOIDAL RUNNER CHANNELS

GLOBAL™ CUTTING TOOLS

GLOBAL™
RUNNER CUTTERS

FOR SLOTTING CHANNELS

IN FERROUS MATERIALS

FEATURES & BENEFITS

The Conical Runner Cutter is another premium micro-grain carbide tool that can easily handle tough slotting operations in tool steel and difficult to machine materials. Machining modified trapezoidal and full round runners with our Conical Runner Cutters saves massive time for the tool and die makers. Featuring AlTiN-X coating, a high strength two flute design and 12 degree helix, it is well suited for abrasion resistance and offers exceptional lubricity, wet or dry. Once again Conical Cutting Tools advances end mill technologies, one end mill at a time.

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GLOBAL™
CUTTING TOOLS

SERIES: RCX

For slotting of high hardness ferrous materials to create the most effective modified trapezoidal runner channels to minimize pressure and heat loss in molds and dies; wet or dry; mold & tools steels, alloy steels and high hardness materials.

Ball end designed for high performance slotting and milling of runners

Two high strength flute design improves chip formation and evacuation for increased feed rates

12° constant helix provides added rigidity to the flutes for cutting hardened materials

Coated for heat resistance, wear resistance and increased lubricity

Eccentric relief for enhanced edge strength along the flutes

Variable Core Design maximizes chip evacuation and provides increased rigidity when the cutter is fully engaged

Premium micro-grain carbide substrate resists chipping, tool deflection, and has a high transverse rupture strength for greater feeds and speeds

Post polishing is performed after the tools are coated to remove surface inconsistencies and increase lubricity. This also increases feed rates and allows for smoother operations. The tool runs cooler and performs longer

TIP & END

SHANK & LENGTH

FLUTE CONFIGURATION

MATERIAL

CB SUB-MICRO GRAIN CARBIDE

COATING

AlTiN Si3N4

RESULTS

Conical Runner Cutters mill channels in molds for use in various plastic injection and tool and die processes. They are specifically designed to mill modified trapezoidal runner channels, varying in degrees, as well as full round runners. Their versatile design is great for maximum tool life and eliminating a second operation needed to create a full round runner. When you use only the best materials, rely on our accumulated 70 years' experience and trust in our end mills to do their assigned tasks, there is nothing that can stop you from succeeding.

Series RCX: Micro-Grain Carbide, 2 Flute; 12° Constant Helix
Subseries: RC10B, RC15B, RC20B
Configuration: Varying Angles; Varying Diameters; Regular Length; 12° Constant Helix; Ball End

RUNNER CUTTERS

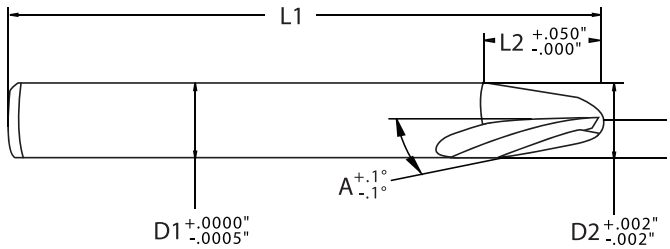
GLOBAL™

SERIES RCX - *CARBIDE, 2 FLUTE, VARYING ANGLES*

MINIMUM WASTE, MAXIMUM PERFORMANCE

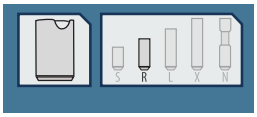
High performance slotting a perfect modified trapezoidal runner in record time, these tools let mold makers design for minimum waste and maximum mold performance.

- Ball end designed for high performance slotting and milling of runners
- Two high strength flute design improves chip formation and evacuation for increased feed rates
- Creates modified round trapezoidal runner channels in molds and dies, the most efficient shape design after full round, while machining only one half of the mold

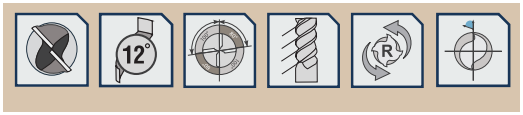


TIP & END

SHANK & LENGTH



FLUTE CONFIGURATION



MATERIAL

COATING

SERIES RC10B - *10 DEGREE, REGULAR LENGTH*

ANGLE PER SIDE (A)	CUTTER DIAMETER (D2)		CORNER RADIUS (R)		SHANK DIAMETER (D1)		FLUTE LENGTH (L2)	OVERALL LENGTH (L1)		ALTIN COATED PART #	ALTIN COATED EDP #
10°	1/16	0.0625	1/32	0.0313	3/16	0.188	0.385	2	2.000	RCJ-001	RJ01B
	3/32	0.0938	3/64	0.0469	3/16	0.188	0.308	2	2.000	RCJ-101	RJ02B
	1/8	0.1250	1/16	0.0625	1/4	0.250	0.413	2 1/2	2.500	RCJ-201	RJ03B
	5/32	0.1563	5/64	0.0781	1/4	0.250	0.338	2 1/2	2.500	RCJ-251	RJ04B
	3/16	0.1875	3/32	0.0938	5/16	0.313	0.442	2 1/2	2.500	RCJ-301	RJ05B
	7/32	0.2188	7/64	0.109	5/16	0.313	0.366	2 1/2	2.500	RCJ-351	RJ06B
	1/4	0.2500	1/8	0.1250	3/8	0.375	0.468	2 1/2	2.500	RCJ-401	RJ07B
	5/16	0.3125	5/32	0.1563	1/2	0.500	0.675	3	3.000	RCJ-501	RJ08B

SERIES RC15B - *15 DEGREE, REGULAR LENGTH*

ANGLE PER SIDE (A)	CUTTER DIAMETER (D2)		CORNER RADIUS (R)		SHANK DIAMETER (D1)		FLUTE LENGTH (L2)	OVERALL LENGTH (L1)		ALTIN COATED PART #	ALTIN COATED EDP #
15°	1/16	0.0625	1/32	0.0313	3/16	0.188	0.261	2	2.000	RCP-001	RP01B
	3/32	0.0938	3/64	0.0469	3/16	0.188	0.216	2	2.000	RCP-101	RP02B
	1/8	0.1250	1/16	0.0625	1/4	0.250	0.288	2 1/2	2.500	RCP-201	RP03B
	5/32	0.1563	5/64	0.0781	1/4	0.250	0.243	2 1/2	2.500	RCP-251	RP04B
	3/16	0.1875	3/32	0.0938	5/16	0.313	0.314	2 1/2	2.500	RCP-301	RP05B
	7/32	0.2188	7/64	0.109	5/16	0.313	0.271	2 1/2	2.500	RCP-351	RP06B
	1/4	0.2500	1/8	0.1250	3/8	0.375	0.342	2 1/2	2.500	RCP-401	RP07B
	5/16	0.3125	5/32	0.1563	1/2	0.500	0.490	3	3.000	RCP-501	RP08B

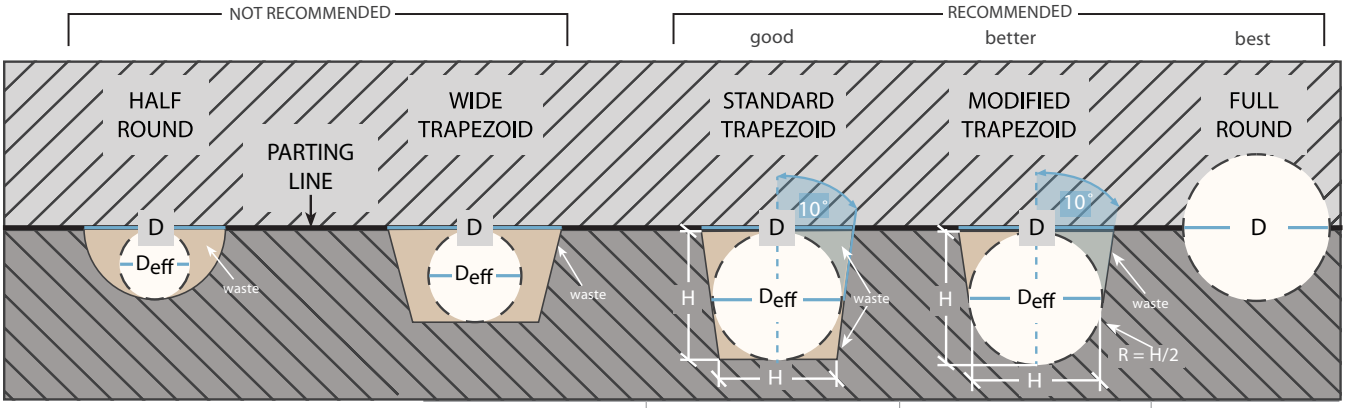
SERIES RC20B - *20 DEGREE, REGULAR LENGTH*

ANGLE PER SIDE (A)	CUTTER DIAMETER (D2)		CORNER RADIUS (R)		SHANK DIAMETER (D1)		FLUTE LENGTH (L2)	OVERALL LENGTH (L1)		ALTIN COATED PART #	ALTIN COATED EDP #
20°	1/16	0.0625	1/32	0.0313	3/16	0.188	0.197	2	2.000	RCT-001	RT01B
	3/32	0.0938	3/64	0.0469	3/16	0.188	0.167	2	2.000	RCT-101	RT02B
	1/8	0.1250	1/16	0.0625	1/4	0.250	0.225	2 1/2	2.500	RCT-201	RT03B
	5/32	0.1563	5/64	0.0781	1/4	0.250	0.194	2 1/2	2.500	RCT-251	RT04B
	1/4	0.2500	1/8	0.1250	3/8	0.375	0.275	2 1/2	2.500	RCT-401	RT05B
	5/16	0.3125	5/32	0.1563	1/2	0.500	0.387	3	3.000	RCT-501	RT06B

RUNNER CUTTERS

GLOBAL™

SERIES RCX - *CARBIDE, 2 FLUTE, VARYING ANGLES*



RECOMMENDED TOOL	Deff = .8771 D	Deff = .9116 D	D
FERROUS	CONICAL TAPERED CARBIDE	RUNNER CUTTER	VORTEX4
NON FERROUS	CONICAL TAPERED HSS	CONICAL TAPERED	ZEPHYR3

Above are common cross section designs for runners. The last three designs are generally recommended and each have unique properties which add pros and cons to their use.

The standard trapezoid is the last recommended design. With nearly twice the waste as the modified trapezoid, its primary attribute is the ability to machine its shape in a single half of the mold without losing considerable effective diameter.

The modified trapezoid is the next most efficient design as it can be machined in a single side of the mold. With minimum waste, resistance and heat loss, its shape has the closest effective hydraulic diameter to a full round runner.

The full-round runner is most ideal in terms of volume to surface ratio, which minimizes flow resistance, pressure drop and heat loss. Its design is the most complicated to employ and requires modifying both halves of the mold to align perfectly when the mold is closed.

RCX APPLICATION GUIDE • SPEED & FEED

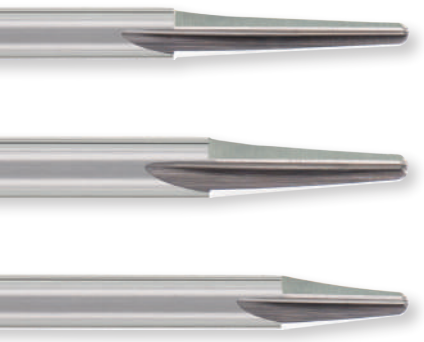
	WORK MATERIAL	TYPE OF CUT	AXIAL DOC	RADIAL DOC	NO. OF FLUTES	SPEED (SFM)	FEED (INCHES PER TOOTH) < 3/32" (2 FL)	1/8" (2 FL)	5/32" (2 FL)	3/16" (2 FL)	7/32" (2 FL)	1/4" (2 FL)	5/16" (2 FL)
ALUMINUM	ALUMINUM ALLOYS Low Silicon Content	Slotting	1 x D	1 x D	2	765 - 990	0.0009 - 0.0011	0.0012 - 0.0015	0.0016 - 0.0019	0.0020 - 0.0023	0.0019 - 0.0023	0.0027 - 0.0031	0.0031 - 0.0036
	ALUMINUM DIE CAST ALLOY High Silicon Content	Slotting	1 x D	1 x D	2	635 - 825	0.0008 - 0.0010	0.0011 - 0.0014	0.0015 - 0.0018	0.0018 - 0.0022	0.0017 - 0.0021	0.0025 - 0.0029	0.0028 - 0.0033
NONFERROUS	MAGNESIUM ALLOYS ≤ 38 HRc	Slotting	1 x D	1 x D	2	1275 - 1650	0.0009 - 0.0011	0.0012 - 0.0015	0.0016 - 0.0019	0.0020 - 0.0023	0.0019 - 0.0023	0.0027 - 0.0031	0.0031 - 0.0036
	COPPER ALLOYS, BRASS & BRONZE 39 to 48 HRc	Slotting	1 x D	1 x D	2	255 - 330	0.0007 - 0.0009	0.0010 - 0.0013	0.0013 - 0.0016	0.0016 - 0.0020	0.0015 - 0.0019	0.0022 - 0.0027	0.0026 - 0.0031
CARBON STEEL	LOW CARBON STEELS ≤ 38 HRc	Slotting	1 x D	1 x D	2	510 - 660	0.0003 - 0.0005	0.0005 - 0.0007	0.0007 - 0.0010	0.0008 - 0.0012	0.0006 - 0.0010	0.0012 - 0.0016	0.0014 - 0.0019
	MEDIUM CARBON STEELS ≤ 38 HRc	Slotting	1 x D	1 x D	2	170 - 220	0.0003 - 0.0005	0.0004 - 0.0007	0.0006 - 0.0009	0.0008 - 0.0011	0.0005 - 0.0009	0.0011 - 0.0015	0.0013 - 0.0018
TOOL STEEL	TOOL & DIE STEELS ≤ 38 HRc	Slotting	1 x D	1 x D	2	170 - 220	0.0003 - 0.0005	0.0004 - 0.0007	0.0006 - 0.0009	0.0008 - 0.0011	0.0005 - 0.0009	0.0011 - 0.0015	0.0013 - 0.0018
	TOOL & DIE STEELS 39 to 48 HRc	Slotting	1 x D	1 x D	2	125 - 165	0.0002 - 0.0004	0.0003 - 0.0006	0.0004 - 0.0007	0.0006 - 0.0009	0.0002 - 0.0006	0.0008 - 0.0013	0.0010 - 0.0015
HARDENED STL	HARDENED STEELS 48 to 57 HRc	Slotting	1 x D	1 x D	2	85 - 110	0.0001 - 0.0003	0.0002 - 0.0004	0.0002 - 0.0005	0.0002 - 0.0006	-0.0002 - 0.0002	0.0002 - 0.0007	0.0003 - 0.0008
	HARDENED STEELS 58 to 65HRc	Slotting	1 x D	1 x D	2	75 - 95	0.0001 - 0.0003	0.0001 - 0.0003	0.0001 - 0.0004	0.0001 - 0.0005	-0.0003 - 0.0001	0.0001 - 0.0006	0.0001 - 0.0006
STAINLESS STEEL	EASY TO MACHINE 72 - 85 HRb	Slotting	1 x D	1 x D	2	380 - 495	0.0003 - 0.0005	0.0004 - 0.0006	0.0005 - 0.0008	0.0005 - 0.0009	0.0002 - 0.0006	0.0007 - 0.0011	0.0008 - 0.0013
	MODERATELY DIFFICULT 79 - 85 HRb; 25 - 41 HRc	Slotting	1 x D	1 x D	2	170 - 220	0.0003 - 0.0005	0.0003 - 0.0006	0.0004 - 0.0007	0.0005 - 0.0008	0.0001 - 0.0005	0.0006 - 0.0010	0.0007 - 0.0012
	DIFFICULT TO MACHINE 31 - 50 HRc	Slotting	1 x D	1 x D	2	125 - 165	0.0002 - 0.0004	0.0002 - 0.0005	0.0002 - 0.0005	0.0003 - 0.0006	-0.0002 - 0.0002	0.0003 - 0.0008	0.0004 - 0.0009
CAST IRON	GRAY 100 - 200 HRb	Slotting	1 x D	1 x D	2	295 - 385	0.0004 - 0.0006	0.0006 - 0.0008	0.0008 - 0.0011	0.0010 - 0.0013	0.0007 - 0.0011	0.0014 - 0.0018	0.0016 - 0.0021
	DUCTILE 150 - 300 HRb	Slotting	1 x D	1 x D	2	210 - 275	0.0004 - 0.0006	0.0006 - 0.0008	0.0008 - 0.0011	0.0010 - 0.0013	0.0007 - 0.0011	0.0014 - 0.0018	0.0016 - 0.0021
	MALLEABLE 150 - 310 HRb	Slotting	1 x D	1 x D	2	170 - 220	0.0004 - 0.0006	0.0006 - 0.0008	0.0008 - 0.0011	0.0010 - 0.0013	0.0007 - 0.0011	0.0014 - 0.0018	0.0016 - 0.0021
ALLOYS	TITANIUM ALLOYS 70 - 100 HRb; 25 - 36 HRc	Slotting	1 x D	1 x D	2	125 - 165	0.0002 - 0.0004	0.0002 - 0.0005	0.0002 - 0.0005	0.0003 - 0.0006	-0.0002 - 0.0002	0.0003 - 0.0008	0.0004 - 0.0009
	HIGH TEMP ALLOYS 83 - 99 HRb; 30 - 52 HRc	Slotting	1 x D	1 x D	2	55 - 75	0.0002 - 0.0004	0.0002 - 0.0005	0.0002 - 0.0005	0.0003 - 0.0006	-0.0002 - 0.0002	0.0003 - 0.0008	0.0004 - 0.0009

CONICAL™ CUTTING TOOLS

GLOBAL™ CUTTING TOOLS

70 YEARS OF INNOVATION

GLOBAL™ DIE SINK CUTTERS



UNCOMPROMISING VALUE

The Global Die Sink end mills add flexibility and versatility to our massive line of available in stock specialty die and mold cutters. To accomplish precisely plunged holes and slot runner channels, in any material, these end mills come in a vast array of flute, end and angle configurations.

Our Global Die Sinks come uncoated for versatility and have over 16 coatings that can be added to increase tool life, based on your specific application and workpiece material. Rigidity is enhanced by the straight flute design, variable core and cylindrical flute, which together create a tool that will stand the tests of any machine process and material. A three flute configuration is available for enhanced productivity in easy to machine materials.

This tool tackles everything from plunge opening tapered holes in molds and dies, to slotting runner channels and gates. The Global Die Sink end mill guarantees versatility, without compromising value.

PERFORMANCE WE STAND BEHIND

We offer our 30 day return policy on standard and non-modified stock tools. Not because it's an industry standard practice, but because we know our tools and our customers rarely need it. We will take unused tools back after evaluation for as long as the tool line remains unchanged. We stand behind our tools and support them through their entire use cycle, which in our case, is a very long time.

Global Cutting Tools
Conical Tool Company

3890 Buchanan Ave SW
Grand Rapids, MI 49548

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F: 616.531.7742 | **E:** info@conicaltool.com

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DIE & MOLD END MILLS
FOR PLUNGE OPENING HOLES & SLOTTING RUNNER CHANNELS

GLOBAL™ CUTTING TOOLS

GLOBAL™

DIE SINK CUTTERS

PLUNGING & SLOTTING

IN ALL MATERIALS

FEATURES & BENEFITS

Global Die Sinks have a versatile design to be used in multiple processes in die and mold manufacturing. They have the versatility to plunge, taper existing holes, machine runners and act as a burr removal tool whenever necessary. The Global way is to go above and beyond current standards in the market, whenever possible. That's why you will find the Global Die Sink end mill with a larger core, high strength flute design and premium micro-grain carbide, which maintains all our products as the last word in value.

General Inquiries:
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GLOBAL™
CUTTING TOOLS

SERIES: DSX

Designed for plunge opening tapered holes in molds and die, contour finishing of details in cavities and slotting of runner channels and gates.

Ball end designed for versatility and high performance plunging of die sinks and optional slotting of runners

Three flute design allows a 50% increase in productivity over two flute designs

Straight flute design to withstand hardened materials

Two high strength flute design improves chip formation and evacuation for increased feed rates

Cylindrical flute grind / relief for enhanced edge strength and improved chip evacuation

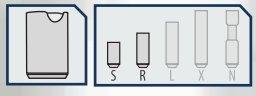
Uncoated for versatility. More than 16 available coatings can be added to increase tool life for your specific application and material

Premium micro-grain carbide substrate resists chipping, tool deflection, and has a high transverse rupture strength for greater feeds and speeds

Variable Core Design maximizes chip evacuation and provides increased rigidity when the cutter is fully engaged

TIP & END

SHANK & LENGTH



FLUTE CONFIGURATION

MATERIAL

CB SUB-MICRO GRAIN CARBIDE

COATING

UNC

RESULTS

The neutral rake angle provides superior chip evacuation and protects the tool edge when machining difficult materials. Whether plunging, slotting or making runners in hardened material, the Conical Die Sink performs amazingly well, as a result of our advanced engineering.

When ferrous material and aluminum are on the machine, this will be your tool of choice. The two flute design clears chips quickly and leaves the finished product for your approval.

Series DSX: Micro-Grain Carbide, 2 & 3 Straight Flutes
Subseries: DS203, DS205, DS207, DS303, DS305, DS307
Configuration: Varying Angles; Varying Diameters; Regular Length; 2 & 3 Straight Flutes; Ball End

DIE SINKS

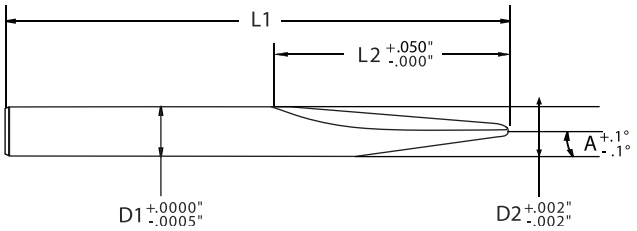
GLOBAL™

SERIES DSX - *CARBIDE, 2 STRAIGHT FLUTES*

VERSATILITY

Our Global Die Sinks have the versatility to plunge, taper existing holes, machine runners and act as a burr removal tool whenever necessary. A three flute configuration is available forenhanced productivity in easy to machine materials.

- Ball end designed for versatility and high performance plunging of die sinks and optional slotting of runners
- Two high strength flute design improves chip formation and evacuation for increased feed rates
- Cylindrical flute grind / relief for enhanced edge strength and improved chip evacuation



To order a corner radius, use code "CR" & actual radius in the part number. For example, a standard AX-203 would be ordered as AX-203-CR-015, with "015" being the radius.

TIP & END | SHANK & LENGTH | FLUTE CONFIGURATION | MATERIAL | COATING

SERIES DS203 - *3 DEGREE, BALL END, VARYING LENGTHS*

ANGLE PER SIDE (A)	CORNER RADIUS (R)		BALL END DIAMETER (D2)		SHANK DIAMETER (D1)		FLUTE LENGTH (L2)		OVERALL LENGTH (L1)		# OF FLUTES	UNCOATED PART #	UNCOATED EDP #
3° / 6°	1/64	0.016	1/32	0.031	1/8	0.125	7/8	0.875	2	2.000	2	DS2-C0001	DC01B
	1/32	0.031	1/16	0.063	1/8	0.125	9/16	0.563	2	2.000		DS2-C001	DC02B
					3/16	0.188	1	1.000	2	2.000		DS2-C002	DC03B
					1/4	0.250	1 1/2	1.500	2 1/2	2.500		DS2-C003	DC04B
	1/16	0.063	1/8	0.125	1/4	0.250	1	1.000	2 1/2	2.500		DS2-C201	DC05B

SERIES DS205 - *5 DEGREE, BALL END, VARYING LENGTHS*

ANGLE PER SIDE (A)	CORNER RADIUS (R)		BALL END DIAMETER (D2)		SHANK DIAMETER (D1)		FLUTE LENGTH (L2)		OVERALL LENGTH (L1)		# OF FLUTES	UNCOATED PART #	UNCOATED EDP #
5° / 10°	1/64	0.016	1/32	0.031	1/8	0.125	1/2	0.500	2	2.000	2	DS2-E0001	DE01B
	1/32	0.031	1/16	0.063	1/8	0.125	3/8	0.375	2	2.000		DS2-E001	DE02B
					3/16	0.188	1 1/16	0.688	2	2.000		DS2-E002	DE03B
					1/4	0.250	1 1/16	1.063	2 1/2	2.500		DS2-E003	DE04B
	1/16	0.063	1/8	0.125	1/4	0.250	1 1/16	0.688	2 1/2	2.500		DS2-E201	DE05B

SERIES DS207 - *7 DEGREE, BALL END, VARYING LENGTHS*

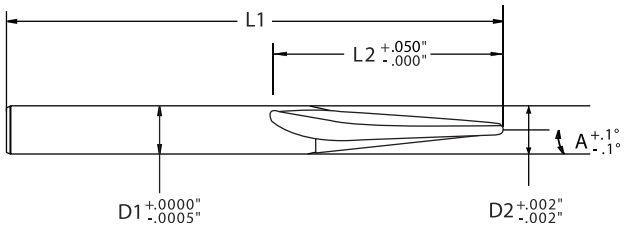
ANGLE PER SIDE (A)	CORNER RADIUS (R)		BALL END DIAMETER (D2)		SHANK DIAMETER (D1)		FLUTE LENGTH (L2)		OVERALL LENGTH (L1)		# OF FLUTES	UNCOATED PART #	UNCOATED EDP #
7° / 14°	1/64	0.016	1/32	0.031	1/8	0.125	3/8	0.375	2	2.000	2	DS2-G0001	DG01B
	1/32	0.031	1/16	0.063	1/8	0.125	1/4	0.250	2	2.000		DS2-G001	DG02B
					3/16	0.188	1/2	0.500	2	2.000		DS2-G002	DG03B
					1/4	0.250	3/4	0.750	2 1/2	2.500		DS2-G003	DG04B
	3/64	0.047	3/32	0.094	3/16	0.188	3/8	0.375	2	2.000		DS2-G101	DG05B
	1/16	0.063	1/8	0.125	1/4	0.250	1/2	0.500	2 1/2	2.500		DS2-G201	DG06B
	3/32	0.094	3/16	0.188	3/8	0.375	3/4	0.750	2 1/2	2.500		DS2-G301	DG07B
	1/8	0.125	1/4	0.250	1/2	0.500	1	1.000	3	3.000		DS2-G401	DG08B

SERIES DSX - *CARBIDE, 3 STRAIGHT FLUTES*

WITHSTANDING ANY TEST

Uncoated for versatility and have over 16 coatings that can be added to increase tool life. Rigidity is enhanced by the straight flute design, variable core and cylindrical flute, which together create a tool that will stand the tests of any machine process and material.

- Uncoated for versatility. More than 16 available coatings can be added to increase tool life for your specific application and material
- Premium micro-grain carbide substrate resists chipping, tool deflection, and has a high transverse rupture strength for greater feeds and speeds
- Variable Core Design maximizes chip evacuation and provides increased rigidity when the cutter is fully engaged



To order a corner radius, use code "CR" & actual radius in the part number. For example, a standard AX-203 would be ordered as AX-203-CR-015, with "015" being the radius.

TIP & END | SHANK & LENGTH | FLUTE CONFIGURATION | MATERIAL | COATING

SERIES DS303 - *3 DEGREE, BALL END, VARYING LENGTHS*

ANGLE PER SIDE (A)	CORNER RADIUS (R)		BALL END DIAMETER (D2)		SHANK DIAMETER (D1)		FLUTE LENGTH (L2)		OVERALL LENGTH (L1)		# OF FLUTES	UNCOATED PART #	UNCOATED EDP #
3° / 6°	1/64	0.016	1/32	0.031	1/8	0.125	7/8	0.875	2	2.000	3	DS3-C0001	SC01B
	1/32	0.031	1/16	0.063	1/8	0.125	9/16	0.563	2	2.000		DS3-C001	SC02B
					3/16	0.188	1	1.000	2	2.000		DS3-C002	SC03B
					1/4	0.250	1 1/2	1.500	2 1/2	2.500		DS3-C003	SC04B
	1/16	0.063	1/8	0.125	1/4	0.250	1	1.000	2 1/2	2.500		DS3-C201	SC05B

SERIES DS305 - *5 DEGREE, BALL END, VARYING LENGTHS*

ANGLE PER SIDE (A)	CORNER RADIUS (R)		BALL END DIAMETER (D2)		SHANK DIAMETER (D1)		FLUTE LENGTH (L2)		OVERALL LENGTH (L1)		# OF FLUTES	UNCOATED PART #	UNCOATED EDP #
5° / 10°	1/64	0.016	1/32	0.031	1/8	0.125	1/2	0.500	2	2.000	3	DS3-E0001	SE01B
	1/32	0.031	1/16	0.063	1/8	0.125	3/8	0.375	2	2.000		DS3-E001	SE02B
					3/16	0.188	1 1/16	0.688	2	2.000		DS3-E002	SE03B
					1/4	0.250	1 1/16	1.063	2 1/2	2.500		DS3-E003	SE04B
	1/16	0.063	1/8	0.125	1/4	0.250	1 1/16	0.688	2 1/2	2.500		DS3-E201	SE05B

SERIES DS307 - *7 DEGREE, BALL END, VARYING LENGTHS*

ANGLE PER SIDE (A)	CORNER RADIUS (R)		BALL END DIAMETER (D2)		SHANK DIAMETER (D1)		FLUTE LENGTH (L2)		OVERALL LENGTH (L1)		# OF FLUTES	UNCOATED PART #	UNCOATED EDP #
7° / 14°	1/64	0.016	1/32	0.031	1/8	0.125	3/8	0.375	2	2.000	3	DS3-G0001	SG01B
	1/32	0.031	1/16	0.063	1/8	0.125	1/4	0.250	2	2.000		DS3-G001	SG02B
					3/16	0.188	1/2	0.500	2	2.000		DS3-G002	SG03B
					1/4	0.250	3/4	0.750	2 1/2	2.500		DS3-G003	SG04B
	3/64	0.047	3/32	0.094	3/16	0.188	3/8	0.375	2	2.000		DS3-G101	SG05B
	1/16	0.063	1/8	0.125	1/4	0.250	1/2	0.500	2 1/2	2.500		DS3-G201	SG06B
	3/32	0.094	3/16	0.188	3/8	0.375	3/4	0.750	2 1/2	2.500		DS3-G301	SG07B
	1/8	0.125	1/4	0.250	1/2	0.500	1	1.000	3	3.000		DS3-G401	SG08B

OUR INDUSTRIES

The original tapered end mill manufacturer, Conical Tool's industry expertise runs deep and we have maintained exceptional relationships with some of the world's largest companies. Our commitment to the industry as hands-on technical experts cross many sectors and geographies. Our 70 year history coupled with analytical, innovative thinking allows us to provide our customers with the most practical and efficient solutions to their tooling needs.

Our industry foresight is based on identifying the key issues our customers face, and developing rigorous programs to provide the most appropriate and beneficial solutions. These are only a small percentage of the industries we serve, contact us today for more information and to find out what we can do for you.

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NEARLY 7,000 DISTRIBUTORS WORLDWIDE & HUNDREDS OF THOUSANDS OF END USERS CAN'T BE WRONG

The manufacturing and materials industry is changing at an unprecedented pace and simply saying we supply tools to the metalworking industry would leave out a large portion of our customer base. Our tools have been used in every application imaginable, from sculptural ice carving to precision manufacturing of custom nuclear reactor parts.

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We analyze the requests of our customers and use innovative engineering to come up with the most cost effective solutions.

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When a traditional tool just won't cut it, we offer a variety of standard end mills that are for a wide variety of applications and materials. Choosing the best end mill for your application is imperative for efficiency, as well as retaining tool life.

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CONICAL™ TAPERED CARBIDE

AN INDUSTRY REVOLUTION

Conical created and eventually patented the tapered end mill in the 1940's. Everything about the design of this tool suggests mature engineering. With a variable lead spiral, tapered core geometry and more than 16 available coatings, this carbide tapered end mill performs in all materials and challenging machining environments. Our designs are specifically engineered to perform in ferrous and high hardness materials as well as soft, easy to machine materials.

In an industry filled with imitators, it's good to know the original. The Conical Tapered Carbide has the patents to prove its origin with us and we have the experience to guarantee our customers apply its potential.

COMPLEX CHALLENGES AND SUPERIOR SOLUTIONS

We know there are many ways we can set ourselves apart from the competition and we believe that quality, value and reliability are only three of the most important attributes a company needs. The most successful companies embrace change and are able to evolve. Nearly 35% of our business model is dedicated to custom tools and new tool development.

Global Cutting Tools
Conical Tool Company

3890 Buchanan Ave SW
Grand Rapids, MI 49548

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F: 616.531.7742 | **E:** info@conicaltool.com

W: www.conicalendmills.com
W: www.globalcuttingtools.com

MANUFACTURING FOR OVER 70 YEARS 1944 - 2014

SEAL OF QUALITY ASSURANCE

Conical Tool Company products are distributed by:

OVER 7,000
DISTRIBUTORS WORLDWIDE

Made in the U.S.A.

CONICAL™
TAPERED CARBIDE

AMERICAN MADE

GLOBALLY RENOWNED

SPECIALTY END MILLS
FOR MACHINING DRAFT ANGLES ANGLES & CHAMFERS

CONICAL™ CUTTING TOOLS

CONICAL™
TAPERED CARBIDE

DRAFT ANGLE & CHAMFER MACHINING

IN ALL MATERIALS

FEATURES & BENEFITS

Every good machinist knows you need all the options you can get to tackle difficult engineering challenges. From varying diameters; stub, regular, long & extra-long lengths, to square end; corner radius & ball ends options, there is a Conical Tapered Carbide end mill. The three and four flute designs facilitate excellent chip evacuation and maximize flute engagement for an improved finish every time. Our tapered end mills are the standard bearer of the industry and come in thousands of configurations.

General Inquiries:
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Grand Rapids, MI 49548

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Custom Tooling:
E: quotes@conicaltool.com
W: conicalendmills.com/custom-tool-ordering

CONICAL™
CUTTING TOOLS

SERIES: TCX

For rough and finish milling of draft angles / chamfers and slotting of tapered walls in most materials; wet or dry; from easy to difficult machinability materials.

Standard square end to create sharp corners in finishing operations

Multi-flute, three and four flute design allows for proper chip evacuation through a variety of materials and applications while maximizing machine performance when possible

Variable lead helix provides increased tool engagement and rigidity

Uncoated for versatility. More than 16 available coatings can be added to increase tool life for your specific application and material

Universal design allows for a multitude of applications, from slotting to finishing

Ball end option for high performance contour milling in finishing operations. Available in 24 to 48 hours

Corner radius option protects corners in roughing operations and difficult to machine materials by preventing corner chipping and tool failure. Available in 24 to 48 hours

Premium micro-grain carbide substrate resists chipping, tool deflection, and has a high transverse rupture strength for greater feeds and speeds

Variable Core Design maximizes chip evacuation and provides increased rigidity when the cutter is fully engaged

TIP & END

SHANK & LENGTH

FLUTE CONFIGURATION

MATERIAL

CB SUB-MICRO GRAIN CARBIDE

COATING

UNC

RESULTS

Workpiece geometries are continuing to become considerably more complex, with pricing that is exponentially more competitive. Our Conical Tapered Carbide end mills feature advanced variable geometries to reduce harmonics, increase speeds and feeds and improve cycle times. Whether you need to finish sharp corners, contour mill with clearance, machine draft angles, add chamfers, finish cavities or taper holes; no one has a larger selection of in stock items, or the years of expertise, to help you select the right tool like we do.

Series TCX: Micro-Grain Carbide, 3 & 4 Flute, 25 - 30° Variable Lead Helix
Subseries: TC0XD, TC01D, TC1XD, TC02D, TC03D, TC04D, TC05D, TC60D, TC07D, TC10D, TC11D, TC12D, TC15D, TC20D, TC25D, TC30D, TC45D
Configuration: Varying Angles; Varying Diameters; Stub, Regular, Long & Extra-Long Lengths; 25 - 30° Variable Lead Helix; Square End, Corner Radius & Ball End

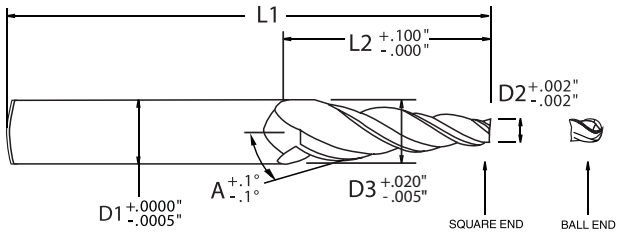
CONICAL TAPERED CARBIDE

SERIES TCX - *CARBIDE, 3 & 4 FLUTE, 25 - 30° VARIABLE LEAD HELIX*

FOR CHALLENGING MACHINING ENVIRONMENTS

With a variable lead spiral, tapered core geometry and more than 16 available coatings, this carbide tapered end mill performs in all materials and challenging machining environments.

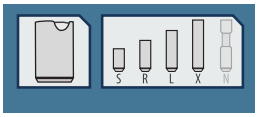
- Standard square end to create sharp corners in finishing operations
- Multi-flute, three and four flute design allows for proper chip evacuation through a variety of materials and applications while maximizing machine performance when possible
- For rough and finish milling of draft angles and slotting of tapered walls in most materials; wet or dry; non-ferrous materials; low carbon steel to titanium



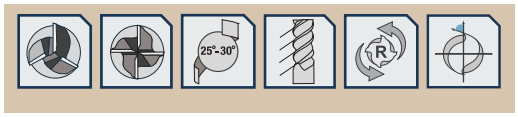
To order a corner radius, use code "CR" & actual radius in the part number. For example, a standard AX-203 would be ordered as AX-203-CR-015, with "015" being the radius.

TIP & END

SHANK & LENGTH



FLUTE CONFIGURATION



MATERIAL

COATING

SERIES TC0XD - *½ DEGREE, VARYING LENGTHS*

ANGLE PER SIDE (A)	TIP DIAMETER (D2)		LARGE DIAMETER (D3)	SHANK DIAMETER (D1)		FLUTE LENGTH (L2)		OVERALL LENGTH (L1)		# OF FLUTES	SQUARE END PART #	SQUARE END EDP #	BALL END PART #	BALL END EDP #
0.5°	1/16	0.063	0.0756	1/4	0.250	3/4	0.750	2 1/2	2.500	3	AX-003C	1Y01S	AX-003C-BE	1Y01B
	3/32	0.094	0.1025	1/4	0.250	1/2	0.500	2	2.000		AX-102C	1Y02S	AX-102C-BE	1Y02B
			0.1068	1/4	0.250	3/4	0.750	2 1/2	2.500		AX-103C	1Y03S	AX-103C-BE	1Y03B
			0.1156	1/4	0.250	1 1/4	1.250	3 1/2	3.500		AX-105C	1Y04S	AX-105C-BE	1Y04B
	1/8	0.125	0.1294	1/4	0.250	1/4	0.250	2	2.000		AX-201C	1Y05S	AX-201C-BE	1Y05B
			0.1315	1/4	0.250	3/8	0.375	2	2.000		AX-2015C	1Y06S	AX-2015C-BE	1Y06B
			0.1337	1/4	0.250	1/2	0.500	2	2.000		AX-202C	1Y07S	AX-202C-BE	1Y07B
			0.1381	1/4	0.250	3/4	0.750	2 1/2	2.500		AX-203C	1Y08S	AX-203C-BE	1Y08B
			0.1425	1/4	0.250	1	1.000	3	3.000		AX-204C	1Y09S	AX-204C-BE	1Y09B
			0.1468	1/4	0.250	1 1/4	1.250	3 1/2	3.500		AX-205C	1Y10S	AX-205C-BE	1Y10B
			0.1512	1/4	0.250	1 1/2	1.500	3 1/2	3.500		AX-206C	1Y11S	AX-206C-BE	1Y11B
	3/16	0.188	0.2006	1/4	0.250	3/4	0.750	2 1/2	2.500		AX-303C	1Y12S	AX-303C-BE	1Y12B
			0.2093	1/4	0.250	1 1/4	1.250	3 1/2	3.500		AX-305C	1Y13S	AX-305C-BE	1Y13B
			0.2180	3/8	0.375	1 3/4	1.750	3 1/2	3.500		AX-307C	1Y14S	AX-307C-BE	1Y14B
			0.2442	3/8	0.375	3 1/4	3.250	5	5.000		AX-313C	1Y15S	AX-313C-BE	1Y15B
	1/4	0.250	0.2631	3/8	0.375	3/4	0.750	2 1/2	2.500		AX-403C	1Y16S	AX-403C-BE	1Y16B
			0.2718	3/8	0.375	1 1/4	1.250	3 1/2	3.500		AX-405C	1Y17S	AX-405C-BE	1Y17B
			0.2893	3/8	0.375	2 1/4	2.250	4	4.000		AX-409C	1Y18S	AX-409C-BE	1Y18B
			0.3067	3/8	0.375	3 1/4	3.250	5	5.000		AX-413C	1Y19S	AX-413C-BE	1Y19B
	3/8	0.375	0.3968	1/2	0.500	1 1/4	1.250	3 1/2	3.500		AX-605C	1Y20S	AX-605C-BE	1Y20B
			0.4143	1/2	0.500	2 1/4	2.250	4 1/2	4.500		AX-609C	1Y21S	AX-609C-BE	1Y21B
			0.4317	1/2	0.500	3 1/4	3.250	6	6.000		AX-613C	1Y22S	AX-613C-BE	1Y22B
	1/2	0.500	0.5218	9/16	0.563	1 1/4	1.250	3 1/2	3.500		AX-805C	1Y23S	AX-805C-BE	1Y23B
			0.5393	9/16	0.563	2 1/4	2.250	5	5.000		AX-809C	1Y24S	AX-809C-BE	1Y24B
			0.5567	9/16	0.563	3 1/4	3.250	5	5.000		AX-813C	1Y25S	AX-813C-BE	1Y25B
	5/8	0.625	0.6643	3/4	0.750	2 1/4	2.250	5	5.000		AX-1009C	1Y26S	AX-1009C-BE	1Y26B
			0.6817	3/4	0.750	3 1/4	3.250	6	6.000		AX-1013C	1Y27S	AX-1013C-BE	1Y27B
			0.6992	3/4	0.750	4 1/4	4.250	7	7.000		AX-1017C	1Y28S	AX-1017C-BE	1Y28B
	7/8	0.875	0.7893	7/8	0.875	2 1/4	2.250	5	5.000		AX-1209C	1Y29S	AX-1209C-BE	1Y29B
			0.8067	7/8	0.875	3 1/4	3.250	6	6.000		AX-1213C	1Y30S	AX-1213C-BE	1Y30B
			0.8242	7/8	0.875	4 1/4	4.250	7	7.000		AX-1217C	1Y31S	AX-1217C-BE	1Y31B
			0.8416	7/8	0.875	5 1/4	5.250	8	8.000		AX-1221C	1Y32S	AX-1221C-BE	1Y32B

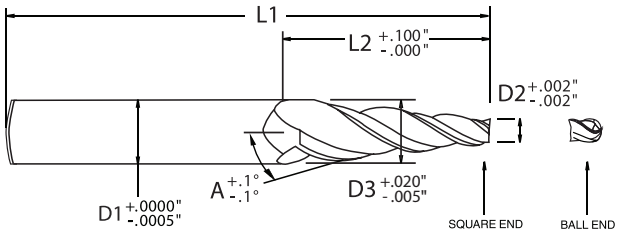
CONICAL TAPERED CARBIDE

SERIES TCX - *CARBIDE, 3 & 4 FLUTE, 25 - 30° VARIABLE LEAD HELIX*

MULTITUDE OF APPLICATIONS

Our designs are specifically engineered to perform in ferrous and high hardness materials as well as soft, easy to machine materials. The universal design allows for a multitude of applications.

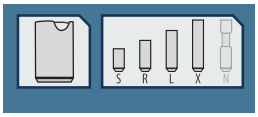
- Premium micro-grain carbide substrate resists chipping, tool deflection, and has a high transverse rupture strength for greater feeds and speeds
- Variable Core Design maximizes chip evacuation and provides increased rigidity when the cutter is fully engaged
- More than 16 available coatings can be added to increase tool life for your specific application and material



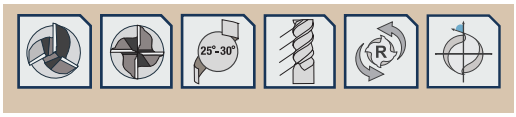
To order a corner radius, use code "CR" & actual radius in the part number. For example, a standard AX-203 would be ordered as AX-203-CR-015, with "015" being the radius.

TIP & END

SHANK & LENGTH



FLUTE CONFIGURATION



MATERIAL

COATING

SERIES TC01D - *1 DEGREE, VARYING LENGTHS*

ANGLE PER SIDE (A)	TIP DIAMETER (D2)		LARGE DIAMETER (D3)	SHANK DIAMETER (D1)		FLUTE LENGTH (L2)		OVERALL LENGTH (L1)		# OF FLUTES	SQUARE END PART #	SQUARE END EDP #	BALL END PART #	BALL END EDP #
1°	1/32	0.031	0.0574	1/4	0.250	3/4	0.750	2 1/2	2.500	3	A-0003C	1A01S	A-0003C-BE	1A01B
	1/16	0.063	0.0712	1/4	0.250	1/4	0.250	2	2.000		A-001C	1A02S	A-001C-BE	1A02B
			0.0887	1/4	0.250	3/4	0.750	2 1/2	2.500		A-003C	1A03S	A-003C-BE	1A03B
	3/32	0.094	0.1112	1/4	0.250	1/2	0.500	2	2.000		A-102C	1A04S	A-102C-BE	1A04B
			0.1199	1/4	0.250	3/4	0.750	2 1/2	2.500		A-103C	1A05S	A-103C-BE	1A05B
			0.1287	1/4	0.250	1	1.000	3	3.000		A-104C	1A06S	A-104C-BE	1A06B
			0.1374	1/4	0.250	1 1/4	1.250	3	3.000		A-105C	1A07S	A-105C-BE	1A07B
			0.1461	1/4	0.250	1 1/2	1.500	3 1/2	3.500		A-106C	1A08S	A-106C-BE	1A08B
	1/8	0.125	0.1337	1/4	0.250	1/4	0.250	2	2.000		A-201C	1A09S	A-201C-BE	1A09B
			0.1381	1/4	0.250	3/8	0.375	2	2.000		A-2015C	1A10S	A-2015C-BE	1A10B
			0.1425	1/4	0.250	1/2	0.500	2 1/2	2.500		A-202C	1A11S	A-202C-BE	1A11B
			0.1512	1/4	0.250	3/4	0.750	2 1/2	2.500		A-203C	1A12S	A-203C-BE	1A12B
			0.1599	1/4	0.250	1	1.000	3	3.000		A-204C	1A13S	A-204C-BE	1A13B
			0.1686	1/4	0.250	1 1/4	1.250	3 1/2	3.500		A-205C	1A14S	A-205C-BE	1A14B
			0.1774	1/4	0.250	1 1/2	1.500	3 1/2	3.500		A-206C	1A15S	A-206C-BE	1A15B
			0.1948	1/4	0.250	2	2.000	4	4.000		A-208C	1A16S	A-208C-BE	1A16B
	3/16	0.188	0.2137	1/4	0.250	3/4	0.750	2 1/2	2.500		A-303C	1A17S	A-303C-BE	1A17B
			0.2311	1/4	0.250	1 1/4	1.250	3 1/2	3.500		A-305C	1A18S	A-305C-BE	1A18B
			0.2486	1/4	0.250	1 3/4	1.750	3 1/2	3.500		A-307C	1A19S	A-307C-BE	1A19B
			0.2573	3/8	0.375	2	2.000	4	4.000		A-308C	1A20S	A-308C-BE	1A20B
			0.2660	3/8	0.375	2 1/4	2.250	4	4.000		A-309C	1A21S	A-309C-BE	1A21B
			0.2748	3/8	0.375	2 1/2	2.500	5	5.000		A-310C	1A22S	A-310C-BE	1A22B
			0.3010	3/8	0.375	3 1/4	3.250	5	5.000		A-313C	1A23S	A-313C-BE	1A23B
	1/4	0.250	0.2762	3/8	0.375	3/4	0.750	3	3.000		A-403C	1A24S	A-403C-BE	1A24B
			0.2936	3/8	0.375	1 1/4	1.250	3 1/2	3.500		A-405C	1A25S	A-405C-BE	1A25B
			0.3111	3/8	0.375	1 3/4	1.750	3 1/2	3.500		A-407C	1A26S	A-407C-BE	1A26B
			0.3198	3/8	0.375	2	2.000	4	4.000		A-408C	1A27S	A-408C-BE	1A27B
			0.3285	3/8	0.375	2 1/4	2.250	4	4.000		A-409C	1A28S	A-409C-BE	1A28B
			0.3635	3/8	0.375	3 1/4	3.250	5	5.000		A-413C	1A29S	A-413C-BE	1A29B
	3/8	0.375	0.4186	1/2	0.500	1 1/4	1.250	3 1/2	3.500		A-605C	1A30S	A-605C-BE	1A30B
			0.4535	1/2	0.500	2 1/4	2.250	4 1/2	4.500		A-609C	1A31S	A-609C-BE	1A31B
			0.4885	1/2	0.500	3 1/4	3.250	6	6.000		A-613C	1A32S	A-613C-BE	1A32B

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CONICAL TAPERED CARBIDE

SERIES TCX - *CARBIDE, 3 & 4 FLUTE, 25 - 30° VARIABLE LEAD HELIX*

FOR CHALLENGING MACHINING ENVIRONMENTS

With a variable lead spiral, tapered core geometry and more than 16 available coatings, this carbide tapered end mill performs in all materials and challenging machining environments.

- Standard square end to create sharp corners in finishing operations
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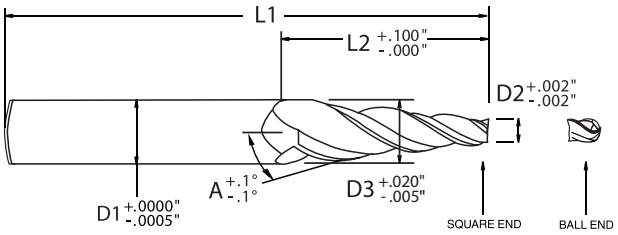

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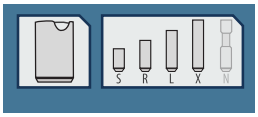
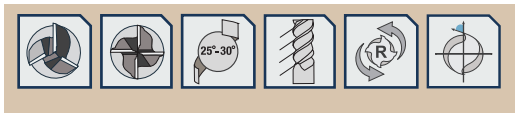
TIP & END

SHANK & LENGTH



FLUTE CONFIGURATION



MATERIAL

COATING

SERIES TC01D - *1 DEGREE, VARYING LENGTHS*

ANGLE PER SIDE (A)	TIP DIAMETER (D2)		LARGE DIAMETER (D3)	SHANK DIAMETER (D1)		FLUTE LENGTH (L2)		OVERALL LENGTH (L1)		# OF FLUTES	SQUARE END PART #	SQUARE END EDP #	BALL END PART #	BALL END EDP #
1°	1/2	0.500	0.5262	5/8	0.625	3/4	0.750	3	3.000	3	A-803C	1A33S	A-803C-BE	1A33B
			0.5436	5/8	0.625	1 1/4	1.250	3 1/2	3.500		A-805C	1A34S	A-805C-BE	1A34B
			0.5785	5/8	0.625	2 1/4	2.250	4	4.000		A-809C	1A35S	A-809C-BE	1A35B
			0.6135	5/8	0.625	3 1/4	3.250	5	5.000		A-813C	1A36S	A-813C-BE	1A36B
	5/8	0.625	0.7035	3/4	0.750	2 1/4	2.250	4	4.000		A-1009C	1A37S	A-1009C-BE	1A37B
			0.7385	3/4	0.750	3 1/4	3.250	5	5.000		A-1013C	1A38S	A-1013C-BE	1A38B
			0.7734	7/8	0.875	4 1/4	4.250	7	7.000		A-1017C	1A39S	A-1017C-BE	1A39B
	3/4	0.750	0.8285	7/8	0.875	2 1/4	2.250	5	5.000		A-1209C	1A40S	A-1209C-BE	1A40B
			0.8635	7/8	0.875	3 1/4	3.250	6	6.000		A-1213C	1A41S	A-1213C-BE	1A41B
			0.8984	1	1.000	4 1/4	4.250	7	7.000		A-1217C	1A42S	A-1217C-BE	1A42B
			0.9333	1	1.000	5 1/4	5.250	8	8.000		A-1221C	1A43S	A-1221C-BE	1A43B

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CONICAL TAPERED CARBIDE

SERIES TCX - *CARBIDE, 3 & 4 FLUTE, 25 - 30° VARIABLE LEAD HELIX*

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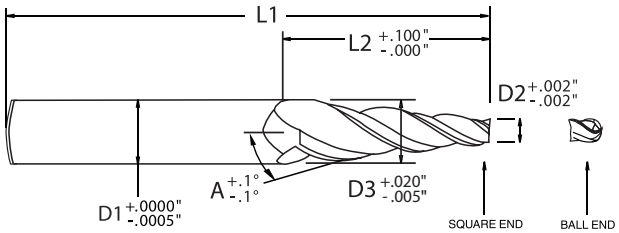

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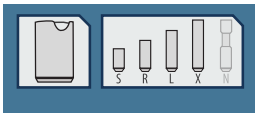
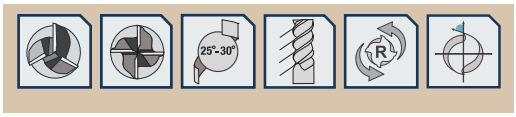
TIP & END

SHANK & LENGTH



FLUTE CONFIGURATION



MATERIAL

COATING

SERIES TC1XD - *1½ DEGREE, VARYING LENGTHS*

ANGLE PER SIDE (A)	TIP DIAMETER (D2)		LARGE DIAMETER (D3)	SHANK DIAMETER (D1)		FLUTE LENGTH (L2)		OVERALL LENGTH (L1)		# OF FLUTES	SQUARE END PART #	SQUARE END EDP #	BALL END PART #	BALL END EDP #
1.5°	1/16	0.063	0.0887	1/4	0.250	1/2	0.500	2	2.000	3	AAX-002C	1Z01S	AAX-002C-BE	1Z01B
			0.1149	1/4	0.250	1	1.000	3	3.000		AAX-004C	1Z02S	AAX-004C-BE	1Z02B
	3/32	0.094	0.1199	1/4	0.250	1/2	0.500	2	2.000		AAX-102C	1Z03S	AAX-102C-BE	1Z03B
			0.1330	1/4	0.250	3/4	0.750	2 1/2	2.500		AAX-103C	1Z04S	AAX-103C-BE	1Z04B
			0.1461	1/4	0.250	1	1.000	3	3.000		AAX-104C	1Z05S	AAX-104C-BE	1Z05B
			0.1592	1/4	0.250	1 1/4	1.250	3	3.000		AAX-105C	1Z06S	AAX-105C-BE	1Z06B
			0.1723	1/4	0.250	1 1/2	1.500	3 1/2	3.500		AAX-106C	1Z07S	AAX-106C-BE	1Z07B
	7/64	0.109	0.1617	1/4	0.250	1	1.000	3	3.000		AAX-154C	1Z08S	AAX-154C-BE	1Z08B
	1/8	0.125	0.1512	1/4	0.250	1/2	0.500	2 1/2	2.500		AAX-202C	1Z09S	AAX-202C-BE	1Z09B
			0.1643	1/4	0.250	3/4	0.750	2 1/2	2.500		AAX-203C	1Z10S	AAX-203C-BE	1Z10B
			0.1774	1/4	0.250	1	1.000	3	3.000		AAX-204C	1Z11S	AAX-204C-BE	1Z11B
			0.1905	1/4	0.250	1 1/4	1.250	3	3.000		AAX-205C	1Z12S	AAX-205C-BE	1Z12B
			0.2036	1/4	0.250	1 1/2	1.500	3 1/2	3.500		AAX-206C	1Z13S	AAX-206C-BE	1Z13B
			0.2297	1/4	0.250	2	2.000	3 1/2	3.500		AAX-208C	1Z14S	AAX-208C-BE	1Z14B
			0.2428	1/4	0.250	2 1/4	2.250	4	4.000		AAX-209C	1Z15S	AAX-209C-BE	1Z15B
			0.2821	5/16	0.313	3	3.000	5	5.000		AAX-212C	1Z16S	AAX-212C-BE	1Z16B
	5/32	0.156	0.1955	1/4	0.250	3/4	0.750	2 1/2	2.500		AAX-253C	1Z17S	AAX-253C-BE	1Z17B
			0.2086	1/4	0.250	1	1.000	3	3.000		AAX-254C	1Z18S	AAX-254C-BE	1Z18B
			0.2217	1/4	0.250	1 1/4	1.250	3	3.000		AAX-255C	1Z19S	AAX-255C-BE	1Z19B
			0.2348	1/4	0.250	1 1/2	1.500	3	3.000		AAX-256C	1Z20S	AAX-256C-BE	1Z20B
			0.2610	5/16	0.313	2	2.000	4	4.000		AAX-258C	1Z21S	AAX-258C-BE	1Z21B
	3/16	0.188	0.2268	1/4	0.250	3/4	0.750	2 1/2	2.500		AAX-303C	1Z22S	AAX-303C-BE	1Z22B
			0.2399	1/4	0.250	1	1.000	3	3.000		AAX-304C	1Z23S	AAX-304C-BE	1Z23B
			0.2530	3/8	0.375	1 1/4	1.250	3 1/2	3.500		AAX-305C	1Z24S	AAX-305C-BE	1Z24B
			0.2792	3/8	0.375	1 3/4	1.750	3 1/2	3.500		AAX-307C	1Z25S	AAX-307C-BE	1Z25B
			0.2922	3/8	0.375	2	2.000	4	4.000		AAX-308C	1Z26S	AAX-308C-BE	1Z26B
			0.3053	3/8	0.375	2 1/4	2.250	4	4.000		AAX-309C	1Z27S	AAX-309C-BE	1Z27B
			0.3577	3/8	0.375	3 1/4	3.250	5	5.000		AAX-313C	1Z28S	AAX-313C-BE	1Z28B
	1/4	0.250	0.2893	3/8	0.375	3/4	0.750	3	3.000		AAX-403C	1Z29S	AAX-403C-BE	1Z29B
			0.3155	3/8	0.375	1 1/4	1.250	3 1/2	3.500		AAX-405C	1Z30S	AAX-405C-BE	1Z30B
			0.3286	3/8	0.375	1 1/2	1.500	3 1/2	3.500		AAX-406C	1Z31S	AAX-406C-BE	1Z31B
			0.3678	3/8	0.375	2 1/4	2.250	4	4.000		AAX-409C	1Z32S	AAX-409C-BE	1Z32B
			0.4202	1/2	0.500	3 1/4	3.250	5	5.000		AAX-413C	1Z33S	AAX-413C-BE	1Z33B

(continued on next page)

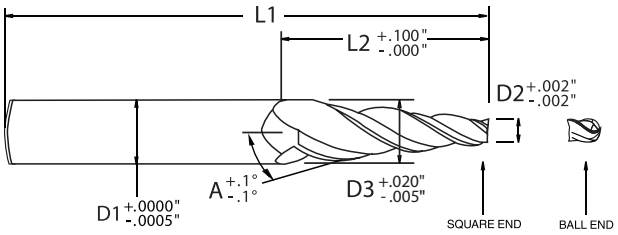
CONICAL TAPERED CARBIDE

SERIES TCX - *CARBIDE, 3 & 4 FLUTE, 25 - 30° VARIABLE LEAD HELIX*

VERSATILE IN STOCK ITEMS

Our Conical Tapered Carbide end mills come in varying diameters; stub, regular, long & extra-long lengths. For any particular machining challenge, there is a Conical Tapered Carbide end mill that fits the bill.

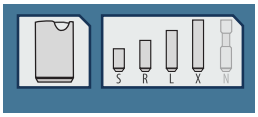
- Constant spiral helix provides increased tool engagement and rigidity
- Ball end option for high performance contour milling in finishing operations. Available in 24 to 48 hours
- Corner radius option protects corners in roughing operations and difficult to machine materials by preventing corner chipping and tool failure. Available in 24 to 48 hours



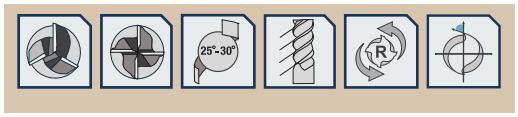
To order a corner radius, use code "CR" & actual radius in the part number. For example, a standard AX-203 would be ordered as AX-203-CR-015, with "015" being the radius.

TIP & END

SHANK & LENGTH



FLUTE CONFIGURATION



MATERIAL

COATING

SERIES TC1XD - *1½ DEGREE, VARYING LENGTHS*

ANGLE PER SIDE (A)	TIP DIAMETER (D2)		LARGE DIAMETER (D3)	SHANK DIAMETER (D1)		FLUTE LENGTH (L2)		OVERALL LENGTH (L1)		# OF FLUTES	SQUARE END PART #	SQUARE END EDP #	BALL END PART #	BALL END EDP #
1.5°	3/8	0.375	0.4405	1/2	0.500	1 1/4	1.250	3 1/2	3.500	3	AAX-605C	1Z34S	AAX-605C-BE	1Z34B
			0.4928	1/2	0.500	2 1/4	2.250	4 1/2	4.500		AAX-609C	1Z35S	AAX-609C-BE	1Z35B
			0.5452	9/16	0.563	3 1/4	3.250	5	5.000		AAX-613C	1Z36S	AAX-613C-BE	1Z36B
	1/2	0.500	0.5655	5/8	0.625	1 1/4	1.250	3 1/2	3.500		AAX-805C	1Z37S	AAX-805C-BE	1Z37B
			0.5786	5/8	0.625	1 1/2	1.500	3 1/2	3.500		AAX-806C	1Z38S	AAX-806C-BE	1Z38B
			0.6178	5/8	0.625	2 1/4	2.250	4	4.000		AAX-809C	1Z39S	AAX-809C-BE	1Z39B
			0.6702	3/4	0.750	3 1/4	3.250	5	5.000		AAX-813C	1Z40S	AAX-813C-BE	1Z40B
	5/8	0.625	0.7428	3/4	0.750	2 1/4	2.250	4	4.000		AAX-1009C	1Z41S	AAX-1009C-BE	1Z41B
			0.7952	7/8	0.875	3 1/4	3.250	6	6.000		AAX-1013C	1Z42S	AAX-1013C-BE	1Z42B
			0.8476	7/8	0.875	4 1/4	4.250	7	7.000		AAX-1017C	1Z43S	AAX-1017C-BE	1Z43B
	3/4	0.750	0.8678	7/8	0.875	2 1/4	2.250	4	4.000		AAX-1209C	1Z44S	AAX-1209C-BE	1Z44B
			0.9202	1	1.000	3 1/4	3.250	6	6.000		AAX-1213C	1Z45S	AAX-1213C-BE	1Z45B

(continued from previous page)

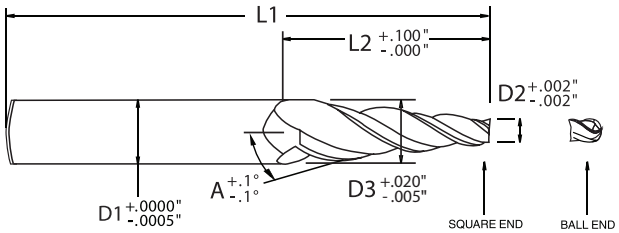
CONICAL TAPERED CARBIDE

SERIES TCX - *CARBIDE, 3 & 4 FLUTE, 25 - 30° VARIABLE LEAD HELIX*

IMPROVED FINISHES

The three and four flute designs facilitate excellent chip evacuation and maximize flute engagement for an improved finish every time.

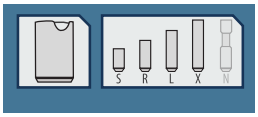
- Universal design allows for a multitude of applications, from slotting to finishing
- Standard square end to create sharp corners in finishing operations
- Multi-flute, three and four flute design allows for proper chip evacuation through a variety of materials and applications while maximizing machine performance when possible



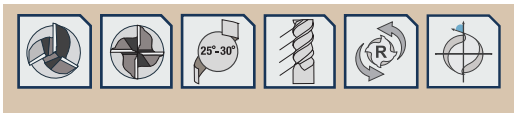
To order a corner radius, use code "CR" & actual radius in the part number. For example, a standard AX-203 would be ordered as AX-203-CR-015, with "015" being the radius.

TIP & END

SHANK & LENGTH



FLUTE CONFIGURATION



MATERIAL

COATING

SERIES TC02D - *2 DEGREE, VARYING LENGTHS*

ANGLE PER SIDE (A)	TIP DIAMETER (D2)		LARGE DIAMETER (D3)	SHANK DIAMETER (D1)		FLUTE LENGTH (L2)		OVERALL LENGTH (L1)		# OF FLUTES	SQUARE END PART #	SQUARE END EDP #	BALL END PART #	BALL END EDP #
2°	1/32	0.031	0.0662	1/4	0.250	1/2	0.500	2	2.000	3	B-0002C	1B01S	B-0002C-BE	1B01B
	1/16	0.063	0.0974	1/4	0.250	1/2	0.500	2	2.000		B-002C	1B02S	B-002C-BE	1B02B
	3/32	0.094	0.1287	1/4	0.250	1/2	0.500	2	2.000		B-102C	1B03S	B-102C-BE	1B03B
			0.1461	1/4	0.250	3/4	0.750	2 1/2	2.500		B-103C	1B04S	B-103C-BE	1B04B
			0.1636	1/4	0.250	1	1.000	3	3.000		B-104C	1B05S	B-104C-BE	1B05B
			0.1811	1/4	0.250	1 1/4	1.250	3	3.000		B-105C	1B06S	B-105C-BE	1B06B
	1/8	0.125	0.1599	1/4	0.250	1/2	0.500	2	2.000		B-202C	1B07S	B-202C-BE	1B07B
			0.1774	1/4	0.250	3/4	0.750	2 1/2	2.500		B-203C	1B08S	B-203C-BE	1B08B
			0.1948	1/4	0.250	1	1.000	3	3.000		B-204C	1B09S	B-204C-BE	1B09B
			0.2123	1/4	0.250	1 1/4	1.250	3	3.000		B-205C	1B10S	B-205C-BE	1B10B
			0.2298	1/4	0.250	1 1/2	1.500	3 1/2	3.500		B-206C	1B11S	B-206C-BE	1B11B
			0.2647	5/16	0.313	2	2.000	3 1/2	3.500		B-208C	1B12S	B-208C-BE	1B12B
			0.2996	5/16	0.313	2 1/2	2.500	4	4.000		B-210C	1B13S	B-210C-BE	1B13B
	3/16	0.188	0.2399	1/4	0.250	3/4	0.750	2 1/2	2.500		B-303C	1B14S	B-303C-BE	1B14B
			0.2748	3/8	0.375	1 1/4	1.250	3 1/2	3.500		B-305C	1B15S	B-305C-BE	1B15B
			0.3097	3/8	0.375	1 3/4	1.750	3 1/2	3.500		B-307C	1B16S	B-307C-BE	1B16B
			0.3446	3/8	0.375	2 1/4	2.250	4	4.000		B-309C	1B17S	B-309C-BE	1B17B
			0.4145	1/2	0.500	3 1/4	3.250	5	5.000		B-313C	1B18S	B-313C-BE	1B18B
	1/4	0.250	0.3024	3/8	0.375	3/4	0.750	3	3.000		B-403C	1B19S	B-403C-BE	1B19B
			0.3373	3/8	0.375	1 1/4	1.250	3 1/2	3.500		B-405C	1B20S	B-405C-BE	1B20B
			0.3722	3/8	0.375	1 3/4	1.750	3 1/2	3.500		B-407C	1B21S	B-407C-BE	1B21B
			0.3897	1/2	0.500	2	2.000	4	4.000		B-408C	1B22S	B-408C-BE	1B22B
			0.4071	1/2	0.500	2 1/4	2.250	4 1/2	4.500		B-409C	1B23S	B-409C-BE	1B23B
			0.4770	1/2	0.500	3 1/4	3.250	5	5.000		B-413C	1B24S	B-413C-BE	1B24B
	3/8	0.375	0.4623	1/2	0.500	1 1/4	1.250	3 1/2	3.500		B-605C	1B25S	B-605C-BE	1B25B
			0.4972	1/2	0.500	1 3/4	1.750	4	4.000		B-607C	1B26S	B-607C-BE	1B26B
			0.5321	9/16	0.563	2 1/4	2.250	4	4.000		B-609C	1B27S	B-609C-BE	1B27B
			0.6020	5/8	0.625	3 1/4	3.250	5	5.000		B-613C	1B28S	B-613C-BE	1B28B
	1/2	0.500	0.5873	5/8	0.625	1 1/4	1.250	3 1/2	3.500		B-805C	1B29S	B-805C-BE	1B29B
			0.6571	3/4	0.750	2 1/4	2.250	5	5.000		B-809C	1B30S	B-809C-BE	1B30B
			0.7270	3/4	0.750	3 1/4	3.250	5	5.000		B-813C	1B31S	B-813C-BE	1B31B
	5/8	0.625	0.7821	7/8	0.875	2 1/4	2.250	5	5.000		B-1009C	1B32S	B-1009C-BE	1B32B
			0.8520	7/8	0.875	3 1/4	3.250	6	6.000		B-1013C	1B33S	B-1013C-BE	1B33B
			0.9218	1	1.000	4 1/4	4.250	7	7.000		B-1017C	1B34S	B-1017C-BE	1B34B
	3/4	0.750	0.9071	1	1.000	2 1/4	2.250	5	5.000		B-1209C	1B35S	B-1209C-BE	1B35B
			0.9770	1	1.000	3 1/4	3.250	6	6.000		B-1213C	1B36S	B-1213C-BE	1B36B

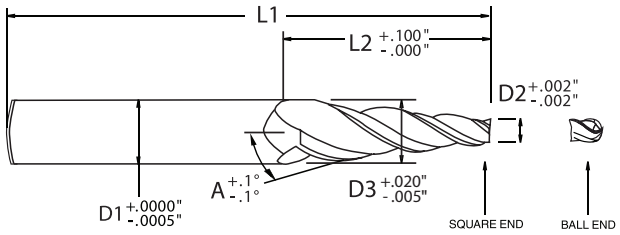
CONICAL TAPERED CARBIDE

SERIES TCX - *CARBIDE, 3 & 4 FLUTE, 25 - 30° VARIABLE LEAD HELIX*

ADVANCED VARIABLE GEOMETRIES

Our Conical Tapered Carbide end mills feature advanced variable geometries to reduce harmonics, increase speeds and feeds and improve cycle times.

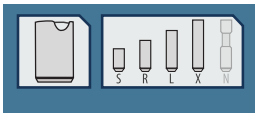
- Standard square end to create sharp corners in finishing operations
- Multi-flute, three and four flute design allows for proper chip evacuation through a variety of materials and applications while maximizing machine performance when possible
- For rough and finish milling of draft angles and slotting of tapered walls in most materials; wet or dry; non-ferrous materials; low carbon steel to titanium



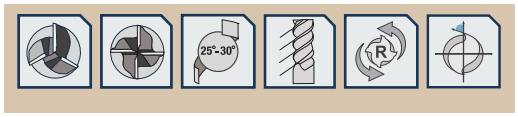
To order a corner radius, use code "CR" & actual radius in the part number. For example, a standard AX-203 would be ordered as AX-203-CR-015, with "015" being the radius.

TIP & END

SHANK & LENGTH



FLUTE CONFIGURATION



MATERIAL

COATING

SERIES TC03D - *3 DEGREE, VARYING LENGTHS*

ANGLE PER SIDE (A)	TIP DIAMETER (D2)		LARGE DIAMETER (D3)	SHANK DIAMETER (D1)		FLUTE LENGTH (L2)		OVERALL LENGTH (L1)		# OF FLUTES	SQUARE END PART #	SQUARE END EDP #	BALL END PART #	BALL END EDP #
3°	1/32	0.031	0.1099	1/4	0.250	3/4	0.750	2 1/2	2.500	3	C-0003C	1C01S	C-0003C-BE	1C01B
	1/16	0.063	0.1149	1/4	0.250	1/2	0.500	2	2.000		C-002C	1C02S	C-002C-BE	1C02B
			0.1673	1/4	0.250	1	1.000	3	3.000		C-004C	1C03S	C-004C-BE	1C03B
	3/32	0.094	0.1724	1/4	0.250	3/4	0.750	2 1/2	2.500		C-103C	1C04S	C-103C-BE	1C04B
			0.1986	1/4	0.250	1	1.000	3	3.000		C-104C	1C05S	C-104C-BE	1C05B
			0.2248	1/4	0.250	1 1/4	1.250	3	3.000		C-105C	1C06S	C-105C-BE	1C06B
			0.2500	1/4	0.250	1 1/2	1.500	3 1/2	3.500		C-106C	1C07S	C-106C-BE	1C07B
			0.2772	5/16	0.313	1 3/4	1.750	3 1/2	3.500		C-107C	1C08S	C-107C-BE	1C08B
			0.3034	3/8	0.375	2	2.000	4	4.000		C-108C	1C09S	C-108C-BE	1C09B
			0.3558	3/8	0.375	2 1/2	2.500	4	4.000		C-110C	1C10S	C-110C-BE	1C10B
	7/64	0.109	0.2142	1/4	0.250	1	1.000	3	3.000		C-154C	1C11S	C-154C-BE	1C11B
			0.2404	1/4	0.250	1 1/4	1.250	3	3.000		C-155C	1C12S	C-155C-BE	1C12B
			0.2666	5/16	0.313	1 1/2	1.500	3	3.000		C-156C	1C13S	C-156C-BE	1C13B
			0.3125	5/16	0.313	2	2.000	4	4.000		C-158C	1C14S	C-158C-BE	1C14B
	1/8	0.125	0.2036	1/4	0.250	3/4	0.750	2 1/2	2.500		C-203C	1C15S	C-203C-BE	1C15B
			0.2298	1/4	0.250	1	1.000	2 1/2	2.500		C-204C	1C16S	C-204C-BE	1C16B
			0.2560	3/8	0.375	1 1/4	1.250	3 1/2	3.500		C-205C	1C17S	C-205C-BE	1C17B
			0.2822	3/8	0.375	1 1/2	1.500	3 1/2	3.500		C-206C	1C18S	C-206C-BE	1C18B
			0.3346	3/8	0.375	2	2.000	4	4.000		C-208C	1C19S	C-208C-BE	1C19B
			0.3608	3/8	0.375	2 1/4	2.250	4	4.000		C-209C	1C20S	C-209C-BE	1C20B
			0.3870	7/16	0.438	2 1/2	2.500	4	4.000		C-210C	1C21S	C-210C-BE	1C21B
			0.4394	1/2	0.500	3	3.000	5	5.000		C-212C	1C22S	C-212C-BE	1C22B
			0.5443	9/16	0.563	4	4.000	6	6.000		C-216C	1C23S	C-216C-BE	1C23B
	5/32	0.156	0.2349	1/4	0.250	3/4	0.750	2 1/2	2.500		C-253C	1C24S	C-253C-BE	1C24B
			0.2611	3/8	0.375	1	1.000	3	3.000		C-254C	1C25S	C-254C-BE	1C25B
			0.2873	3/8	0.375	1 1/4	1.250	3	3.000		C-255C	1C26S	C-255C-BE	1C26B
			0.3135	3/8	0.375	1 1/2	1.500	3 1/2	3.500		C-256C	1C27S	C-256C-BE	1C27B
			0.3397	3/8	0.375	1 3/4	1.750	3 1/2	3.500		C-257C	1C28S	C-257C-BE	1C28B
			0.3659	3/8	0.375	2	2.000	4	4.000		C-258C	1C29S	C-258C-BE	1C29B

(continued on next page)

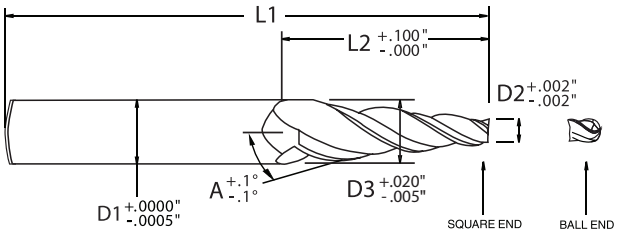
CONICAL TAPERED CARBIDE

SERIES TCX - *CARBIDE, 3 & 4 FLUTE, 25 - 30° VARIABLE LEAD HELIX*

IN STOCK OPTIONS

We have square end, corner radius & ball end options in stock. For any particular machining challenge, there is a Conical Tapered Carbide end mill that fits the bill.

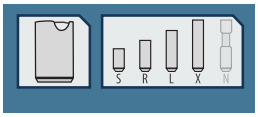
- Constant spiral helix provides increased tool engagement and rigidity
- Ball end option for high performance contour milling in finishing operations. Available in 24 to 48 hours
- Corner radius option protects corners in roughing operations and difficult to machine materials by preventing corner chipping and tool failure. Available in 24 to 48 hours



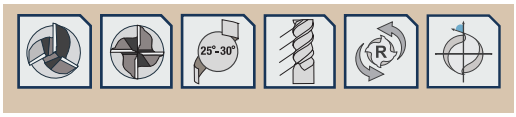
To order a corner radius, use code "CR" & actual radius in the part number. For example, a standard AX-203 would be ordered as AX-203-CR-015, with "015" being the radius.

TIP & END

SHANK & LENGTH



FLUTE CONFIGURATION



MATERIAL

COATING

SERIES TC03D - *3 DEGREE, VARYING LENGTHS*

ANGLE PER SIDE (A)	TIP DIAMETER (D2)		LARGE DIAMETER (D3)	SHANK DIAMETER (D1)		FLUTE LENGTH (L2)		OVERALL LENGTH (L1)		# OF FLUTES	SQUARE END PART #	SQUARE END EDP #	BALL END PART #	BALL END EDP #
3°	3/16	0.188	0.2661	3/8	0.375	3/4	0.750	3	3.000	3	C-303C	1C30S	C-303C-BE	1C30B
			0.2923	3/8	0.375	1	1.000	3	3.000		C-304C	1C31S	C-304C-BE	1C31B
			0.3185	3/8	0.375	1 1/4	1.250	3 1/2	3.500		C-305C	1C32S	C-305C-BE	1C32B
			0.3447	3/8	0.375	1 1/2	1.500	3 1/2	3.500		C-306C	1C33S	C-306C-BE	1C33B
			0.4495	1/2	0.500	2 1/2	2.500	4 1/2	4.500		C-310C	1C34S	C-310C-BE	1C34B
			0.5000	1/2	0.500	3	3.000	5	5.000		C-312C	1C35S	C-312C-BE	1C35B
			0.5282	9/16	0.563	3 1/4	3.250	5	5.000		C-313C	1C36S	C-313C-BE	1C36B
			0.6068	5/8	0.625	4	4.000	6	6.000		C-316C	1C37S	C-316C-BE	1C37B
			0.7116	3/4	0.750	5	5.000	7	7.000		C-320C	1C38S	C-320C-BE	1C38B
	1/4	0.250	0.3286	3/8	0.375	3/4	0.750	3	3.000		C-403C	1C39S	C-403C-BE	1C39B
			0.3548	3/8	0.375	1	1.000	3	3.000		C-404C	1C40S	C-404C-BE	1C40B
			0.3750	3/8	0.375	1 1/4	1.250	3 1/2	3.500		C-405C	1C41S	C-405C-BE	1C41B
			0.4596	1/2	0.500	2	2.000	4	4.000		C-408C	1C42S	C-408C-BE	1C42B
			0.4858	1/2	0.500	2 1/4	2.250	4 1/2	4.500		C-409C	1C43S	C-409C-BE	1C43B
			0.5907	5/8	0.625	3 1/4	3.250	5	5.000		C-413C	1C44S	C-413C-BE	1C44B
			0.6693	3/4	0.750	4	4.000	6	6.000		C-416C	1C45S	C-416C-BE	1C45B
			0.7741	7/8	0.875	5	5.000	7	7.000		C-420C	1C46S	C-420C-BE	1C46B
	5/16	0.313	0.4173	1/2	0.500	1	1.000	3	3.000		C-504C	1C47S	C-504C-BE	1C47B
			0.4959	1/2	0.500	1 3/4	1.750	3 1/2	3.500		C-507C	1C48S	C-507C-BE	1C48B
	3/8	0.375	0.4798	1/2	0.500	1	1.000	3	3.000		C-604C	1C49S	C-604C-BE	1C49B
			0.5000	1/2	0.500	1 1/4	1.250	3 1/2	3.500		C-605C	1C50S	C-605C-BE	1C50B
			0.6108	5/8	0.625	2 1/4	2.250	4	4.000		C-609C	1C51S	C-609C-BE	1C51B
			0.7157	3/4	0.750	3 1/4	3.250	5	5.000		C-613C	1C52S	C-613C-BE	1C52B
			0.7943	7/8	0.875	4	4.000	6	6.000		C-616C	1C53S	C-616C-BE	1C53B
			0.8991	1	1.000	5	5.000	8	8.000		C-620C	1C54S	C-620C-BE	1C54B
	1/2	0.500	0.6310	3/4	0.750	1 1/4	1.250	4	4.000		C-805C	1C55S	C-805C-BE	1C55B
			0.7358	3/4	0.750	2 1/4	2.250	5	5.000		C-809C	1C56S	C-809C-BE	1C56B
			0.8407	7/8	0.875	3 1/4	3.250	6	6.000		C-813C	1C57S	C-813C-BE	1C57B
			0.9193	1	1.000	4	4.000	7	7.000		C-816C	1C58S	C-816C-BE	1C58B
	5/8	0.625	0.8608	7/8	0.875	2 1/4	2.250	5	5.000		C-1009C	1C59S	C-1009C-BE	1C59B
			0.9657	1	1.000	3 1/4	3.250	6	6.000		C-1013C	1C60S	C-1013C-BE	1C60B
	3/4	0.750	0.9858	1	1.000	2 1/4	2.250	5	5.000		C-1209C	1C61S	C-1209C-BE	1C61B

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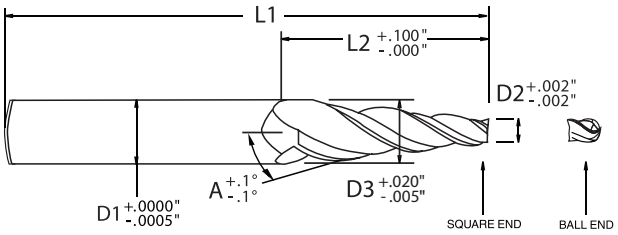
CONICAL TAPERED CARBIDE

SERIES TCX - *CARBIDE, 3 & 4 FLUTE, 25 - 30° VARIABLE LEAD HELIX*

VERSATILE IN STOCK ITEMS

Our Conical Tapered Carbide end mills come in varying diameters; stub, regular, long & extra-long lengths. For any particular machining challenge, there is a Conical Tapered Carbide end mill that fits the bill.

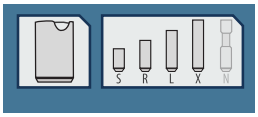
- Constant spiral helix provides increased tool engagement and rigidity
- Ball end option for high performance contour milling in finishing operations. Available in 24 to 48 hours
- Corner radius option protects corners in roughing operations and difficult to machine materials by preventing corner chipping and tool failure. Available in 24 to 48 hours



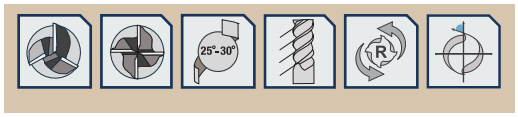
To order a corner radius, use code "CR" & actual radius in the part number. For example, a standard AX-203 would be ordered as AX-203-CR-015, with "015" being the radius.

TIP & END

SHANK & LENGTH



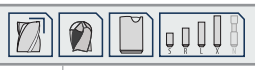
FLUTE CONFIGURATION



MATERIAL

COATING

SERIES TC04D - *4 DEGREE, VARYING LENGTHS*



ANGLE PER SIDE (A)	TIP DIAMETER (D2)		LARGE DIAMETER (D3)	SHANK DIAMETER (D1)		FLUTE LENGTH (L2)		OVERALL LENGTH (L1)		# OF FLUTES	SQUARE END PART #	SQUARE END EDP #	BALL END PART #	BALL END EDP #
4°	1/32	0.031	0.1711	1/4	0.250	1	1.000	3	3.000	3	D-0004C	1C62S	D-0004C-BE	1C62B
	1/16	0.063	0.2024	1/4	0.250	1	1.000	3	3.000		D-004C	1D01S	D-004C-BE	1D01B
	3/32	0.094	0.1986	1/4	0.250	3/4	0.750	2 1/2	2.500		D-103C	1D02S	D-103C-BE	1D02B
			0.2336	1/4	0.250	1	1.000	3	3.000		D-104C	1D03S	D-104C-BE	1D03B
	1/8	0.125	0.2299	1/4	0.250	3/4	0.750	2 1/2	2.500		D-203C	1D04S	D-203C-BE	1D04B
			0.2649	3/8	0.375	1	1.000	3	3.000		D-204C	1D05S	D-204C-BE	1D05B
			0.3348	3/8	0.375	1 1/2	1.500	3 1/2	3.500		D-206C	1D06S	D-206C-BE	1D06B
			0.4047	1/2	0.500	2	2.000	4	4.000		D-208C	1D07S	D-208C-BE	1D07B
			0.4746	1/2	0.500	2 1/2	2.500	5	5.000		D-210C	1D08S	D-210C-BE	1D08B
	3/16	0.188	0.2924	3/8	0.375	3/4	0.750	3	3.000		D-303C	1D09S	D-303C-BE	1D09B
			0.3623	3/8	0.375	1 1/4	1.250	3 1/2	3.500		D-305C	1D10S	D-305C-BE	1D10B
			0.6420	3/4	0.750	3 1/4	3.250	5	5.000		D-313C	1D11S	D-313C-BE	1D11B
			0.7469	3/4	0.750	4	4.000	6	6.000		D-316C	1D12S	D-316C-BE	1D12B
	1/4	0.250	0.3549	3/8	0.375	3/4	0.750	2 1/2	2.500		D-403C	1D13S	D-403C-BE	1D13B
			0.4248	1/2	0.500	1 1/4	1.250	3 1/2	3.500		D-405C	1D14S	D-405C-BE	1D14B
			0.5647	5/8	0.625	2 1/4	2.250	4	4.000		D-409C	1D15S	D-409C-BE	1D15B
			0.7045	3/4	0.750	3 1/4	3.250	5	5.000		D-413C	1D16S	D-413C-BE	1D16B
			0.8094	7/8	0.875	4	4.000	7	7.000		D-416C	1D17S	D-416C-BE	1D17B
	3/8	0.375	0.5498	9/16	0.563	1 1/4	1.250	3	3.000		D-605C	1D18S	D-605C-BE	1D18B
			0.6897	3/4	0.750	2 1/4	2.250	4	4.000		D-609C	1D19S	D-609C-BE	1D19B
			0.8295	7/8	0.875	3 1/4	3.250	6	6.000		D-613C	1D20S	D-613C-BE	1D20B
			0.9344	1	1.000	4	4.000	7	7.000		D-616C	1D21S	D-616C-BE	1D21B
	1/2	0.500	0.6748	3/4	0.750	1 1/4	1.250	3 1/2	3.500		D-805C	1D22S	D-805C-BE	1D22B
			0.7447	3/4	0.750	1 3/4	1.750	4	4.000		D-807C	1D23S	D-807C-BE	1D23B
			0.8147	7/8	0.875	2 1/4	2.250	5	5.000		D-809C	1D24S	D-809C-BE	1D24B
			0.9545	1	1.000	3 1/4	3.250	6	6.000		D-813C	1D25S	D-813C-BE	1D25B

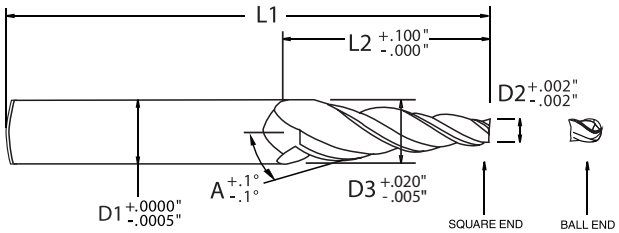
CONICAL TAPERED CARBIDE

SERIES TCX - *CARBIDE, 3 & 4 FLUTE, 25 - 30° VARIABLE LEAD HELIX*

IMPROVED FINISHES

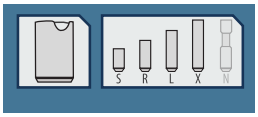
The three and four flute designs facilitate excellent chip evacuation and maximize flute engagement for an improved finish every time.

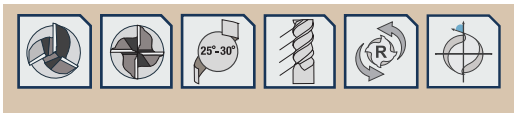
- Universal design allows for a multitude of applications, from slotting to finishing
- Standard square end to create sharp corners in finishing operations
- Multi-flute, three and four flute design allows for proper chip evacuation through a variety of materials and applications while maximizing machine performance when possible



To order a corner radius, use code "CR" & actual radius in the part number. For example, a standard AX-203 would be ordered as AX-203-CR-015, with "015" being the radius.

TIP & END | SHANK & LENGTH | FLUTE CONFIGURATION | MATERIAL | COATING





SERIES TC05D - *5 DEGREE, VARYING LENGTHS*

ANGLE PER SIDE (A)	TIP DIAMETER (D2)		LARGE DIAMETER (D3)	SHANK DIAMETER (D1)		FLUTE LENGTH (L2)		OVERALL LENGTH (L1)		# OF FLUTES	SQUARE END PART #	SQUARE END EDP #	BALL END PART #	BALL END EDP #
5°	1/32	0.031	0.1187	1/4	0.250	1/2	0.500	2	2.000	3	E-0002C	1E01S	E-0002C-BE	1E01B
			0.2500	1/4	0.250	1 1/4	1.250	3	3.000		E-0005C	1E02S	E-0005C-BE	1E02B
	1/16	0.063	0.1500	1/4	0.250	1/2	0.500	2	2.000		E-002C	1E03S	E-002C-BE	1E03B
			0.1937	1/4	0.250	3/4	0.750	2 1/2	2.500		E-003C	1E04S	E-003C-BE	1E04B
			0.2375	1/4	0.250	1	1.000	3	3.000		E-004C	1E05S	E-004C-BE	1E05B
			0.3250	3/8	0.375	1 1/2	1.500	3 1/2	3.500		E-006C	1E06S	E-006C-BE	1E06B
	3/32	0.094	0.1812	1/4	0.250	1/2	0.500	2	2.000		E-102C	1E07S	E-102C-BE	1E07B
			0.2250	1/4	0.250	3/4	0.750	3	3.000		E-103C	1E08S	E-103C-BE	1E08B
			0.2687	3/8	0.375	1	1.000	3	3.000		E-104C	1E09S	E-104C-BE	1E09B
			0.3125	3/8	0.375	1 1/4	1.250	3 1/2	3.500		E-105C	1E10S	E-105C-BE	1E10B
			0.3562	3/8	0.375	1 1/2	1.500	3 1/2	3.500		E-106C	1E11S	E-106C-BE	1E11B
			0.4437	1/2	0.500	2	2.000	4	4.000		E-108C	1E12S	E-108C-BE	1E12B
	7/64	0.109	0.2844	3/8	0.375	1	1.000	3 1/2	3.500		E-154C	1E13S	E-154C-BE	1E13B
			0.3281	3/8	0.375	1 1/4	1.250	3	3.000		E-155C	1E14S	E-155C-BE	1E14B
			0.3718	3/8	0.375	1 1/2	1.500	3 1/2	3.500		E-156C	1E15S	E-156C-BE	1E15B
	1/8	0.125	0.2500	1/4	0.250	3/4	0.750	3	3.000		E-203C	1E16S	E-203C-BE	1E16B
			0.3000	3/8	0.375	1	1.000	3	3.000		E-204C	1E17S	E-204C-BE	1E17B
			0.3437	3/8	0.375	1 1/4	1.250	3 1/2	3.500		E-205C	1E18S	E-205C-BE	1E18B
			0.3750	3/8	0.375	1 1/2	1.500	3 1/2	3.500		E-206C	1E19S	E-206C-BE	1E19B
			0.4312	1/2	0.500	1 3/4	1.750	4	4.000		E-207C	1E20S	E-207C-BE	1E20B
			0.4750	1/2	0.500	2	2.000	4	4.000		E-208C	1E21S	E-208C-BE	1E21B
			0.5624	5/8	0.625	2 1/2	2.500	5	5.000		E-210C	1E22S	E-210C-BE	1E22B
			0.6499	3/4	0.750	3	3.000	5	5.000		E-212C	1E23S	E-212C-BE	1E23B
	5/32	0.156	0.2875	3/8	0.375	3/4	0.750	2 1/2	2.500		E-253C	1E24S	E-253C-BE	1E24B
			0.3312	3/8	0.375	1	1.000	3	3.000		E-254C	1E25S	E-254C-BE	1E25B
			0.3750	3/8	0.375	1 1/4	1.250	3	3.000		E-255C	1E26S	E-255C-BE	1E26B
			0.4187	1/2	0.500	1 1/2	1.500	3 1/2	3.500		E-256C	1E27S	E-256C-BE	1E27B
			0.4625	1/2	0.500	1 3/4	1.750	4	4.000		E-257C	1E28S	E-257C-BE	1E28B
			0.5000	1/2	0.500	2	2.000	4	4.000		E-258C	1E29S	E-258C-BE	1E29B

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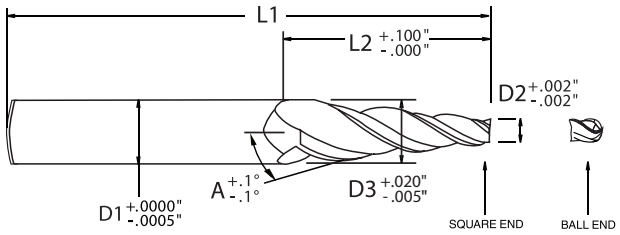
CONICAL TAPERED CARBIDE

SERIES TCX - *CARBIDE, 3 & 4 FLUTE, 25 - 30° VARIABLE LEAD HELIX*

FOR CHALLENGING MACHINING ENVIRONMENTS

With a variable lead spiral, tapered core geometry and more than 16 available coatings, this carbide tapered end mill performs in all materials and challenging machining environments.

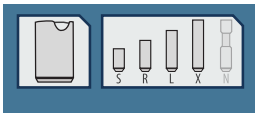
- Standard square end to create sharp corners in finishing operations
- Multi-flute, three and four flute design allows for proper chip evacuation through a variety of materials and applications while maximizing machine performance when possible
- For rough and finish milling of draft angles and slotting of tapered walls in most materials; wet or dry; non-ferrous materials; low carbon steel to titanium



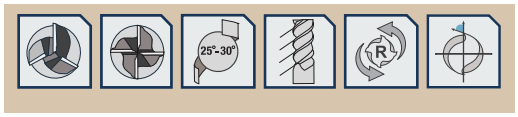
To order a corner radius, use code "CR" & actual radius in the part number. For example, a standard AX-203 would be ordered as AX-203-CR-015, with "015" being the radius.

TIP & END

SHANK & LENGTH



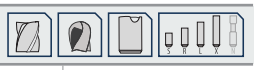
FLUTE CONFIGURATION



MATERIAL

COATING

SERIES TC05D - *5 DEGREE, VARYING LENGTHS*



ANGLE PER SIDE (A)	TIP DIAMETER (D2)		LARGE DIAMETER (D3)	SHANK DIAMETER (D1)		FLUTE LENGTH (L2)		OVERALL LENGTH (L1)		# OF FLUTES	SQUARE END PART #	SQUARE END EDP #	BALL END PART #	BALL END EDP #
5°	3/16	0.188	0.3187	3/8	0.375	3/4	0.750	3	3.000	3	E-303C	1E30S	E-303C-BE	1E30B
			0.3625	3/8	0.375	1	1.000	3	3.000		E-304C	1E31S	E-304C-BE	1E31B
			0.4062	1/2	0.500	1 1/4	1.250	3 1/2	3.500		E-305C	1E32S	E-305C-BE	1E32B
			0.4500	1/2	0.500	1 1/2	1.500	3 1/2	3.500		E-306C	1E33S	E-306C-BE	1E33B
			0.4937	1/2	0.500	1 3/4	1.750	4	4.000		E-307C	1E34S	E-307C-BE	1E34B
			0.5375	9/16	0.563	2	2.000	4	4.000		E-308C	1E35S	E-308C-BE	1E35B
			0.6249	5/8	0.625	2 1/2	2.500	5	5.000		E-310C	1E36S	E-310C-BE	1E36B
			0.7124	3/4	0.750	3	3.000	5	5.000		E-312C	1E37S	E-312C-BE	1E37B
			0.7562	7/8	0.875	3 1/4	3.250	6	6.000		E-313C	1E38S	E-313C-BE	1E38B
			0.8874	1	1.000	4	4.000	7	7.000		E-316C	1E39S	E-316C-BE	1E39B
	1/4	0.250	0.3750	3/8	0.375	3/4	0.750	3	3.000		E-403C	1E40S	E-403C-BE	1E40B
			0.4250	1/2	0.500	1	1.000	3	3.000		E-404C	1E41S	E-404C-BE	1E41B
			0.4687	1/2	0.500	1 1/4	1.250	3 1/2	3.500		E-405C	1E42S	E-405C-BE	1E42B
			0.5000	1/2	0.500	1 1/2	1.500	3 1/2	3.500		E-406C	1E43S	E-406C-BE	1E43B
			0.5562	5/8	0.625	1 3/4	1.750	4	4.000		E-407C	1E44S	E-407C-BE	1E44B
			0.6000	5/8	0.625	2	2.000	4	4.000		E-408C	1E45S	E-408C-BE	1E45B
			0.6437	3/4	0.750	2 1/4	2.250	5	5.000		E-409C	1E46S	E-409C-BE	1E46B
			0.6874	3/4	0.750	2 1/2	2.500	5	5.000		E-410C	1E47S	E-410C-BE	1E47B
			0.7312	3/4	0.750	2 3/4	2.750	5	5.000		E-411C	1E48S	E-411C-BE	1E48B
			0.8187	7/8	0.875	3 1/4	3.250	6	6.000		E-413C	1E49S	E-413C-BE	1E49B
			0.9499	1	1.000	4	4.000	7	7.000		E-416C	1E50S	E-416C-BE	1E50B
	5/16	0.313	0.4875	1/2	0.500	1	1.000	3	3.000		E-504C	1E51S	E-504C-BE	1E51B
			0.7062	3/4	0.750	2 1/4	2.250	5	5.000		E-509C	1E52S	E-509C-BE	1E52B
	3/8	0.375	0.5000	1/2	0.500	3/4	0.750	3	3.000		E-603C	1E53S	E-603C-BE	1E53B
			0.5500	5/8	0.625	1	1.000	3 1/2	3.500		E-604C	1E54S	E-604C-BE	1E54B
			0.5937	5/8	0.625	1 1/4	1.250	3 1/2	3.500		E-605C	1E55S	E-605C-BE	1E55B
			0.7250	7/8	0.875	2	2.000	4 1/2	4.500		E-608C	1E56S	E-608C-BE	1E56B
			0.7687	7/8	0.875	2 1/4	2.250	5	5.000		E-609C	1E57S	E-609C-BE	1E57B
			0.9437	1	1.000	3 1/4	3.250	6	6.000		E-613C	1E58S	E-613C-BE	1E58B
	1/2	0.500	0.7187	3/4	0.750	1 1/4	1.250	3	3.000		E-805C	1E59S	E-805C-BE	1E59B
			0.7625	7/8	0.875	1 1/2	1.500	4	4.000		E-806C	1E60S	E-806C-BE	1E60B
			0.8937	1	1.000	2 1/4	2.250	5	5.000		E-809C	1E61S	E-809C-BE	1E61B

(continued from previous page)

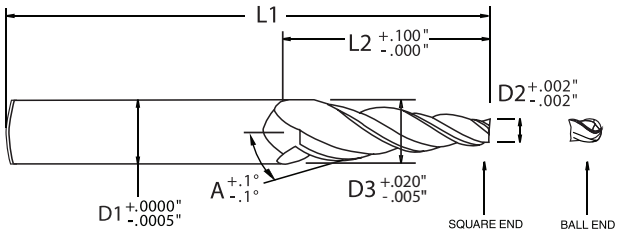
CONICAL TAPERED CARBIDE

SERIES TCX - *CARBIDE, 3 & 4 FLUTE, 25 - 30° VARIABLE LEAD HELIX*

MULTITUDE OF APPLICATIONS

Our designs are specifically engineered to perform in ferrous and high hardness materials as well as soft, easy to machine materials. The universal design allows for a multitude of applications.

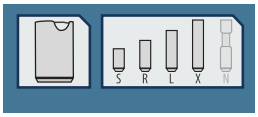
- Premium micro-grain carbide substrate resists chipping, tool deflection, and has a high transverse rupture strength for greater feeds and speeds
- Variable Core Design maximizes chip evacuation and provides increased rigidity when the cutter is fully engaged
- More than 16 available coatings can be added to increase tool life for your specific application and material



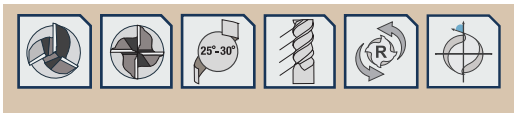
To order a corner radius, use code "CR" & actual radius in the part number. For example, a standard AX-203 would be ordered as AX-203-CR-015, with "015" being the radius.

TIP & END

SHANK & LENGTH



FLUTE CONFIGURATION



MATERIAL

COATING

SERIES TC06D - *6 DEGREE, VARYING LENGTHS*

ANGLE PER SIDE (A)	TIP DIAMETER (D2)		LARGE DIAMETER (D3)	SHANK DIAMETER (D1)		FLUTE LENGTH (L2)		OVERALL LENGTH (L1)		# OF FLUTES	SQUARE END PART #	SQUARE END EDP #	BALL END PART #	BALL END EDP #
6°	1/16	0.063	0.2727	5/16	0.313	1	1.000	3	3.000	3	F-004C	1F01S	F-004C-BE	1F01B
	3/32	0.094	0.3040	5/16	0.313	1	1.000	3	3.000		F-104C	1F02S	F-104C-BE	1F02B
	1/8	0.125	0.3352	3/8	0.375	1	1.000	3	3.000		F-204C	1F03S	F-204C-BE	1F03B
			0.4403	1/2	0.500	1 1/2	1.500	3 1/2	3.500		F-206C	1F04S	F-206C-BE	1F04B
	1/4	0.250	0.5625	9/16	0.563	1 1/2	1.500	3 1/2	3.500		F-406C	1F05S	F-406C-BE	1F05B
	3/8	0.375	0.4801	1/2	0.500	1/2	0.500	2 1/2	2.500		F-602C	1F06S	F-602C-BE	1F06B

GUARANTEED TEST TOOL

*TEST OUR STANDARD END MILLS

CARBIDE | HSS | COBALT

SELECTING YOUR END MILL

We realize that selecting the optimal end mill for your particular job can be confusing. That's why our team of experts are here to help. Our outstanding customer service can help you select the best end mill for your job, as well as the expertise needed to choose the most advantageous tool for your machining needs.

VISIT OUR WEBSITE OR CALL FOR YOUR TOOL TODAY!

*not applicable to specials

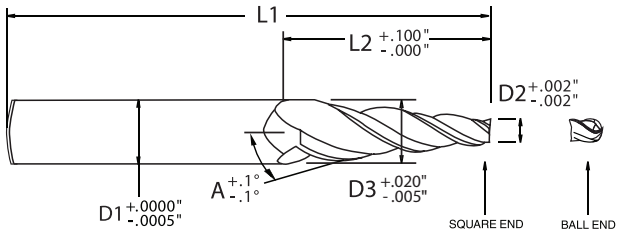
CONICAL TAPERED CARBIDE

SERIES TCX - *CARBIDE, 3 & 4 FLUTE, 25 - 30° VARIABLE LEAD HELIX*

LARGE SELECTION

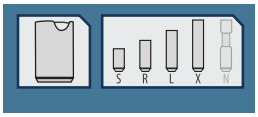
Whether you need to finish sharp corners, contour mill with clearance, machine draft angles, add chamfers, finish cavities or taper holes; no one has a larger selection of in stock items.

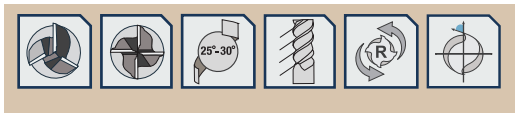
- Constant spiral helix provides increased tool engagement and rigidity
- Ball end option for high performance contour milling in finishing operations. Available in 24 to 48 hours
- Corner radius option protects corners in roughing operations and difficult to machine materials by preventing corner chipping and tool failure. Available in 24 to 48 hours



To order a corner radius, use code "CR" & actual radius in the part number. For example, a standard AX-203 would be ordered as AX-203-CR-015, with "015" being the radius.

TIP & END | SHANK & LENGTH | FLUTE CONFIGURATION | MATERIAL | COATING





SERIES TC07D - *7 DEGREE, VARYING LENGTHS*

ANGLE PER SIDE (A)	TIP DIAMETER (D2)		LARGE DIAMETER (D3)	SHANK DIAMETER (D1)		FLUTE LENGTH (L2)		OVERALL LENGTH (L1)		# OF FLUTES	SQUARE END PART #	SQUARE END EDP #	BALL END PART #	BALL END EDP #
	1/32	0.031	0.2154	1/4	0.250	3/4	0.750	2 1/2	2.500		G-0003C	1G01S	G-0003C-BE	1G01B
			0.2768	3/8	0.375	1	1.000	3	3.000		G-0004C	1G02S	G-0004C-BE	1G02B
	1/16	0.063	0.1239	1/4	0.250	1/4	0.250	2	2.000		G-001C	1G03S	G-001C-BE	1G03B
			0.1853	1/4	0.250	1/2	0.500	2 1/2	2.500		G-002C	1G04S	G-002C-BE	1G04B
			0.2467	3/8	0.375	3/4	0.750	3	3.000		G-003C	1G05S	G-003C-BE	1G05B
			0.3081	3/8	0.375	1	1.000	3	3.000		G-004C	1G06S	G-004C-BE	1G06B
	5/64	0.078	0.3237	3/8	0.375	1	1.000	3	3.000		G-054C	1G07S	G-054C-BE	1G07B
	3/32	0.094	0.2165	1/4	0.250	1/2	0.500	2 1/2	2.500		G-102C	1G08S	G-102C-BE	1G08B
			0.3393	3/8	0.375	1	1.000	3	3.000		G-104C	1G09S	G-104C-BE	1G09B
			0.4621	1/2	0.500	1 1/2	1.500	3 1/2	3.500		G-106C	1G10S	G-106C-BE	1G10B
	1/8	0.125	0.2478	1/4	0.250	1/2	0.500	2 1/2	2.500		G-202C	1G11S	G-202C-BE	1G11B
			0.3092	3/8	0.375	3/4	0.750	3	3.000		G-203C	1G12S	G-203C-BE	1G12B
			0.3706	3/8	0.375	1	1.000	3	3.000		G-204C	1G13S	G-204C-BE	1G13B
			0.4934	1/2	0.500	1 1/2	1.500	3 1/2	3.500		G-206C	1G14S	G-206C-BE	1G14B
7°			0.6161	5/8	0.625	2	2.000	4	4.000	3	G-208C	1G15S	G-208C-BE	1G15B
			0.8617	7/8	0.875	3	3.000	5	5.000		G-212C	1G16S	G-212C-BE	1G16B
	5/32	0.156	0.3404	3/8	0.375	3/4	0.750	2 1/2	2.500		G-253C	1G17S	G-253C-BE	1G17B
			0.3404	3/8	0.375			3	3.000		G-253C-XL	1G18S	G-253C-XL-BE	1G18B
	3/16	0.188	0.4945	1/2	0.500	1 1/4	1.250	3 1/2	3.500		G-305C	1G19S	G-305C-BE	1G19B
	1/4	0.250	0.4342	1/2	0.500	3/4	0.750	3	3.000		G-403C	1G20S	G-403C-BE	1G20B
			0.4956	1/2	0.500	1	1.000	3	3.000		G-404C	1G21S	G-404C-BE	1G21B
			0.5570	5/8	0.625	1 1/4	1.250	3 1/2	3.500		G-405C	1G22S	G-405C-BE	1G22B
			0.7411	3/4	0.750	2	2.000	4	4.000		G-408C	1G23S	G-408C-BE	1G23B
			0.8025	7/8	0.875	2 1/4	2.250	5	5.000		G-409C	1G24S	G-409C-BE	1G24B
	3/8	0.375	0.6820	3/4	0.750	1 1/4	1.250	4	4.000		G-605C	1G25S	G-605C-BE	1G25B
			0.9275	1	1.000	2 1/4	2.250	5	5.000		G-609C	1G26S	G-609C-BE	1G26B
			0.9889	1	1.000	2 1/2	2.500	5	5.000		G-610C	1G27S	G-610C-BE	1G27B
	1/2	0.500	0.7500	3/4	0.750	1 1/4	1.250	4	4.000		G-805C	1G28S	G-805C-BE	1G28B
			0.9911	1	1.000	2	2.000	5	5.000		G-808C	1G29S	G-808C-BE	1G29B

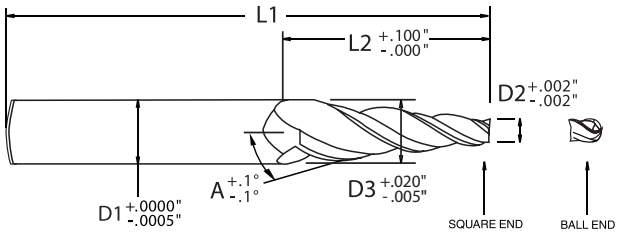
CONICAL TAPERED CARBIDE

SERIES TCX - *CARBIDE, 3 & 4 FLUTE, 25 - 30° VARIABLE LEAD HELIX*

PERFORMS IN ALL MATERIALS

With a variable lead spiral, tapered core geometry and more than 16 available coatings, this carbide tapered end mill performs in all materials and challenging machining environments.

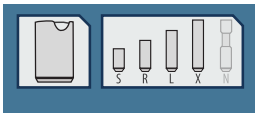
- Universal design allows for a multitude of applications, from slotting to finishing
- Standard square end to create sharp corners in finishing operations
- Multi-flute, three and four flute design allows for proper chip evacuation through a variety of materials and applications while maximizing machine performance when possible



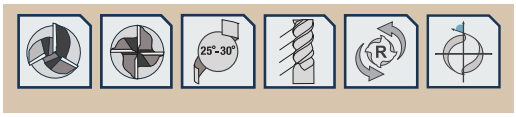
To order a corner radius, use code "CR" & actual radius in the part number. For example, a standard AX-203 would be ordered as AX-203-CR-015, with "015" being the radius.

TIP & END

SHANK & LENGTH



FLUTE CONFIGURATION



MATERIAL

COATING

SERIES TC08D - *8 DEGREE, VARYING LENGTHS*

ANGLE PER SIDE (A)	TIP DIAMETER (D2)		LARGE DIAMETER (D3)	SHANK DIAMETER (D1)		FLUTE LENGTH (L2)		OVERALL LENGTH (L1)		# OF FLUTES	SQUARE END PART #	SQUARE END EDP #	BALL END PART #	BALL END EDP #
8°	1/4	0.250	0.4608	1/2	0.500	3/4	0.750	3	3.000	3	H-403C	1H01S	H-403C-BE	1H01B

SERIES TC10D - *10 DEGREE, VARYING LENGTHS*

ANGLE PER SIDE (A)	TIP DIAMETER (D2)		LARGE DIAMETER (D3)	SHANK DIAMETER (D1)		FLUTE LENGTH (L2)		OVERALL LENGTH (L1)		# OF FLUTES	SQUARE END PART #	SQUARE END EDP #	BALL END PART #	BALL END EDP #
10°	1/32	0.031	0.2076	1/4	0.250	1/2	0.500	2 1/2	2.500	3	J-0002C	1J01S	J-0002C-BE	1J01B
			0.2957	3/8	0.375	3/4	0.750	3	3.000		J-0003C	1J02S	J-0003C-BE	1J02B
	1/16	0.063	0.2388	1/4	0.250	1/2	0.500	2 1/2	2.500		J-002C	1J03S	J-002C-BE	1J03B
			0.3270	3/8	0.375	3/4	0.750	2 1/2	2.500		J-003C	1J04S	J-003C-BE	1J04B
			0.4152	1/2	0.500	1	1.000	3	3.000		J-004C	1J05S	J-004C-BE	1J05B
			0.5000	1/2	0.500	1 1/4	1.250	3 1/2	3.500		J-005C	1J06S	J-005C-BE	1J06B
	3/32	0.094	0.1819	1/4	0.250	1/4	0.250	2	2.000		J-101C	1J07S	J-101C-BE	1J07B
			0.2701	3/8	0.375	1/2	0.500	2 1/2	2.500		J-102C	1J08S	J-102C-BE	1J08B
			0.3582	3/8	0.375	3/4	0.750	2 1/2	2.500		J-103C	1J09S	J-103C-BE	1J09B
			0.4464	1/2	0.500	1	1.000	3	3.000		J-104C	1J10S	J-104C-BE	1J10B
			0.6227	5/8	0.625	1 1/2	1.500	3 1/2	3.500		J-106C	1J11S	J-106C-BE	1J11B
	1/8	0.125	0.3750	3/8	0.375	3/4	0.750	2 1/2	2.500		J-203C	1J12S	J-203C-BE	1J12B
			0.4777	1/2	0.500	1	1.000	3 1/2	3.500		J-204C	1J13S	J-204C-BE	1J13B
			0.5658	5/8	0.625	1 1/4	1.250	3 1/2	3.500		J-205C	1J14S	J-205C-BE	1J14B
			0.6540	3/4	0.750	1 1/2	1.500	3 1/2	3.500		J-206C	1J15S	J-206C-BE	1J15B
	5/32	0.156	0.5000	1/2	0.500	1	1.000	3	3.000		J-254C	1J16S	J-254C-BE	1J16B
			0.8616	7/8	0.875	2	2.000	4	4.000		J-258C	1J17S	J-258C-BE	1J17B
	3/16	0.188	0.4520	1/2	0.500	3/4	0.750	3	3.000		J-303C	1J18S	J-303C-BE	1J18B
			0.6250	5/8	0.625	1 1/4	1.250	3 1/2	3.500		J-305C	1J19S	J-305C-BE	1J19B
			0.9810	1	1.000	2 1/4	2.250	5	5.000		J-309C	1J20S	J-309C-BE	1J20B
	1/4	0.250	0.5000	1/2	0.500	3/4	0.750	3	3.000		J-403C	1J21S	J-403C-BE	1J21B
			0.6027	5/8	0.625	1	1.000	3	3.000		J-404C	1J22S	J-404C-BE	1J22B
			0.6908	3/4	0.750	1 1/4	1.250	4	4.000		J-405C	1J23S	J-405C-BE	1J23B
			0.9553	1	1.000	2	2.000	4	4.000		J-408C	1J24S	J-408C-BE	1J24B
	3/8	0.375	0.7277	3/4	0.750	1	1.000	3	3.000		J-604C	1J25S	J-604C-BE	1J25B
			0.8158	7/8	0.875	1 1/4	1.250	4	4.000		J-605C	1J26S	J-605C-BE	1J26B
	1/2	0.500	0.9408	1	1.000	1 1/4	1.250	4	4.000	4	J-805C-A	1J27S	J-805C-A-BE	1J27B
			0.9408	3/4	0.750	1 1/4	1.250	3 1/2	3.500		J-805C-B	1J28S	J-805C-B-BE	1J28B

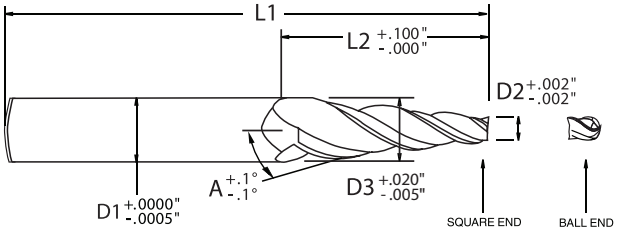
CONICAL TAPERED CARBIDE

SERIES TCX - *CARBIDE, 3 & 4 FLUTE, 25 - 30° VARIABLE LEAD HELIX*

SPECIFIC ENGINEERING

Our designs are specifically engineered to perform in ferrous and high hardness materials as well as soft, easy to machine materials.

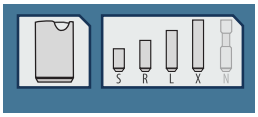
- Standard square end to create sharp corners in finishing operations
- Multi-flute, three and four flute design allows for proper chip evacuation through a variety of materials and applications while maximizing machine performance when possible
- For rough and finish milling of draft angles and slotting of tapered walls in most materials; wet or dry; non-ferrous materials; low carbon steel to titanium



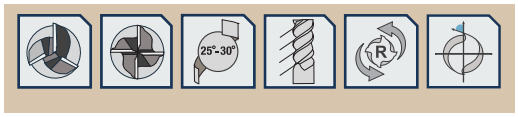
To order a corner radius, use code "CR" & actual radius in the part number. For example, a standard AX-203 would be ordered as AX-203-CR-015, with "015" being the radius.

TIP & END

SHANK & LENGTH



FLUTE CONFIGURATION



MATERIAL

COATING

SERIES TC11D - *11 DEGREE, VARYING LENGTHS*

ANGLE PER SIDE (A)	TIP DIAMETER (D2)		LARGE DIAMETER (D3)	SHANK DIAMETER (D1)		FLUTE LENGTH (L2)		OVERALL LENGTH (L1)		# OF FLUTES	SQUARE END PART #	SQUARE END EDP #	BALL END PART #	BALL END EDP #
11°	1/32	0.031	0.3228	3/8	0.375	3/4	0.750	3	3.000	3	K-0003C	1K01S	K-0003C-BE	1K01B
	1/16	0.063	0.3541	3/8	0.375	3/4	0.750	3	3.000		K-003C	1K02S	K-003C-BE	1K02B
	3/32	0.094	0.3853	1/2	0.500	3/4	0.750	2 1/2	2.500		K-103C	1K03S	K-103C-BE	1K03B
	1/8	0.125	0.4166	1/2	0.500	3/4	0.750	2 1/2	2.500		K-203C	1K04S	K-203C-BE	1K04B

SERIES TC12D - *12 DEGREE, VARYING LENGTHS*

ANGLE PER SIDE (A)	TIP DIAMETER (D2)		LARGE DIAMETER (D3)	SHANK DIAMETER (D1)		FLUTE LENGTH (L2)		OVERALL LENGTH (L1)		# OF FLUTES	SQUARE END PART #	SQUARE END EDP #	BALL END PART #	BALL END EDP #
12°	1/8	0.125	0.3376	3/8	0.375	1/2	0.500	2 1/2	2.500	3	L-202C	1L01S	L-202C-BE	1L01B
			0.5501	9/16	0.563	1	1.000	3	3.000		L-204C	1L02S	L-204C-BE	1L02B
	1/4	0.250	0.5625	9/16	0.563	3/4	0.750	3	3.000		L-403C	1L03S	L-403C-BE	1L03B

RECONDITIONING PROGRAM

REGRIND ONLY: 1 WEEK; REGRIND & COATING: 2 WEEKS

70 YEARS OF GRINDING EXPERIENCE

RE-SHARPENING SERVICES

Prices vary and are based on coating and diameter size. It does not matter how badly the tool may be damaged, we can regrind most any end mill. We will re-sharpen or recondition any tool, even competitor brands. Most any tool can be re-sharpened, however, when normal re-sharpening is not sufficient, reconditioning may be needed.

SEE PAGES 14 -15 FOR DETAILS

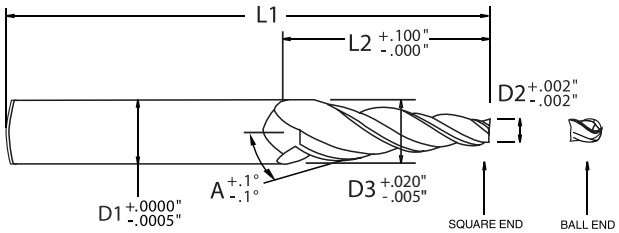
CONICAL TAPERED CARBIDE

SERIES TCX - *CARBIDE, 3 & 4 FLUTE, 25 - 30° VARIABLE LEAD HELIX*

FOR ANY MACHINING CHALLENGE

Our Conical Tapered Carbide end mills come in varying diameters; stub, regular, long & extra-long lengths. For any particular machining challenge, there is a Conical Tapered Carbide end mill that fits the bill.

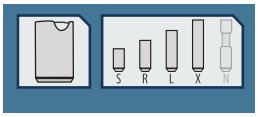
- Premium micro-grain carbide substrate resists chipping, tool deflection, and has a high transverse rupture strength for greater feeds and speeds
- Variable Core Design maximizes chip evacuation and provides increased rigidity when the cutter is fully engaged
- More than 16 available coatings can be added to increase tool life for your specific application and material



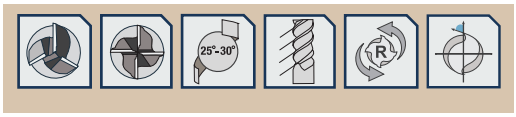
To order a corner radius, use code "CR" & actual radius in the part number. For example, a standard AX-203 would be ordered as AX-203-CR-015, with "015" being the radius.

TIP & END

SHANK & LENGTH



FLUTE CONFIGURATION



MATERIAL

COATING

SERIES TC15D - *15 DEGREE, VARYING LENGTHS*

ANGLE PER SIDE (A)	TIP DIAMETER (D2)		LARGE DIAMETER (D3)	SHANK DIAMETER (D1)		FLUTE LENGTH (L2)		OVERALL LENGTH (L1)		# OF FLUTES	SQUARE END PART #	SQUARE END EDP #	BALL END PART #	BALL END EDP #
15°	1/32	0.031	0.1652	1/4	0.250	1/4	0.250	2	2.000	3	P-0001C	1P01S	P-0001C-BE	1P01B
			0.4332	1/2	0.500	3/4	0.750	3	3.000		P-0003C	1P02S	P-0003C-BE	1P02B
	1/16	0.063	0.1965	1/4	0.250	1/4	0.250	2	2.000		P-001C	1P03S	P-001C-BE	1P03B
			0.4644	1/2	0.500	3/4	0.750	3	3.000		P-003C	1P04S	P-003C-BE	1P04B
	3/32	0.094	0.2277	1/4	0.250	1/4	0.250	2	2.000		P-101C	1P05S	P-101C-BE	1P05B
			0.3617	3/8	0.375	1/2	0.500	2 1/2	2.500		P-102C	1P06S	P-102C-BE	1P06B
			0.4957	1/2	0.500	3/4	0.750	3	3.000		P-103C	1P07S	P-103C-BE	1P07B
			0.6250	5/8	0.625	1	1.000	3	3.000		P-104C	1P08S	P-104C-BE	1P08B
			0.8976	1	1.000	1 1/2	1.500	4	4.000		P-106C	1P09S	P-106C-BE	1P09B
	1/8	0.125	0.3750	3/8	0.375	1/2	0.500	2 1/2	2.500		P-202C	1P10S	P-202C-BE	1P10B
			0.5269	9/16	0.563	3/4	0.750	3	3.000		P-203C	1P11S	P-203C-BE	1P11B
			0.6250	5/8	0.625	1	1.000	3	3.000		P-204C	1P12S	P-204C-BE	1P12B
			0.9288	1	1.000	1 1/2	1.500	4	4.000		P-206C	1P13S	P-206C-BE	1P13B
	3/16	0.188	0.7234	3/4	0.750	1	1.000	3	3.000		P-304C-A	1P14S	P-304C-A-BE	1P14B
			0.7234	1/2	0.500	1	1.000	3	3.000		P-304C-B	1P15S	P-304C-B-BE	1P15B
			0.8574	7/8	0.875	1 1/4	1.250	3 1/2	3.500		P-305C	1P16S	P-305C-BE	1P16B
	1/4	0.250	0.7500	3/4	0.750	1	1.000	3	3.000	4	P-404C-A	1P17S	P-404C-A-BE	1P17B
			0.7859	1/2	0.500	1	1.000	3	3.000		P-404C-B	1P18S	P-404C-B-BE	1P18B
	1/5	0.200	0.8699	1	1.000	1 1/4	1.250	4	4.000		P-405C	1P19S	P-405C-BE	1P19B
	5/16	0.313	0.8484	7/8	0.875	1	1.000	3 1/2	3.500		P-504C	1P20S	P-504C-BE	1P20B
	3/8	0.375	1.1788	3/4	0.750	1 1/2	1.500	4	4.000		P-606C	1P21S	P-606C-BE	1P21B
	1/2	0.500	1.0000	1	1.000	1	1.000	3	3.000		P-804C	1P22S	P-804C-BE	1P22B
			1.1699	3/4	0.750	1 1/4	1.250	3 1/2	3.500		P-805C	1P23S	P-805C-BE	1P23B
			1.7058	1	1.000	2 1/4	2.250	4 1/4	4.250		P-809C	1P24S	P-809C-BE	1P24B

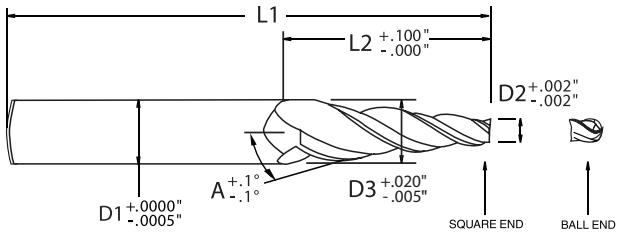
CONICAL TAPERED CARBIDE

SERIES TCX - *CARBIDE, 3 & 4 FLUTE, 25 - 30° VARIABLE LEAD HELIX*

IMPROVED FINISHES

The three and four flute designs facilitate excellent chip evacuation and maximize flute engagement for an improved finish every time.

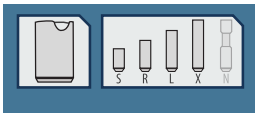
- Constant spiral helix provides increased tool engagement and rigidity
- Ball end option for high performance contour milling in finishing operations. Available in 24 to 48 hours
- Corner radius option protects corners in roughing operations and difficult to machine materials by preventing corner chipping and tool failure. Available in 24 to 48 hours



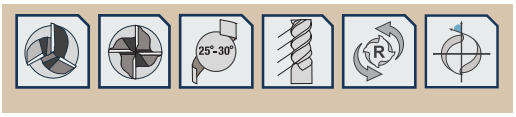
To order a corner radius, use code "CR" & actual radius in the part number. For example, a standard AX-203 would be ordered as AX-203-CR-015, with "015" being the radius.

TIP & END

SHANK & LENGTH



FLUTE CONFIGURATION



MATERIAL

COATING

SERIES TC20D - *20 DEGREE, VARYING LENGTHS*

ANGLE PER SIDE (A)	TIP DIAMETER (D2)		LARGE DIAMETER (D3)	SHANK DIAMETER (D1)		FLUTE LENGTH (L2)		OVERALL LENGTH (L1)		# OF FLUTES	SQUARE END PART #	SQUARE END EDP #	BALL END PART #	BALL END EDP #
20°	1/32	0.031	0.2132	1/4	0.250	1/4	0.250	2	2.000	3	T-0001C	1T01S	T-0001C-BE	1T01B
	1/16	0.063	0.2445	1/4	0.250	1/4	0.250	2	2.000		T-001C	1T02S	T-001C-BE	1T02B
			0.4265	1/2	0.500	1/2	0.500	3	3.000		T-002C	1T03S	T-002C-BE	1T03B
	3/32	0.094	0.4577	1/2	0.500	1/2	0.500	3	3.000		T-102C	1T04S	T-102C-BE	1T04B
			0.6397	3/4	0.750	3/4	0.750	3	3.000		T-103C	1T05S	T-103C-BE	1T05B
	1/8	0.125	0.3070	3/8	0.375	1/4	0.250	2 1/2	2.500		T-201C	1T06S	T-201C-BE	1T06B
			0.4890	1/2	0.500	1/2	0.500	3	3.000		T-202C	1T07S	T-202C-BE	1T07B
	1/8	0.125	0.8529	7/8	0.875	1	1.000	3	3.000	4	T-204C	1T08S	T-204C-BE	1T08B
	3/16	0.188	0.9154	1	1.000	1	1.000	3	3.000		T-304C-A	1T09S	T-304C-A-BE	1T09B
			0.9154	1/2	0.500	1	1.000	3	3.000		T-304C-B	1T10S	T-304C-B-BE	1T10B
	1/4	0.250	0.9779	1	1.000	1	1.000	3	3.000		T-404C-A	1T11S	T-404C-A-BE	1T11B
			0.9779	1/2	0.500	1	1.000	3	3.000		T-404C-B	1T12S	T-404C-B-BE	1T12B
	3/8	0.375	1.4669	3/4	0.750	1 1/2	1.500	4	4.000		T-606C	1T13S	T-606C-BE	1T13B

SERIES TC25D - *25 DEGREE, VARYING LENGTHS*

ANGLE PER SIDE (A)	TIP DIAMETER (D2)		LARGE DIAMETER (D3)	SHANK DIAMETER (D1)		FLUTE LENGTH (L2)		OVERALL LENGTH (L1)		# OF FLUTES	SQUARE END PART #	SQUARE END EDP #	BALL END PART #	BALL END EDP #
25°	1/16	0.063	0.2957	3/8	0.375	1/4	0.250	2 1/2	2.500	3	R-001C	1R01S	R-001C-BE	1R01B
			0.5288	9/16	0.563	1/2	0.500	3	3.000		R-002C	1R02S	R-002C-BE	1R02B
	3/32	0.094	0.3269	3/8	0.375	1/4	0.250	2 1/2	2.500		R-101C	1R03S	R-101C-BE	1R03B
			0.7500	3/4	0.750	3/4	0.750	3	3.000		R-103C	1R04S	R-103C-BE	1R04B
			1.0000	1	1.000	1	1.000	3	3.000		R-104C	1R05S	R-104C-BE	1R05B
	1/8	0.125	0.3582	3/8	0.375	1/4	0.250	2 1/2	2.500		R-201C	1R06S	R-201C-BE	1R06B
			0.5913	5/8	0.625	1/2	0.500	2 1/2	2.500		R-202C	1R07S	R-202C-BE	1R07B
	1/8	0.125	1.0000	1	1.000	1	1.000	3	3.000	4	R-204C-A	1R08S	R-204C-A-BE	1R08B
			1.0576	5/8	0.625	1	1.000	3	3.000		R-204C-B	1R09S	R-204C-B-BE	1R09B

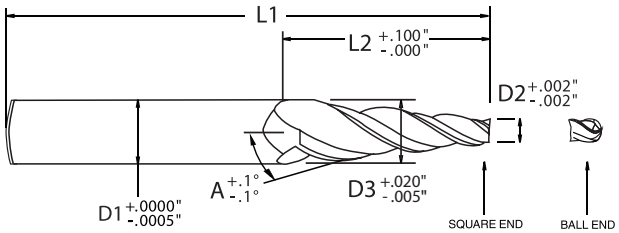
CONICAL TAPERED CARBIDE

SERIES TCX - *CARBIDE, 3 & 4 FLUTE, 25 - 30° VARIABLE LEAD HELIX*

THOUSANDS OF CONFIGURATIONS

Our tapered end mills are the standard bearer of the industry and come in thousands of configurations. Call us today and we'll help find the perfect tool for you.

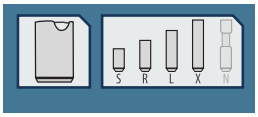
- Universal design allows for a multitude of applications, from slotting to finishing
- Standard square end to create sharp corners in finishing operations
- Multi-flute, three and four flute design allows for proper chip evacuation through a variety of materials and applications while maximizing machine performance when possible



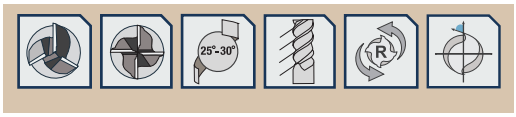
To order a corner radius, use code "CR" & actual radius in the part number. For example, a standard AX-203 would be ordered as AX-203-CR-015, with "015" being the radius.

TIP & END

SHANK & LENGTH



FLUTE CONFIGURATION



MATERIAL

COATING

SERIES TC30D - *30 DEGREE, VARYING LENGTHS*

ANGLE PER SIDE (A)	TIP DIAMETER (D2)		LARGE DIAMETER (D3)	SHANK DIAMETER (D1)		FLUTE LENGTH (L2)		OVERALL LENGTH (L1)		# OF FLUTES	SQUARE END PART #	SQUARE END EDP #	BALL END PART #	BALL END EDP #
30°	1/32	0.031	0.3199	3/8	0.375	1/4	0.250	2 1/2	2.500	3	U-0001C	1U01S	U-0001C-BE	1U01B
			0.6086	5/8	0.625	1/2	0.500	3	3.000		U-0002C	1U02S	U-0002C-BE	1U02B
	1/16	0.063	0.3512	3/8	0.375	1/4	0.250	2 1/2	2.500		U-001C	1U03S	U-001C-BE	1U03B
			0.6250	5/8	0.625	1/2	0.500	3	3.000		U-002C	1U04S	U-002C-BE	1U04B
	3/32	0.094	0.3750	3/8	0.375	1/4	0.250	2 1/2	2.500		U-101C	1U05S	U-101C-BE	1U05B
			0.9598	1	1.000	3/4	0.750	3	3.000		U-103C	1U06S	U-103C-BE	1U06B
	1/8	0.125	0.4137	1/2	0.500	1/4	0.250	3	3.000		U-201C	1U07S	U-201C-BE	1U07B
			0.7024	3/4	0.750	1/2	0.500	3	3.000		U-202C-A	1U08S	U-202C-A-BE	1U08B
			0.7024	1/2	0.500	1/2	0.500	2 1/2	2.500		U-202C-B	1U09S	U-202C-B-BE	1U09B
			0.9910	1	1.000	3/4	0.750	3	3.000		U-203C-B	1U10S	U-203C-B-BE	1U10B
	1/4	0.250	1.4047	3/4	0.750	1	1.000	3	3.000	4	U-404C	1U11S	U-404C-BE	1U11B

SERIES TC45D - *45 DEGREE, VARYING LENGTHS*

ANGLE PER SIDE (A)	TIP DIAMETER (D2)		LARGE DIAMETER (D3)	SHANK DIAMETER (D1)		FLUTE LENGTH (L2)		OVERALL LENGTH (L1)		# OF FLUTES	SQUARE END PART #	SQUARE END EDP #	BALL END PART #	BALL END EDP #
45°	1/8	0.125	1.0000	1	1.000	7/16	0.438	3	3.000	3	WA-215C-A	1W01S	WA-215C-A-BE	1W01B
			1.0000	1/2	0.500	7/16	0.438	2 1/2	2.500		WA-215C-B	1W02S	WA-215C-B-BE	1W02B
	1/8	0.125	1.6250	1	1.000	3/4	0.750	3	3.000	4	WA-203C	1W03S	WA-203C-BE	1W03B

TCX APPLICATION GUIDE • SPEED & FEED

	WORK MATERIAL	TYPE OF CUT	AXIAL DOC	RADIAL DOC	FLUTES	SPEED (SFM)	FEED (INCHES PER TOOTH) 1/8" (3 & 4 FL)	1/4" (3 & 4 FL)	3/8" (3 & 4 FL)	1/2" (3 & 4 FL)	5/8" (3 & 4 FL)	3/4" (3 & 4 FL)	1" (3 & 4 FL)
CARBON STEEL	LOW CARBON STEELS ≤ 38 HRc 10xx; 11xx; 12xx; 12Lxx, 15xx	Slotting	.5 x D	1 x D	3 / 4	190 - 245	0.0003 - 0.0005	0.0006 - 0.0010	0.0009 - 0.0015	0.0011 - 0.0019	0.0013 - 0.0023	0.0017 - 0.0029	0.0022 - 0.0038
		Roughing	1.5 x D	.3 x D	3 / 4	235 - 305	0.0005 - 0.0009	0.0009 - 0.0014	0.0013 - 0.0021	0.0018 - 0.0028	0.0022 - 0.0035	0.0027 - 0.0042	0.0035 - 0.0056
		Finishing	1.5 x D	.01 x D	3 / 4	295 - 385	0.0006 - 0.0010	0.0011 - 0.0016	0.0017 - 0.0024	0.0023 - 0.0032	0.0029 - 0.0040	0.0035 - 0.0049	0.0046 - 0.0065
	MEDIUM CARBON STEELS ≤ 38 HRc 13xx; 41xx; 43xx; 86xx, 92xx; 93xx; Chromoly	Slotting	.5 x D	1 x D	3 / 4	160 - 210	0.0033 - 0.0035	0.0064 - 0.0068	0.0097 - 0.0103	0.0128 - 0.0136	0.0159 - 0.0169	0.0192 - 0.0204	0.0256 - 0.0272
		Roughing	1.5 x D	.3 x D	3 / 4	200 - 260	0.0050 - 0.0054	0.0099 - 0.0104	0.0148 - 0.0156	0.0198 - 0.0208	0.0247 - 0.0260	0.0297 - 0.0312	0.0395 - 0.0416
		Finishing	1.5 x D	.01 x D	3 / 4	255 - 330	0.0063 - 0.0067	0.0124 - 0.0129	0.0186 - 0.0193	0.0248 - 0.0257	0.0310 - 0.0321	0.0372 - 0.0386	0.0496 - 0.0515
TOOL STEEL	TOOL & DIE STEELS ≤ 38 HRc A2; A3; D2; H11; H13; M1; O-1; S-7; NAK 55	Slotting	.5 x D	1 x D	3 / 4	95 - 125	0.0003 - 0.0005	0.0004 - 0.0008	0.0007 - 0.0013	0.0008 - 0.0016	0.0010 - 0.0020	0.0013 - 0.0025	0.0017 - 0.0033
		Roughing	1.5 x D	.3 x D	3 / 4	120 - 155	0.0004 - 0.0008	0.0007 - 0.0012	0.0010 - 0.0018	0.0014 - 0.0024	0.0017 - 0.0030	0.0021 - 0.0036	0.0027 - 0.0048
		Finishing	1.5 x D	.01 x D	3 / 4	150 - 195	0.0005 - 0.0009	0.0009 - 0.0014	0.0014 - 0.0021	0.0018 - 0.0027	0.0023 - 0.0034	0.0027 - 0.0041	0.0036 - 0.0055
	TOOL & DIE STEELS 39 to 48 HRc P20; P21; S-136; PX-5; NAK 80	Slotting	.5 x D	1 x D	3 / 4	85 - 110	0.0003 - 0.0005	0.0004 - 0.0008	0.0007 - 0.0013	0.0008 - 0.0016	0.0010 - 0.0020	0.0013 - 0.0025	0.0017 - 0.0033
		Roughing	1.5 x D	.3 x D	3 / 4	105 - 140	0.0004 - 0.0008	0.0007 - 0.0012	0.0010 - 0.0018	0.0014 - 0.0024	0.0017 - 0.0030	0.0021 - 0.0036	0.0027 - 0.0048
		Finishing	1.5 x D	.01 x D	3 / 4	135 - 175	0.0005 - 0.0009	0.0009 - 0.0014	0.0014 - 0.0021	0.0018 - 0.0027	0.0023 - 0.0034	0.0027 - 0.0041	0.0036 - 0.0055
HARDENED STEEL	HARDENED STEELS 48 to 57 HRc	Slotting	.5 x D	1 x D	3 / 4	75 - 95	0.0003 - 0.0005	0.0004 - 0.0008	0.0007 - 0.0013	0.0008 - 0.0016	0.0010 - 0.0020	0.0013 - 0.0025	0.0017 - 0.0033
		Roughing	1.5 x D	.25 x D	3 / 4	95 - 120	0.0004 - 0.0008	0.0007 - 0.0012	0.0010 - 0.0018	0.0014 - 0.0024	0.0017 - 0.0030	0.0021 - 0.0036	0.0027 - 0.0048
		Finishing	1.5 x D	.01 x D	3 / 4	115 - 150	0.0005 - 0.0009	0.0009 - 0.0014	0.0014 - 0.0021	0.0018 - 0.0027	0.0023 - 0.0034	0.0027 - 0.0041	0.0036 - 0.0055
	HARDENED STEELS 58 to 65HRc	Slotting	.5 x D	1 x D	3 / 4	65 - 80	0.0003 - 0.0005	0.0004 - 0.0008	0.0007 - 0.0013	0.0008 - 0.0016	0.0010 - 0.0020	0.0013 - 0.0025	0.0017 - 0.0033
		Roughing	1.5 x D	.25 x D	3 / 4	80 - 105	0.0004 - 0.0008	0.0007 - 0.0012	0.0010 - 0.0018	0.0014 - 0.0024	0.0017 - 0.0030	0.0021 - 0.0036	0.0027 - 0.0048
		Finishing	1.5 x D	.01 x D	3 / 4	100 - 130	0.0005 - 0.0009	0.0009 - 0.0014	0.0014 - 0.0021	0.0018 - 0.0027	0.0023 - 0.0034	0.0027 - 0.0041	0.0036 - 0.0055
STAINLESS STEEL	EASY TO MACHINE 72 - 85 HRb 410; 416; 420; 430F; 440C; 302; 303	Slotting	.5 x D	1 x D	3 / 4	135 - 175	0.0001 - 0.0003	0.0002 - 0.0006	0.0003 - 0.0009	0.0003 - 0.0011	0.0003 - 0.0013	0.0005 - 0.0017	0.0006 - 0.0022
		Roughing	1.25 x D	.3 x D	3 / 4	170 - 220	0.0002 - 0.0006	0.0003 - 0.0008	0.0004 - 0.0012	0.0006 - 0.0016	0.0007 - 0.0020	0.0009 - 0.0024	0.0011 - 0.0032
		Finishing	1.5 x D	.01 x D	3 / 4	210 - 275	0.0003 - 0.0007	0.0004 - 0.0009	0.0006 - 0.0013	0.0008 - 0.0017	0.0010 - 0.0021	0.0012 - 0.0026	0.0016 - 0.0035
	MODERATELY DIFFICULT 79 - 85 HRb; 25 - 41 HRc 304; 304L; 316; 316L; 320; 321; 347; Invar 36; Kovar	Slotting	.5 x D	1 x D	3 / 4	105 - 140	0.0001 - 0.0003	0.0002 - 0.0006	0.0003 - 0.0009	0.0003 - 0.0011	0.0003 - 0.0013	0.0005 - 0.0017	0.0006 - 0.0022
		Roughing	1.25 x D	.25 x D	3 / 4	135 - 175	0.0002 - 0.0006	0.0003 - 0.0008	0.0004 - 0.0012	0.0006 - 0.0016	0.0007 - 0.0020	0.0009 - 0.0024	0.0011 - 0.0032
		Finishing	1.5 x D	.01 x D	3 / 4	170 - 220	0.0003 - 0.0007	0.0004 - 0.0009	0.0006 - 0.0013	0.0008 - 0.0017	0.0010 - 0.0021	0.0012 - 0.0026	0.0016 - 0.0035
	DIFFICULT TO MACHINE 31 - 50 HRc 13-8 PH; 15-5 PH; 17-4 PH; Carpenter; Custo 465; Invar	Slotting	.5 x D	1 x D	3 / 4	80 - 105	0.0002 - 0.0004	0.0003 - 0.0007	0.0005 - 0.0011	0.0006 - 0.0014	0.0006 - 0.0016	0.0009 - 0.0021	0.0012 - 0.0028
		Roughing	1.25 x D	.25 x D	3 / 4	100 - 130	0.0003 - 0.0007	0.0005 - 0.0010	0.0007 - 0.0015	0.0010 - 0.0020	0.0012 - 0.0025	0.0015 - 0.0030	0.0019 - 0.0040
		Finishing	1.5 x D	.01 x D	3 / 4	125 - 165	0.0004 - 0.0008	0.0006 - 0.0011	0.0010 - 0.0017	0.0013 - 0.0022	0.0016 - 0.0027	0.0020 - 0.0034	0.0026 - 0.0045
CAST IRON	GRAY 100 - 200 HRb	Slotting	.5 x D	1 x D	3 / 4	190 - 245	0.0003 - 0.0005	0.0006 - 0.0010	0.0009 - 0.0015	0.0011 - 0.0019	0.0013 - 0.0023	0.0017 - 0.0029	0.0022 - 0.0038
		Roughing	1.5 x D	.3 x D	3 / 4	235 - 305	0.0005 - 0.0009	0.0009 - 0.0014	0.0013 - 0.0021	0.0018 - 0.0028	0.0022 - 0.0035	0.0027 - 0.0042	0.0035 - 0.0056
		Finishing	1.5 x D	.01 x D	3 / 4	295 - 385	0.0006 - 0.0010	0.0011 - 0.0016	0.0017 - 0.0024	0.0023 - 0.0032	0.0029 - 0.0040	0.0035 - 0.0049	0.0046 - 0.0065
	DUCTILE 150 - 300 HRb	Slotting	.5 x D	1 x D	3 / 4	160 - 210	0.0003 - 0.0005	0.0006 - 0.0010	0.0009 - 0.0015	0.0011 - 0.0019	0.0013 - 0.0023	0.0017 - 0.0029	0.0022 - 0.0038
		Roughing	1.5 x D	.3 x D	3 / 4	200 - 260	0.0005 - 0.0009	0.0009 - 0.0014	0.0013 - 0.0021	0.0018 - 0.0028	0.0022 - 0.0035	0.0027 - 0.0042	0.0035 - 0.0056
		Finishing	1.5 x D	.01 x D	3 / 4	255 - 330	0.0006 - 0.0010	0.0011 - 0.0016	0.0017 - 0.0024	0.0023 - 0.0032	0.0029 - 0.0040	0.0035 - 0.0049	0.0046 - 0.0065
	MALLEABLE 150 - 310 HRb	Slotting	.5 x D	1 x D	3 / 4	135 - 175	0.0003 - 0.0005	0.0005 - 0.0009	0.0008 - 0.0014	0.0010 - 0.0018	0.0011 - 0.0021	0.0015 - 0.0027	0.0019 - 0.0035
		Roughing	1.5 x D	.3 x D	3 / 4	170 - 220	0.0005 - 0.0009	0.0008 - 0.0013	0.0012 - 0.0020	0.0016 - 0.0026	0.0019 - 0.0032	0.0024 - 0.0039	0.0031 - 0.0052
		Finishing	1.5 x D	.01 x D	3 / 4	210 - 275	0.0006 - 0.0010	0.0010 - 0.0015	0.0015 - 0.0022	0.0020 - 0.0029	0.0026 - 0.0037	0.0031 - 0.0045	0.0041 - 0.0060
ALLOYS	TITANIUM ALLOYS 70 - 100 HRb; 25 - 36 HRc Ti61AL4V; Grades 5-38	Slotting	.5 x D	1 x D	3 / 4	120 - 155	0.0002 - 0.0004	0.0003 - 0.0007	0.0005 - 0.0011	0.0006 - 0.0014	0.0006 - 0.0016	0.0009 - 0.0021	0.0012 - 0.0028
		Roughing	1.25 x D	.25 x D	3 / 4	150 - 195	0.0003 - 0.0007	0.0005 - 0.0010	0.0007 - 0.0015	0.0010 - 0.0020	0.0012 - 0.0025	0.0015 - 0.0030	0.0019 - 0.0040
		Finishing	1.5 x D	.01 x D	3 / 4	190 - 245	0.0004 - 0.0008	0.0006 - 0.0011	0.0010 - 0.0017	0.0013 - 0.0022	0.0016 - 0.0027	0.0020 - 0.0034	0.0026 - 0.0045
	HIGH TEMP ALLOYS 83 - 99 HRb; 30 - 52 HRc Inconel; Monel; A286; Rene; Stelite; Haynes; Hastalloy;	Slotting	.25 x D	1 x D	3 / 4	55 - 75	0.0003 - 0.0005	0.0004 - 0.0008	0.0007 - 0.0013	0.0008 - 0.0016	0.0010 - 0.0020	0.0013 - 0.0025	0.0017 - 0.0033
		Roughing	1.25 x D	.25 x D	3 / 4	70 - 95	0.0004 - 0.0008	0.0007 - 0.0012	0.0010 - 0.0018	0.0014 - 0.0024	0.0017 - 0.0030	0.0021 - 0.0036	0.0027 - 0.0048
		Finishing	1.5 x D	.01 x D	3 / 4	90 - 120	0.0005 - 0.0009	0.0009 - 0.0014	0.0014 - 0.0021	0.0018 - 0.0027	0.0023 - 0.0034	0.0027 - 0.0041	0.0036 - 0.0055
ALUMINUM	ALUMINUM ALLOYS Low Silicon Content 20xx; 50xx; 60xx; 70xx	Slotting	1 x D	1 x D	3 / 4	975 - 1265	0.0007 - 0.0009	0.0012 - 0.0016	0.0019 - 0.0025	0.0024 - 0.0032	0.0029 - 0.0039	0.0036 - 0.0048	0.0048 - 0.0064
		Roughing	1 x D	.3 x D	3 / 4	1220 - 1580	0.0010 - 0.0014	0.0019 - 0.0024	0.0028 - 0.0036	0.0038 - 0.0048	0.0047 - 0.0060	0.0057 - 0.0072	0.0075 - 0.0096
		Finishing	1.5 x D	.01 x D	3 / 4	1530 - 1980	0.0013 - 0.0017	0.0024 - 0.0029	0.0036 - 0.0043	0.0048 - 0.0057	0.0060 - 0.0071	0.0072 - 0.0086	0.0096 - 0.0115
	ALUMINUM DIE CAST ALLOY High Silicon Content A-38x; A-39x; B39x	Slotting	.75 x D	1 x D	3 / 4	540 - 700	0.0007 - 0.0009	0.0012 - 0.0016	0.0019 - 0.0025	0.0024 - 0.0032	0.0029 - 0.0039	0.0036 - 0.0048	0.0048 - 0.0064
		Roughing	1 x D	.3 x D	3 / 4	680 - 880	0.0010 - 0.0014	0.0019 - 0.0024	0.0028 - 0.0036	0.0038 - 0.0048	0.0047 - 0.0060	0.0057 - 0.0072	0.0075 - 0.0096
		Finishing	1.5 x D	.01 x D	3 / 4	850 - 1100	0.0013 - 0.0017	0.0024 - 0.0029	0.0036 - 0.0043	0.0048 - 0.0057	0.0060 - 0.0071	0.0072 - 0.0086	0.0096 - 0.0115
NONFERROUS	MAGNESIUM ALLOYS ≤ 38 HRc	Slotting	1 x D	1 x D	3 / 4	815 - 1055	0.0007 - 0.0009	0.0012 - 0.0016	0.0019 - 0.0025	0.0024 - 0.0032	0.0029 - 0.0039	0.0036 - 0.0048	0.0048 - 0.0064
		Roughing	1 x D	.3 x D	3 / 4	1020 - 1320	0.0010 - 0.0014	0.0019 - 0.0024	0.0028 - 0.0036	0.0038 - 0.0048	0.0047 - 0.0060	0.0057 - 0.0072	0.0075 - 0.0096
		Finishing	1.5 x D	.01 x D	3 / 4	1275 - 1650	0.0013 - 0.0017	0.0024 - 0.0029	0.0036 - 0.0043	0.0048 - 0.0057	0.0060 - 0.0071	0.0072 - 0.0086	0.0096 - 0.0115
	COPPER ALLOYS, BRASS & BRONZE 39 to 48 HRc Manganese Bronze, Tin Bronze, Beryllium Copper	Slotting	1 x D	1 x D	3 / 4	540 - 700	0.0007 - 0.0009	0.0012 - 0.0016	0.0019 - 0.0025	0.0024 - 0.0032	0.0029 - 0.0039	0.0036 - 0.0048	0.0048 - 0.0064
		Roughing	1 x D	.3 x D	3 / 4	680 - 880	0.0010 - 0.0014	0.0019 - 0.0024	0.0028 - 0.0036	0.0038 - 0.0048	0.0047 - 0.0060	0.0057 - 0.0072	0.0075 - 0.0096
		Finishing	1.5 x D	.01 x D	3 / 4	850 - 1100	0.0013 - 0.0017	0.0024 - 0.0029	0.0036 - 0.0043	0.0048 - 0.0057	0.0060 - 0.0071	0.0072 - 0.0086	0.0096 - 0.0115
	COMPOSITES, PLASTICS & FIBERGLASS - 48 to 57 HRc ABS, Polycarbonate, PVC, Polypropylene	Slotting	1 x D	1 x D	3 / 4	270 - 350	0.0007 - 0.0009	0.0012 - 0.0016	0.0019 - 0.0025	0.0024 - 0.0032	0.0029 - 0.0039	0.0036 - 0.0048	0.0048 - 0.0064
		Roughing	1 x D	.3 x D	3 / 4	340 - 440	0.0010 - 0.0014	0.0019 - 0.0024	0.0028 - 0.0036	0.0038 - 0.0048	0.0047 - 0.0060	0.0057 - 0.0072	0.0075 - 0.0096
		Finishing	1.5 x D	.01 x D	3 / 4	425 - 550	0.0013 - 0.0017	0.0024 - 0.0029	0.0036 - 0.0043	0.0048 - 0.0057	0.0060 - 0.0071	0.0072 - 0.0086	0.0096 - 0.0115

MODIFICATION PROGRAM

MODIFICATION OF IN-STOCK TOOLS

IN AS LITTLE AS 48 HOURS

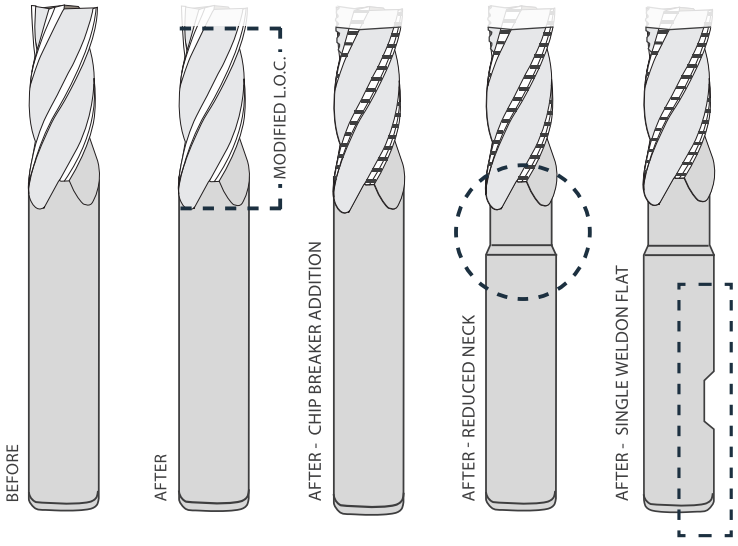
END MODIFICATIONS

SHANK MODIFICATIONS

FLUTE MODIFICATIONS

LENGTH MODIFICATIONS

SPECIALTY MODIFICATIONS



SEE PAGE 16 - 21 FOR DETAILS OR
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WE CAN MODIFY MOST ANY TOOL

We can modify our standard tools or manufacture a highly specialized tool to your exact specifications. Modifications ensure fast delivery of your tool (subject to availability) and decrease costs on small batch runs. Most modifications ship within 2 - 3 business days. Please allow additional time when adding coatings. If you need assistance with modification selection or have any questions, please contact us.

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70 YEARS OF INNOVATION

CONICAL™
TAPERED HIGH SPEED STEEL

VALUE & VERSATILITY

With the widest selection of high speed steel tapered end mills available and an average 99.8% in stock status, the Conical Tapered High Speed Steel end mill is the go-to tool for unique machining challenges. Whether machining draft angles, or chamfers in easy and medium machinability materials, the universal design allows for a multitude of applications, which include slotting and finishing.

The functionality of a tool determines its worth. It's a simple fact that a quality tool will provide better performance. When you add the experience and technical support Conical provides, there's no question which manufacturer to select. Experience counts when you make your investment in a cutting tool manufacturer.

We all need reliable partners and Conical pledges to be just that. The metalworking industry moves at a blistering pace, so why not trust in a company who has a proven history of innovation and success?

A HISTORY OF SUCCESS

From declining markets to global conflicts, and patent infringement to extensive changes in the manufacturing industry, we have had just the right people at the helm to succeed in the face of adversity. Our customer first focus and innovation at every turn mantra, provides us with the momentum needed to stay ahead in the industry and conquer any adversity that may come.

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Conical Tool Company

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TAPERED HIGH SPEED STEEL

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SPECIALTY END MILLS

FOR MACHINING DRAFT ANGLES & CHAMFERS

CONICAL™ CUTTING TOOLS

CONICAL™

TAPERED HIGH SPEED STEEL

DRAFT ANGLE & CHAMFER MACHINING

IN EASY & MEDIUM MACHINABILITY MATERIALS

FEATURES & BENEFITS

Our Conical Tapered High Speed Steel end mills have many of the same characteristics of our carbide variety, but are available in significantly more configurations. They are the perfect choice for easy and medium to machine materials or applications with minor machining requirements. The Conical Tapered end mill was created by us in the 1940's to reduce significant fixturing time, combine multiple operations into one and create parts that were previously impossible to machine. These tools are a household name and our quality has been tested time and time again.

General Inquiries:
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CONICAL™
CUTTING TOOLS

SERIES: THX

For rough and finish milling of draft angles / chamfers and slotting of tapered walls in most materials; wet or dry; from easy to medium machinability materials.

Standard square end to create sharp corners in finishing operations

Ball end option for high performance contour milling in finishing operations. Available in 24 to 48 hours

Variable lead helix provides increased tool engagement and rigidity

Variable Core Design maximizes chip evacuation and provides increased rigidity when the cutter is fully engaged

Corner radius option protects corners in roughing operations and difficult to machine materials by preventing corner chipping and tool failure. Available in 24 to 48 hours

Multi-flute, three and four flute design allows for proper chip evacuation through a variety of materials and applications while maximizing machine performance when possible

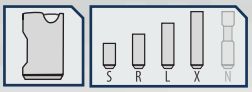
Premium high speed steel improves rigidity, hardness and wear resistance for milling of easy to medium machinability materials

Universal design allows for a multitude of applications, from slotting to finishing

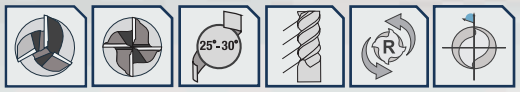
Uncoated for versatility. More than 16 available coatings can be added to increase tool life for your specific application and material

TIP & END

SHANK & LENGTH



FLUTE CONFIGURATION



MATERIAL

HSS
HIGH SPEED STEEL

COATING

UNC

RESULTS

Having the ability to cut setup time and eliminate costly programming, while maximizing production rates, may seem too good to be true. Our customers can testify to the fact that the Conical Tapered end mill does just that. A wide variety of configurations perform in finish milling of draft angles and slotting tapered walls, in most materials. Employing the three or four flute design facilitates chip disposal and maximizes feed rates, which brings your work closer to completion with every rotation of the tool.

Series THX: High Speed Steel, 3 & 4 Flute, 25 - 30° Variable Lead Helix
Subseries: TH0XD, TH01D, TH1XD, TH02D, TH03D, TH04D, TH05D, TH60D, TH07D, TH08D, TH10D, TH11D, TH12D, TH15D, TH20D, TH25D, TH30D, TH35D TH40D, TH45D
Configuration: Varying Angles; Varying Diameters; Stub, Regular, Long & Extra-Long Lengths; 25 - 30° Variable Lead Helix; Square End, Corner Radius & Ball End

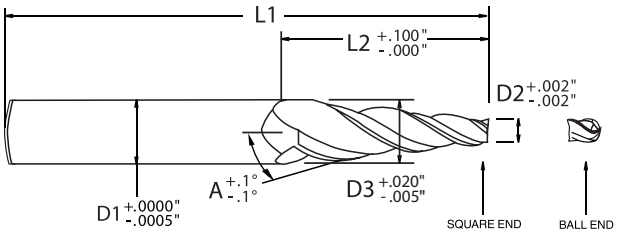
CONICAL TAPERED HSS

SERIES THX - *HIGH SPEED STEEL, 3 & 4 FLUTE, 25 - 30° VARIABLE LEAD HELIX*

99.8% IN STOCK STATUS

With the widest selection of high speed steel tapered end mills available and an average 99.8% in stock status, the Conical Tapered High Speed Steel end mill is the go-to tool for unique machining challenges.

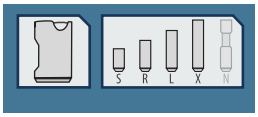
- Standard square end to create sharp corners in finishing operations
- Ball end option for high performance contour milling in finishing operations. Available in 24 to 48 hours
- Constant spiral helix provides increased tool engagement and rigidity
- Variable Core Design maximizes chip evacuation and provides increased rigidity when the cutter is fully engaged



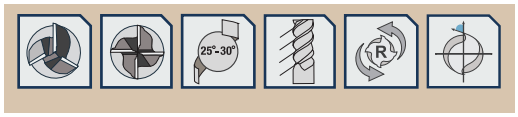
To order a corner radius, use code "CR" & actual radius in the part number. For example, a standard AX-203 would be ordered as AX-203-CR-015, with "015" being the radius.

TIP & END

SHANK & LENGTH



FLUTE CONFIGURATION



MATERIAL

COATING

SERIES TH0XD - *½ DEGREE, VARYING LENGTHS*

ANGLE PER SIDE (A)	TIP DIAMETER (D2)		LARGE DIAMETER (D3)	SHANK DIAMETER (D1)		FLUTE LENGTH (L2)		OVERALL LENGTH (L1)		# OF FLUTES	SQUARE END PART #	SQUARE END EDP #	BALL END PART #	BALL END EDP #
0.5°	1/16	0.0625	0.0756	3/8	0.375	3/4	0.750	2 7/8	2.875	3	AX-003	2Y01S	AX-003-BE	2Y01B
	3/32	0.0938	0.1025	3/8	0.375	1/2	0.500	2 5/8	2.625		AX-102	2Y02S	AX-102-BE	2Y02B
			0.1068	3/8	0.375	3/4	0.750	2 7/8	2.875		AX-103	2Y03S	AX-103-BE	2Y03B
			0.1156	3/8	0.375	1 1/4	1.250	3 1/4	3.250		AX-105	2Y04S	AX-105-BE	2Y04B
	1/8	0.1250	0.1294	3/8	0.375	1/4	0.250	2 5/8	2.625		AX-201	2Y05S	AX-201-BE	2Y05B
			0.1337	3/8	0.375	1/2	0.500	2 5/8	2.625		AX-202	2Y06S	AX-202-BE	2Y06B
			0.1381	3/8	0.375	3/4	0.750	2 7/8	2.875		AX-203	2Y07S	AX-203-BE	2Y07B
			0.1425	3/8	0.375	1	1.000	2 7/8	2.875		AX-204	2Y08S	AX-204-BE	2Y08B
			0.1468	3/8	0.375	1 1/4	1.250	3 1/4	3.250		AX-205	2Y09S	AX-205-BE	2Y09B
			0.1512	3/8	0.375	1 1/2	1.500	3 1/4	3.250		AX-206	2Y10S	AX-206-BE	2Y10B
	3/16	0.1875	0.2006	3/8	0.375	3/4	0.750	2 7/8	2.875		AX-303	2Y11S	AX-303-BE	2Y11B
			0.2093	3/8	0.375	1 1/4	1.250	3 1/4	3.250		AX-305	2Y12S	AX-305-BE	2Y12B
			0.2180	3/8	0.375	1 3/4	1.750	3 7/8	3.875		AX-307	2Y13S	AX-307-BE	2Y13B
	1/4	0.2500	0.2631	3/8	0.375	3/4	0.750	2 7/8	2.875		AX-403	2Y14S	AX-403-BE	2Y14B
			0.2718	3/8	0.375	1 1/4	1.250	3 1/4	3.250		AX-405	2Y15S	AX-405-BE	2Y15B
			0.2893	1/2	0.500	2 1/4	2.250	4 1/4	4.250		AX-409	2Y16S	AX-409-BE	2Y16B
			0.3067	1/2	0.500	3 1/4	3.250	5 1/2	5.500		AX-413	2Y17S	AX-413-BE	2Y17B
	3/8	0.3750	0.3968	1/2	0.500	1 1/4	1.250	3 1/4	3.250		AX-605	2Y18S	AX-605-BE	2Y18B
			0.4143	1/2	0.500	2 1/4	2.250	4 1/4	4.250		AX-609	2Y19S	AX-609-BE	2Y19B
			0.4317	1/2	0.500	3 1/4	3.250	5 1/2	5.500		AX-613	2Y20S	AX-613-BE	2Y20B
	1/2	0.5000	0.5218	1/2	0.500	1 1/4	1.250	3 1/4	3.250		AX-805	2Y21S	AX-805-BE	2Y21B
			0.5393	1/2	0.500	2 1/4	2.250	4 1/4	4.250		AX-809	2Y22S	AX-809-BE	2Y22B
			0.5567	1/2	0.500	3 1/4	3.250	5 3/8	5.375		AX-813	2Y23S	AX-813-BE	2Y23B
	5/8	0.6250	0.6643	5/8	0.625	2 1/4	2.250	4 1/2	4.500		AX-1009	2Y24S	AX-1009-BE	2Y24B
			0.6817	5/8	0.625	3 1/4	3.250	5 1/2	5.500		AX-1013	2Y25S	AX-1013-BE	2Y25B
			0.6992	5/8	0.625	4 1/4	4.250	6 1/2	6.500		AX-1017	2Y26S	AX-1017-BE	2Y26B
	3/4	0.7500	0.7893	3/4	0.750	2 1/4	2.250	4 1/2	4.500		AX-1209	2Y27S	AX-1209-BE	2Y27B
			0.8067	3/4	0.750	3 1/4	3.250	5 3/4	5.750		AX-1213	2Y28S	AX-1213-BE	2Y28B
			0.8155	3/4	0.750	3 3/4	3.750	6 1/2	6.500		AX-1217	2Y29S	AX-1217-BE	2Y29B
			0.8416	3/4	0.750	5 1/4	5.250	7 3/4	7.750		AX-1221	2Y30S	AX-1221-BE	2Y30B
	1	1.0000	1.1047	1	1.000	6	6.000	8 1/2	8.500	4	AX-1624	2Y31S	AX-1624-BE	2Y31B

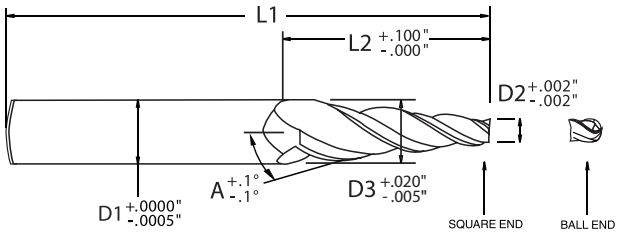
CONICAL TAPERED HSS

SERIES THX - *HIGH SPEED STEEL, 3 & 4 FLUTE, 25 - 30° VARIABLE LEAD HELIX*

MULTITUDE OF APPLICATIONS

Whether machining draft angles, or chamfers in easy and medium machinability materials, the universal design allows for a multitude of applications, which include slotting and finishing.

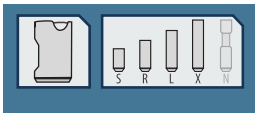
- Corner radius option protects corners in roughing operations and difficult to machine materials by preventing corner chipping and tool failure. Available in 24 to 48 hours
- Multi-flute, three and four flute design allows for proper chip evacuation through a variety of materials and applications while maximizing machine performance when possible
- Premium high speed steel improves rigidity, hardness and wear resistance for milling of easy to medium machinability materials



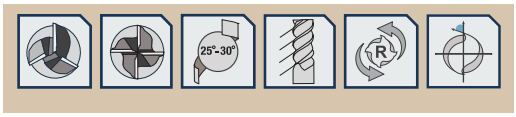
To order a corner radius, use code "CR" & actual radius in the part number. For example, a standard AX-203 would be ordered as AX-203-CR-015, with "015" being the radius.

TIP & END

SHANK & LENGTH



FLUTE CONFIGURATION



MATERIAL

COATING

SERIES TH01D - *1 DEGREE, VARYING LENGTHS*

ANGLE PER SIDE (A)	TIP DIAMETER (D2)		LARGE DIAMETER (D3)	SHANK DIAMETER (D1)		FLUTE LENGTH (L2)		OVERALL LENGTH (L1)		# OF FLUTES	SQUARE END PART #	SQUARE END EDP #	BALL END PART #	BALL END EDP #
1.0°	1/16	0.0625	0.0887	3/8	0.375	3/4	0.750	2 7/8	2.875	3	A-003	2A01S	A-003-BE	2A01B
	3/32	0.0938	0.1112	3/8	0.375	1/2	0.500	2 5/8	2.625		A-102	2A02S	A-102-BE	2A02B
			0.1199	3/8	0.375	3/4	0.750	2 7/8	2.875		A-103	2A03S	A-103-BE	2A03B
			0.1374	3/8	0.375	1 1/4	1.250	3 1/8	3.125		A-105	2A04S	A-105-BE	2A04B
			0.1461	3/8	0.375	1 1/2	1.500	3 3/8	3.375		A-106	2A05S	A-106-BE	2A05B
	1/8	0.1250	0.1337	3/8	0.375	1/4	0.250	2 5/8	2.625		A-201	2A06S	A-201-BE	2A06B
			0.1425	3/8	0.375	1/2	0.500	2 5/8	2.625		A-202	2A07S	A-202-BE	2A07B
			0.1512	3/8	0.375	3/4	0.750	2 7/8	2.875		A-203	2A08S	A-203-BE	2A08B
			0.1599	3/8	0.375	1	1.000	2 7/8	2.875		A-204	2A09S	A-204-BE	2A09B
			0.1686	3/8	0.375	1 1/4	1.250	3 1/4	3.250		A-205	2A10S	A-205-BE	2A10B
			0.1774	3/8	0.375	1 1/2	1.500	3 1/4	3.250		A-206	2A11S	A-206-BE	2A11B
			0.1948	3/8	0.375	2	2.000	4	4.000		A-208	2A12S	A-208-BE	2A12B
	3/16	0.1875	0.2137	3/8	0.375	3/4	0.750	2 7/8	2.875		A-303	2A13S	A-303-BE	2A13B
			0.2311	3/8	0.375	1 1/4	1.250	3 1/4	3.250		A-305	2A14S	A-305-BE	2A14B
			0.2573	3/8	0.375	2	2.000	7	4.000		A-308	2A15S	A-308-BE	2A15B
	1/4	0.2500	0.2762	3/8	0.375	3/4	0.750	2 7/8	2.875		A-403	2A16S	A-403-BE	2A16B
			0.2936	3/8	0.375	1 1/4	1.250	3 1/4	3.250		A-405	2A17S	A-405-BE	2A17B
			0.3285	1/2	0.500	2 1/4	2.250	4 1/8	4.125		A-409	2A18S	A-409-BE	2A18B
			0.3634	1/2	0.500	3 1/4	3.250	5 1/2	5.500		A-413	2A19S	A-413-BE	2A19B
	3/8	0.3750	0.4186	1/2	0.500	1 1/4	1.250	3 1/4	3.250		A-605	2A20S	A-605-BE	2A20B
			0.4535	1/2	0.500	2 1/4	2.250	4 1/4	4.250		A-609	2A21S	A-609-BE	2A21B
			0.4884	1/2	0.500	3 1/4	3.250	5 1/2	5.500		A-613	2A22S	A-613-BE	2A22B
	1/2	0.5000	0.5436	1/2	0.500	1 1/4	1.250	3 1/4	3.250		A-805	2A23S	A-805-BE	2A23B
			0.5785	1/2	0.500	2 1/4	2.250	4 1/4	4.250		A-809	2A24S	A-809-BE	2A24B
			0.6134	1/2	0.500	3 1/4	3.250	5 1/2	5.500		A-813	2A25S	A-813-BE	2A25B
	5/8	0.6250	0.7035	5/8	0.625	2 1/4	2.250	4 1/2	4.500		A-1009	2A26S	A-1009-BE	2A26B
			0.7384	5/8	0.625	3 1/4	3.250	5 1/2	5.500		A-1013	2A27S	A-1013-BE	2A27B
			0.7733	5/8	0.625	4 1/4	4.250	6 1/2	6.500		A-1017	2A28S	A-1017-BE	2A28B
	3/4	0.7500	0.8634	3/4	0.750	3 1/4	3.250	5 3/4	5.750		A-1213	2A29S	A-1213-BE	2A29B
			0.8984	3/4	0.750	4 1/4	4.250	6 7/8	6.875		A-1217	2A30S	A-1217-BE	2A30B
			0.9332	3/4	0.750	5 1/4	5.250	7 1/2	7.500		A-1221	2A31S	A-1221-BE	2A31B
	1	1.0000	1.2094	1	1.000	6	6.000	8 1/2	8.500	4	A-1624	2A32S	A-1624-BE	2A32B

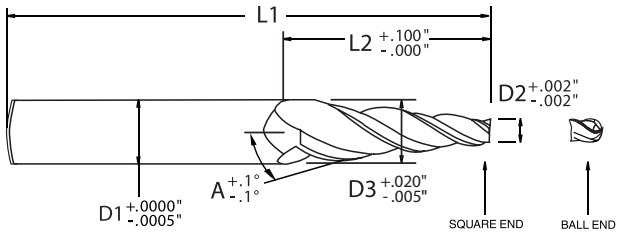
CONICAL TAPERED HSS

SERIES THX - *HIGH SPEED STEEL, 3 & 4 FLUTE, 25 - 30° VARIABLE LEAD HELIX*

CUSTOMER SUPPORT

The functionality of a tool determines its worth. It's a simple fact that a quality tool will provide better performance. When you add the experience and technical support Conical provides, there's no question which manufacturer to select.

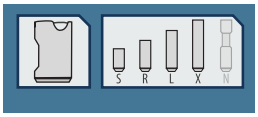
- Universal design allows for a multitude of applications, from slotting to finishing
- Uncoated for versatility. More than 16 available coatings can be added to increase tool life for your specific application and material
- Ball end option for high performance contour milling in finishing operations. Available in 24 to 48 hours



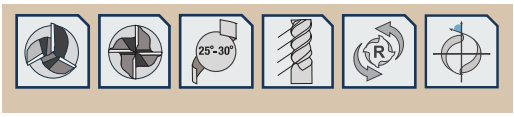
To order a corner radius, use code "CR" & actual radius in the part number. For example, a standard AX-203 would be ordered as AX-203-CR-015, with "015" being the radius.

TIP & END

SHANK & LENGTH



FLUTE CONFIGURATION



MATERIAL

COATING

SERIES TH1XD - *1 ½ DEGREE, VARYING LENGTHS*

ANGLE PER SIDE (A)	TIP DIAMETER (D2)		LARGE DIAMETER (D3)	SHANK DIAMETER (D1)		FLUTE LENGTH (L2)		OVERALL LENGTH (L1)		# OF FLUTES	SQUARE END PART #	SQUARE END EDP #	BALL END PART #	BALL END EDP #
1.5°	1/16	0.0625	0.1018	3/8	0.375	3/4	0.750	2 7/8	2.875	3	AAX-003	2Z01S	AAX-003-BE	2Z01B
	3/32	0.0938	0.1199	3/8	0.375	1/2	0.500	2 5/8	2.625		AAX-102	2Z02S	AAX-102-BE	2Z02B
			0.1330	3/8	0.375	3/4	0.750	2 7/8	2.875		AAX-103	2Z03S	AAX-103-BE	2Z03B
			0.1461	3/8	0.375	1	1.000	2 7/8	2.875		AAX-104	2Z04S	AAX-104-BE	2Z04B
			0.1592	3/8	0.375	1 1/4	1.250	3 1/4	3.250		AAX-105	2Z05S	AAX-105-BE	2Z05B
			0.1723	3/8	0.375	1 1/2	1.500	3 1/4	3.250		AAX-106	2Z06S	AAX-106-BE	2Z06B
	7/64	0.1094	0.1617	3/8	0.375	1	1.000	2 7/8	2.875		AAX-154	2Z07S	AAX-154-BE	2Z07B
			0.1879	3/8	0.375	1 1/2	1.500	3 1/4	3.250		AAX-156	2Z08S	AAX-156-BE	2Z08B
	1/8	0.1250	0.1512	3/8	0.375	1/2	0.500	2 5/8	2.625		AAX-202	2Z09S	AAX-202-BE	2Z09B
			0.1643	3/8	0.375	3/4	0.750	2 7/8	2.875		AAX-203	2Z10S	AAX-203-BE	2Z10B
			0.1774	3/8	0.375	1	1.000	2 7/8	2.875		AAX-204	2Z11S	AAX-204-BE	2Z11B
			0.1905	3/8	0.375	1 1/4	1.250	3 1/4	3.250		AAX-205	2Z12S	AAX-205-BE	2Z12B
			0.2035	3/8	0.375	1 1/2	1.500	3 1/4	3.250		AAX-206	2Z13S	AAX-206-BE	2Z13B
			0.2297	3/8	0.375	2	2.000	3 7/8	3.875		AAX-208	2Z14S	AAX-208-BE	2Z14B
	5/32	0.1563	0.2086	3/8	0.375	1	1.000	2 7/8	2.875		AAX-254	2Z15S	AAX-254-BE	2Z15B
			0.2217	3/8	0.375	1 1/4	1.250	3 1/4	3.250		AAX-255	2Z16S	AAX-255-BE	2Z16B
			0.2348	3/8	0.375	1 1/2	1.500	3 1/4	3.250		AAX-256	2Z17S	AAX-256-BE	2Z17B
	3/16	0.1875	0.2268	3/8	0.375	3/4	0.750	2 7/8	2.875		AAX-303	2Z18S	AAX-303-BE	2Z18B
			0.2530	3/8	0.375	1 1/4	1.250	3 1/4	3.250		AAX-305	2Z19S	AAX-305-BE	2Z19B
			0.2922	3/8	0.375	2	2.000	3 7/8	3.875		AAX-308	2Z20S	AAX-308-BE	2Z20B
			0.3053	3/8	0.375	2 1/4	2.250	4 1/4	4.250		AAX-309	2Z21S	AAX-309-BE	2Z21B
	1/4	0.2500	0.2893	3/8	0.375	3/4	0.750	2 7/8	2.875		AAX-403	2Z22S	AAX-403-BE	2Z22B
			0.3155	3/8	0.375	1 1/4	1.250	3 1/4	3.250		AAX-405	2Z23S	AAX-405-BE	2Z23B
			0.3678	1/2	0.500	2 1/4	2.250	4 1/4	4.250		AAX-409	2Z24S	AAX-409-BE	2Z24B
			0.4202	1/2	0.500	3 1/4	3.250	5 1/2	5.500		AAX-413	2Z25S	AAX-413-BE	2Z25B
	3/8	0.3750	0.4405	1/2	0.500	1 1/4	1.250	3 1/4	3.250		AAX-605	2Z26S	AAX-605-BE	2Z26B
			0.4928	1/2	0.500	2 1/4	2.250	4 1/4	4.250		AAX-609	2Z27S	AAX-609-BE	2Z27B
			0.5452	5/8	0.625	3 1/4	3.250	5 1/2	5.500		AAX-613	2Z28S	AAX-613-BE	2Z28B
	1/2	0.5000	0.5655	1/2	0.500	1 1/4	1.250	3 1/4	3.250		AAX-805	2Z29S	AAX-805-BE	2Z29B
			0.6178	1/2	0.500	2 1/4	2.250	4 1/4	4.250		AAX-809	2Z30S	AAX-809-BE	2Z30B
			0.6702	5/8	0.625	3 1/4	3.250	5 1/2	5.500		AAX-813	2Z31S	AAX-813-BE	2Z31B
	5/8	0.6250	0.7428	3/4	0.750	2 1/4	2.250	4 1/2	4.500		AAX-1009	2Z32S	AAX-1009-BE	2Z32B
			0.7952	3/4	0.750	3 1/4	3.250	5 1/2	5.500		AAX-1013	2Z33S	AAX-1013-BE	2Z33B
			0.8475	3/4	0.750	4 1/4	4.250	6 1/2	6.500		AAX-1017	2Z34S	AAX-1017-BE	2Z34B
	3/4	0.7500	0.8678	3/4	0.750	2 1/4	2.250	4 1/2	4.500		AAX-1209	2Z35S	AAX-1209-BE	2Z35B
			1.0249	1	1.000	5 1/4	5.250	8	8.000		AAX-1221	2Z36S	AAX-1221-BE	2Z36B
	1	1.0000	1.3142	1 1/4	1.250	6	6.000	8 3/4	8.750	4	AAX-1624	2Z37S	AAX-1624-BE	2Z37B

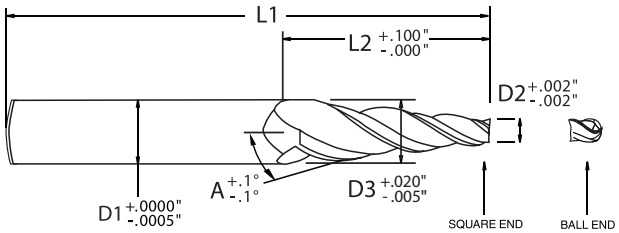
CONICAL TAPERED HSS

SERIES THX - *HIGH SPEED STEEL, 3 & 4 FLUTE, 25 - 30° VARIABLE LEAD HELIX*

A RELIABLE PARTNER

Experience counts when you make your investment in a cutting tool manufacturer. We all need reliable partners and Conical pledges to be just that.

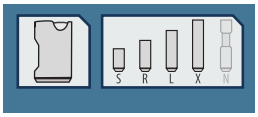
- Standard square end to create sharp corners in finishing operations
- Ball end option for high performance contour milling in finishing operations. Available in 24 to 48 hours
- Constant spiral helix provides increased tool engagement and rigidity
- Variable Core Design maximizes chip evacuation and provides increased rigidity when the cutter is fully engaged



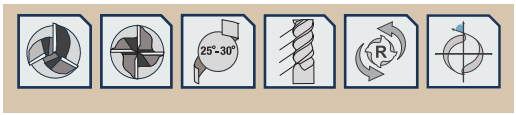
To order a corner radius, use code "CR" & actual radius in the part number. For example, a standard AX-203 would be ordered as AX-203-CR-015, with "015" being the radius.

TIP & END

SHANK & LENGTH



FLUTE CONFIGURATION



MATERIAL

COATING

SERIES TH02D - *2 DEGREE, VARYING LENGTHS*

ANGLE PER SIDE (A)	TIP DIAMETER (D2)		LARGE DIAMETER (D3)	SHANK DIAMETER (D1)		FLUTE LENGTH (L2)		OVERALL LENGTH (L1)		# OF FLUTES	SQUARE END PART #	SQUARE END EDP #	BALL END PART #	BALL END EDP #
2.0°	1/32	0.0313	0.0662	3/8	0.375	1/2	0.500	2 5/8	2.625	3	B-0002	2B01S	B-0002-BE	2B01B
			0.0836	3/8	0.375	3/4	0.750	2 7/8	2.875		B-0003	2B02S	B-0003-BE	2B02B
	1/16	0.0625	0.0974	3/8	0.375	1/2	0.500	2 5/8	2.625		B-002	2B03S	B-002-BE	2B03B
			0.1323	3/8	0.375	1	1.000	2 7/8	2.875		B-004	2B04S	B-004-BE	2B04B
			0.1498	3/8	0.375	1 1/4	1.250	3 1/4	3.250		B-005	2B05S	B-005-BE	2B05B
	3/32	0.0938	0.1287	3/8	0.375	1/2	0.500	2 5/8	2.625		B-102	2B06S	B-102-BE	2B06B
			0.1461	3/8	0.375	3/4	0.750	2 7/8	2.875		B-103	2B07S	B-103-BE	2B07B
			0.1636	3/8	0.375	1	1.000	2 7/8	2.875		B-104	2B08S	B-104-BE	2B08B
			0.1811	3/8	0.375	1 1/4	1.250	3 1/4	3.250		B-105	2B09S	B-105-BE	2B09B
			0.1985	3/8	0.375	1 1/2	1.500	3 1/2	3.500		B-106	2B10S	B-106-BE	2B10B
	1/8	0.1250	0.1599	3/8	0.375	1/2	0.500	2 5/8	2.625		B-202	2B11S	B-202-BE	2B11B
			0.1774	3/8	0.375	3/4	0.750	2 7/8	2.875		B-203	2B12S	B-203-BE	2B12B
			0.1948	3/8	0.375	1	1.000	2 7/8	2.875		B-204	2B13S	B-204-BE	2B13B
			0.2123	3/8	0.375	1 1/4	1.250	3	3.000		B-205	2B14S	B-205-BE	2B14B
			0.2298	3/8	0.375	1 1/2	1.500	3 1/4	3.250		B-206	2B15S	B-206-BE	2B15B
			0.2647	3/8	0.375	2	2.000	3 7/8	3.875		B-208	2B16S	B-208-BE	2B16B
			0.2996	1/2	0.500	2 1/2	2.500	4 3/4	4.750		B-210	2B17S	B-210-BE	2B17B
			0.1774	3/8	0.375	3/4	0.750	2 7/8	2.875		B-303	2B18S	B-303-BE	2B18B
	3/16	0.1875	0.2748	3/8	0.375	1 1/4	1.250	3 1/4	3.250		B-305	2B19S	B-305-BE	2B19B
			0.3272	3/8	0.375	2	2.000	3 7/8	3.875		B-308	2B20S	B-308-BE	2B20B
			0.2399	3/8	0.375	3/4	0.750	2 7/8	2.875		B-403	2B21S	B-403-BE	2B21B
	1/4	0.2500	0.3373	3/8	0.375	1 1/4	1.250	3 1/4	3.250		B-405	2B22S	B-405-BE	2B22B
			0.4071	1/2	0.500	2 1/4	2.250	4 1/4	4.250		B-409	2B23S	B-409-BE	2B23B
			0.4770	1/2	0.500	3 1/4	3.250	5 1/2	5.500		B-413	2B24S	B-413-BE	2B24B
	3/8	0.3750	0.4623	1/2	0.500	1 1/4	1.250	3 1/4	3.250		B-605	2B25S	B-605-BE	2B25B
			0.5321	1/2	0.500	2 1/4	2.250	4 1/4	4.250		B-609	2B26S	B-609-BE	2B26B
			0.6020	5/8	0.625	3 1/4	3.250	5 1/2	5.500		B-613	2B27S	B-613-BE	2B27B
	1/2	0.5000	0.5873	1/2	0.500	1 1/4	1.250	3 1/4	3.250		B-805	2B28S	B-805-BE	2B28B
			0.6571	1/2	0.500	2 1/4	2.250	4 1/4	4.250		B-809	2B29S	B-809-BE	2B29B
			0.7270	5/8	0.625	3 1/4	3.250	5 1/2	5.500		B-813	2B30S	B-813-BE	2B30B
	5/8	0.6250	0.7821	3/4	0.750	2 1/4	2.250	4 1/2	4.500		B-1009	2B31S	B-1009-BE	2B31B
			0.8520	3/4	0.750	3 1/4	3.250	5 1/2	5.500		B-1013	2B32S	B-1013-BE	2B32B
			0.9218	3/4	0.750	4 1/4	4.250	6 1/4	6.250		B-1017	2B33S	B-1017-BE	2B33B
	3/4	0.7500	0.9071	3/4	0.750	2 1/4	2.250	4 1/2	4.500		B-1209	2B34S	B-1209-BE	2B34B
			0.9770	1	1.000	3 1/4	3.250	6	6.000		B-1213	2B35S	B-1213-BE	2B35B
			1.1167	1	1.000	5 1/4	5.250	7 3/4	7.750		B-1221	2B36S	B-1221-BE	2B36B
	1	1.0000	1.4190	1 1/4	1.250	6	6.000	8 1/2	8.500	4	B-1624	2B37S	B-1624-BE	2B37B

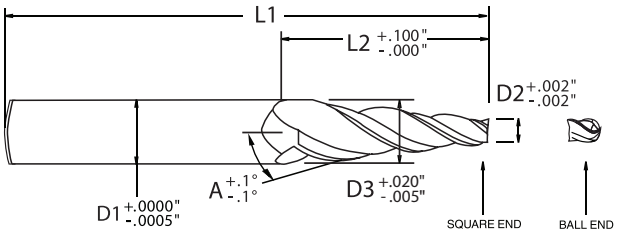
CONICAL TAPERED HSS

SERIES THX - *HIGH SPEED STEEL, 3 & 4 FLUTE, 25 - 30° VARIABLE LEAD HELIX*

COMBINES MULTIPLE OPERATIONS

The perfect choice for easy and medium to machine materials or applications with minor machining requirements. Reduces significant fixturing time, combines multiple operations into one and creates parts that were previously impossible to machine.

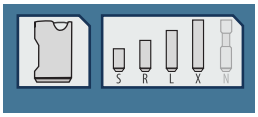
- Corner radius option protects corners in roughing operations and difficult to machine materials by preventing corner chipping and tool failure. Available in 24 to 48 hours
- Multi-flute, three and four flute design allows for proper chip evacuation through a variety of materials and applications while maximizing machine performance when possible
- Premium high speed steel improves rigidity, hardness and wear resistance for milling of easy to medium machinability materials



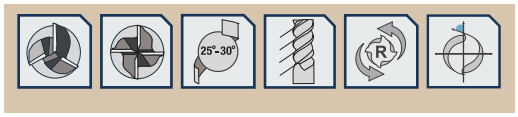
To order a corner radius, use code "CR" & actual radius in the part number. For example, a standard AX-203 would be ordered as AX-203-CR-015, with "015" being the radius.

TIP & END

SHANK & LENGTH



FLUTE CONFIGURATION



MATERIAL

COATING

SERIES TH03D - *3 DEGREE, VARYING LENGTHS*

ANGLE PER SIDE (A)	TIP DIAMETER (D2)		LARGE DIAMETER (D3)	SHANK DIAMETER (D1)		FLUTE LENGTH (L2)		OVERALL LENGTH (L1)		# OF FLUTES	SQUARE END PART #	SQUARE END EDP #	BALL END PART #	BALL END EDP #
3.0°	1/4	0.2500	0.3286	3/8	0.375	3/4	0.750	2 7/8	2.875	3	C-403	2C32S	C-403-BE	2C32B
			0.3810	3/8	0.375	1 1/4	1.250	3 1/4	3.250		C-405	2C33S	C-405-BE	2C33B
			0.4858	1/2	0.500	2 1/4	2.250	4 1/4	4.250		C-409	2C34S	C-409-BE	2C34B
			0.5907	5/8	0.625	3 1/4	3.250	5 1/2	5.500		C-413	2C35S	C-413-BE	2C35B
			0.6693	5/8	0.625	4	4.000	6 1/2	6.500		C-416	2C36S	C-416-BE	2C36B
			0.7741	3/4	0.750	5	5.000	7 1/4	7.250		C-420	2C37S	C-420-BE	2C37B
	3/8	0.3750	0.5060	1/2	0.500	1 1/4	1.250	3 1/4	3.250		C-605	2C38S	C-605-BE	2C38B
			0.6108	5/8	0.625	2 1/4	2.250	4 1/4	4.250		C-609	2C39S	C-609-BE	2C39B
			0.7157	3/4	0.750	3 1/4	3.250	5 1/2	5.500		C-613	2C40S	C-613-BE	2C40B
			0.7943	3/4	0.750	4	4.000	6 1/2	6.500		C-616	2C41S	C-616-BE	2C41B
			0.8991	3/4	0.750	5	5.000	7 1/2	7.500		C-620	2C42S	C-620-BE	2C42B
			1.0039	1	1.000	6	6.000	8 1/2	8.500		C-624	2C43S	C-624-BE	2C43B
	1/2	0.5000	0.6310	1/2	0.500	1 1/4	1.250	3 1/4	3.250		C-805	2C44S	C-805-BE	2C44B
			0.7358	5/8	0.625	2 1/4	2.250	4 3/8	4.375		C-809	2C45S	C-809-BE	2C45B
			0.8407	3/4	0.750	3 1/4	3.250	5 1/2	5.500		C-813	2C46S	C-813-BE	2C46B
			0.9193	3/4	0.750	4	4.000	6 1/2	6.500		C-816	2C47S	C-816-BE	2C47B
			1.0241	1	1.000	5	5.000	7 1/2	7.500		C-820	2C48S	C-820-BE	2C48B
			1.1289	1	1.000	6	6.000	8 1/2	8.500		C-824	2C49S	C-824-BE	2C49B
	5/8	0.6250	0.6905	1	1.000	5/8	0.625	4 1/2	4.500		C-1009	2C50S	C-1009-BE	2C50B
			0.9657	1	1.000	3 1/4	3.250	5 1/2	5.500		C-1013	2C51S	C-1013-BE	2C51B
			1.0443	1	1.000	4	4.000	6 1/2	6.500		C-1016	2C52S	C-1016-BE	2C52B
			1.1491	1	1.000	5	5.000	7 1/2	7.500		C-1020	2C53S	C-1020-BE	2C53B
	3/4	0.7500	0.9858	1	1.000	2 1/4	2.250	4 3/4	4.750		C-1209	2C54S	C-1209-BE	2C54B
			1.0907	1	1.000	3 1/4	3.250	5 3/4	5.750		C-1213	2C55S	C-1213-BE	2C55B
			1.1693	1	1.000	4	4.000	6 1/2	6.500	4	C-1216	2C56S	C-1216-BE	2C56B
			1.2741	1	1.000	5	5.000	7 1/2	7.500		C-1220	2C57S	C-1220-BE	2C57B
			1.3789	1 1/4	1.250	6	6.000	8 1/2	8.500		C-1224	2C58S	C-1224-BE	2C58B
	1	1.0000	1.6289	1 1/4	1.250	6	6.000	8 1/2	8.500		C-1624	2C59S	C-1624-BE	2C59B

(continued on next page)

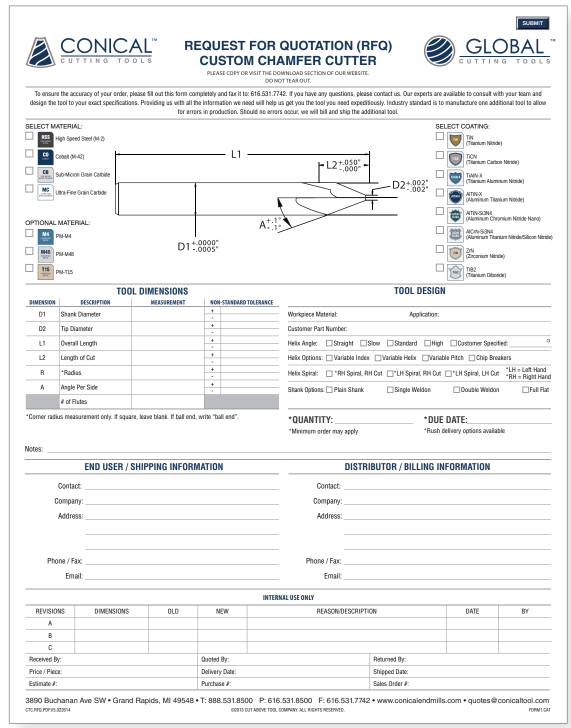
CUSTOM TOOL ORDERING

TO SOLVE MACHINING CHALLENGES

"JUST IN TIME" AVAILABILITY

WE'LL HELP YOU FIND THE SOLUTION

Along with our standard tool offerings, Conical Tool Company manufactures custom carbide and high speed steel end mills and cutters. Whether a variation of a standard tool or specialized tool meant to combine multiple processes into one pass, our custom tools improve performance and reduce cycle time at the best value in the industry.



SUBMIT

CONICAL CUTTING TOOLS™

REQUEST FOR QUOTATION (RFQ)
CUSTOM CHAMFER CUTTER

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DO NOT TEAR OUT.

GLOBAL CUTTING TOOLS™

To ensure the accuracy of your order, please fill out this form completely and fax it to: 616.531.7742. If you have any questions, please contact us. Our experts are available to consult with your team and design the tool to your exact specifications. Providing us with all the information we need will help us get you the tool you need expeditiously. Industry standard is to manufacture one additional tool to allow for errors in production. Should no errors occur, we will bill and ship the additional tool.

SELECT MATERIAL:
- ☐ HSS High Speed Steel (M-2)
- ☐ CO Cobalt (M-42)
- ☐ CB Sub-Micron Grain Carbide
- ☐ MC Ultra-Fine Grain Carbide

OPTIONAL MATERIAL:
- ☐ M4 PM-M4
- ☐ M48 PM-M48
- ☐ T15 PM-T15

SELECT COATING:
- ☐ TiN (Titanium Nitride)
- ☐ TiCN (Titanium Carbon Nitride)
- ☐ TiAlN-X (Titanium Aluminum Nitride)
- ☐ AlTiN-X (Aluminum Titanium Nitride)
- ☐ AlTiN-Si3N4 (Aluminum Chromium Nitride Nano)
- ☐ AlCrN-Si3N4 (Aluminum Titanium Nitride/Silicon Nitride)
- ☐ ZrN (Zirconium Nitride)
- ☐ TIB2 (Titanium Diboride)

TOOL DIMENSIONS

DIMENSION	DESCRIPTION	MEASUREMENT	NON-STANDARD TOLERANCE
D1	Shank Diameter		+ / -
D2	Tip Diameter		+ / -
L1	Overall Length		+ / -
L2	Length of Cut		+ / -
R	*Radius		+ / -
A	Angle Per Side		+ / -
	# of Flutes		

*Corner radius measurement only. If square, leave blank. If ball end, write "ball end".

TOOL DESIGN

Workpiece Material: Application:

Customer Part Number:

Helix Angle: ☐ Straight ☐ Slow ☐ Standard ☐ High ☐ Customer Specified: °

Helix Options: ☐ Variable Index ☐ Variable Helix ☐ Variable Pitch ☐ Chip Breakers

Helix Spiral: ☐ *RH Spiral, RH Cut ☐ *LH Spiral, RH Cut ☐ *LH Spiral, LH Cut *LH = Left Hand *RH = Right Hand

Shank Options: ☐ Plain Shank ☐ Single Weldon ☐ Double Weldon ☐ Full Flat

***QUANTITY:**
*Minimum order may apply

***DUE DATE:**
*Rush delivery options available

Notes:

END USER / SHIPPING INFORMATION

Contact:
Company:
Address:
Phone / Fax:
Email:

DISTRIBUTOR / BILLING INFORMATION

Contact:
Company:
Address:
Phone / Fax:
Email:

INTERNAL USE ONLY

REVISIONS	DIMENSIONS	OLD	NEW	REASON/DESCRIPTION	DATE	BY
A						
B						
C						

Received By:	Quoted By:	Returned By:
Price / Piece:	Delivery Date:	Shipped Date:
Estimate #:	Purchase #:	Sales Order #:

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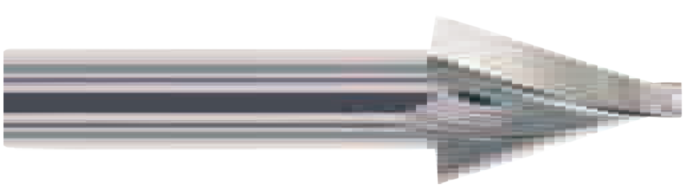

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REQUEST FOR QUOTE

CONICAL CUTTING TOOLS™

GLOBAL CUTTING TOOLS™

We can modify our standard tools or manufacture a highly specialized tool to your exact specifications. Request for Quote documents for custom tools are on the following pages. We cannot process your quote without this form. RFQ's are typically returned within 24 hours. A full list of definitions and acronyms can be found on pages 80-81. If you need assistance with your custom tool design or have any questions, please contact us.

CONICAL TOOL COMPANY 70 YEARS IN BUSINESS 1944 - 2014

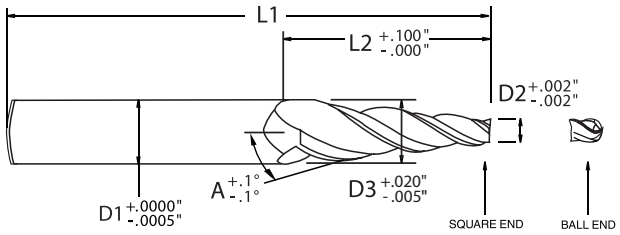
CONICAL TAPERED HSS

SERIES THX - *HIGH SPEED STEEL, 3 & 4 FLUTE, 25 - 30° VARIABLE LEAD HELIX*

WIDE VARIETY OF CONFIGURATIONS

A wide variety of configurations perform in finish milling of draft angles and slotting tapered walls, in most materials. Average 99.8% in stock status.

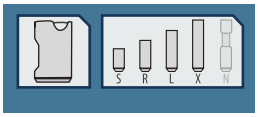
- Standard square end to create sharp corners in finishing operations
- Ball end option for high performance contour milling in finishing operations. Available in 24 to 48 hours
- Constant spiral helix provides increased tool engagement and rigidity
- Variable Core Design maximizes chip evacuation and provides increased rigidity when the cutter is fully engaged



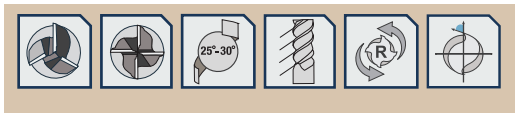
To order a corner radius, use code "CR" & actual radius in the part number. For example, a standard AX-203 would be ordered as AX-203-CR-015, with "015" being the radius.

TIP & END

SHANK & LENGTH



FLUTE CONFIGURATION



MATERIAL

COATING

SERIES TH04D - *4 DEGREE, VARYING LENGTHS*

ANGLE PER SIDE (A)	TIP DIAMETER (D2)		LARGE DIAMETER (D3)	SHANK DIAMETER (D1)		FLUTE LENGTH (L2)		OVERALL LENGTH (L1)		# OF FLUTES	SQUARE END PART #	SQUARE END EDP #	BALL END PART #	BALL END EDP #
4.0°	1/32	0.0313	0.1711	3/8	0.375	1	1.000	2 7/8	2.875	3	D-0004	2D01S	D-0004-BE	2D01B
	1/16	0.0625	0.2024	3/8	0.375	1	1.000	2 7/8	2.875		D-004	2D02S	D-004-BE	2D02B
			0.2723	3/8	0.375	1 1/2	1.500	3 1/4	3.250		D-006	2D03S	D-006-BE	2D03B
	3/32	0.0938	0.2336	3/8	0.375	1	1.000	2 7/8	2.875		D-104	2D04S	D-104-BE	2D04B
	1/8	0.1250	0.2299	3/8	0.375	3/4	0.750	2 7/8	2.875		D-203	2D05S	D-203-BE	2D05B
			0.2649	3/8	0.375	1	1.000	2 7/8	2.875		D-204	2D06S	D-204-BE	2D06B
			0.3348	3/8	0.375	1 1/2	1.500	3 1/4	3.250		D-206	2D07S	D-206-BE	2D07B
			0.4047	1/2	0.500	2	2.000	3 7/8	3.875		D-208	2D08S	D-208-BE	2D08B
			0.4747	1/2	0.500	2 1/2	2.500	4 1/2	4.500		D-210	2D09S	D-210-BE	2D09B
	3/16	0.1875	0.2924	3/8	0.375	3/4	0.750	2 7/8	2.875		D-303	2D10S	D-303-BE	2D10B
			0.3623	3/8	0.375	1 1/4	1.250	3 1/4	3.250		D-305	2D11S	D-305-BE	2D11B
			0.5372	1/2	0.500	2 1/2	2.500	4 1/2	4.500		D-310	2D12S	D-310-BE	2D12B
			0.6420	5/8	0.625	3 1/4	3.250	5 1/2	5.500		D-313	2D13S	D-313-BE	2D13B
			0.7469	3/4	0.750	4	4.000	6 1/2	6.500		D-316	2D14S	D-316-BE	2D14B
	1/4	0.2500	0.3549	3/8	0.375	3/4	0.750	2 7/8	2.875		D-403	2D15S	D-403-BE	2D15B
			0.4248	1/2	0.500	1 1/4	1.250	3 1/4	3.250		D-405	2D16S	D-405-BE	2D16B
			0.5647	5/8	0.625	2 1/4	2.250	4 1/2	4.500		D-409	2D17S	D-409-BE	2D17B
			0.7045	3/4	0.750	3 1/4	3.250	5 5/8	5.625		D-413	2D18S	D-413-BE	2D18B
			0.8094	3/4	0.750	4	4.000	6 1/2	6.500		D-416	2D19S	D-416-BE	2D19B
	3/8	0.3750	0.5498	1/2	0.500	1 1/4	1.250	3 1/4	3.250		D-605	2D20S	D-605-BE	2D20B
			0.6897	5/8	0.625	2 1/4	2.250	4 1/4	4.250		D-609	2D21S	D-609-BE	2D21B
			0.8295	3/4	0.750	3 1/4	3.250	5 1/2	5.500		D-613	2D22S	D-613-BE	2D22B
			0.9344	3/4	0.750	4	4.000	6 1/2	6.500		D-616	2D23S	D-616-BE	2D23B
	1/2	0.5000	0.6748	1/2	0.500	1 1/4	1.250	3 1/4	3.250		D-805	2D24S	D-805-BE	2D24B
			0.8147	3/4	0.750	2 1/4	2.250	4 1/2	4.500		D-809	2D25S	D-809-BE	2D25B
			1.0594	1	1.000	4	4.000	6 1/2	6.500		D-816	2D26S	D-816-BE	2D26B
			1.1993	1	1.000	5	5.000	7 1/2	7.500		D-820	2D27S	D-820-BE	2D27B

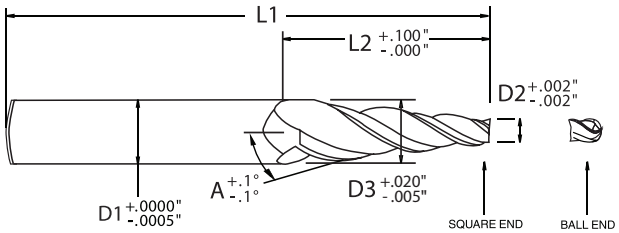
CONICAL TAPERED HSS

SERIES THX - *HIGH SPEED STEEL, 3 & 4 FLUTE, 25 - 30° VARIABLE LEAD HELIX*

MAXIMIZE FEED RATES

Employing the three or four flute design facilitates chip disposal and maximizes feed rates, which brings your work closer to completion with every rotation of the tool.

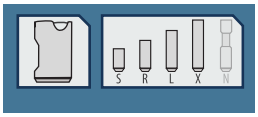
- Corner radius option protects corners in roughing operations and difficult to machine materials by preventing corner chipping and tool failure. Available in 24 to 48 hours
- Multi-flute, three and four flute design allows for proper chip evacuation through a variety of materials and applications while maximizing machine performance when possible
- Premium high speed steel improves rigidity, hardness and wear resistance for milling of easy to medium machinability materials



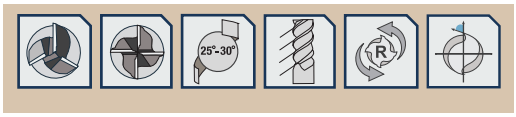
To order a corner radius, use code "CR" & actual radius in the part number. For example, a standard AX-203 would be ordered as AX-203-CR-015, with "015" being the radius.

TIP & END

SHANK & LENGTH



FLUTE CONFIGURATION



MATERIAL

COATING

SERIES TH05D - *5 DEGREE, VARYING LENGTHS*

ANGLE PER SIDE (A)	TIP DIAMETER (D2)		LARGE DIAMETER (D3)	SHANK DIAMETER (D1)		FLUTE LENGTH (L2)		OVERALL LENGTH (L1)		# OF FLUTES	SQUARE END PART #	SQUARE END EDP #	BALL END PART #	BALL END EDP #
5.0°	1/32	0.0313	0.1187	3/8	0.375	1/2	0.500	2 5/8	2.625	3	E-0002	2E01S	E-0002-BE	2E01B
			0.1625	3/8	0.375	3/4	0.750	2 7/8	2.875		E-0003	2E02S	E-0003-BE	2E02B
	1/16	0.0625	0.1500	3/8	0.375	1/2	0.500	2 5/8	2.625		E-002	2E03S	E-002-BE	2E03B
			0.1937	3/8	0.375	3/4	0.750	2 7/8	2.875		E-003	2E04S	E-003-BE	2E04B
			0.2375	3/8	0.375	1	1.000	2 7/8	2.875		E-004	2E05S	E-004-BE	2E05B
			0.3250	3/8	0.375	1 1/2	1.500	3 1/4	3.250		E-006	2E06S	E-006-BE	2E06B
	3/32	0.0938	0.1812	3/8	0.375	1/2	0.500	2 5/8	2.625		E-102	2E07S	E-102-BE	2E07B
			0.2250	3/8	0.375	3/4	0.750	2 7/8	2.875		E-103	2E08S	E-103-BE	2E08B
			0.2687	3/8	0.375	1	1.000	2 7/8	2.875		E-104	2E09S	E-104-BE	2E09B
			0.3125	3/8	0.375	1 1/4	1.250	3 1/4	3.250		E-105	2E10S	E-105-BE	2E10B
			0.3562	3/8	0.375	1 1/2	1.500	3 1/4	3.250		E-106	2E11S	E-106-BE	2E11B
			0.4437	1/2	0.500	2	2.000	3 7/8	3.875		E-108	2E12S	E-108-BE	2E12B
			0.5312	1/2	0.500	2 1/2	2.500	4 1/2	4.500		E-110	2E13S	E-110-BE	2E13B
	7/64	0.1094	0.2844	3/8	0.375	1	1.000	2 7/8	2.875		E-154	2E14S	E-154-BE	2E14B
			0.3718	3/8	0.375	1 1/2	1.500	3 1/4	3.250		E-156	2E15S	E-156-BE	2E15B
			0.4593	1/2	0.500	2	2.000	3 7/8	3.875		E-158	2E16S	E-158-BE	2E16B
	1/8	0.1250	0.2562	3/8	0.375	3/4	0.750	2 7/8	2.875		E-203	2E17S	E-203-BE	2E17B
			0.3000	3/8	0.375	1	1.000	2 7/8	2.875		E-204	2E18S	E-204-BE	2E18B
			0.3437	3/8	0.375	1 1/4	1.250	3 1/4	3.250		E-205	2E19S	E-205-BE	2E19B
			0.3875	3/8	0.375	1 1/2	1.500	3 1/4	3.250		E-206	2E20S	E-206-BE	2E20B
			0.4750	1/2	0.500	2	2.000	3 7/8	3.875		E-208	2E21S	E-208-BE	2E21B
			0.5625	1/2	0.500	2 1/2	2.500	4 1/2	4.500		E-210B	2E22S	E-210B-BE	2E22B
			0.5625	5/8	0.625	2 1/2	2.500	4 3/4	4.750		E-210A	2E23S	E-210A-BE	2E23B
	5/32	0.1563	0.3312	3/8	0.375	1	1.000	2 7/8	2.875		E-254	2E24S	E-254-BE	2E24B
			0.3750	3/8	0.375	1 1/4	1.250	3 1/4	3.250		E-255	2E25S	E-255-BE	2E25B
			0.4187	1/2	0.500	1 1/2	1.500	3 5/8	3.625		E-256	2E26S	E-256-BE	2E26B
			0.5062	1/2	0.500	2	2.000	3 7/8	3.875		E-258	2E27S	E-258-BE	2E27B
	3/16	0.1875	0.3187	3/8	0.375	3/4	0.750	2 7/8	2.875		E-303	2E28S	E-303-BE	2E28B
			0.4062	1/2	0.500	1 1/4	1.250	3 1/4	3.250		E-305	2E29S	E-305-BE	2E29B
			0.5375	1/2	0.500	2	2.000	4 1/8	4.125		E-308	2E30S	E-308-BE	2E30B
			0.6250	1/2	0.500	2 1/2	2.500	4 1/2	4.500		E-310B	2E31S	E-310B-BE	2E31B
			0.6250	5/8	0.625	2 1/2	2.500	4 3/4	4.750		E-310A	2E32S	E-310A-BE	2E32B
			0.7562	3/4	0.750	3 1/4	3.250	5 1/2	5.500		E-313	2E33S	E-313-BE	2E33B
			1.0624	3/4	0.750	4	4.000	6 1/2	6.500		E-316	2E34S	E-316-BE	2E34B
			1.0624	1	1.000	5	5.000	7 1/2	7.500		E-320	2E35S	E-320-BE	2E35B
			1.2374	1	1.000	6	6.000	8 1/2	8.500		E-324	2E36S	E-324-BE	2E36B

(continued on next page)

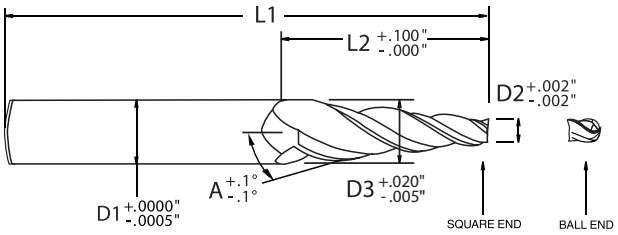
CONICAL TAPERED HSS

SERIES THX - *HIGH SPEED STEEL, 3 & 4 FLUTE, 25 - 30° VARIABLE LEAD HELIX*

THE GO-TO TOOL

With the widest selection of high speed steel tapered end mills available and an average 99.8% in stock status, the Conical Tapered High Speed Steel end mill is the go-to tool for unique machining challenges.

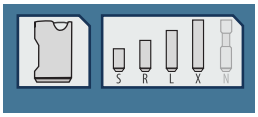
- Universal design allows for a multitude of applications, from slotting to finishing
- Uncoated for versatility. More than 16 available coatings can be added to increase tool life for your specific application and material
- Ball end option for high performance contour milling in finishing operations. Available in 24 to 48 hours



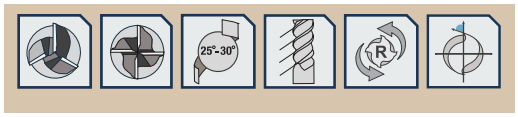
To order a corner radius, use code "CR" & actual radius in the part number. For example, a standard AX-203 would be ordered as AX-203-CR-015, with "015" being the radius.

TIP & END

SHANK & LENGTH



FLUTE CONFIGURATION



MATERIAL

COATING

SERIES TH05D - *5 DEGREE, VARYING LENGTHS*

ANGLE PER SIDE (A)	TIP DIAMETER (D2)		LARGE DIAMETER (D3)	SHANK DIAMETER (D1)		FLUTE LENGTH (L2)		OVERALL LENGTH (L1)		# OF FLUTES	SQUARE END PART #	SQUARE END EDP #	BALL END PART #	BALL END EDP #
5.0°	1/4	0.2500	0.3812	3/8	0.375	3/4	0.750	2 7/8	2.875	3	E-403	2E37S	E-403-BE	2E37B
			0.4687	1/2	0.500	1 1/4	1.250	3 1/4	3.250		E-405	2E38S	E-405-BE	2E38B
			0.6437	1/2	0.500	2 1/4	2.250	4 1/4	4.250		E-409B	2E39S	E-409B-BE	2E39B
			0.6437	5/8	0.625	2 1/4	2.250	4 1/2	4.500		E-409A	2E40S	E-409A-BE	2E40B
			0.8187	3/4	0.750	3 1/4	3.250	5 1/2	5.500		E-413	2E41S	E-413-BE	2E41B
			0.9499	3/4	0.750	4	4.000	6 1/2	6.500		E-416	2E42S	E-416-BE	2E42B
			1.2999	1	1.000	6	6.000	8 1/2	8.500		E-424	2E43S	E-424-BE	2E43B
	3/8	0.3750	0.5937	1/2	0.500	1 1/4	1.250	3 1/4	3.250		E-605	2E44S	E-605-BE	2E44B
			0.7687	3/4	0.750	2 1/4	2.250	4 3/4	4.750		E-609	2E45S	E-609-BE	2E45B
			0.9437	3/4	0.750	3 1/4	3.250	5 1/2	5.500		E-613	2E46S	E-613-BE	2E46B
			1.0749	1	1.000	4	4.000	6 1/2	6.500		E-616	2E47S	E-616-BE	2E47B
			1.2499	1 1/4	1.250	5	5.000	7 1/4	7.250		E-620	2E48S	E-620-BE	2E48B
			1.4249	1 1/4	1.250	6	6.000	8 1/2	8.500		E-624	2E49S	E-624-BE	2E49B
	1/2	0.5000	0.7187	1/2	0.500	1 1/4	1.250	3 1/4	3.250		E-805	2E50S	E-805-BE	2E50B
			0.8937	3/4	0.750	2 1/4	2.250	4 1/2	4.500		E-809	2E51S	E-809-BE	2E51B
			1.0687	1	1.000	3 1/4	3.250	6	6.000		E-813	2E52S	E-813-BE	2E52B
			1.1999	1	1.000	4	4.000	6 1/2	6.500		E-816	2E53S	E-816-BE	2E53B
			1.3749	1 1/4	1.250	5	5.000	7 1/2	7.500		E-820	2E54S	E-820-BE	2E54B
			1.5499	1 1/4	1.250	6	6.000	8 1/2	8.500		E-824	2E55S	E-824-BE	2E55B
	5/8	0.6250	1.0187	3/4	0.750	2 1/4	2.250	4 1/2	4.500		E-1009	2E56S	E-1009-BE	2E56B
			1.4999	1 1/4	1.250	5	5.000	7 1/2	7.500	4	E-1020	2E57S	E-1020-BE	2E57B
	3/4	0.7500	1.1437	3/4	0.750	2 1/4	2.250	4 3/4	4.750	3	E-1209	2E58S	E-1209-BE	2E58B
			1.4499	1 1/4	1.250	4	4.000	6 1/2	6.500		E-1216	2E59S	E-1216-BE	2E59B
			1.6249	1 1/4	1.250	5	5.000	7 3/4	7.750		E-1220	2E60S	E-1220-BE	2E60B
			1.7999	1 1/4	1.250	6	6.000	8 3/4	8.750		E-1224	2E61S	E-1224-BE	2E61B
	1	1.0000	1.8749	1 1/4	1.250	5	5.000	7 3/4	7.750	4	E-1620	2E62S	E-1620-BE	2E62B
			2.0499	2	2.000	6	6.000	9 1/2	9.500		E-1624	2E63S	E-1624-BE	2E63B
	1 1/2	1.5000	2.5499	2	2.000	6	6.000	9 1/2	9.500		E-2424	2E64S	E-2424-BE	2E64B

(continued from previous page)

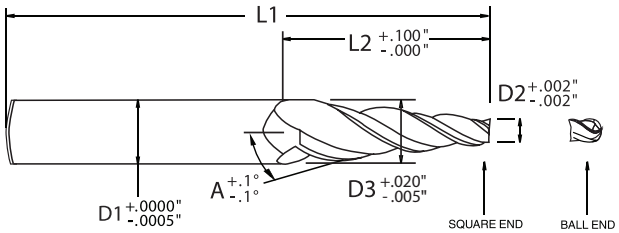
CONICAL TAPERED HSS

SERIES THX - *HIGH SPEED STEEL, 3 & 4 FLUTE, 25 - 30° VARIABLE LEAD HELIX*

UNIVERSAL DESIGN

Whether machining draft angles, or chamfers in easy and medium machinability materials, the universal design allows for a multitude of applications, which include slotting and finishing.

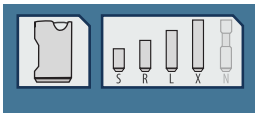
- Standard square end to create sharp corners in finishing operations
- Ball end option for high performance contour milling in finishing operations. Available in 24 to 48 hours
- Constant spiral helix provides increased tool engagement and rigidity
- Variable Core Design maximizes chip evacuation and provides increased rigidity when the cutter is fully engaged



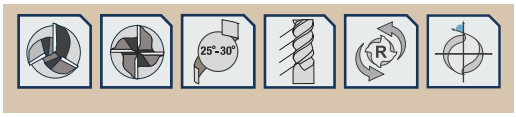
To order a corner radius, use code "CR" & actual radius in the part number. For example, a standard AX-203 would be ordered as AX-203-CR-015, with "015" being the radius.

TIP & END

SHANK & LENGTH



FLUTE CONFIGURATION



MATERIAL

COATING

SERIES TH06D - *6 DEGREE, VARYING LENGTHS*

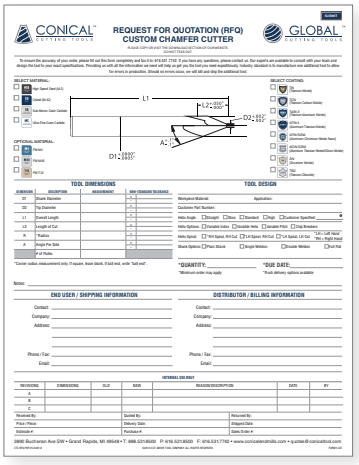
ANGLE PER SIDE (A)	TIP DIAMETER (D2)		LARGE DIAMETER (D3)	SHANK DIAMETER (D1)		FLUTE LENGTH (L2)		OVERALL LENGTH (L1)		# OF FLUTES	SQUARE END PART #	SQUARE END EDP #	BALL END PART #	BALL END EDP #
6.0°	1/16	0.0625	0.2727	3/8	0.375	1	1.000	2 7/8	2.875	3	F-004	2F01S	F-004-BE	2F01B
	3/32	0.0938	0.3040	3/8	0.375	1	1.000	2 7/8	2.875		F-104	2F02S	F-104-BE	2F02B
	1/8	0.1250	0.3352	3/8	0.375	1	1.000	2 7/8	2.875		F-204	2F03S	F-204-BE	2F03B
			0.4403	3/8	0.375	1 1/2	1.500	3 1/2	3.500		F-206	2F04S	F-206-BE	2F04B
	1/4	0.2500	0.5653	1/2	0.500	1 1/2	1.500	3 1/2	3.500		F-406	2F05S	F-406-BE	2F05B
	3/8	0.3750	0.6378	1/2	0.500	1 1/4	1.250	3 1/4	3.250		F-605	2F06S	F-605-BE	2F06B
	1/2	0.5000	0.7628	5/8	0.625	1 1/4	1.250	3 1/4	3.250		F-805	2F07S	F-805-BE	2F07B

CUSTOM TOOL ORDERING

TO SOLVE MACHINING CHALLENGES

WE'LL HELP YOU FIND THE SOLUTION

Along with our standard tool offerings, Conical Tool Company manufactures custom carbide and high speed steel end mills and cutters. Whether a variation of a standard tool or specialized tool meant to combine multiple processes into one pass, our custom tools improve performance and reduce cycle time at the best value in the industry.



SEE PAGES 27- 36 FOR DETAILS, VISIT CONICALENDMILLS.COM, OR CALL (888) 531-8500

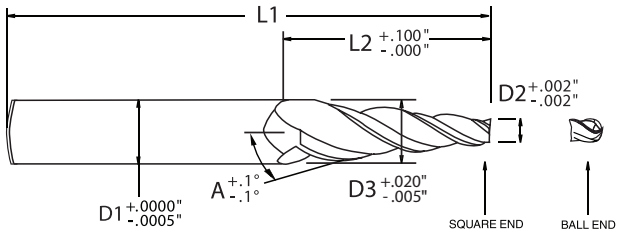
CONICAL TAPERED HSS

SERIES THX - *HIGH SPEED STEEL, 3 & 4 FLUTE, 25 - 30° VARIABLE LEAD HELIX*

BETTER PERFORMANCE

The functionality of a tool determines its worth. It's a simple fact that a quality tool will provide better performance. When you add the experience and technical support Conical provides, there's no question which manufacturer to select.

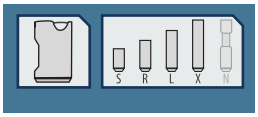
- Corner radius option protects corners in roughing operations and difficult to machine materials by preventing corner chipping and tool failure. Available in 24 to 48 hours
- Multi-flute, three and four flute design allows for proper chip evacuation through a variety of materials and applications while maximizing machine performance when possible
- Premium high speed steel improves rigidity, hardness and wear resistance for milling of easy to medium machinability materials



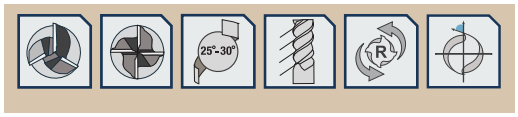
To order a corner radius, use code "CR" & actual radius in the part number. For example, a standard AX-203 would be ordered as AX-203-CR-015, with "015" being the radius.

TIP & END

SHANK & LENGTH



FLUTE CONFIGURATION



MATERIAL

COATING

SERIES TH07D - *7 DEGREE, VARYING LENGTHS*

ANGLE PER SIDE (A)	TIP DIAMETER (D2)		LARGE DIAMETER (D3)	SHANK DIAMETER (D1)		FLUTE LENGTH (L2)		OVERALL LENGTH (L1)		# OF FLUTES	SQUARE END PART #	SQUARE END EDP #	BALL END PART #	BALL END EDP #
7.0°	1/32	0.0313	0.2154	3/8	0.375	3/4	0.750	2 7/8	2.875	3	G-0003	2G01S	G-0003-BE	2G01B
	1/16	0.0625	0.3081	3/8	0.375	1	1.000	2 7/8	2.875		G-004	2G02S	G-004-BE	2G02B
			0.4308	1/2	0.500	1 1/2	1.500	3 3/8	3.375		G-006	2G03S	G-006-BE	2G03B
	3/32	0.0938	0.3393	3/8	0.375	1	1.000	2 7/8	2.875		G-104	2G04S	G-104-BE	2G04B
			0.4621	1/2	0.500	1 1/2	1.500	3 3/8	3.375		G-106	2G05S	G-106-BE	2G05B
	1/8	0.1250	0.3092	3/8	0.375	3/4	0.750	2 7/8	2.875		G-203	2G06S	G-203-BE	2G06B
			0.3706	3/8	0.375	1	1.000	2 7/8	2.875		G-204	2G07S	G-204-BE	2G07B
			0.4933	1/2	0.500	1 1/2	1.500	3 1/4	3.250		G-206	2G08S	G-206-BE	2G08B
			0.6161	5/8	0.625	2	2.000	4 1/8	4.125		G-208	2G09S	G-208-BE	2G09B
			0.8617	3/4	0.750	3	3.000	5 1/2	5.500		G-212	2G10S	G-212-BE	2G10B
	3/16	0.1875	0.4945	1/2	0.500	1 1/4	1.250	3 1/8	3.125		G-305	2G11S	G-305-BE	2G11B
			0.9242	3/4	0.750	3	3.000	5 1/4	5.250		G-312	2G12S	G-312-BE	2G12B
	1/4	0.2500	0.4342	1/2	0.500	3/4	0.750	3	3.000		G-403	2G13S	G-403-BE	2G13B
			0.5570	1/2	0.500	1 1/4	1.250	3 1/4	3.250		G-405	2G14S	G-405-BE	2G14B
			0.8025	3/4	0.750	2 1/4	2.250	4 1/2	4.500		G-409	2G15S	G-409-BE	2G15B
			1.0481	1	1.000	3 1/4	3.250	5 3/4	5.750		G-413	2G16S	G-413-BE	2G16B
			1.2322	1	1.000	4	4.000	6 1/2	6.500		G-416	2G17S	G-416-BE	2G17B
	5/16	0.3125	1.1106	1	1.000	3 1/4	3.250	5 3/4	5.750		G-513	2G18S	G-513-BE	2G18B
	3/8	0.3750	0.6820	5/8	0.625	1 1/4	1.250	3 1/2	3.500		G-605	2G19S	G-605-BE	2G19B
			0.9275	3/4	0.750	2 1/4	2.250	4 1/2	4.500		G-609	2G20S	G-609-BE	2G20B
			1.1731	1	1.000	3 1/4	3.250	5 3/4	5.750		G-613	2G21S	G-613-BE	2G21B
			1.3572	1	1.000	4	4.000	6 1/2	6.500		G-616	2G22S	G-616-BE	2G22B
			1.8484	1 1/4	1.250	6	6.000	8 1/2	8.500		G-624	2G23S	G-624-BE	2G23B
	1/2	0.5000	0.8070	5/8	0.625	1 1/4	1.250	3 3/8	3.375		G-805	2G24S	G-805-BE	2G24B
			1.0525	1	1.000	2 1/4	2.250	4 3/4	4.750		G-809	2G25S	G-809-BE	2G25B
			1.2981	1 1/4	1.250	3 1/4	3.250	5 3/4	5.750		G-813	2G26S	G-813-BE	2G26B
			1.4822	1 1/4	1.250	4	4.000	6 1/2	6.500		G-816	2G27S	G-816-BE	2G27B
			1.9734	1 1/4	1.250	6	6.000	8 1/2	8.500		G-824	2G28S	G-824-BE	2G28B
	5/8	0.6250	1.6072	1 1/4	1.250	4	4.000	6 1/2	6.500	4	G-1016	2G29S	G-1016-BE	2G29B
			1.8528	1 1/4	1.250	5	5.000	7 1/2	7.500		G-1020	2G30S	G-1020-BE	2G30B
	3/4	0.7500	1.5481	1 1/4	1.250	3 1/4	3.250	5 3/4	5.750		G-1213	2G31S	G-1213-BE	2G31B
			1.7322	1 1/4	1.250	4	4.000	6 3/4	6.750		G-1216	2G32S	G-1216-BE	2G32B
			2.2234	2	2.000	6	6.000	9 1/2	9.500		G-1224	2G33S	G-1224-BE	2G33B
	1	1.0000	2.4734	2	2.000	6	6.000	9 1/2	9.500		G-1624	2G34S	G-1624-BE	2G34B
	1 1/2	1.5000	2.9734	2	2.000	6	6.000	9 1/2	9.500		G-2424	2G35S	G-2424-BE	2G35B

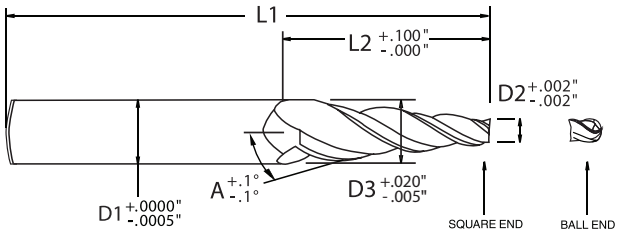
CONICAL TAPERED HSS

SERIES THX - *HIGH SPEED STEEL, 3 & 4 FLUTE, 25 - 30° VARIABLE LEAD HELIX*

EXPERIENCE COUNTS

Experience counts when you make your investment in a cutting tool manufacturer. We all need reliable partners and Conical pledges to be just that.

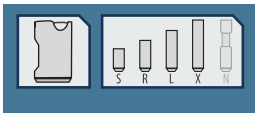
- Universal design allows for a multitude of applications, from slotting to finishing
- Uncoated for versatility. More than 16 available coatings can be added to increase tool life for your specific application and material
- Ball end option for high performance contour milling in finishing operations. Available in 24 to 48 hours



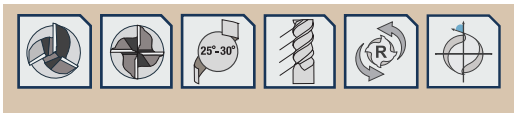
To order a corner radius, use code "CR" & actual radius in the part number. For example, a standard AX-203 would be ordered as AX-203-CR-015, with "015" being the radius.

TIP & END

SHANK & LENGTH



FLUTE CONFIGURATION



MATERIAL

COATING

SERIES TH08D - *8 DEGREE, VARYING LENGTHS*

ANGLE PER SIDE (A)	TIP DIAMETER (D2)		LARGE DIAMETER (D3)	SHANK DIAMETER (D1)		FLUTE LENGTH (L2)		OVERALL LENGTH (L1)		# OF FLUTES	SQUARE END PART #	SQUARE END EDP #	BALL END PART #	BALL END EDP #
8.0°	1/32	0.0313	0.1718	3/8	0.375	1/2	0.500	2 5/8	2.625	3	H-0002	2H01S	H-0002-BE	2H01B
	1/16	0.0625	0.2733	3/8	0.375	3/4	0.750	2 7/8	2.875		H-003	2H02S	H-003-BE	2H02B
			0.3436	3/8	0.375	1	1.000	2 7/8	2.875		H-004	2H03S	H-004-BE	2H03B
			0.4139	3/8	0.375	1 1/4	1.250	3 1/8	3.125		H-005	2H04S	H-005-BE	2H04B
			0.4841	3/8	0.375	1 1/2	1.500	3 1/2	3.500		H-006	2H05S	H-006-BE	2H05B
	3/32	0.0938	0.3046	3/8	0.375	3/4	0.750	2 5/8	2.625		H-103	2H06S	H-103-BE	2H06B
			0.3748	3/8	0.375	1	1.000	2 7/8	2.875		H-104	2H07S	H-104-BE	2H07B
	1/8	0.1250	0.3358	3/8	0.375	3/4	0.750	3	3.000		H-203	2H08S	H-203-BE	2H08B
			0.4061	3/8	0.375	1	1.000	3	3.000		H-204	2H09S	H-204-BE	2H09B
			0.6872	5/8	0.625	2	2.000	4	4.000		H-208	2H10S	H-208-BE	2H10B
	1/4	0.2500	0.4608	1/2	0.500	3/4	0.750	2 7/8	2.875		H-403	2H11S	H-403-BE	2H11B
			0.8122	3/4	0.750	2	2.000	4 1/8	4.125		H-408	2H12S	H-408-BE	2H12B
	3/8	0.3750	0.5858	1/2	0.500	3/4	0.750	2 3/4	2.750		H-603	2H13S	H-603-BE	2H13B
	1/2	0.5000	0.7108	5/8	0.625	3/4	0.750	2 7/8	2.875		H-803	2H14S	H-803-BE	2H14B

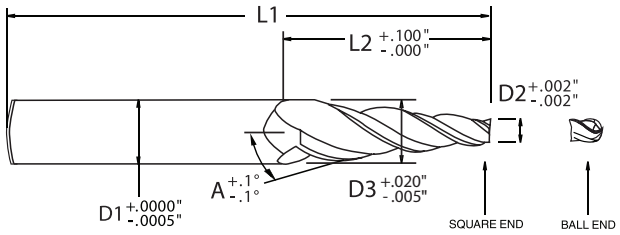
CONICAL TAPERED HSS

SERIES THX - *HIGH SPEED STEEL, 3 & 4 FLUTE, 25 - 30° VARIABLE LEAD HELIX*

THE PERFECT CHOICE

The perfect choice for easy and medium to machine materials or applications with minor machining requirements. Reduces significant fixturing time, combines multiple operations into one and creates parts that were previously impossible to machine.

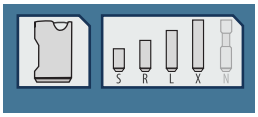
- Standard square end to create sharp corners in finishing operations
- Ball end option for high performance contour milling in finishing operations. Available in 24 to 48 hours
- Constant spiral helix provides increased tool engagement and rigidity
- Variable Core Design maximizes chip evacuation and provides increased rigidity when the cutter is fully engaged



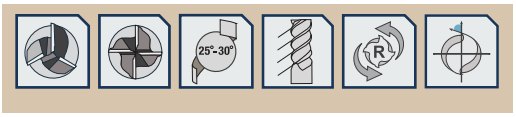
To order a corner radius, use code "CR" & actual radius in the part number. For example, a standard AX-203 would be ordered as AX-203-CR-015, with "015" being the radius.

TIP & END

SHANK & LENGTH



FLUTE CONFIGURATION



MATERIAL

COATING

SERIES TH10D - *10 DEGREE, VARYING LENGTHS*

ANGLE PER SIDE (A)	TIP DIAMETER (D2)		LARGE DIAMETER (D3)	SHANK DIAMETER (D1)		FLUTE LENGTH (L2)		OVERALL LENGTH (L1)		# OF FLUTES	SQUARE END PART #	SQUARE END EDP #	BALL END PART #	BALL END EDP #
10.0°	1/32	0.0313	0.2957	3/8	0.375	3/4	0.750	2 7/8	2.875	3	J-0003	2J01S	J-0003-BE	2J01B
	1/16	0.0625	0.4152	3/8	0.375	1	1.000	2 7/8	2.875	3	J-004	2J02S	J-004-BE	2J02B
	3/32	0.0938	0.2701	3/8	0.375	1/2	0.500	2 5/8	2.625	3	J-102	2J03S	J-102-BE	2J03B
			0.3582	3/8	0.375	3/4	0.750	2 7/8	2.875	3	J-103	2J04S	J-103-BE	2J04B
			0.6227	1/2	0.500	1 1/2	1.500	3 1/2	3.500	3	J-106	2J05S	J-106-BE	2J05B
	1/8	0.1250	0.3895	3/8	0.375	3/4	0.750	2 7/8	2.875	3	J-203	2J06S	J-203-BE	2J06B
			0.5658	1/2	0.500	1 1/4	1.250	3 1/4	3.250	3	J-205	2J07S	J-205-BE	2J07B
			0.6540	1/2	0.500	1 1/2	1.500	3 5/8	3.625	3	J-206	2J08S	J-206-BE	2J08B
	3/16	0.1875	0.6283	1/2	0.500	1 1/4	1.250	3 1/4	3.250	3	J-305	2J09S	J-305-BE	2J09B
			0.9810	3/4	0.750	2 1/4	2.250	4 1/2	4.500	3	J-309	2J10S	J-309-BE	2J10B
	1/4	0.2500	0.5145	1/2	0.500	3/4	0.750	2 7/8	2.875	3	J-403	2J11S	J-403-BE	2J11B
			0.6908	1/2	0.500	1 1/4	1.250	3 1/4	3.250	3	J-405	2J12S	J-405-BE	2J12B
			1.0435	3/4	0.750	2 1/4	2.250	4 1/2	4.500	4	J-409	2J13S	J-409-BE	2J13B
			1.3961	1	1.000	3 1/4	3.250	5 3/4	5.750	4	J-413	2J14S	J-413-BE	2J14B
	3/8	0.3750	0.8158	5/8	0.625	1 1/4	1.250	3 1/2	3.500	3	J-605	2J15S	J-605-BE	2J15B
			1.1685	1	1.000	2 1/4	2.250	4 5/8	4.625	3	J-609	2J16S	J-609-BE	2J16B
			1.5211	1 1/4	1.250	3 1/4	3.250	5 3/4	5.750	4	J-613	2J17S	J-613-BE	2J17B
	1/2	0.5000	0.9408	3/4	0.750	1 1/4	1.250	3 1/2	3.500	3	J-805	2J18S	J-805-BE	2J18B
			1.2935	1	1.000	2 1/4	2.250	4 3/4	4.750	3	J-809	2J19S	J-809-BE	2J19B
			1.6461	1 1/4	1.250	3 1/4	3.250	6	6.000	4	J-813	2J20S	J-813-BE	2J20B
			1.9106	1 1/4	1.250	4	4.000	6 1/2	6.500	4	J-816	2J21S	J-816-BE	2J21B

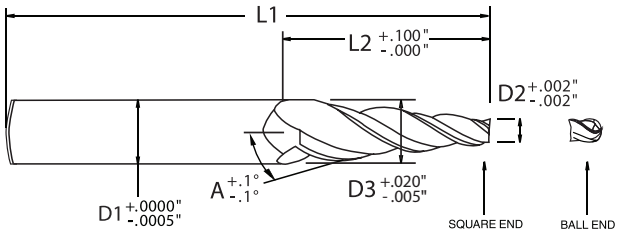
CONICAL TAPERED HSS

SERIES THX - *HIGH SPEED STEEL, 3 & 4 FLUTE, 25 - 30° VARIABLE LEAD HELIX*

ELIMINATE COSTLY PROGRAMMING

Having the ability to cut setup time and eliminate costly programming, while maximizing production rates, may seem too good to be true. Our customers can testify to the fact that the Conical Tapered end mill does just that.

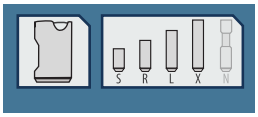
- Corner radius option protects corners in roughing operations and difficult to machine materials by preventing corner chipping and tool failure. Available in 24 to 48 hours
- Multi-flute, three and four flute design allows for proper chip evacuation through a variety of materials and applications while maximizing machine performance when possible
- Premium high speed steel improves rigidity, hardness and wear resistance for milling of easy to medium machinability materials



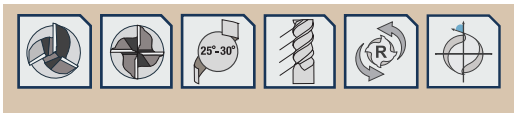
To order a corner radius, use code "CR" & actual radius in the part number. For example, a standard AX-203 would be ordered as AX-203-CR-015, with "015" being the radius.

TIP & END

SHANK & LENGTH



FLUTE CONFIGURATION



MATERIAL

COATING

SERIES TH11D - *11 DEGREE, VARYING LENGTHS*

ANGLE PER SIDE (A)	TIP DIAMETER (D2)		LARGE DIAMETER (D3)	SHANK DIAMETER (D1)		FLUTE LENGTH (L2)		OVERALL LENGTH (L1)		# OF FLUTES	SQUARE END PART #	SQUARE END EDP #	BALL END PART #	BALL END EDP #
11.0°	1/32	0.0313	0.3228	3/8	0.375	3/4	0.750	2 7/8	2.875	3	K-0003	2K01S	K-0003-BE	2K01B
	1/16	0.0625	0.3541	3/8	0.375	3/4	0.750	2 7/8	2.875		K-003	2K02S	K-003-BE	2K02B
			0.4513	3/8	0.375	1	1.000	2 7/8	2.875		K-004	2K03S	K-004-BE	2K03B
	3/32	0.0938	0.3367	3/8	0.375	5/8	0.625	2 7/8	2.875		K-103	2K04S	K-103-BE	2K04B

SERIES TH12D - *12 DEGREE, VARYING LENGTHS*

ANGLE PER SIDE (A)	TIP DIAMETER (D2)		LARGE DIAMETER (D3)	SHANK DIAMETER (D1)		FLUTE LENGTH (L2)		OVERALL LENGTH (L1)		# OF FLUTES	SQUARE END PART #	SQUARE END EDP #	BALL END PART #	BALL END EDP #
12.0°	3/32	0.0938	0.4126	3/8	0.375	3/4	0.750	2 7/8	2.875	3	L-103	2L01S	L-103-BE	2L01B
	1/8	0.1250	0.6564	1/2	0.500	1 1/4	1.250	3 1/8	3.125		L-205	2L02S	L-205-BE	2L02B
	1/4	0.2500	0.8877	5/8	0.625	1 1/2	1.500	3 5/8	3.625		L-406	2L03S	L-406-BE	2L03B
			1.2065	1	1.000	2 1/4	2.250	4 1/2	4.500	4	L-409	2L04S	L-409-BE	2L04B

SERIES TH13D - *13 DEGREE, VARYING LENGTHS*

ANGLE PER SIDE (A)	TIP DIAMETER (D2)		LARGE DIAMETER (D3)	SHANK DIAMETER (D1)		FLUTE LENGTH (L2)		OVERALL LENGTH (L1)		# OF FLUTES	SQUARE END PART #	SQUARE END EDP #	BALL END PART #	BALL END EDP #
13.0°	1/4	0.2500	1.7506	1 1/4	1.250	3 1/4	3.250	5 3/4	5.750	4	M-413	2M01S	M-413-BE	2M01B

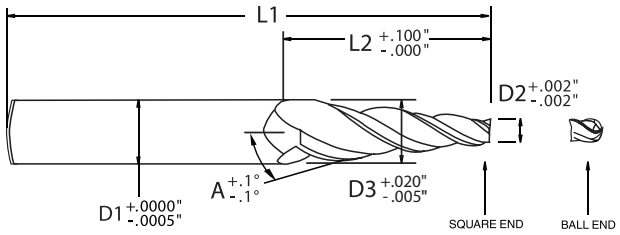
CONICAL TAPERED HSS

SERIES THX - *HIGH SPEED STEEL, 3 & 4 FLUTE, 25 - 30° VARIABLE LEAD HELIX*

99.8% IN STOCK STATUS

A wide variety of configurations perform in finish milling of draft angles and slotting tapered walls, in most materials. Average 99.8% in stock status.

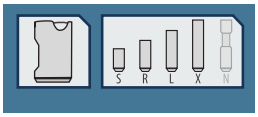
- Universal design allows for a multitude of applications, from slotting to finishing
- Uncoated for versatility. More than 16 available coatings can be added to increase tool life for your specific application and material
- Ball end option for high performance contour milling in finishing operations. Available in 24 to 48 hours



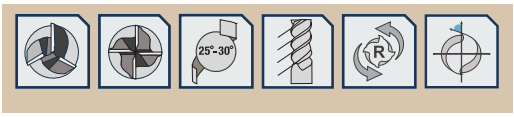
To order a corner radius, use code "CR" & actual radius in the part number. For example, a standard AX-203 would be ordered as AX-203-CR-015, with "015" being the radius.

TIP & END

SHANK & LENGTH



FLUTE CONFIGURATION



MATERIAL

COATING

SERIES TH15D - *15 DEGREE, VARYING LENGTHS*

ANGLE PER SIDE (A)	TIP DIAMETER (D2)		LARGE DIAMETER (D3)	SHANK DIAMETER (D1)		FLUTE LENGTH (L2)		OVERALL LENGTH (L1)		# OF FLUTES	SQUARE END PART #	SQUARE END EDP #	BALL END PART #	BALL END EDP #
15.0°	1/32	0.0313	0.4332	1/2	0.500	3/4	0.750	2 3/4	2.750	3	P-0003	2P01S	P-0003-BE	2P01B
	1/16	0.0625	0.4644	1/2	0.500	3/4	0.750	2 3/4	2.750		P-003	2P02S	P-003-BE	2P02B
	3/32	0.0938	0.4957	1/2	0.500	3/4	0.750	2 3/4	2.750		P-103	2P03S	P-103-BE	2P03B
			0.8976	3/4	0.750	1 1/2	1.500	3 3/4	3.750		P-106	2P04S	P-106-BE	2P04B
	1/8	0.1250	0.3930	3/8	0.375	1/2	0.500	2 7/8	2.875		P-202	2P05S	P-202-BE	2P05B
			0.6609	1/2	0.500	1	1.000	3	3.000		P-204	2P06S	P-204-BE	2P06B
	3/16	0.1875	0.7234	1/2	0.500	1	1.000	3	3.000		P-304	2P07S	P-304-BE	2P07B
			0.8574	3/4	0.750	1 1/4	1.250	3 1/2	3.500	4	P-305	2P08S	P-305-BE	2P08B
			1.2593	1	1.000	2	2.000	4 1/2	4.500	3	P-308	2P09S	P-308-BE	2P09B
	1/4	0.2500	0.7859	1/2	0.500	1	1.000	3	3.000	4	P-404	2P10S	P-404-BE	2P10B
			1.0539	3/4	0.750	1 1/2	1.500	3 3/4	3.750		P-406	2P11S	P-406-BE	2P11B
			1.4558	1	1.000	2 1/4	2.250	4 3/4	4.750		P-409	2P12S	P-409-BE	2P12B
			1.9917	1 1/4	1.250	3 1/4	3.250	5 3/4	5.750		P-413	2P13S	P-413-BE	2P13B
	5/16	0.3125	0.8484	3/4	0.750	1	1.000	3 1/4	3.250		P-504	2P14S	P-504-BE	2P14B
			1.1164	3/4	0.750	1 1/2	1.500	3 3/4	3.750		P-506	2P15S	P-506-BE	2P15B
	3/8	0.3750	1.0449	3/4	0.750	1 1/4	1.250	3 5/8	3.625		P-605	2P16S	P-605-BE	2P16B
			1.5808	1 1/4	1.250	2 1/4	2.250	4 3/4	4.750		P-609	2P17S	P-609-BE	2P17B
	1/2	0.5000	1.1699	3/4	0.750	1 1/4	1.250	3 1/2	3.500		P-805	2P18S	P-805-BE	2P18B
			1.4378	1	1.000	1 3/4	1.750	4 1/4	4.250		P-807	2P19S	P-807-BE	2P19B
			1.7058	1 1/4	1.250	2 1/4	2.250	4 3/4	4.750		P-809	2P20S	P-809-BE	2P20B
			2.2417	1 1/4	1.250	3 1/4	3.250	6	6.000		P-813	2P21S	P-813-BE	2P21B

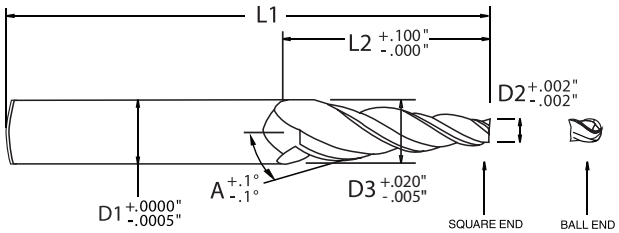
CONICAL TAPERED HSS

SERIES THX - *HIGH SPEED STEEL, 3 & 4 FLUTE, 25 - 30° VARIABLE LEAD HELIX*

FACILITATING CHIP DISPOSAL

Employing the three or four flute design facilitates chip disposal and maximizes feed rates, which brings your work closer to completion with every rotation of the tool.

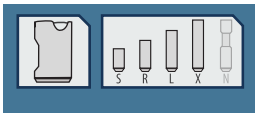
- Standard square end to create sharp corners in finishing operations
- Ball end option for high performance contour milling in finishing operations. Available in 24 to 48 hours
- Constant spiral helix provides increased tool engagement and rigidity
- Variable Core Design maximizes chip evacuation and provides increased rigidity when the cutter is fully engaged



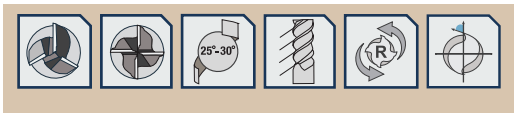
To order a corner radius, use code "CR" & actual radius in the part number. For example, a standard AX-203 would be ordered as AX-203-CR-015, with "015" being the radius.

TIP & END

SHANK & LENGTH



FLUTE CONFIGURATION



MATERIAL

COATING

SERIES TH20D - *20 DEGREE, VARYING LENGTHS*

ANGLE PER SIDE (A)	TIP DIAMETER (D2)		LARGE DIAMETER (D3)	SHANK DIAMETER (D1)		FLUTE LENGTH (L2)		OVERALL LENGTH (L1)		# OF FLUTES	SQUARE END PART #	SQUARE END EDP #	BALL END PART #	BALL END EDP #
20.0°	1/32	0.0313	0.3952	3/8	0.375	1/2	0.500	2 1/2	2.500	3	T-0002	2T01S	T-0002-BE	2T01B
	1/16	0.0625	0.4265	3/8	0.375	1/2	0.500	2 1/2	2.500		T-002	2T02S	T-002-BE	2T02B
	3/32	0.0938	0.6397	1/2	0.500	3/4	0.750	2 3/4	2.750		T-103	2T03S	T-103-BE	2T03B
	1/8	0.1250	0.4890	3/8	0.375	1/2	0.500	2 1/2	2.500		T-202	2T04S	T-202-BE	2T04B
			0.8529	1/2	0.500	1	1.000	3	3.000	4	T-204	2T05S	T-204-BE	2T05B
	3/16	0.1875	0.9154	1/2	0.500	1	1.000	3	3.000		T-304	2T06S	T-304-BE	2T06B
	1/4	0.2500	0.9779	1/2	0.500	1	1.000	3	3.000		T-404	2T07S	T-404-BE	2T07B
			1.3419	3/4	0.750	1 1/2	1.500	4	4.000		T-406	2T08S	T-406-BE	2T08B
	5/16	0.3125	1.0404	3/4	0.750	1	1.000	3 3/8	3.375		T-504	2T09S	T-504-BE	2T09B
			1.4044	3/4	0.750	1 1/2	1.500	3 1/2	3.500		T-506	2T10S	T-506-BE	2T10B
	3/8	0.3750	1.4669	3/4	0.750	1 1/2	1.500	4	4.000		T-606	2T11S	T-606-BE	2T11B
			1.8309	1	1.000	2	2.000	4 1/2	4.500		T-608	2T12S	T-608-BE	2T12B
	1/2	0.5000	2.1379	1 1/4	1.250	2 1/4	2.250	4 3/4	4.750		T-809	2T13S	T-809-BE	2T13B

SURFACE TREATMENTS & COATINGS

SELECT ADVANCED SPECIALTY COATING

SELECTING YOUR COATING

Certain applications, materials or performances simply require the enhancement of a specialty coating and knowledge of the properties of the coatings available. Temperature, friction resistance, hardness, lubricity, toughness and cohesion of the resulting process must be examined prior to the selection.

UNC	TiN	TiCN	TiAlN-X	AlTiN-X	AlTiN Si3N4	AlCrN Si3N4	ZrN	TiB2	DIA
UNCOATED	TITANIUM NITRIDE	TITANIUM CARBON NITRIDE	TITANIUM ALUMINUM NITRIDE NANO	ALUMINUM TITANIUM NITRIDE NANO	ALUMINUM TITANIUM NITRIDE/ SILICON NITRIDE	ALUMINUM CHROMIUM NITRIDE NANO	ZIRCONIUM NITRIDE	TITANIUM DIBORIDE	AMORPHOUS DIAMOND & CVD

SEE PAGES 42 - 44 FOR DETAILS

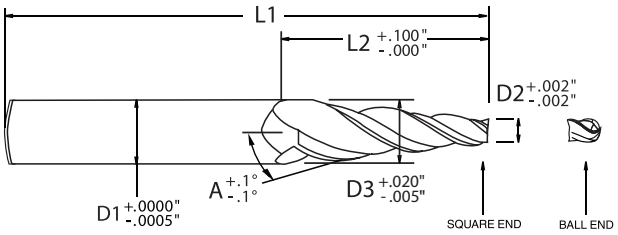
CONICAL TAPERED HSS

SERIES THX - *HIGH SPEED STEEL, 3 & 4 FLUTE, 25 - 30° VARIABLE LEAD HELIX*

UNIQUE MACHINING CHALLENGES

With the widest selection of high speed steel tapered end mills available and an average 99.8% in stock status, the Conical Tapered High Speed Steel end mill is the go-to tool for unique machining challenges.

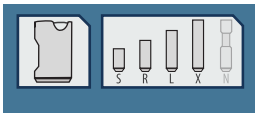
- Corner radius option protects corners in roughing operations and difficult to machine materials by preventing corner chipping and tool failure. Available in 24 to 48 hours
- Multi-flute, three and four flute design allows for proper chip evacuation through a variety of materials and applications while maximizing machine performance when possible
- Premium high speed steel improves rigidity, hardness and wear resistance for milling of easy to medium machinability materials



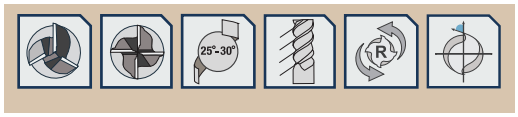
To order a corner radius, use code "CR" & actual radius in the part number. For example, a standard AX-203 would be ordered as AX-203-CR-015, with "015" being the radius.

TIP & END

SHANK & LENGTH



FLUTE CONFIGURATION



MATERIAL

COATING

SERIES TH25D - *25 DEGREE, VARYING LENGTHS*

ANGLE PER SIDE (A)	TIP DIAMETER (D2)		LARGE DIAMETER (D3)	SHANK DIAMETER (D1)		FLUTE LENGTH (L2)		OVERALL LENGTH (L1)		# OF FLUTES	SQUARE END PART #	SQUARE END EDP #	BALL END PART #	BALL END EDP #
25.0°	3/32	0.0938	0.7932	1/2	0.500	3/4	0.750	3	3.000	3	R-103	2R01S	R-103-BE	2R01B
	1/8	0.1250	0.5913	1/2	0.500	1/2	0.500	2 1/2	2.500		R-202	2R02S	R-202-BE	2R02B
			1.0576	5/8	0.625	1	1.000	3	3.000	4	R-204	2R03S	R-204-BE	2R03B
	1/4	0.2500	1.1826	5/8	0.625	1	1.000	3 1/4	3.250		R-404	2R04S	R-404-BE	2R04B
			1.6489	3/4	0.750	1 1/2	1.500	3 3/4	3.750		R-406	2R05S	R-406-BE	2R05B
	5/16	0.3125	1.0120	5/8	0.625	3/4	0.750	3	3.000		R-503	2R06S	R-503-BE	2R06B
			1.2451	3/4	0.750	1	1.000	3 1/2	3.500		R-504	2R07S	R-504-BE	2R07B
			1.7114	1	1.000	1 1/2	1.500	4	4.000		R-506	2R08S	R-506-BE	2R08B
	3/8	0.3750	1.0745	5/8	0.625	3/4	0.750	3	3.000		R-603	2R09S	R-603-BE	2R09B
			1.3076	3/4	0.750	1	1.000	3 1/4	3.250		R-604	2R10S	R-604-BE	2R10B
			1.7739	1	1.000	1 1/2	1.500	4	4.000		R-606	2R11S	R-606-BE	2R11B
	1/2	0.5000	1.6658	1	1.000	1 1/4	1.250	3 3/4	3.750		R-805	2R12S	R-805-BE	2R12B

SERIES TH30D - *30 DEGREE, VARYING LENGTHS*

ANGLE PER SIDE (A)	TIP DIAMETER (D2)		LARGE DIAMETER (D3)	SHANK DIAMETER (D1)		FLUTE LENGTH (L2)		OVERALL LENGTH (L1)		# OF FLUTES	SQUARE END PART #	SQUARE END EDP #	BALL END PART #	BALL END EDP #
30.0°	1/16	0.0625	0.6399	1/2	0.500	1/2	0.500	2 1/2	2.500	3	U-002A	2U01S	U-002A-BE	2U01B
			0.6399	3/8	0.375	1/2	0.500	2 1/2	2.500		U-002B	2U02S	U-002B-BE	2U02B
	3/32	0.0938	0.9598	1/2	0.500	3/4	0.750	2 3/4	2.750		U-103	2U03S	U-103-BE	2U03B
	1/8	0.1250	0.7024	1/2	0.500	1/2	0.500	2 1/2	2.500	4	U-202	2U04S	U-202-BE	2U04B
			1.2797	5/8	0.625	1	1.000	3 1/8	3.125		U-204A	2U05S	U-204A-BE	2U05B
			1.2797	1/2	0.500	1	1.000	3 1/8	3.125		U-204B	2U06S	U-204B-BE	2U06B
	1/4	0.2500	1.4047	3/4	0.750	1	1.000	3 1/2	3.500		U-404	2U07S	U-404-BE	2U07B
			1.9821	1	1.000	1 1/2	1.500	4 1/8	4.125		U-406	2U08S	U-406-BE	2U08B
	3/8	0.3750	1.8184	1	1.000	1 1/4	1.250	4	4.000		U-605	2U09S	U-605-BE	2U09B
			2.1071	1	1.000	1 1/2	1.500	4 1/4	4.250		U-606	2U10S	U-606-BE	2U10B
	1/2	0.5000	1.9434	1	1.000	1 1/4	1.250	4	4.000		U-805	2U11S	U-805-BE	2U11B
			2.2321	1	1.000	1 1/2	1.500	4 1/4	4.250		U-806	2U12S	U-806-BE	2U12B

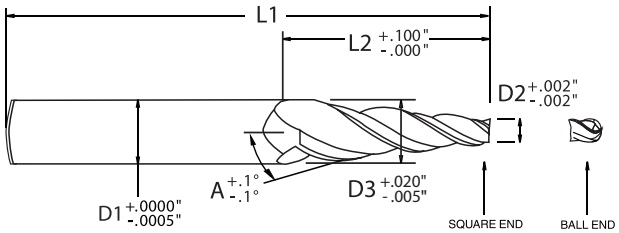
CONICAL TAPERED HSS

SERIES THX - *HIGH SPEED STEEL, 3 & 4 FLUTE, 25 - 30° VARIABLE LEAD HELIX*

EASY AND MEDIUM MACHINABILITY MATERIALS

Whether machining draft angles, or chamfers in easy and medium machinability materials, the universal design allows for a multitude of applications, which include slotting and finishing.

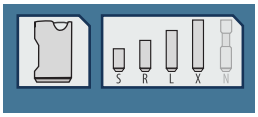
- Universal design allows for a multitude of applications, from slotting to finishing
- Uncoated for versatility. More than 16 available coatings can be added to increase tool life for your specific application and material
- Ball end option for high performance contour milling in finishing operations. Available in 24 to 48 hours



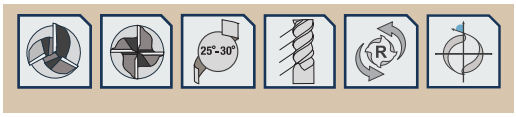
To order a corner radius, use code "CR" & actual radius in the part number. For example, a standard AX-203 would be ordered as AX-203-CR-015, with "015" being the radius.

TIP & END

SHANK & LENGTH



FLUTE CONFIGURATION



MATERIAL

COATING

SERIES TH35D - *35 DEGREE, VARYING LENGTHS*

ANGLE PER SIDE (A)	TIP DIAMETER (D2)		LARGE DIAMETER (D3)	SHANK DIAMETER (D1)		FLUTE LENGTH (L2)		OVERALL LENGTH (L1)		# OF FLUTES	SQUARE END PART #	SQUARE END EDP #	BALL END PART #	BALL END EDP #
35.0°	1/8	0.1250	1.1753	1/2	0.500	3/4	0.750	3	3.000	4	V-203	2V01S	V-203-BE	2V01B
	1/4	0.2500	1.6504	1	1.000	1	1.000	3 1/4	3.250		V-404	2V02S	V-404-BE	2V02B

SERIES TH40D - *40 DEGREE, VARYING LENGTHS*

ANGLE PER SIDE (A)	TIP DIAMETER (D2)		LARGE DIAMETER (D3)	SHANK DIAMETER (D1)		FLUTE LENGTH (L2)		OVERALL LENGTH (L1)		# OF FLUTES	SQUARE END PART #	SQUARE END EDP #	BALL END PART #	BALL END EDP #
40.0°	1/8	0.1250	1.8030	1	1.000	1	1.000	3 5/8	3.625	4	X-204	2X01S	X-204-BE	2X01B
	1/4	0.2500	1.9280	1	1.000	1	1.000	3 5/8	3.625		X-404	2X02S	X-404-BE	2X02B

SERIES TH45D - *45 DEGREE, VARYING LENGTHS*

ANGLE PER SIDE (A)	TIP DIAMETER (D2)		LARGE DIAMETER (D3)	SHANK DIAMETER (D1)		FLUTE LENGTH (L2)		OVERALL LENGTH (L1)		# OF FLUTES	SQUARE END PART #	SQUARE END EDP #	BALL END PART #	BALL END EDP #
45.0°	1/8	0.1250	0.7500	1/2	0.500	5/16	0.313	2 5/8	2.625	4	WA-215	2W01S	WA-215-BE	2W01B
			0.7500	1/2	0.500	5/16	0.313	2 5/8	2.625		WA-215SP	2W02S	WA-215SP-BE	2W02B
			1.6250	5/8	0.625	3/4	0.750	3 1/4	3.250		WA-203	2W03S	WA-203-BE	2W03B
			1.6250	5/8	0.625	3/4	0.750	3 1/4	3.250		WA-203SP	2W04S	WA-203SP-BE	2W04B
			2.1250	3/4	0.750	1	1.000	3 3/4	3.750		WA-204B	2W05S	WA-204B-BE	2W05B
			2.1250	3/4	0.750	1	1.000	3 3/4	3.750		WA-204BSP	2W06S	WA-204BSP-BE	2W06B
			2.1250	1	1.000	1	1.000	3 3/4	3.750		WA-204A	2W07S	WA-204A-BE	2W07B
			2.1250	1	1.000	1	1.000	3 3/4	3.750		WA-204ASP	2W08S	WA-204ASP-BE	2W08B

THX APPLICATION GUIDE • SPEED & FEED

	WORK MATERIAL	TYPE OF CUT	AXIAL DOC	RADIAL DOC	FLUTES	SPEED (SFM)	FEED (INCHES PER TOOTH) 1/8" (3 & 4 FL)	1/4" (3 & 4 FL)	3/8" (3 & 4 FL)	1/2" (3 & 4 FL)	5/8" (3 & 4 FL)	3/4" (3 & 4 FL)	1" (3 & 4 FL)
CARBON STEEL	LOW CARBON STEELS ≤ 38 HRc 10xx; 11xx; 12xx; 12Lxx, 15xx	Slotting	.5 x D	1 x D	3 / 4	85 - 115	0.0003 - 0.0005	0.0004 - 0.0008	0.0007 - 0.0013	0.0008 - 0.0016	0.0010 - 0.0020	0.0013 - 0.0025	0.0017 - 0.0033
		Roughing	1.5 x D	.3 x D	3 / 4	110 - 145	0.0004 - 0.0008	0.0007 - 0.0012	0.0010 - 0.0018	0.0014 - 0.0024	0.0017 - 0.0030	0.0021 - 0.0036	0.0027 - 0.0048
		Finishing	1.5 x D	.01 x D	3 / 4	140 - 180	0.0005 - 0.0009	0.0009 - 0.0014	0.0014 - 0.0021	0.0018 - 0.0027	0.0023 - 0.0034	0.0027 - 0.0041	0.0036 - 0.0055
	MEDIUM CARBON STEELS ≤ 38 HRc 13xx; 41xx; 43xx; 86xx, 92xx; 93xx; Chromoly	Slotting	.5 x D	1 x D	3 / 4	35 - 45	0.0002 - 0.0004	0.0003 - 0.0007	0.0005 - 0.0011	0.0006 - 0.0014	0.0006 - 0.0016	0.0009 - 0.0021	0.0012 - 0.0028
		Roughing	1.5 x D	.3 x D	3 / 4	45 - 60	0.0003 - 0.0007	0.0005 - 0.0010	0.0007 - 0.0015	0.0010 - 0.0020	0.0012 - 0.0025	0.0015 - 0.0030	0.0019 - 0.0040
		Finishing	1.5 x D	.01 x D	3 / 4	55 - 75	0.0004 - 0.0008	0.0006 - 0.0011	0.0010 - 0.0017	0.0013 - 0.0022	0.0016 - 0.0027	0.0020 - 0.0034	0.0026 - 0.0045
TOOL STEEL	TOOL & DIE STEELS ≤ 38 HRc A2; A3; D2; H11; H13; M1; O-1; S-7; NAK 55	Slotting	.5 x D	1 x D	3 / 4	50 - 65	0.0001 - 0.0003	0.0002 - 0.0006	0.0003 - 0.0009	0.0003 - 0.0011	0.0003 - 0.0013	0.0005 - 0.0017	0.0006 - 0.0022
		Roughing	1.5 x D	.3 x D	3 / 4	60 - 80	0.0002 - 0.0006	0.0003 - 0.0008	0.0004 - 0.0012	0.0006 - 0.0016	0.0007 - 0.0020	0.0009 - 0.0024	0.0011 - 0.0032
		Finishing	1.5 x D	.01 x D	3 / 4	80 - 100	0.0003 - 0.0007	0.0004 - 0.0009	0.0006 - 0.0013	0.0008 - 0.0017	0.0010 - 0.0021	0.0012 - 0.0026	0.0016 - 0.0035
	TOOL & DIE STEELS 39 to 48 HRc P20; P21; S-136; PX-5; NAK 80	Slotting	.5 x D	1 x D	3 / 4	45 - 55	0.0001 - 0.0003	0.0002 - 0.0006	0.0003 - 0.0009	0.0003 - 0.0011	0.0003 - 0.0013	0.0005 - 0.0017	0.0006 - 0.0022
		Roughing	1.5 x D	.3 x D	3 / 4	55 - 70	0.0002 - 0.0006	0.0003 - 0.0008	0.0004 - 0.0012	0.0006 - 0.0016	0.0007 - 0.0020	0.0009 - 0.0024	0.0011 - 0.0032
		Finishing	1.5 x D	.01 x D	3 / 4	70 - 90	0.0003 - 0.0007	0.0004 - 0.0009	0.0006 - 0.0013	0.0008 - 0.0017	0.0010 - 0.0021	0.0012 - 0.0026	0.0016 - 0.0035
HARDENED STEEL	HARDENED STEELS 48 to 57 HRc	Slotting	.5 x D	1 x D	3 / 4	40 - 50	0.0001 - 0.0003	0.0002 - 0.0006	0.0003 - 0.0009	0.0003 - 0.0011	0.0003 - 0.0013	0.0005 - 0.0017	0.0006 - 0.0022
		Roughing	1.5 x D	.25 x D	3 / 4	50 - 65	0.0002 - 0.0006	0.0003 - 0.0008	0.0004 - 0.0012	0.0006 - 0.0016	0.0007 - 0.0020	0.0009 - 0.0024	0.0011 - 0.0032
		Finishing	1.5 x D	.01 x D	3 / 4	60 - 80	0.0003 - 0.0007	0.0004 - 0.0009	0.0006 - 0.0013	0.0008 - 0.0017	0.0010 - 0.0021	0.0012 - 0.0026	0.0016 - 0.0035
	HARDENED STEELS 58 to 65HRc	Slotting	.5 x D	1 x D	3 / 4	35 - 45	0.0001 - 0.0003	0.0002 - 0.0006	0.0003 - 0.0009	0.0003 - 0.0011	0.0003 - 0.0013	0.0005 - 0.0017	0.0006 - 0.0022
		Roughing	1.5 x D	.25 x D	3 / 4	40 - 55	0.0002 - 0.0006	0.0003 - 0.0008	0.0004 - 0.0012	0.0006 - 0.0016	0.0007 - 0.0020	0.0009 - 0.0024	0.0011 - 0.0032
		Finishing	1.5 x D	.01 x D	3 / 4	55 - 70	0.0003 - 0.0007	0.0004 - 0.0009	0.0006 - 0.0013	0.0008 - 0.0017	0.0010 - 0.0021	0.0012 - 0.0026	0.0016 - 0.0035
STAINLESS STEEL	EASY TO MACHINE 72 - 85 HRb 410; 416; 420; 430F; 440C; 302; 303	Slotting	.5 x D	1 x D	3 / 4	65 - 80	0.0003 - 0.0005	0.0005 - 0.0009	0.0008 - 0.0014	0.0010 - 0.0018	0.0011 - 0.0021	0.0015 - 0.0027	0.0019 - 0.0035
		Roughing	1.25 x D	.3 x D	3 / 4	80 - 105	0.0005 - 0.0009	0.0008 - 0.0013	0.0012 - 0.0020	0.0016 - 0.0026	0.0019 - 0.0032	0.0024 - 0.0039	0.0031 - 0.0052
		Finishing	1.5 x D	.01 x D	3 / 4	100 - 130	0.0006 - 0.0010	0.0010 - 0.0015	0.0015 - 0.0022	0.0020 - 0.0029	0.0026 - 0.0037	0.0031 - 0.0045	0.0041 - 0.0060
	MODERATELY DIFFICULT 79 - 85 HRb; 25 - 41 HRc 304; 304L; 316; 316L; 320; 321; 347; Invar 36; Kovar	Slotting	.5 x D	1 x D	3 / 4	55 - 75	0.0003 - 0.0005	0.0004 - 0.0008	0.0007 - 0.0013	0.0008 - 0.0016	0.0010 - 0.0020	0.0013 - 0.0025	0.0017 - 0.0033
		Roughing	1.25 x D	.25 x D	3 / 4	70 - 95	0.0004 - 0.0008	0.0007 - 0.0012	0.0010 - 0.0018	0.0014 - 0.0024	0.0017 - 0.0030	0.0021 - 0.0036	0.0027 - 0.0048
		Finishing	1.5 x D	.01 x D	3 / 4	90 - 120	0.0005 - 0.0009	0.0009 - 0.0014	0.0014 - 0.0021	0.0018 - 0.0027	0.0023 - 0.0034	0.0027 - 0.0041	0.0036 - 0.0055
	DIFFICULT TO MACHINE 31 - 50 HRc 13-8 PH; 15-5 PH; 17-4 PH; Carpenter; Custo 465; Invar	Slotting	.5 x D	1 x D	3 / 4	40 - 55	0.0001 - 0.0003	0.0002 - 0.0006	0.0003 - 0.0009	0.0003 - 0.0011	0.0003 - 0.0013	0.0005 - 0.0017	0.0006 - 0.0022
		Roughing	1.25 x D	.25 x D	3 / 4	50 - 70	0.0002 - 0.0006	0.0003 - 0.0008	0.0004 - 0.0012	0.0006 - 0.0016	0.0007 - 0.0020	0.0009 - 0.0024	0.0011 - 0.0032
		Finishing	1.5 x D	.01 x D	3 / 4	65 - 85	0.0003 - 0.0007	0.0004 - 0.0009	0.0006 - 0.0013	0.0008 - 0.0017	0.0010 - 0.0021	0.0012 - 0.0026	0.0016 - 0.0035
CAST IRON	GRAY 100 - 200 HRb	Slotting	.5 x D	1 x D	3 / 4	65 - 85	0.0003 - 0.0005	0.0006 - 0.0010	0.0009 - 0.0015	0.0011 - 0.0019	0.0013 - 0.0023	0.0017 - 0.0029	0.0022 - 0.0038
		Roughing	1.5 x D	.3 x D	3 / 4	85 - 110	0.0005 - 0.0009	0.0009 - 0.0014	0.0013 - 0.0021	0.0018 - 0.0028	0.0022 - 0.0035	0.0027 - 0.0042	0.0035 - 0.0056
		Finishing	1.5 x D	.01 x D	3 / 4	105 - 135	0.0006 - 0.0010	0.0011 - 0.0016	0.0017 - 0.0024	0.0023 - 0.0032	0.0029 - 0.0040	0.0035 - 0.0049	0.0046 - 0.0065
	DUCTILE 150 - 300 HRb	Slotting	.5 x D	1 x D	3 / 4	65 - 85	0.0003 - 0.0005	0.0006 - 0.0010	0.0009 - 0.0015	0.0011 - 0.0019	0.0013 - 0.0023	0.0017 - 0.0029	0.0022 - 0.0038
		Roughing	1.5 x D	.3 x D	3 / 4	85 - 110	0.0005 - 0.0009	0.0009 - 0.0014	0.0013 - 0.0021	0.0018 - 0.0028	0.0022 - 0.0035	0.0027 - 0.0042	0.0035 - 0.0056
		Finishing	1.5 x D	.01 x D	3 / 4	105 - 135	0.0006 - 0.0010	0.0011 - 0.0016	0.0017 - 0.0024	0.0023 - 0.0032	0.0029 - 0.0040	0.0035 - 0.0049	0.0046 - 0.0065
	MALLEABLE 150 - 310 HRb	Slotting	.5 x D	1 x D	3 / 4	55 - 75	0.0002 - 0.0004	0.0003 - 0.0007	0.0005 - 0.0011	0.0006 - 0.0014	0.0006 - 0.0016	0.0009 - 0.0021	0.0012 - 0.0028
		Roughing	1.5 x D	.3 x D	3 / 4	70 - 95	0.0003 - 0.0007	0.0005 - 0.0010	0.0007 - 0.0015	0.0010 - 0.0020	0.0012 - 0.0025	0.0015 - 0.0030	0.0019 - 0.0040
		Finishing	1.5 x D	.01 x D	3 / 4	90 - 120	0.0004 - 0.0008	0.0006 - 0.0011	0.0010 - 0.0017	0.0013 - 0.0022	0.0016 - 0.0027	0.0020 - 0.0034	0.0026 - 0.0045
ALLOYS	TITANIUM ALLOYS 70 - 100 HRb; 25 - 36 HRc Ti61AL4V; Grades 5-38	Slotting	.5 x D	1 x D	3 / 4	45 - 60	0.0001 - 0.0003	0.0002 - 0.0006	0.0003 - 0.0009	0.0003 - 0.0011	0.0003 - 0.0013	0.0005 - 0.0017	0.0006 - 0.0022
		Roughing	1.25 x D	.25 x D	3 / 4	60 - 75	0.0002 - 0.0006	0.0003 - 0.0008	0.0004 - 0.0012	0.0006 - 0.0016	0.0007 - 0.0020	0.0009 - 0.0024	0.0011 - 0.0032
		Finishing	1.5 x D	.01 x D	3 / 4	75 - 95	0.0003 - 0.0007	0.0004 - 0.0009	0.0006 - 0.0013	0.0008 - 0.0017	0.0010 - 0.0021	0.0012 - 0.0026	0.0016 - 0.0035
	HIGH TEMP ALLOYS 83 - 99 HRb; 30 - 52 HRc Inconel; Monel; A286; Rene; Stelite; Haynes; Waspalloy; Hastalloy; etc	Slotting	.25 x D	1 x D	3 / 4	10 - 15	0.0001 - 0.0003	0.0002 - 0.0006	0.0003 - 0.0009	0.0003 - 0.0011	0.0003 - 0.0013	0.0005 - 0.0017	0.0006 - 0.0022
		Roughing	1.25 x D	.25 x D	3 / 4	15 - 20	0.0002 - 0.0006	0.0003 - 0.0008	0.0004 - 0.0012	0.0006 - 0.0016	0.0007 - 0.0020	0.0009 - 0.0024	0.0011 - 0.0032
		Finishing	1.5 x D	.01 x D	3 / 4	20 - 25	0.0003 - 0.0007	0.0004 - 0.0009	0.0006 - 0.0013	0.0008 - 0.0017	0.0010 - 0.0021	0.0012 - 0.0026	0.0016 - 0.0035
ALUMINUM	ALUMINUM ALLOYS Low Silicon Content 20xx; 50xx; 60xx; 70xx	Slotting	1 x D	1 x D	3 / 4	380 - 490	0.0004 - 0.0006	0.0007 - 0.0011	0.0011 - 0.0017	0.0014 - 0.0022	0.0016 - 0.0026	0.0020 - 0.0032	0.0027 - 0.0043
		Roughing	1 x D	.3 x D	3 / 4	475 - 615	0.0006 - 0.0010	0.0011 - 0.0016	0.0016 - 0.0024	0.0022 - 0.0032	0.0027 - 0.0040	0.0033 - 0.0048	0.0043 - 0.0064
		Finishing	1.5 x D	.01 x D	3 / 4	595 - 770	0.0008 - 0.0012	0.0014 - 0.0019	0.0021 - 0.0028	0.0028 - 0.0037	0.0035 - 0.0046	0.0042 - 0.0056	0.0056 - 0.0075
	ALUMINUM DIE CAST ALLOY High Silicon Content A-38x; A-39x; B39x	Slotting	.75 x D	1 x D	3 / 4	270 - 350	0.0003 - 0.0005	0.0006 - 0.0010	0.0009 - 0.0015	0.0011 - 0.0019	0.0013 - 0.0023	0.0017 - 0.0029	0.0022 - 0.0038
		Roughing	1 x D	.3 x D	3 / 4	340 - 440	0.0005 - 0.0009	0.0009 - 0.0014	0.0013 - 0.0021	0.0018 - 0.0028	0.0022 - 0.0035	0.0027 - 0.0042	0.0035 - 0.0056
		Finishing	1.5 x D	.01 x D	3 / 4	425 - 550	0.0006 - 0.0010	0.0011 - 0.0016	0.0017 - 0.0024	0.0023 - 0.0032	0.0029 - 0.0040	0.0035 - 0.0049	0.0046 - 0.0065
NONFERROUS	MAGNESIUM ALLOYS ≤ 38 HRc	Slotting	1 x D	1 x D	3 / 4	325 - 420	0.0005 - 0.0007	0.0008 - 0.0012	0.0013 - 0.0019	0.0016 - 0.0024	0.0019 - 0.0029	0.0024 - 0.0036	0.0032 - 0.0048
		Roughing	1 x D	.3 x D	3 / 4	405 - 525	0.0007 - 0.0011	0.0013 - 0.0018	0.0019 - 0.0027	0.0026 - 0.0036	0.0032 - 0.0045	0.0039 - 0.0054	0.0051 - 0.0072
		Finishing	1.5 x D	.01 x D	3 / 4	510 - 660	0.0009 - 0.0013	0.0016 - 0.0021	0.0025 - 0.0032	0.0033 - 0.0042	0.0041 - 0.0052	0.0050 - 0.0064	0.0066 - 0.0085
	COPPER ALLOYS, BRASS & BRONZE 39 to 48 HRc Manganese Bronze, Tin Bronze, Beryllium Copper	Slotting	1 x D	1 x D	3 / 4	270 - 350	0.0003 - 0.0005	0.0005 - 0.0009	0.0008 - 0.0014	0.0010 - 0.0018	0.0011 - 0.0021	0.0015 - 0.0027	0.0019 - 0.0035
		Roughing	1 x D	.3 x D	3 / 4	340 - 440	0.0005 - 0.0009	0.0008 - 0.0013	0.0012 - 0.0020	0.0016 - 0.0026	0.0019 - 0.0032	0.0024 - 0.0039	0.0031 - 0.0052
		Finishing	1.5 x D	.01 x D	3 / 4	425 - 550	0.0006 - 0.0010	0.0010 - 0.0015	0.0015 - 0.0022	0.0020 - 0.0029	0.0026 - 0.0037	0.0031 - 0.0045	0.0041 - 0.0060
	COMPOSITES, PLASTICS & FIBER-GLASS48 to 57 HRc ABS, Polycarbonate, PVC, Polypropylene	Slotting	1 x D	1 x D	3 / 4	270 - 350	0.0003 - 0.0005	0.0005 - 0.0009	0.0008 - 0.0014	0.0010 - 0.0018	0.0011 - 0.0021	0.0015 - 0.0027	0.0019 - 0.0035
		Roughing	1 x D	.3 x D	3 / 4	340 - 440	0.0005 - 0.0009	0.0008 - 0.0013	0.0012 - 0.0020	0.0016 - 0.0026	0.0019 - 0.0032	0.0024 - 0.0039	0.0031 - 0.0052
		Finishing	1.5 x D	.01 x D	3 / 4	425 - 550	0.0006 - 0.0010	0.0010 - 0.0015	0.0015 - 0.0022	0.0020 - 0.0029	0.0026 - 0.0037	0.0031 - 0.0045	0.0041 - 0.0060

CONICAL™

TAPERED LEFT HAND SPIRAL

AMERICAN MADE

GLOBALLY RENOWNED

SPECIALTY END MILLS

FOR FINISHING DRAFT ANGLES ON THROUGH HOLES

CONICAL™ CUTTING TOOLS

CONICAL™

TAPERED LEFT HAND SPIRAL

FOR FINISHING DRAFT ANGLES

ON INTERNAL DIAMETER THROUGH HOLES

FEATURES & BENEFITS

The square end option completes finishing operations, while creating crisp clean corners. Premium high speed steel improves rigidity, hardness and wear resistance in easy to machine materials. Tool life is always an important consideration and adding a coating will ensure the tool lasts longer, but we will let you decide if it's necessary for your specific operation and material. That way you take an active part in your savings and once again our success relies on yours.

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W: conicalendmills.com/custom-tool-ordering

CONICAL™
CUTTING TOOLS

SERIES: LHX

For finish milling of draft angles on internal diameter through holes in most materials; wet or dry; from easy to difficult machinability materials.

Square end option to create sharp corners in finishing operations

Multi-flute, three and four flute design allows for proper chip evacuation through a variety of materials and creates stability, minimizing harmonics while tapering walls in through-hole operations

Cylindrical land for excellent surface finishes

Uncoated for versatility. More than 16 available coatings can be added to increase tool life for your specific application and material

Premium high speed steel improves rigidity, hardness and wear resistance for milling of easy to machine materials

Variable Core Design maximizes chip evacuation and provides increased rigidity when the cutter is fully engaged

TIP & END

SHANK & LENGTH

S R L X N

FLUTE CONFIGURATION

12°

MATERIAL

HSS HIGH SPEED STEEL

COATING

UNC

RESULTS

The Conical Left Hand Spiral Tapered end mill demonstrates our ingenuity by making possible the impossible. The tool pushes material through the cutting hole, thus eliminating the natural "screwing" action and the necessity for continuous pecking, while creating a superior finish. The left hand spiral recreates the shearing action that would normally be present when profiling, allowing the tool to cut rather than grab. Contact us today, to find out what we mean by "innovation to succeed".

Series LHX: High Speed Steel, 3 & 4 Flute; 12° Left Hand Slow Helix, Right Hand Cut
Subseries: LH1XD, LH02D LH03D, LH05D, LH07D
Configuration: Varying Angles; Varying Diameters; Regular & Long Lengths;
12° Left Hand Slow Helix, Right Hand Cut; Cylindrical Land; No End Cut

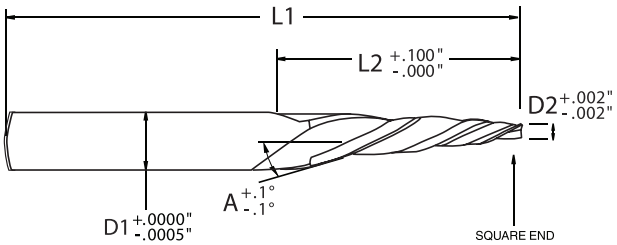
CONICAL TAPERED LEFT HAND SPIRAL

SERIES LHX - *HIGH SPEED STEEL, 3 & 4 FLUTE, 12° LEFT HAND SLOW HELIX*

QUALITY, VALUE AND DURABILITY

We apply years of experience to create end mills of the highest quality, value and durability. The Conical Left Hand Spiral Tapered end mill is engineered for difficult tapered hole machining.

- Square end option to create sharp corners in finishing operations
- Multi-flute, three and four flute design allows for proper chip evacuation through a variety of materials and creates stability, minimizing harmonics while tapering walls in through-hole operations
- Cylindrical land for excellent surface finishes



TIP & END | SHANK & LENGTH | FLUTE CONFIGURATION | MATERIAL | COATING

SERIES LH1XD - *1 ½ DEGREE, 3 & 4 FLUTE, REGULAR LENGTH*

ANGLE PER SIDE (A)	TIP DIAMETER (D2)		LARGE DIAMETER	SHANK DIAMETER (D1)		FLUTE LENGTH (L2)		OVERALL LENGTH (L1)		# OF FLUTES	SQUARE END PART #	SQUARE END EDP #
1.5°	1/8	0.125	0.204	3/8	0.375	1 1/2	1.500	3 3/4	3.750	3	LAAX-206	3Z01S
	3/16	0.188	0.292			2	2.000	4 3/8	4.375	4	LAAX-308	3Z02S

SERIES LH02D - *2 DEGREE, 3 & 4 FLUTE, REGULAR LENGTH*

ANGLE PER SIDE (A)	TIP DIAMETER (D2)		LARGE DIAMETER	SHANK DIAMETER (D1)		FLUTE LENGTH (L2)		OVERALL LENGTH (L1)		# OF FLUTES	SQUARE END PART #	SQUARE END EDP #
2.0°	3/32	0.094	0.199	3/8	0.375	1 1/2	1.500	3 3/4	3.750	3	LB-106	3B01S
	1/8	0.125	0.265			2	2.000	4 1/4	4.250		LB-208	3B02S
	3/16	0.188	0.327			2	2.000	4 3/8	4.375	4	LB-308	3B03S

SERIES LH03D - *3 DEGREE, 3 & 4 FLUTE, LONG LENGTH*

ANGLE PER SIDE (A)	TIP DIAMETER (D2)		LARGE DIAMETER	SHANK DIAMETER (D1)		FLUTE LENGTH (L2)		OVERALL LENGTH (L1)		# OF FLUTES		SQUARE END PART #	SQUARE END EDP #
3.0°	3/32	0.094	0.199	3/8	0.375	1	1.000	3 1/4	3.250	3		LC-104	3C01S
			0.251			1 1/2	1.500	3 3/4	3.750			LC-106	3C02S
	1/8	0.125	0.230			1	1.000	3 1/4	3.250			LC-204	3C03S
			0.282			1 1/2	1.500	3 3/4	3.750			LC-206	3C04S
			0.335			2	2.000	4 1/4	4.250			LC-208	3C05S
			0.387	1/2	0.500	2 1/2	2.500	5	5.000			LC-210	3C06S
			0.439			3	3.000	5 3/4	5.750			LC-212	3C07S
	3/16	0.188	0.345	3/8	0.375	1 1/2	1.500	3 3/4	3.750	4		LC-306	3C08S
			0.607	5/8	0.625	4	4.000	7	7.000		○	LC-316	3C09S
	1/4	0.250	0.407	1/2	0.500	1 1/2	1.500	4	4.000			LC-406	3C10S
			0.486			2 1/4	2.250	4 3/4	4.750			LC-409	3C11S
			0.669	5/8	0.625	4	4.000	7	7.000		○	LC-416	3C12S

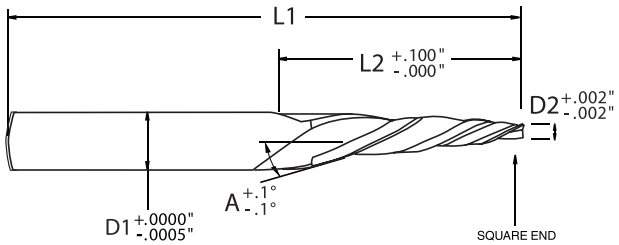
CONICAL TAPERED LEFT HAND SPIRAL

SERIES LHX - *HIGH SPEED STEEL, 3 & 4 FLUTE, 12° LEFT HAND SLOW HELIX*

SUPERIOR FINISHES

The tool pushes material through the cutting hole, thus eliminating the natural "screwing" action and the necessity for continuous pecking, while creating a superior finish.

- Variable Core Design maximizes chip evacuation and provides increased rigidity when the cutter is fully engaged
- Uncoated for versatility. More than 16 available coatings can be added to increase tool life for your specific application and material
- Premium high speed steel improves rigidity, hardness and wear resistance for milling of easy to machine materials



TIP & END | SHANK & LENGTH | FLUTE CONFIGURATION | MATERIAL | COATING

SERIES LH05D - *5 DEGREE, VARYING LENGTHS*

ANGLE PER SIDE (A)	TIP DIAMETER (D2)		LARGE DIAMETER	SHANK DIAMETER (D1)		FLUTE LENGTH (L2)		OVERALL LENGTH (L1)		# OF FLUTES	SQUARE END PART #	SQUARE END EDP #
5.0°	3/32	0.094	0.269	3/8	0.375	1	1.000	3 1/4	3 1/4	3	LE-104	3E01S
			0.356			1 1/2	1.500	3 3/4	3.750		LE-106	3E02S
			0.444	1/2	0.500	2	2.000	4 1/4	4.250		LE-108	3E03S
	1/8	0.125	0.300	3/8	0.375	1	1.000	3 1/4	3.250		LE-204	3E04S
			0.387			1 1/2	1.500	3 3/4	3.750		LE-206	3E05S
			0.475	1/2	0.500	2	2.000	4 1/4	4.250		LE-208	3E06S
			0.562			2 1/2	2.500	5	5.000		LE-210	3E07S
			0.650	5/8	0.625	3	3.000	5 3/4	5.750		LE-212	3E08S
	3/16	0.188	0.450	1/2	0.500	1 1/2	1.500	3 3/4	3.750	4	LE-306	3E09S
			0.537			2	2.000	4 3/8	4.375		LE-308	3E10S
	1/4	0.250	0.512	1/2	0.500	1 1/2	1.500	4	4.000		LE-406	3E11S
			0.644	5/8	0.625	2 1/4	2.250	5 1/4	5.250		LE-409	3E12S
			0.950	3/4	0.750	4	4.000	7	7.000		⊙ LE-416	3E13S

⊙ indicates center hole in tip

SERIES LH07D - *7 DEGREE, 3 & 4 FLUTE, LONG LENGTH*

ANGLE PER SIDE (A)	TIP DIAMETER (D2)		LARGE DIAMETER	SHANK DIAMETER (D1)		FLUTE LENGTH (L2)		OVERALL LENGTH (L1)		# OF FLUTES	SQUARE END PART #	SQUARE END EDP #
7.0°	3/32	0.094	0.339	3/8	0.375	1	1.000	3 1/4	3.250	3	LG-104	3G01S
	1/8	0.125	0.493	1/2	0.500	1 1/2	1.500	3 3/4	3.750		LG-205	3G02S
	3/16	0.188	0.679			2	2.000	4 3/8	4.375	4	LG-308	3G03S

CONICAL™ CUTTING TOOLS

GLOBAL™ CUTTING TOOLS

70 YEARS OF INNOVATION

CONICAL™ CHAMFER CUTTERS

FLAWLESS FORM

Conical Chamfer Cutters were developed to mill edge breaks and full chamfers, but also function well for replacing expensive hand deburring operations. Two primary designs were created to provide customers with the exact tool they need, for any application and material.

The two flute design features a positive rake for aggressive chip removal in easy to machine materials and the four flute design combines a neutral rake with an eccentric relief for improved edge strength in difficult to machine materials. The two and four flute designs, respectively, have specific applications for maximum clearance and aggressive milling.

The Conical Chamfer Cutters are the easy answer for difficult operations. Minimize the time spent setting up and machining by choosing the only name in tapered tooling, Conical Cutting Tools.

CHANGING DEFINITIONS IN PERFORMANCE

Providing more than just a quality tool is inherent in our service and mission. We have developed solutions for nearly every major machine tool manufacturer and even contributed to the custom tools used to manufacture parts on the international space station. It's not how you buy that's important; it's who you buy from. We have a history of proven experience, with an ability to change the definition of performance.

Global Cutting Tools
Conical Tool Company

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CHAMFER CUTTERS

AMERICAN MADE

GLOBALLY RENOWNED

SPECIALTY END MILLS
FOR EDGE BREAK, FULL CHAMFER & DEBURRING IN ALL MATERIALS

CONICAL™ CUTTING TOOLS

CONICAL™
CHAMFER CUTTERS

FOR EDGE BREAK & FULL CHAMFER MILLING
IN ALL MATERIALS

FEATURES & BENEFITS

Our Conical Chamfer Cutters are manufactured from premium micro-grain carbide for use with all materials. There are four standard combinations of flutes and coating, in multiple variations of angle and length of cut. Softer material benefit from the two flute design for aggressive chip removal and clearance, while harder materials are better suited to a coated end mill with our four flute, high strength design. Whether performing an edge break, full chamfer, or eliminating costly hand deburring operations, this tool does the work you need done now.

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CONICAL™
CUTTING TOOLS

SERIES: CFX

For milling full chamfers, edge breaks or deburring in most materials; wet or dry; from easy to difficult machinability materials.

Two flute design with positive rake and clearance for aggressive machining in easy to machine materials

Four high strength flutes, designed with neutral rake and clearance for difficult to machine materials

Optional coating for heat resistance, wear resistance and increased lubricity

Premium micro-grain carbide substrate resists chipping, tool deflection, and has a high transverse rupture strength for greater feeds and speeds

Excellent alternative to hand deburring operations

TIP & END

SHANK & LENGTH

S R L X N

FLUTE CONFIGURATION

MATERIAL

CB
SUB-MICRO GRAIN CARBIDE

COATING

AlTiN Si3N4

UNC

RESULTS

The Conical Chamfer Cutter is an excellent alternative for hand deburring processes, as well as traditional chamfering. Improving the part finish and speed of operation will improve output and quality standards. Multiple configurations make the Conical Chamfer Cutter versatile in the full range of materials. Softer materials benefit from the positive rake and two flute design for proper clearance. Hard ferrous materials are better suited for the four flute, AlTiN-X Nano coated design, to protect against heat and wear.

Series: CFX2 & CFX4: Micro-Grain Carbide, 2 & 4 Flute, 15 - 75°
Subseries: CF15D, CF20D, CF22D, CF25D, CF30D, CF35D, CF40D, CF45D, CF50D, CF55D, CF60D, CF65D, CF70D
Configuration: Varying Angles; Varying Diameters; Stub, Regular & Long Lengths ; Pointed Ends

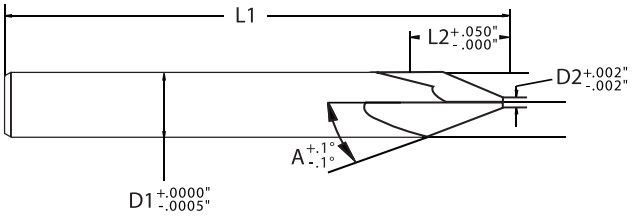
CHAMFER CUTTERS — CONICAL™

SERIES CFX - *CARBIDE, 2 & 4 FLUTE, ALTIN-X COATED & UNCOATED*

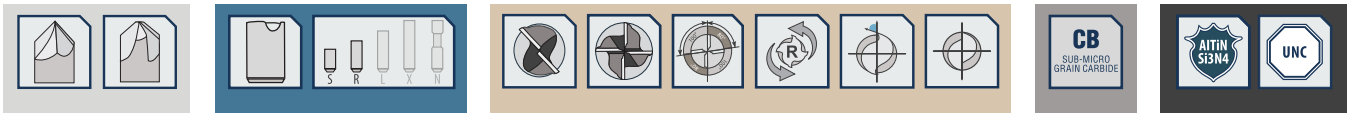
FOR ANY APPLICATION AND MATERIAL

Developed to mill edge breaks and full chamfers, but also function well for replacing expensive hand deburring operations. Two primary designs were created to provide customers with the exact tool they need, for any application and material.

- Two flute design with positive rake and clearance for aggressive machining in easy to machine materials
- Four high strength flutes, designed with neutral rake and clearance for difficult to machine materials
- Eccentric relief for enhanced edge strength along the flute



TIP & END | SHANK & LENGTH | FLUTE CONFIGURATION | MATERIAL | COATING



SERIES CF15D -15 *DEGREE, VARYING LENGTHS*

ANGLE PER SIDE (A)	TIP DIAMETER (D2)	SHANK DIAMETER (D1)		FLUTE LENGTH (L2)	OVERALL LENGTH (L1)		# OF FLUTES	UNCOATED PART #	UNCOATED EDP #	ALTIN/SI3N4 COATED PART #	ALTIN/SI3N4 COATED EDP #
15°	0.010	3/16	0.188	0.350	2	2.000	2	CF2-1503	7P010	CF2-1503-C4	7P050
	0.010	1/4	0.250	0.466	2 1/2	2.500		CF2-1504	7P020	CF2-1504-C4	7P060
	0.010	3/8	0.375	0.699	2 1/2	2.500		CF2-1506	7P030	CF2-1506-C4	7P070
	0.010	1/2	0.500	0.933	3	3.000		CF2-1508	7P040	CF2-1508-C4	7P080
15°	0.010	3/16	0.188	0.350	2	2.000	4	CF4-1503	8P010	CF4-1503-C4	8P050
	0.010	1/4	0.250	0.466	2 1/2	2.500		CF4-1504	8P020	CF4-1504-C4	8P060
	0.010	3/8	0.375	0.699	2 1/2	2.500		CF4-1506	8P030	CF4-1506-C4	8P070
	0.010	1/2	0.500	0.933	3	3.000		CF4-1508	8P040	CF4-1508-C4	8P080

SERIES CF20D - *20 DEGREE, VARYING LENGTHS*

ANGLE PER SIDE (A)	TIP DIAMETER (D2)	SHANK DIAMETER (D1)		FLUTE LENGTH (L2)	OVERALL LENGTH (L1)		# OF FLUTES	UNCOATED PART #	UNCOATED EDP #	ALTIN/SI3N4 COATED PART #	ALTIN/SI3N4 COATED EDP #
20°	0.010	3/16	0.188	0.258	2	2.000	2	CF2-2003	7T010	CF2-2003-C4	7T050
	0.010	1/4	0.250	0.343	2 1/2	2.500		CF2-2004	7T020	CF2-2004-C4	7T060
	0.010	3/8	0.375	0.515	2 1/2	2.500		CF2-2006	7T030	CF2-2006-C4	7T070
	0.010	1/2	0.500	0.687	3	3.000		CF2-2008	7T040	CF2-2008-C4	7T080
20°	0.010	3/16	0.188	0.258	2	2.000	4	CF4-2003	8T010	CF4-2003-C4	8T050
	0.010	1/4	0.250	0.343	2 1/2	2.500		CF4-2004	8T020	CF4-2004-C4	8T060
	0.010	3/8	0.375	0.515	2 1/2	2.500		CF4-2006	8T030	CF4-2006-C4	8T070
	0.010	1/2	0.500	0.687	3	3.000		CF4-2008	8T040	CF4-2008-C4	8T080

SERIES CF22D - *22 ½ DEGREE, VARYING LENGTHS*

ANGLE PER SIDE (A)	TIP DIAMETER (D2)	SHANK DIAMETER (D1)		FLUTE LENGTH (L2)	OVERALL LENGTH (L1)		# OF FLUTES	UNCOATED PART #	UNCOATED EDP #	ALTIN/SI3N4 COATED PART #	ALTIN/SI3N4 COATED EDP #
22.5°	0.010	3/16	0.188	0.227	2	2.000	2	CF2-2203	7S010	CF2-2203-C4	7S060
	0.010	1/4	0.250	0.302	2 1/2	2.500		CF2-2204	7S020	CF2-2204-C4	7S070
	0.010	3/8	0.375	0.453	2 1/2	2.500		CF2-2206	7S030	CF2-2206-C4	7S080
	0.010	1/2	0.500	0.603	3	3.000		CF2-2208	7S040	CF2-2208-C4	7S090
	0.010	3/4	0.750	0.905	3	3.000		CF2-2212	7S050	CF2-2212-C4	7S100
22.5°	0.010	3/16	0.188	0.227	2	2.000	4	CF4-2203	8S010	CF4-2203-C4	8S060
	0.010	1/4	0.250	0.302	2 1/2	2.500		CF4-2204	8S020	CF4-2204-C4	8S070
	0.010	3/8	0.375	0.453	2 1/2	2.500		CF4-2206	8S030	CF4-2206-C4	8S080
	0.010	1/2	0.500	0.603	3	3.000		CF4-2208	8S040	CF4-2208-C4	8S090
	0.010	3/4	0.750	0.905	3	3.000		CF4-2212	8S050	CF4-2212-C4	8S100

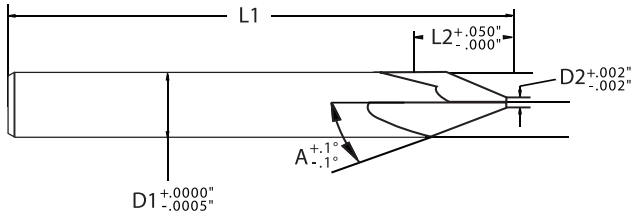
CHAMFER CUTTERS — CONICAL™

SERIES CFX - *CARBIDE, 2 & 4 FLUTE, ALTIN-X COATED & UNCOATED*

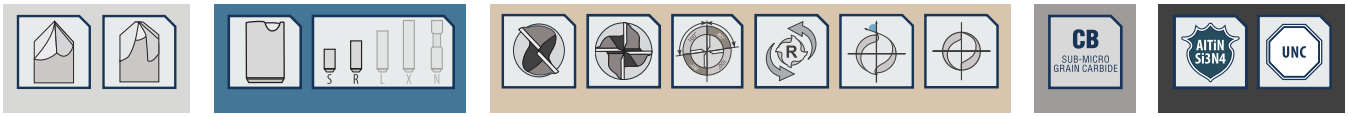
AGGRESSIVE CHIP REMOVAL

The two flute design features a positive rake for aggressive chip removal in easy to machine materials and the four flute design combines a neutral rake with an eccentric relief for improved edge strength in difficult to machine materials.

- Optional coating for heat resistance, wear resistance and increased lubricity
- Premium micro-grain carbide substrate resists chipping, tool deflection, and has a high transverse rupture strength for greater feeds and speeds
- Excellent alternative to hand deburring operations



TIP & END | SHANK & LENGTH | FLUTE CONFIGURATION | MATERIAL | COATING



SERIES CF25D - *25 DEGREE, VARYING LENGTHS*

ANGLE PER SIDE (A)	TIP DIAMETER (D2)	SHANK DIAMETER (D1)		FLUTE LENGTH (L2)	OVERALL LENGTH (L1)		# OF FLUTES	UNCOATED PART #	UNCOATED EDP #	ALTIN/SI3N4 COATED PART #	ALTIN/SI3N4 COATED EDP #
	0.010	3/16	0.188	0.202	2	2.000		CF2-2503	7R010	CF2-2503-C4	7R060
	0.010	1/4	0.250	0.268	2 1/2	2.500		CF2-2504	7R020	CF2-2504-C4	7R070
25°	0.010	3/8	0.375	0.402	2 1/2	2.500	2	CF2-2506	7R030	CF2-2506-C4	7R080
	0.010	1/2	0.500	0.536	3	3.000		CF2-2508	7R040	CF2-2508-C4	7R090
	0.010	3/4	0.750	0.804	3	3.000		CF2-2512	7R050	CF2-2512-C4	7R100
	0.010	3/16	0.188	0.202	2	2.000		CF4-2503	8R010	CF4-2503-C4	8R060
	0.010	1/4	0.250	0.268	2 1/2	2.500		CF4-2504	8R020	CF4-2504-C4	8R070
25°	0.010	3/8	0.375	0.402	2 1/2	2.500	4	CF4-2506	8R030	CF4-2506-C4	8R080
	0.010	1/2	0.500	0.536	3	3.000		CF4-2508	8R040	CF4-2508-C4	8R090
	0.010	3/4	0.750	0.804	3	3.000		CF4-2512	8R050	CF4-2512-C4	8R100

SERIES CF30D - *30 DEGREE, VARYING LENGTHS*

ANGLE PER SIDE (A)	TIP DIAMETER (D2)	SHANK DIAMETER (D1)		FLUTE LENGTH (L2)	OVERALL LENGTH (L1)		# OF FLUTES	UNCOATED PART #	UNCOATED EDP #	ALTIN/SI3N4 COATED PART #	ALTIN/SI3N4 COATED EDP #
	0.010	3/16	0.188	0.162	2	2.000		CF2-3003	7U010	CF2-3003-C4	7U060
	0.010	1/4	0.250	0.216	2 1/2	2.500		CF2-3004	7U020	CF2-3004-C4	7U070
30°	0.010	3/8	0.375	0.324	2 1/2	2.500	2	CF2-3006	7U030	CF2-3006-C4	7U080
	0.010	1/2	0.500	0.433	3	3.000		CF2-3008	7U040	CF2-3008-C4	7U090
	0.010	3/4	0.750	0.649	3	3.000		CF2-3012	7U050	CF2-3012-C4	7U100
	0.010	3/16	0.188	0.162	2	2.000		CF4-3003	8U010	CF4-3003-C4	8U060
	0.010	1/4	0.250	0.216	2 1/2	2.500		CF4-3004	8U020	CF4-3004-C4	8U070
30°	0.010	3/8	0.375	0.324	2 1/2	2.500	4	CF4-3006	8U030	CF4-3006-C4	8U080
	0.010	1/2	0.500	0.433	3	3.000		CF4-3008	8U040	CF4-3008-C4	8U090
	0.010	3/4	0.750	0.649	3	3.000		CF4-3012	8U050	CF4-3012-C4	8U100

SERIES CF35D - *35 DEGREE, VARYING LENGTHS*

ANGLE PER SIDE (A)	TIP DIAMETER (D2)	SHANK DIAMETER (D1)		FLUTE LENGTH (L2)	OVERALL LENGTH (L1)		# OF FLUTES	UNCOATED PART #	UNCOATED EDP #	ALTIN/SI3N4 COATED PART #	ALTIN/SI3N4 COATED EDP #
35°	0.010	1/4	0.250	0.178	2 1/2	2.500	2	CF2-3504	7V010	CF2-3504-C4	7V030
	0.010	3/8	0.375	0.268	2 1/2	2.500		CF2-3506	7V020	CF2-3506-C4	7V040
35°	0.010	1/4	0.250	0.178	2 1/2	2.500	4	CF4-3504	8V010	CF4-3504-C4	8V030
	0.010	3/8	0.375	0.268	2 1/2	2.500		CF4-3506	8V020	CF4-3506-C4	8V040

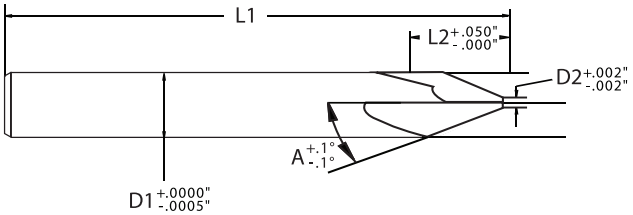
CHAMFER CUTTERS — CONICAL™

SERIES CFX - *CARBIDE, 2 & 4 FLUTE, ALTIN-X COATED & UNCOATED*

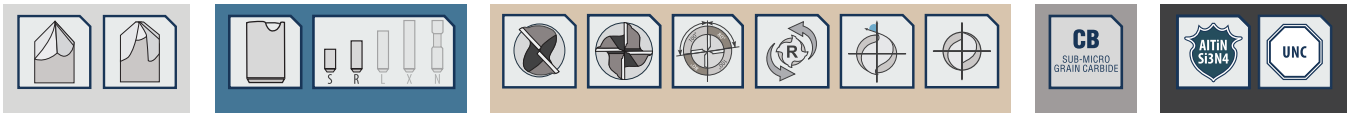
2 & 4 FLUTE CONFIGURATIONS

Softer material benefit from the two flute design for aggressive chip removal and clearance, while harder materials are better suited to a coated end mill with our four flute, high strength design.

- Two flute design with positive rake and clearance for aggressive machining in easy to machine materials
- Four high strength flutes, designed with neutral rake and clearance for difficult to machine materials
- Eccentric relief for enhanced edge strength along the flute



TIP & END | SHANK & LENGTH | FLUTE CONFIGURATION | MATERIAL | COATING



SERIES CF40D - *40 DEGREE, VARYING LENGTHS*

ANGLE PER SIDE (A)	TIP DIAMETER (D2)	SHANK DIAMETER (D1)		FLUTE LENGTH (L2)	OVERALL LENGTH (L1)		# OF FLUTES	UNCOATED PART #	UNCOATED EDP #	ALTIN/SI3N4 COATED PART #	ALTIN/SI3N4 COATED EDP #
40°	0.010	1/4	0.250	0.149	2 1/2	2.500	2	CF2-4004	7X010	CF2-4004-C4	7X030
	0.010	3/8	0.375	0.223	2 1/2	2.500		CF2-4006	7X020	CF2-4006-C4	7X040
40°	0.010	1/4	0.250	0.149	2 1/2	2.500	4	CF4-4004	8X010	CF4-4004-C4	8X030
	0.010	3/8	0.375	0.223	2 1/2	2.500		CF4-4006	8X020	CF4-4006-C4	8X040

SERIES CF45D - *45 DEGREE, VARYING LENGTHS*

ANGLE PER SIDE (A)	TIP DIAMETER (D2)	SHANK DIAMETER (D1)		FLUTE LENGTH (L2)	OVERALL LENGTH (L1)		# OF FLUTES	UNCOATED PART #	UNCOATED EDP #	ALTIN/SI3N4 COATED PART #	ALTIN/SI3N4 COATED EDP #
45°	0.010	3/16	0.188	0.093	2	2.000	2	CF2-4503	7W010	CF2-4503-C4	7W060
	0.010	1/4	0.250	0.125	2 1/2	2.500		CF2-4504	7W020	CF2-4504-C4	7W070
	0.010	3/8	0.375	0.187	2 1/2	2.500		CF2-4506	7W030	CF2-4506-C4	7W080
	0.010	1/2	0.500	0.250	3	3.000		CF2-4508	7W040	CF2-4508-C4	7W090
	0.010	3/4	0.750	0.375	3	3.000		CF2-4512	7W050	CF2-4512-C4	7W100
45°	0.010	3/16	0.188	0.093	2	2.000	4	CF4-4503	8W010	CF4-4503-C4	8W060
	0.010	1/4	0.250	0.125	2 1/2	2.500		CF4-4504	8W020	CF4-4504-C4	8W070
	0.010	3/8	0.375	0.187	2 1/2	2.500		CF4-4506	8W030	CF4-4506-C4	8W080
	0.010	1/2	0.500	0.250	3	3.000		CF4-4508	8W040	CF4-4508-C4	8W090
	0.010	3/4	0.750	0.375	3	3.000		CF4-4512	8W050	CF4-4512-C4	8W100

SERIES CF50D - *50 DEGREE, VARYING LENGTHS*

ANGLE PER SIDE (A)	TIP DIAMETER (D2)	SHANK DIAMETER (D1)		FLUTE LENGTH (L2)	OVERALL LENGTH (L1)		# OF FLUTES	UNCOATED PART #	UNCOATED EDP #	ALTIN/SI3N4 COATED PART #	ALTIN/SI3N4 COATED EDP #
50°	0.010	1/4	0.250	0.075	2 1/2	2.500	2	CF2-5004	7A010	CF2-5004-C4	7A040
	0.010	3/8	0.375	0.112	2 1/2	2.500		CF2-5006	7A020	CF2-5006-C4	7A050
	0.010	1/2	0.500	0.150	3	3.000		CF2-5008	7A030	CF2-5008-C4	7A060
50°	0.010	1/4	0.250	0.075	2 1/2	2.500	4	CF4-5004	8A010	CF4-5004-C4	8A040
	0.010	3/8	0.375	0.112	2 1/2	2.500		CF4-5006	8A020	CF4-5006-C4	8A050
	0.010	1/2	0.500	0.150	3	3.000		CF4-5008	8A030	CF4-5008-C4	8A060

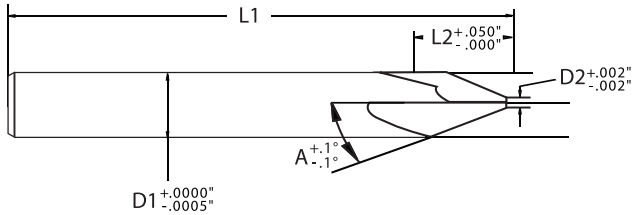
CHAMFER CUTTERS CONICAL™

SERIES CFX - *CARBIDE, 2 & 4 FLUTE, ALTIN-X COATED & UNCOATED*

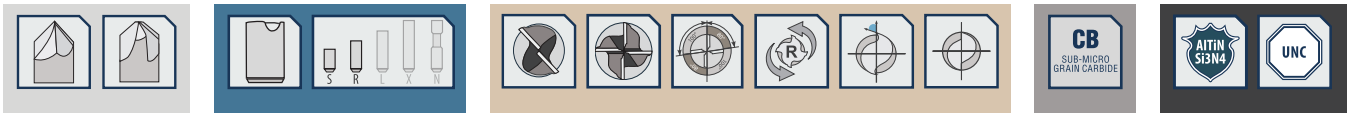
ELIMINATE COSTS

Whether performing an edge break, full chamfer, or eliminating costly hand deburring operations, this tool does the work you need done now.

- Optional coating for heat resistance, wear resistance and increased lubricity
- Premium micro-grain carbide substrate resists chipping, tool deflection, and has a high transverse rupture strength for greater feeds and speeds
- Excellent alternative to hand deburring operations



TIP & END | SHANK & LENGTH | FLUTE CONFIGURATION | MATERIAL | COATING



SERIES CF55D - *55 DEGREE, VARYING LENGTHS*

ANGLE PER SIDE (A)	TIP DIAMETER (D2)	SHANK DIAMETER (D1)		FLUTE LENGTH (L2)	OVERALL LENGTH (L1)		# OF FLUTES	UNCOATED PART #	UNCOATED EDP #	ALTIN/SI3N4 COATED PART #	ALTIN/SI3N4 COATED EDP #
55°	0.010	1/4	0.250	0.088	2 1/2	2.500	2	CF2-5504	7B010	CF2-5504-C4	7B030
	0.010	3/8	0.375	0.131	2 1/2	2.500		CF2-5506	7B020	CF2-5506-C4	7B040
55°	0.010	1/4	0.250	0.088	2 1/2	2.500	4	CF4-5504	8B010	CF4-5504-C4	8B030
	0.010	3/8	0.375	0.131	2 1/2	2.500		CF4-5506	8B020	CF4-5506-C4	8B040

SERIES CF60D - *60 DEGREE, VARYING LENGTHS*

ANGLE PER SIDE (A)	TIP DIAMETER (D2)	SHANK DIAMETER (D1)		FLUTE LENGTH (L2)	OVERALL LENGTH (L1)		# OF FLUTES	UNCOATED PART #	UNCOATED EDP #	ALTIN/SI3N4 COATED PART #	ALTIN/SI3N4 COATED EDP #
60°	0.010	3/16	0.188	0.056	2	2.000	2	CF2-6003	7C010	CF2-6003-C4	7C060
	0.010	1/4	0.250	0.075	2 1/2	2.500		CF2-6004	7C020	CF2-6004-C4	7C070
	0.010	3/8	0.375	0.112	2 1/2	2.500		CF2-6006	7C030	CF2-6006-C4	7C080
	0.010	1/2	0.500	0.150	3	3.000		CF2-6008	7C040	CF2-6008-C4	7C090
	0.010	3/4	0.750	0.225	3	3.000		CF2-6012	7C050	CF2-6012-C4	7C100
60°	0.010	3/16	0.188	0.056	2	2.000	4	CF4-6003	8C010	CF4-6003-C4	8C060
	0.010	1/4	0.250	0.075	2 1/2	2.500		CF4-6004	8C020	CF4-6004-C4	8C070
	0.010	3/8	0.375	0.112	2 1/2	2.500		CF4-6006	8C030	CF4-6006-C4	8C080
	0.010	1/2	0.500	0.150	3	3.000		CF4-6008	8C040	CF4-6008-C4	8C090
	0.010	3/4	0.750	0.225	3	3.000		CF4-6012	8C050	CF4-6012-C4	8C100

SERIES CF65D - *65 DEGREE, VARYING LENGTHS*

ANGLE PER SIDE (A)	TIP DIAMETER (D2)	SHANK DIAMETER (D1)		FLUTE LENGTH (L2)	OVERALL LENGTH (L1)		# OF FLUTES	UNCOATED PART #	UNCOATED EDP #	ALTIN/SI3N4 COATED PART #	ALTIN/SI3N4 COATED EDP #
65°	0.010	1/4	0.250	0.058	2 1/2	2.500	2	CF2-6504	7D010	CF2-6504-C4	7D030
	0.010	3/8	0.375	0.087	2 1/2	2.500		CF2-6506	7D020	CF2-6506-C4	7D040
65°	0.010	1/4	0.250	0.058	2 1/2	2.500	4	CF4-6504	8D010	CF4-6504-C4	8D030
	0.010	3/8	0.375	0.087	2 1/2	2.500		CF4-6506	8D020	CF4-6506-C4	8D040

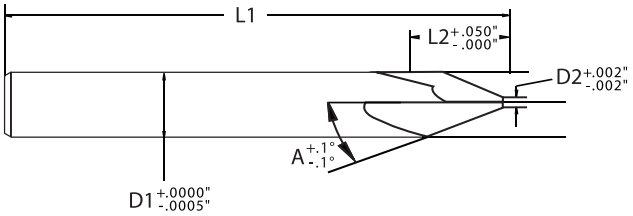
CHAMFER CUTTERS — CONICAL™

SERIES CFX - *CARBIDE, 2 & 4 FLUTE, ALTIN-X COATED & UNCOATED*

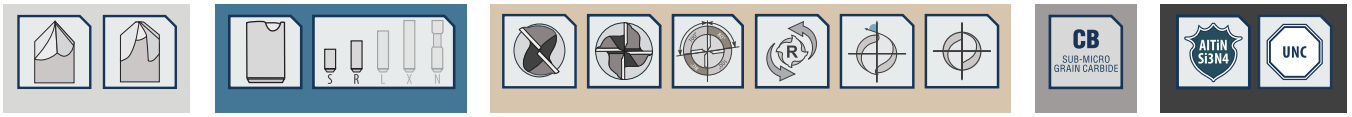
IMPROVED FINISHES AND SPEEDS

Improving the part finish and speed of operation will improve output and quality standards. Multiple configurations make the Conical Chamfer Cutter versatile in the full range of materials.

- Two flute design with positive rake and clearance for aggressive machining in easy to machine materials
- Four high strength flutes, designed with neutral rake and clearance for difficult to machine materials
- Eccentric relief for enhanced edge strength along the flute



TIP & END | SHANK & LENGTH | FLUTE CONFIGURATION | MATERIAL | COATING



SERIES CF70D - *70 DEGREE, VARYING LENGTHS*

ANGLE PER SIDE (A)	TIP DIAMETER (D2)	SHANK DIAMETER (D1)		FLUTE LENGTH (L2)	OVERALL LENGTH (L1)		# OF FLUTES	UNCOATED		ALTIN/SI3N4 COATED	
								PART #	EDP #	PART #	EDP #
70°	0.010	1/4	0.250	0.046	2 1/2	2.500	2	CF2-7004	7E010	CF2-7004-C4	7E030
	0.010	3/8	0.375	0.068	2 1/2	2.500		CF2-7006	7E020	CF2-7006-C4	7E040
70°	0.010	1/4	0.250	0.046	2 1/2	2.500	4	CF4-7004	8E010	CF4-7004-C4	8E030
	0.010	3/8	0.375	0.068	2 1/2	2.500		CF4-7006	8E020	CF4-7006-C4	8E040

SERIES CF75D - *75 DEGREE, VARYING LENGTHS*

ANGLE PER SIDE (A)	TIP DIAMETER (D2)	SHANK DIAMETER (D1)		FLUTE LENGTH (L2)	OVERALL LENGTH (L1)		# OF FLUTES	UNCOATED		ALTIN/SI3N4 COATED	
								PART #	EDP #	PART #	EDP #
75°	0.010	1/4	0.250	0.033	2 1/2	2.500	2	CF2-7504	7F010	CF2-7504-C4	7F030
	0.010	3/8	0.375	0.050	2 1/2	2.500		CF2-7506	7F020	CF2-7506-C4	7F040
75°	0.010	1/4	0.250	0.033	2 1/2	2.500	4	CF4-7504	8F010	CF4-7504-C4	8F030
	0.010	3/8	0.375	0.050	2 1/2	2.500		CF4-7506	8F020	CF4-7506-C4	8F040

CFX APPLICATION GUIDE • SPEED & FEED

	WORK MATERIAL	TYPE OF CUT	AXIAL DOC	RADIAL DOC	FLUTES	SPEED (SFM)	FEED (INCHES PER TOOTH) BASED ON EFFECTIVE CUTTING DIAMETER						
							1/64" (2 & 4 FL)	1/32" (2 & 4 FL)	1/16" (2 & 4 FL)	1/8" (2 & 4 FL)	1/4" (2 & 4 FL)	3/8" (2 & 4 FL)	1/2" (2 & 4 FL)
ALUMINUM	ALUMINUM ALLOYS Low Silicon Content 20xx; 50xx; 60xx; 70xx	Edge Break	1 x D	.3 x D	2 / 4	805 - 1045	0.00013 - 0.00018	0.00025 - 0.00035	0.00047 - 0.00062	0.00106 - 0.00131	0.00206 - 0.00246	0.00322 - 0.00387	0.00425 - 0.00525
		Full Chamfer	1 x D	.1 x D	2 / 4	725 - 940	0.00009 - 0.00014	0.00017 - 0.00027	0.00032 - 0.00047	0.00077 - 0.00102	0.00148 - 0.00188	0.00233 - 0.00298	0.00307 - 0.00407
	ALUMINUM DIE CAST ALLOY High Silicon Content A-38x; A-39x; B39x	Edge Break	1 x D	.3 x D	2 / 4	595 - 770	0.00016 - 0.00021	0.00031 - 0.00041	0.00057 - 0.00072	0.00127 - 0.00152	0.00249 - 0.00289	0.00389 - 0.00454	0.00514 - 0.00614
		Full Chamfer	1 x D	.1 x D	2 / 4	535 - 690	0.00013 - 0.00018	0.00025 - 0.00035	0.00047 - 0.00062	0.00106 - 0.00131	0.00206 - 0.00246	0.00322 - 0.00387	0.00425 - 0.00525
NONFERROUS	MAGNESIUM ALLOYS ≤ 38 HRc	Edge Break	1 x D	.3 x D	2 / 4	1275 - 1650	0.00018 - 0.00023	0.00035 - 0.00045	0.00065 - 0.00080	0.00142 - 0.00167	0.00278 - 0.00318	0.00434 - 0.00499	0.00574 - 0.00674
		Full Chamfer	1 x D	.1 x D	2 / 4	1145 - 1485	0.00015 - 0.00020	0.00029 - 0.00039	0.00054 - 0.00069	0.00120 - 0.00145	0.00235 - 0.00275	0.00367 - 0.00432	0.00485 - 0.00585
	COPPER ALLOYS, BRASS, BRONZE 39 to 48 HRc Manganese Bronze, Tin Bronze, Beryllium Copper	Edge Break	1 x D	.3 x D	2 / 4	380 - 495	0.00014 - 0.00019	0.00027 - 0.00037	0.00050 - 0.00065	0.00113 - 0.00138	0.00220 - 0.00260	0.00345 - 0.00410	0.00455 - 0.00555
		Full Chamfer	1 x D	.1 x D	2 / 4	340 - 445	0.00008 - 0.00013	0.00015 - 0.00025	0.00029 - 0.00044	0.00070 - 0.00095	0.00134 - 0.00174	0.00211 - 0.00276	0.00277 - 0.00377
	COMPOSITES, PLASTICS & FIBERGLASS ABS, Polycarbonate, PVC, Polypropylene	Edge Break	1 x D	.3 x D	2 / 4	645 - 835	0.00013 - 0.00018	0.00025 - 0.00035	0.00047 - 0.00062	0.00106 - 0.00131	0.00206 - 0.00246	0.00322 - 0.00387	0.00425 - 0.00525
		Full Chamfer	1 x D	.1 x D	2 / 4	580 - 750	0.00008 - 0.00013	0.00015 - 0.00025	0.00029 - 0.00044	0.00070 - 0.00095	0.00134 - 0.00174	0.00211 - 0.00276	0.00277 - 0.00377
CARBON STEEL	LOW CARBON STEELS ≤ 38 HRc 10xx; 11xx; 12xx; 12Lxx, 15xx	Edge Break	1 x D	.3 x D	2 / 4	510 - 660	0.00007 - 0.00012	0.00013 - 0.00023	0.00025 - 0.00040	0.00062 - 0.00087	0.00120 - 0.00160	0.00188 - 0.00253	0.00247 - 0.00347c
		Full Chamfer	1 x D	.1 x D	2 / 4	455 - 590	0.00004 - 0.00009	0.00007 - 0.00017	0.00014 - 0.00029	0.00041 - 0.00066	0.00076 - 0.00116	0.00121 - 0.00186	0.00158 - 0.00258
	MEDIUM CARBON STEELS ≤ 38 HRc 13xx; 41xx; 43xx; 86xx, 92xx; 93xx; Chromoly	Edge Break	1 x D	.3 x D	2 / 4	170 - 220	0.00006 - 0.00011	0.00011 - 0.00021	0.00021 - 0.00036	0.00055 - 0.00080	0.00105 - 0.00145	0.00166 - 0.00231	0.00217 - 0.00317
		Full Chamfer	1 x D	.1 x D	2 / 4	150 - 195	0.00003 - 0.00008	0.00006 - 0.00016	0.00012 - 0.00027	0.00037 - 0.00062	0.00069 - 0.00109	0.00110 - 0.00175	0.00143 - 0.00243
TOOL STEEL	TOOL & DIE STEELS ≤ 38 HRc A2; A3; D2; H11; H13; M1; O-1; S-7; NAK 55	Edge Break	1 x D	.3 x D	2 / 4	170 - 220	0.00007 - 0.00012	0.00013 - 0.00023	0.00025 - 0.00040	0.00062 - 0.00087	0.00120 - 0.00160	0.00188 - 0.00253	0.00247 - 0.00347
		Full Chamfer	1 x D	.1 x D	2 / 4	150 - 195	0.00004 - 0.00009	0.00007 - 0.00017	0.00014 - 0.00029	0.00041 - 0.00066	0.00076 - 0.00116	0.00121 - 0.00186	0.00158 - 0.00258
	TOOL & DIE STEELS 39 to 48 HRc P20; P21; S-136; PX-5; NAK 80	Edge Break	1 x D	.3 x D	2 / 4	125 - 165	0.00003 - 0.00008	0.00005 - 0.00015	0.00011 - 0.00026	0.00034 - 0.00059	0.00062 - 0.00102	0.00099 - 0.00164	0.00128 - 0.00228
		Full Chamfer	1 x D	.1 x D	2 / 4	110 - 145	0.00001 - 0.00006	0.00002 - 0.00012	0.00005 - 0.00020	0.00023 - 0.00048	0.00040 - 0.00080	0.00066 - 0.00131	0.00084 - 0.00184
HARDENED STEEL	HARDENED STEELS 48 to 57 HRc	Edge Break	1 x D	.3 x D	2 / 4	85 - 110	0.00006 - 0.00011	0.00011 - 0.00021	0.00021 - 0.00036	0.00055 - 0.00080	0.00105 - 0.00145	0.00166 - 0.00231	0.00217 - 0.00317
		Full Chamfer	1 x D	.1 x D	2 / 4	75 - 95	0.00003 - 0.00008	0.00006 - 0.00016	0.00012 - 0.00027	0.00037 - 0.00062	0.00069 - 0.00109	0.00110 - 0.00175	0.00143 - 0.00243
	HARDENED STEELS 58 to 65HRc	Edge Break	1 x D	.3 x D	2 / 4	75 - 95	0.00003 - 0.00008	0.00005 - 0.00015	0.00011 - 0.00026	0.00034 - 0.00059	0.00062 - 0.00102	0.00099 - 0.00164	0.00128 - 0.00228
		Full Chamfer	1 x D	.1 x D	2 / 4	65 - 85	0.00001 - 0.00006	0.00002 - 0.00012	0.00005 - 0.00020	0.00023 - 0.00048	0.00040 - 0.00080	0.00066 - 0.00131	0.00084 - 0.00184
STAINLESS STEEL	EASY TO MACHINE 72 - 85 HRb 410; 416; 420; 430F; 440C; 302; 303	Edge Break	1 x D	.3 x D	2 / 4	380 - 495	0.00007 - 0.00012	0.00013 - 0.00023	0.00025 - 0.00040	0.00062 - 0.00087	0.00120 - 0.00160	0.00188 - 0.00253	0.00247 - 0.00347
		Full Chamfer	1 x D	.1 x D	2 / 4	340 - 445	0.00004 - 0.00009	0.00007 - 0.00017	0.00014 - 0.00029	0.00041 - 0.00066	0.00076 - 0.00116	0.00121 - 0.00186	0.00158 - 0.00258
	MODERATELY DIFFICULT 79 - 85 HRb; 25 - 41 HRc 304; 304L; 316; 316L; 320; 321; 347; Invar 36; Kovar	Edge Break	1 x D	.3 x D	2 / 4	170 - 220	0.00006 - 0.00011	0.00011 - 0.00021	0.00021 - 0.00036	0.00055 - 0.00080	0.00105 - 0.00145	0.00166 - 0.00231	0.00217 - 0.00317
		Full Chamfer	1 x D	.1 x D	2 / 4	150 - 195	0.00003 - 0.00008	0.00006 - 0.00016	0.00012 - 0.00027	0.00037 - 0.00062	0.00069 - 0.00109	0.00110 - 0.00175	0.00143 - 0.00243
	DIFFICULT TO MACHINE 31 - 50 HRc 13-8 PH; 15-5 PH; 17-4 PH; Carpenter; Custo 465; Invar	Edge Break	1 x D	.3 x D	2 / 4	125 - 165	0.00004 - 0.00009	0.00007 - 0.00017	0.00014 - 0.00029	0.00041 - 0.00066	0.00076 - 0.00116	0.00121 - 0.00186	0.00158 - 0.00258
		Full Chamfer	1 x D	.1 x D	2 / 4	110 - 145	0.00001 - 0.00006	0.00002 - 0.00012	0.00005 - 0.00020	0.00023 - 0.00048	0.00040 - 0.00080	0.00066 - 0.00131	0.00084 - 0.00184
CAST IRON	GRAY 100 - 200 HRb	Edge Break	1 x D	.3 x D	2 / 4	425 - 550	0.00007 - 0.00012	0.00013 - 0.00023	0.00025 - 0.00040	0.00062 - 0.00087	0.00120 - 0.00160	0.00188 - 0.00253	0.00247 - 0.00347
		Full Chamfer	1 x D	.1 x D	2 / 4	380 - 495	0.00004 - 0.00009	0.00007 - 0.00017	0.00014 - 0.00029	0.00041 - 0.00066	0.00076 - 0.00116	0.00121 - 0.00186	0.00158 - 0.00258
	DUCTILE 150 - 300 HRb	Edge Break	1 x D	.3 x D	2 / 4	380 - 495	0.00007 - 0.00012	0.00013 - 0.00023	0.00025 - 0.00040	0.00062 - 0.00087	0.00120 - 0.00160	0.00188 - 0.00253	0.00247 - 0.00347
		Full Chamfer	1 x D	.1 x D	2 / 4	340 - 445	0.00004 - 0.00009	0.00007 - 0.00017	0.00014 - 0.00029	0.00041 - 0.00066	0.00076 - 0.00116	0.00121 - 0.00186	0.00158 - 0.00258
	MALLEABLE 150 - 310 HRb	Edge Break	1 x D	.3 x D	2 / 4	315 - 410	0.00006 - 0.00011	0.00011 - 0.00021	0.00021 - 0.00036	0.00055 - 0.00080	0.00105 - 0.00145	0.00166 - 0.00231	0.00217 - 0.00317
		Full Chamfer	1 x D	.1 x D	2 / 4	285 - 370	-0.00003 - 0.00003	-0.00005 - 0.00005	-0.00008 - 0.00008	-0.00003 - 0.00023	-0.00010 - 0.00030	-0.00013 - 0.00053	-0.00020 - 0.00080
ALLOYS	TITANIUM ALLOYS 70 - 100 HRb; 25 - 36 HRc Ti61AL4V; Grades 5-38	Edge Break	1 x D	.3 x D	2 / 4	100 - 130	0.00003 - 0.00008	0.00005 - 0.00015	0.00011 - 0.00026	0.00034 - 0.00059	0.00062 - 0.00102	0.00099 - 0.00164	0.00128 - 0.00228
		Full Chamfer	1 x D	.1 x D	2 / 4	90 - 115	0.00001 - 0.00006	0.00002 - 0.00012	0.00005 - 0.00020	0.00023 - 0.00048	0.00040 - 0.00080	0.00066 - 0.00131	0.00084 - 0.00184
	HIGH TEMP ALLOYS 83 - 99 HRb; 30 - 52 HRc Inconel; Monel; A286; Rene; Stelite; Haynes; Waspalloy	Edge Break	1 x D	.3 x D	2 / 4	55 - 75	0.00003 - 0.00008	0.00005 - 0.00015	0.00011 - 0.00026	0.00034 - 0.00059	0.00062 - 0.00102	0.00099 - 0.00164	0.00128 - 0.00228
		Full Chamfer	1 x D	.1 x D	2 / 4	50 - 65	0.00001 - 0.00006	0.00002 - 0.00012	0.00005 - 0.00020	0.00023 - 0.00048	0.00040 - 0.00080	0.00066 - 0.00131	0.00084 - 0.00184

CONICAL™ CUTTING TOOLS

GLOBAL™ CUTTING TOOLS

70 YEARS OF INNOVATION

CONICAL™ CARBIDE MINIATURES

SURGICAL PRECISION

Once again, we standardized the performance of micro precision end milling with our Conical Tapered Miniatures. These little tools excel at detailed, tight tolerance machining, to make draft angles and chamfers in all materials.

Consisting of the best micro-grain carbide available and the Conical standard variable geometries, the Conical Tapered Mini's can be used for slotting tapered walls and micro-finishing applications. The size of the core does matter, even for smaller applications. By balancing flute depth and helix angle, we create a stable tool for high speed finishing.

The true value of a tool isn't fully known until the machine is running and you hear it is working properly. When you need to struggle to hear anything at all, you can be assured you have the consistent and smooth engineering of our Conical Tapered Miniature end mill, finishing your parts.

GLOBALLY RENOWNED

Our roster of skilled tool makers and excellent support staff has made the transition from a manufacturer of specialty tapered end mills to a premier manufacturer of high performance cutting tools, seamless. Don't be deceived by our global capacity, we pride ourselves on our ability to benefit all our small business partners, through mutual respect and professionalism.

Global Cutting Tools
Conical Tool Company

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Grand Rapids, MI 49548

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Conical Tool Company products are distributed by:

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Made in the U.S.A.

CONICAL™
CARBIDE MINIATURES

AMERICAN MADE

GLOBALLY RENOWNED

SPECIALTY END MILLS
FOR MICRO PRECISION MACHINING OF DRAFT ANGLES & CHAMFERS

CONICAL™ CUTTING TOOLS

CONICAL™
CARBIDE MINIATURES

MICRO PRECISION MACHINING
IN ALL MATERIALS

FEATURES & BENEFITS

Regardless of their size, these end mills will rapidly and accurately remove material from precision and micro machining operations. The smart vibration dampening geometry, works to demonstrate almost surgical milling. This end mill is perfect for applications ranging from medical instruments to electronics. We persistently refine our engineering and after witnessing the results, one would be hard-pressed to find a better tool.

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CONICAL™
CUTTING TOOLS

SERIES: CCM

For finish milling of draft angles / chamfers and slotting of tapered walls in most materials; wet or dry; from easy to difficult machinability materials.

Standard square end to create sharp corners in finishing operations

Three flute design to balance chip evacuation and tool engagement

Variable lead helix provides increased tool engagement and rigidity

Variable Core Design maximizes chip evacuation and provides increased rigidity when the cutter is fully engaged

Ball end option for high performance contour milling in finishing operations. Available in 24 to 48 hours

Corner radius option protects corners in roughing operations and difficult to machine materials by preventing corner chipping and tool failure. Available in 24 to 48 hours

Premium micro-grain carbide substrate resists chipping, tool deflection, and has a high transverse rupture strength for greater feeds and speeds

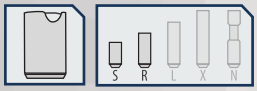
CB SUB-MICRO GRAIN CARBIDE

Uncoated for versatility. More than 16 available coatings can be added to increase tool life for your specific application and material

Universal design allows for a multitude of applications, from slotting to finishing

TIP & END

SHANK & LENGTH



FLUTE CONFIGURATION

MATERIAL

CB SUB-MICRO GRAIN CARBIDE

COATING

UNC

RESULTS

When the workload requires surgical precision, detail and tight tolerances, you can rely on our Conical Tapered Miniatures to be the most finely tuned tools in the industry. Our tapered minis hold tighter tolerances and create a more superior surface finish than traditional micro machining tools. Fabricated from the best performing micro-grain carbide available, the Conical Tapered Miniatures provide the results you need, instead of extra stress you need to avoid.

Series CCM: Micro-Grain Carbide, 3 Flutes, 17 - 22° Variable Lead Helix
Subseries: CM0XD, CM01D CM1XD, CM02D, CM03D, CM05D
Configuration: Varying Angles; Varying Diameters; Stub & Regular Lengths; 17 - 22° Variable Lead Helix; Square End, Corner Radius & Ball End

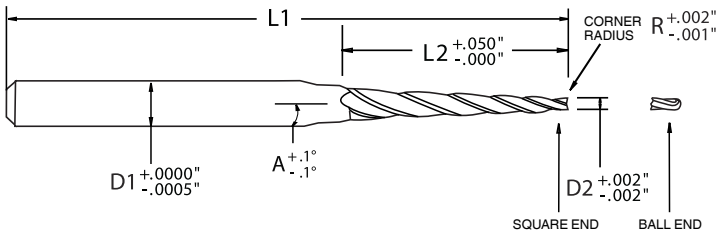
CONICAL TAPERED MINIS

SERIES CCM - *CARBIDE, 3 FLUTE, 17 - 22° VARIABLE LEAD HELIX*

DETAILED, TIGHT TOLERANCE MACHINING

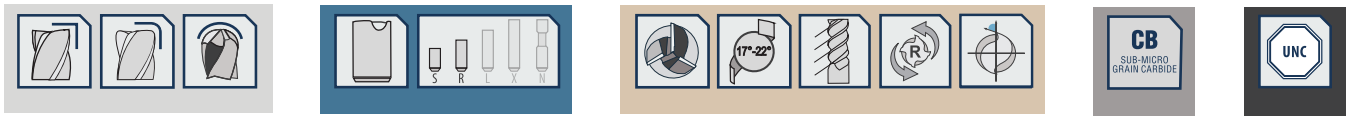
These tools excel at detailed, tight tolerance machining, to make draft angles and chamfers in all materials. Fabricated from the best performing micro- grain carbide available.

- Standard square end to create sharp corners in finishing operations
- Three flute design to balance chip evacuation and tool engagement
- Corner radius option protects corners in roughing operations and difficult to machine materials by preventing corner chipping and tool failure. Available in 24 to 48 hours



To order a corner radius, use code "CR" & actual radius in the part number. For example, a standard AX-203 would be ordered as AX-203-CR-015, with "015" being the radius.

TIP & END | SHANK & LENGTH | FLUTE CONFIGURATION | MATERIAL | COATING



SERIES CM0XD - *½ DEGREE, VARYING LENGTHS*

ANGLE PER SIDE (A)	TIP DIAMETER (D2)		LARGE DIAMETER (D1)	SHANK DIAMETER (D1)		FLUTE LENGTH (L2)		OVERALL LENGTH (L1)		# OF FLUTES	SQUARE END PART #	SQUARE END EDP #	BALL END PART #	BALL END EDP #
.5°	1/32	0.031	0.036	1/8	0.125	1/4	0.250	2 1/2	2.500	3	CM-AX-0001	6Y01S	CM-AX-0001-BE	6Y01B
			0.040			1/2	0.500				CM-AX-0002	6Y02S	CM-AX-0002-BE	6Y02B
	3/64	0.047	0.051	1/8	0.125	1/4	0.250	2 1/2	2.500		CM-AX-011	6Y03S	CM-AX-011-BE	6Y03B
			0.056			1/2	0.500				CM-AX-012	6Y04S	CM-AX-012-BE	6Y04B
	1/16	0.063	0.067	1/8	0.125	1/4	0.250	2 1/2	2.500		CM-AX-001	6Y05S	CM-AX-001-BE	6Y05B
			0.071			1/2	0.500				CM-AX-002	6Y06S	CM-AX-002-BE	6Y06B
			0.076			3/4	0.750				CM-AX-003	6Y07S	CM-AX-003-BE	6Y07B
			0.080			1	1.000				CM-AX-004	6Y08S	CM-AX-004-BE	6Y08B
	5/64	0.078	0.087	1/8	0.125	1/2	0.500	2 1/2	2.500		CM-AX-022	6Y09S	CM-AX-022-BE	6Y09B
			0.091			3/4	0.750				CM-AX-023	6Y10S	CM-AX-023-BE	6Y10B
			0.096			1	1.000				CM-AX-024	6Y11S	CM-AX-024-BE	6Y11B

SERIES CM0XD - *1 DEGREE, VARYING LENGTHS*

ANGLE PER SIDE (A)	TIP DIAMETER (D2)		LARGE DIAMETER (D1)	SHANK DIAMETER (D1)		FLUTE LENGTH (L2)		OVERALL LENGTH (L1)		# OF FLUTES	SQUARE END PART #	SQUARE END EDP #	BALL END PART #	BALL END EDP #
1°	1/32	0.031	0.040	1/8	0.125	1/4	0.250	2 1/2	2.500	3	CM-A-0001	6A01S	CM-A-0001-BE	6A01B
			0.049			1/2	0.500				CM-A-0002	6A02S	CM-A-0002-BE	6A02B
	3/64	0.047	0.056	1/8	0.125	1/4	0.250	2 1/2	2.500		CM-A-011	6A03S	CM-A-011-BE	6A03B
			0.064			1/2	0.500				CM-A-012	6A04S	CM-A-012-BE	6A04B
	1/16	0.063	0.071	1/8	0.125	1/4	0.250	2 1/2	2.500		CM-A-001	6A05S	CM-A-001-BE	6A05B
			0.080			1/2	0.500				CM-A-002	6A06S	CM-A-002-BE	6A06B
			0.089			3/4	0.750				CM-A-003	6A07S	CM-A-003-BE	6A07B
			0.097			1	1.000				CM-A-004	6A08S	CM-A-004-BE	6A08B
	5/64	0.078	0.096	1/8	0.125	1/2	0.500	2 1/2	2.500		CM-A-022	6A09S	CM-A-022-BE	6A09B
			0.104			3/4	0.750				CM-A-023	6A10S	CM-A-023-BE	6A10B
			0.113			1	1.000				CM-A-024	6A11S	CM-A-024-BE	6A11B

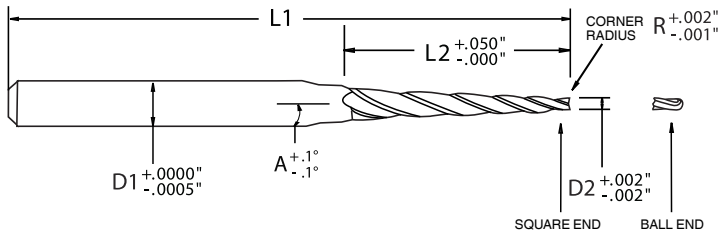
CONICAL TAPERED MINIS

SERIES CCM - *CARBIDE, 3 FLUTE, 17 - 22° VARIABLE LEAD HELIX*

RAPIDLY & ACCURATELY REMOVE MATERIAL

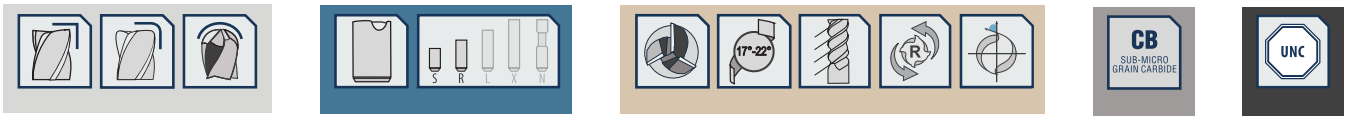
Conical Tapered Minis can be used for slotting tapered walls and microfinishing applications. These end mills will rapidly and accurately remove material from precision and micro machining operations.

- Variable Core Design maximizes chip evacuation and provides increased rigidity when the cutter is fully engaged
- Ball end option for high performance contour milling in finishing operations. Available in 24 to 48 hours
- Variable lead helix provides increased tool engagement and rigidity



To order a corner radius, use code "CR" & actual radius in the part number. For example, a standard AX-203 would be ordered as AX-203-CR-015, with "015" being the radius.

TIP & END | SHANK & LENGTH | FLUTE CONFIGURATION | MATERIAL | COATING



SERIES CM01XD - *1 ½ DEGREE, VARYING LENGTHS*

ANGLE PER SIDE (A)	TIP DIAMETER (D2)		LARGE DIAMETER (D1)	SHANK DIAMETER (D1)		FLUTE LENGTH (L2)		OVERALL LENGTH (L1)		# OF FLUTES	SQUARE END PART #	SQUARE END EDP #	BALL END PART #	BALL END EDP #
1.5°	1/32	0.031	0.044	1/8	0.125	1/4	0.250	2 1/2	2.500	3	CM-AAX-0001	6Z01S	CM-AAX-0001-BE	6Z01B
			0.057			1/2	0.500				CM-AAX-0002	6Z02S	CM-AAX-0002-BE	6Z02B
	3/64	0.047	0.060	1/8	0.125	1/4	0.250	2 1/2	2.500		CM-AAX-011	6Z03S	CM-AAX-011-BE	6Z03B
			0.073			1/2	0.500				CM-AAX-012	6Z04S	CM-AAX-012-BE	6Z04B
	1/16	0.063	0.076	1/8	0.125	1/4	0.250	2 1/2	2.500		CM-AAX-001	6Z05S	CM-AAX-001-BE	6Z05B
			0.089			1/2	0.500				CM-AAX-002	6Z06S	CM-AAX-002-BE	6Z06B
			0.102			3/4	0.750				CM-AAX-003	6Z07S	CM-AAX-003-BE	6Z07B
			0.115	3/16	0.188	1	1.000	3	3.000		CM-AAX-004	6Z08S	CM-AAX-004-BE	6Z08B
	5/64	0.078	0.104	1/8	0.125	1/2	0.500	2 1/2	2.500		CM-AAX-022	6Z09S	CM-AAX-022-BE	6Z09B
			0.117			3/4	0.750				CM-AAX-023	6Z10S	CM-AAX-023-BE	6Z10B
			0.130	3 /16	0.188	1	1.000	3	3.000		CM-AAX-024	6Z11S	CM-AAX-024-BE	6Z11B

SERIES CM02D - *2 DEGREE, VARYING LENGTHS*

ANGLE PER SIDE (A)	TIP DIAMETER (D2)		LARGE DIAMETER (D1)	SHANK DIAMETER (D1)		FLUTE LENGTH (L2)		OVERALL LENGTH (L1)		# OF FLUTES	SQUARE END PART #	SQUARE END EDP #	BALL END PART #	BALL END EDP #
2°	1/32	0.031	0.049	1/8	0.125	1/4	0.250	2 1/2	2.500	3	CM-B-0001	6B01S	CM-B-0001-BE	6B01B
			0.066			1/2	0.500				CM-B-0002	6B02S	CM-B-0002-BE	6B02B
	3/64	0.047	0.064	1/8	0.125	1/4	0.250	2 1/2	2.500		CM-B-011	6B03S	CM-B-011-BE	6B03B
			0.082			1/2	0.500				CM-B-012	6B04S	CM-B-012-BE	6B04B
	1/16	0.063	0.080	1/8	0.125	1/4	0.250	2 1/2	2.500		CM-B-001	6B05S	CM-B-001-BE	6B05B
			0.097			1/2	0.500				CM-B-002	6B06S	CM-B-002-BE	6B06B
			0.115			3/4	0.750				CM-B-003	6B07S	CM-B-003-BE	6B07B
			0.132	3/16	0.188	1	1.000	3	3.000		CM-B-004	6B08S	CM-B-004-BE	6B08B
	5/64	0.078	0.113	1/8	0.125	1/2	0.500	2 1/2	2.500		CM-B-022	6B09S	CM-B-022-BE	6B09B
			0.131	3/16	0.188	3/4	0.750	3	3.000		CM-B-023	6B10S	CM-B-023-BE	6B10B
			0.148			1	1.000				CM-B-024	6B11S	CM-B-024-BE	6B11B

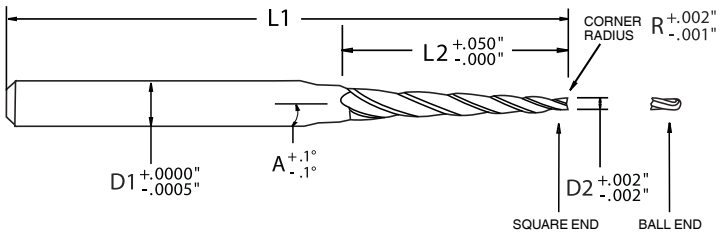
CONICAL TAPERED MINIS

SERIES CCM - *CARBIDE, 3 FLUTE, 17 - 22° VARIABLE LEAD HELIX*

VIBRATION DAMPENING GEOMETRY

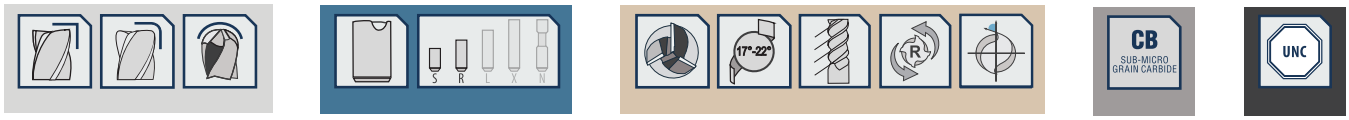
The smart vibration dampening geometry, works to demonstrate almost surgical milling. This end mill is perfect for applications ranging from medical instruments to electronics.

- Premium micro-grain carbide substrate resists chipping, tool deflection, and has a high transverse rupture strength for greater feeds and speeds
- Uncoated for versatility. More than 16 available coatings can be added to increase tool life for your specific application and material
- Universal design allows for a multitude of applications, from slotting to finishing



To order a corner radius, use code "CR" & actual radius in the part number. For example, a standard AX-203 would be ordered as AX-203-CR-015, with "015" being the radius.

TIP & END | SHANK & LENGTH | FLUTE CONFIGURATION | MATERIAL | COATING



SERIES CM03D - *3 DEGREE, VARYING LENGTHS*

ANGLE PER SIDE (A)	TIP DIAMETER (D2)		LARGE DIAMETER (D1)	SHANK DIAMETER (D1)		FLUTE LENGTH (L2)		OVERALL LENGTH (L1)		# OF FLUTES	SQUARE END PART #	SQUARE END EDP #	BALL END PART #	BALL END EDP #
3°	1/32	0.031	0.057	1/8	0.125	1/4	0.250	2 1/2	2.500	3	CM-C-0001	6C01S	CM-C-0001-BE	6C01B
			0.084			1/2	0.500				CM-C-0002	6C02S	CM-C-0002-BE	6C02B
	3/64	0.047	0.073	1/8	0.125	1/4	0.250	2 1/2	2.500		CM-C-011	6C03S	CM-C-011-BE	6C03B
			0.099			1/2	0.500				CM-C-012	6C04S	CM-C-012-BE	6C04B
	1/16	0.063	0.115	1/8	0.125	1/2	0.500	2 1/2	2.500		CM-C-001	6C05S	CM-C-001-BE	6C05B
			0.115			1/2	0.500				CM-C-002	6C06S	CM-C-002-BE	6C06B
			0.141	3/16	0.188	3/4	0.750	3	3.000		CM-C-003	6C07S	CM-C-003-BE	6C07B
			0.167			1	1.000				CM-C-004	6C08S	CM-C-004-BE	6C08B
	5/64	0.078	0.131	3/16	0.188	1/2	0.500	3	3		CM-C-022	6C09S	CM-C-022-BE	6C09B
			0.157			3/4	0.750				CM-C-023	6C10S	CM-C-023-BE	6C10B
			0.183			1	1.000				CM-C-024	6C11S	CM-C-024-BE	6C11B

SERIES CM05D - *5 DEGREE, VARYING LENGTHS*

ANGLE PER SIDE (A)	TIP DIAMETER (D2)		LARGE DIAMETER (D1)	SHANK DIAMETER (D1)		FLUTE LENGTH (L2)		OVERALL LENGTH (L1)		# OF FLUTES	SQUARE END PART #	SQUARE END EDP #	BALL END PART #	BALL END EDP #
5°	1/32	0.031	0.075	1/8	0.125	1/4	0.250	2 1/2	2.500	3	CM-E-0001	6E01S	CM-E-0001-BE	6E01B
			0.119	3/16	0.188	1/2	0.500	3	3.000		CM-E-0002	6E02S	CM-E-0002-BE	6E02B
	3/64	0.047	0.091	1/8	0.125	1/4	0.250	2 1/2	2.500		CM-E-011	6E03S	CM-E-011-BE	6E03B
			0.134	3/16	0.188	1/2	0.500	3	3.000		CM-E-012	6E04S	CM-E-012-BE	6E04B
	1/16	0.063	0.106	1/8	0.125	1/4	0.250	2 1/2	2.500		CM-E-001	6E05S	CM-E-001-BE	6E05B
			0.150			1/2	0.500				CM-E-002	6E06S	CM-E-002-BE	6E06B
			0.194	1/4	0.250	3/4	0.750	2 1/2	2.500		CM-E-003	6E07S	CM-E-003-BE	6E07B
			0.237			1	1.000				CM-E-004	6E08S	CM-E-004-BE	6E08B
	5/64	0.078	0.166	3/16	0.188	1/2	0.500	3	3.000		CM-E-022	6E09S	CM-E-022-BE	6E09B
			0.209	1/4	0.250	3/4	0.750	2 1/2	2.500		CM-E-023	6E10S	CM-E-023-BE	6E10B
			0.253	3/8	0.375	1	1.000				CM-E-024	6E11S	CM-E-024-BE	6E11B

CONICAL™
AUTOMOTIVE TAPERS

AMERICAN MADE

GLOBALLY RENOWNED

SPECIALTY END MILLS

FOR ROUGHING AND REAMING OF BALL JOINTS & TIE ROD ENDS

CONICAL™ CUTTING TOOLS

CONICAL™
AUTOMOTIVE TAPERS

ROUGHING & REAMING

BALL JOINTS AND TIE ROD ENDS

FEATURES & BENEFITS

We designed our Conical Automotive Tapers with a left hand spiral and right hand cut, to get the most out of the high speed steel and create a superior surface finish. The addition of a cylindrical land design creates a smooth cutting tool that can handle the needs of the automotive industry. We pride ourselves on being an expert resource, to all our partners and industries, with results that can be reproduced without exception.

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Grand Rapids, MI 49548

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F: (616) 531-7742
E: info@conicaltool.com

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E: sales@conicaltool.com

Custom Tooling:
E: quotes@conicaltool.com
W: conicalendmills.com/custom-tool-ordering

CONICAL™
CUTTING TOOLS

SERIES: ATX

For milling of ball joints and tie rod internal diameter holes; ferrous materials.

Four flute design to balance and improve tool engagement in hardened materials

Premium high speed steel improves rigidity, hardness and wear resistance for milling of easy to machine materials

Cylindrical land for excellent surface finishes

No end cut to increase tool stability and edge strength

Uncoated for versatility. More than 16 available coatings can be added to increase tool life for your specific application and material

Variable Core Design maximizes chip evacuation and provides increased rigidity when the cutter is fully engaged

TIP & END

SHANK & LENGTH

S R L X N

FLUTE CONFIGURATION

12°

R

MATERIAL

HSS HIGH SPEED STEEL

COATING

UNC

RESULTS

Designed for reaming ball joints and tie rod ends, the left hand spiral and right hand cut end mills, offer a slow spiral to avoid grabbing the material, while milling the intended area. At 1-1/2 Taper Per Foot, these tapered end mills are used on “through holes” or “predrilled holes” for heavy construction vehicles, recreational vehicles (ATVs), buses, snowmobiles and golf carts. The simple fact is our end mills are astonishingly effective and leave no need for us to make claims when the results are irrefutable.

Series ATX: Premium High Speed Steel, 4 Flute, 12° Left Hand Slow Helix
Subseries: ATX
Configuration: 1.5” Taper Per Foot, Varying Diameters, Regular & Long Length, 12° Left Hand Spiral, Right Hand Cut; Cylindrical Land; No End Cut

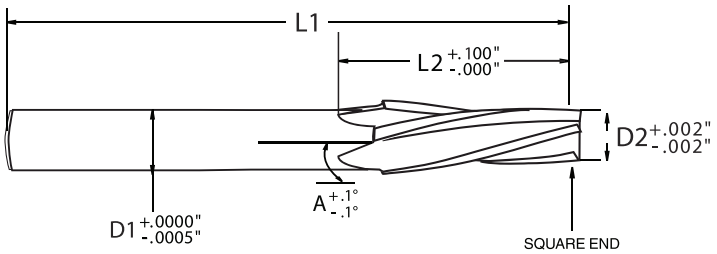
AUTOMOTIVE TAPERS CONICAL™

SERIES ATX - *HIGH SPEED STEEL, 4 FLUTE, 12° LEFT HAND SLOW HELIX*

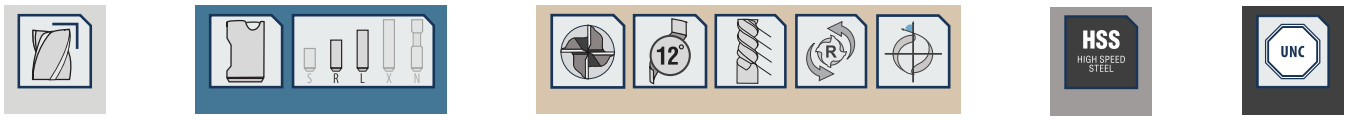
SMOOTH CUTTING

A cylindric land design creates a smooth cutting tool that can handle the needs of the automotive industry. They offer a slow spiral to avoid grabbing the material. Used for heavy construction vehicles, recreational vehicles (ATVs), buses, snowmobiles and golf carts.

- Tapered Neck provides increased rigidity and strength
- Use for milling or sinking dies or mold cavities
- Increase shank diameter for better strength
- Special flute design provides faster cutting



TIP & END | SHANK & LENGTH | FLUTE CONFIGURATION | MATERIAL | COATING



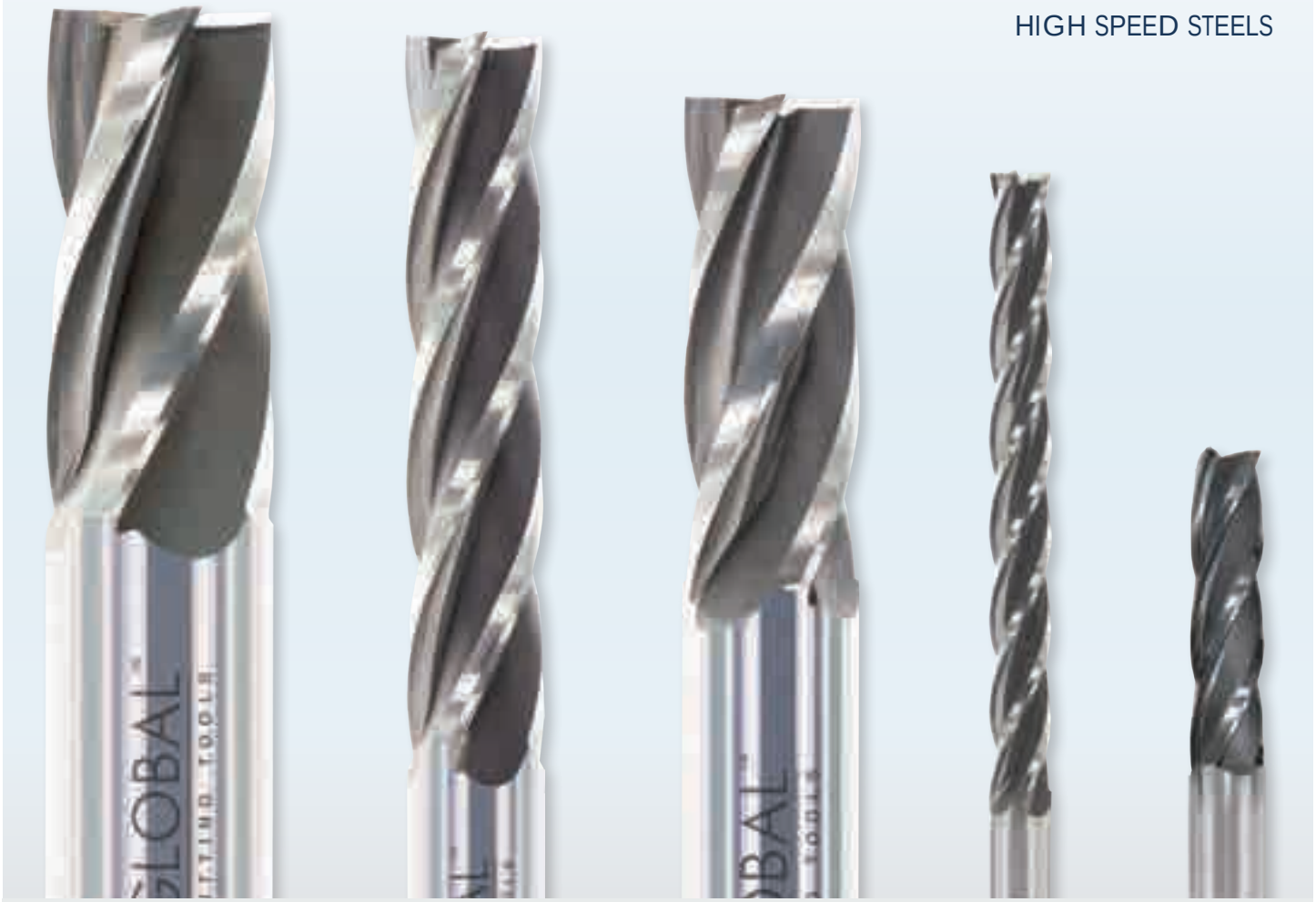
SERIES ATX - *1.5" TAPER/FT, REGULAR & LONG LENGTHS*

ANGLE PER SIDE (A)	TIP DIAMETER (D2)		LARGE DIAMETER (D1)	SHANK DIAMETER (D1)		FLUTE LENGTH (L2)		OVERALL LENGTH (L1)		# OF FLUTES	SQUARE END PART #	SQUARE END EDP #
3° 34'35" 1.5" Taper Per Foot	3/8	0.375	0.625	1/2	0.500	2	2.000	4 3/8	4.375	4	AT-608	4Z01S
			0.875	3/4	0.750	4	4.000	6 5/8	6.625		⊙ AT-616	4Z02S
	1/2	0.500	0.750	1/2	0.500	2	2.000	4 3/8	4.375		AT-808	4Z03S
			1.000	3/4	0.750	4	4.000	6 5/8	6.625		⊙ AT-816	4Z04S
	5/8	0.625	0.875	3/4	0.750	2	2.000	4 5/8	4.625		⊙ AT-1008	4Z05S
			1.125	1	1.000	4	4.000	6 7/8	6.875		⊙ AT-1016	4Z06S
	3/4	0.750	1.000	3/4	0.750	2	2.000	4 5/8	4.625		⊙ AT-1208	4Z07S
			1.250	1	1.000	4	4.000	6 7/8	6.875		⊙ AT-1216	4Z08S
	7/8	0.875	1.125	1	1.000	2	2.000	4 7/8	4.875		⊙ AT-1408	4Z09S
			1.375	1 1/4	1.250	4	4.000	6 7/8	6.875		⊙ AT-1416	4Z10S
	1	1.000	1.250	1	1.000	2	2.000	4 7/8	4.875		⊙ AT-1608	4Z11S
			1.500	1 1/4	1.250	4	4.000	6 7/8	6.875		⊙ AT-1616	4Z12S

⊙ indicates center hole in tip

10 GENERAL PURPOSE END MILLS

WE USE SUPERIOR GRADE
HIGH SPEED STEELS



Our end mills offer maximum core diameters, smooth finishes, better accuracy and unrelenting stability.

Any one, or combination, of these attributes can be enhanced through innovative engineering, which makes it possible for our customers to cut costs substantially.

QUALITY

Our general purpose end mills use the finest grade high speed steel, rather than trying to cut our costs. We build value into our tools, which ultimately reduces costs for our customers. Our integrity promotes quality, and in turn passes the savings onto you.

VALUE

We pride ourselves on not only being an expert resource for your tooling needs, but in being a fair and honest partner in building value through the entire supply chain. We have been helping leading companies across the world increase quality and reduce cycle times for decades.

(888) 531.8500 | info@conicaltool.com | www.conicalendmills.com

CONICAL™ CUTTING TOOLS

GLOBAL™ CUTTING TOOLS

MANUFACTURING FOR OVER 70 YEARS 1944 - 2014

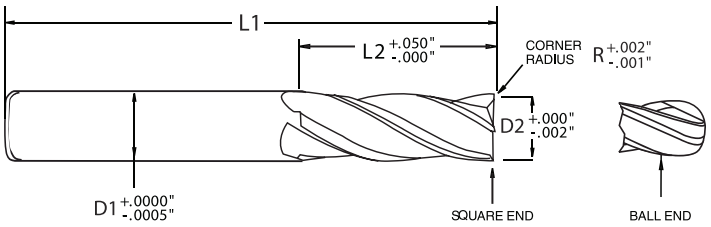
GENERAL PURPOSE GLOBAL™

SERIES SL - *HIGH SPEED STEEL, 4 FLUTE, 30° CONSTANT HELIX*

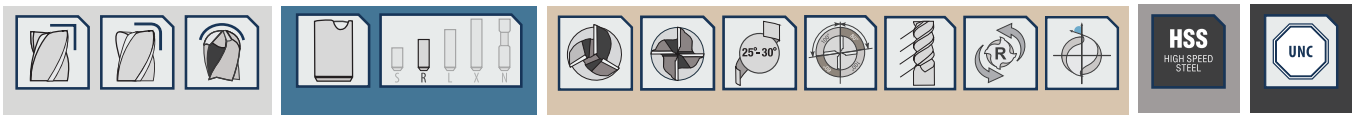
VERSATILITY

Our tools have been used in every application imaginable, from sculptural ice carving to precision manufacturing of custom nuclear reactor parts.

- Square end to create sharp corners in finishing operations
- Premium high speed steel improves rigidity, hardness and wear resistance for milling of easy to machine materials
- Uncoated for versatility. More than 16 available coatings can be added to increase tool life for your specific application and material



TIP & END | SHANK & LENGTH | FLUTE CONFIGURATION | MATERIAL | COATING



SERIES SL - *SQUARE END, VARYING LENGTHS*

DIAMETER				LENGTH				FLUTES	SQUARE END		BALL END	
TIP SIZE (D2)		SHANK (D1)		OF CUT (L2)		OVERALL (L1)			PART #	EDP #	PART #	EDP #
1/8	0.125	3/8	0.375	3/8	0.375	2 5/8	2.625	3	SL-201	0S01S	SL-201-BE	0S01B
				3/4	0.750	2 7/8	2.875	3	SL-203	0S02S	SL-203-BE	0S02B
3/16	0.188	3/8	0.375	1/2	0.500	2 5/8	2.625	3	SL-302	0S03S	SL-302-BE	0S03B
				1 1/4	1.250	3 1/4	3.250	3	SL-305	0S04S	SL-305-BE	0S04B
1/4	0.250	3/8	0.375	3/4	0.750	2 5/8	2.625	3	SL-401	0S05S	SL-401-BE	0S05B
				1 1/4	1.250	3 1/4	3.250	3	SL-405	0S06S	SL-405-BE	0S06B
				2 1/4	2.250	4	4.000	4	SL-409	0S07S	SL-409-BE	0S07B
3/8	0.375	3/8	0.375	1	1.000	2 7/8	2.875	3	SL-601	0S08S	SL-601-BE	0S08B
				1 1/2	1.500	3 1/4	3.250	3	SL-602	0S09S	SL-602-BE	0S09B
				3	3.000	4 3/4	4.750	4	SL-603	0S10S	SL-603-BE	0S10B
1/2	0.500	1/2	0.500	1	1.000	3	3.000	3	SL-801	0S11S	SL-801-BE	0S11B
				2	2.000	4	4.000	4	SL-802	0S12S	SL-802-BE	0S12B
				3	3.000	5	5.000	4	SL-803	0S13S	SL-803-BE	0S13B
				4	4.000	6	6.000	4	⊙ SL-804	0S14S	SL-804-BE	0S14B
				5	5.000	7	7.000	4	⊙ SL-805	0S15S	SL-805-BE	0S15B
5/8	0.625	5/8	0.625	1 1/2	1.500	5 5/8	5.625	4	⊙ SL-1015	0S16S	SL-1015-BE	0S16B
				2	2.000	4 1/8	4.125	4	⊙ SL-1002	0S17S	SL-1002-BE	0S17B
				3	3.000	5 1/8	5.125	4	⊙ SL-1003	0S18S	SL-1003-BE	0S18B
				4	4.000	6 1/8	6.125	4	⊙ SL-1004	0S19S	SL-1004-BE	0S19B
				5	5.000	7 1/8	7.125	4	⊙ SL-1005	0S20S	SL-1005-BE	0S20B

⊙ indicates center hole in tip

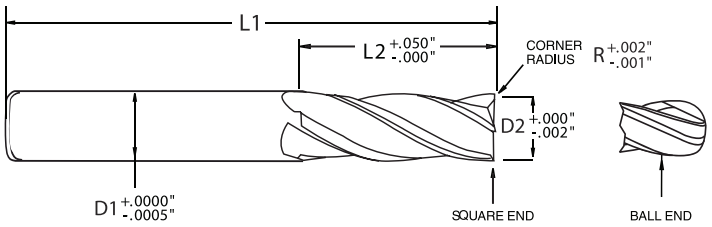
GENERAL PURPOSE GLOBAL™

SERIES SL - *HIGH SPEED STEEL, 4 FLUTE, 30° CONSTANT HELIX*

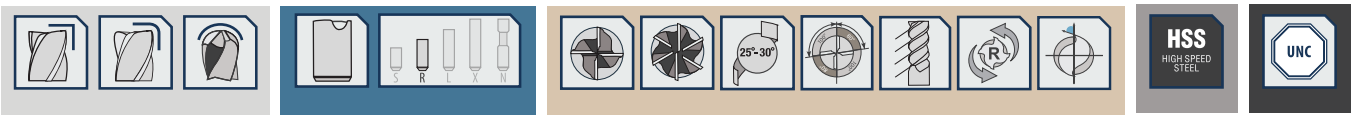
INNOVATION IN ENGINEERING

We have decided that innovation is the future. We have added new tooling lines, new products, smaller tooling, and more high-tech tooling. Moving forward with CNC machining centers and equipment to keep up with new technologies. Your future is ours as well.

- Ball end option for high performance contour milling in finishing operations. Available in 24 to 48 hours
- Corner radius option protects corners in roughing operations and difficult to machine materials by preventing corner chipping and tool failure. Available in 24 to 48 hours
- Square end to create sharp corners in finishing operations



TIP & END | SHANK & LENGTH | FLUTE CONFIGURATION | MATERIAL | COATING



SERIES SL - *SQUARE END, VARYING LENGTHS*

DIAMETER				LENGTH				FLUTES	SQUARE END		BALL END	
TIP SIZE (D2)		SHANK (D1)		OF CUT (L2)		OVERALL (L1)			PART #	EDP #	PART #	EDP #
3/4	0.750	3/4	0.750	2	2.000	4 1/4	4.250	4	⊙ SL-1202	0S21S	SL-1202-BE	0S21B
				3	3.000	5 1/4	5.250	4	⊙ SL-1203	0S22S	SL-1203-BE	0S22B
				4	4.000	6 1/4	6.250	4	⊙ SL-1204	0S23S	SL-1204-BE	0S23B
				5	5.000	7 1/4	7.250	4	⊙ SL-1205	0S24S	SL-1205-BE	0S24B
				6	6.000	8 1/4	8.250	4	⊙ SL-1206	0S25S	SL-1206-BE	0S25B
1	1.000	1	1.000	2	2.000	4 1/2	4.500	4	⊙ SL-1602	0S26S	SL-1602-BE	0S26B
				3	3.000	5 1/2	5.500	4	⊙ SL-1603	0S27S	SL-1603-BE	0S27B
				4	4.000	6 1/2	6.500	4	⊙ SL-1604	0S28S	SL-1604-BE	0S28B
				3	3.000	8 1/2	8.500	4	⊙ SL-1606	0S29S	SL-1606-BE	0S29B
1 1/4	1.250	1 1/4	1.250	2	2.000	4 1/2	4.500	4	⊙ SL-2002	0S30S	SL-2002-BE	0S30B
				3	3.000	5 1/2	5.500	4	⊙ SL-2003	0S31S	SL-2003-BE	0S31B
				5	5.000	7 1/2	7.500	4	⊙ SL-2005	0S32S	SL-2005-BE	0S32B
				7	7.000	9 1/2	9.500	4	⊙ SL-2007	0S33S	SL-2007-BE	0S33B
1 1/2	1.500	1 1/4	1.250	3	3.000	5 1/2	5.500	6	⊙ SL-2403	0S34S	SL-2403-BE	0S34B
				4	4.000	6 1/2	6.500	6	⊙ SL-2404	0S35S	SL-2404-BE	0S35B
				5	5.000	7 1/2	7.500	6	⊙ SL-2405	0S36S	SL-2405-BE	0S36B
				7	7.000	9 1/2	9.500	6	⊙ SL-2407	0S37S	SL-2407-BE	0S37B

⊙ indicates center hole in tip

CUSTOM TOOL ORDERING

TO SOLVE MACHINING CHALLENGES

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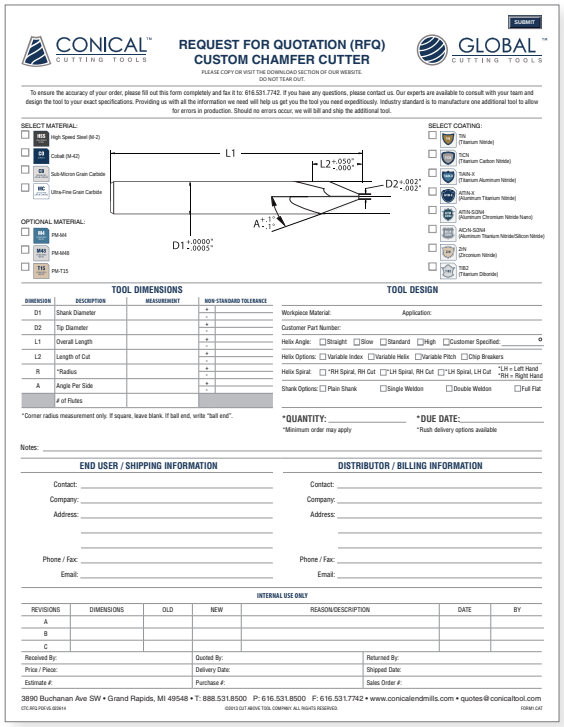
Along with our standard tool offerings, Conical Tool Company manufactures custom carbide and high speed steel end mills and cutters. Whether a variation of a standard tool or specialized tool meant to combine multiple processes into one pass, our custom tools improve performance and reduce cycle time at the best value in the industry.



CONICAL™ CUTTING TOOLS

REQUEST FOR QUOTATION (RFQ)
CUSTOM CHAMFER CUTTER

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GLOBAL™ CUTTING TOOLS

SUBMIT

To ensure the accuracy of your order, please fill out this form completely and fax it to: 616.531.7742. If you have any questions, please contact us. Our experts are available to consult with your team and design the tool to your exact specifications. Providing us with all the information we need will help us get you the tool you need expeditiously. Industry standard is to manufacture one additional tool to allow for errors in production. Should no errors occur, we will bill and ship the additional tool.

SELECT MATERIAL:
- HSS — High Speed Steel (M-2)
- C8 — Cobalt (M-42)
- C9 — Sub-Micron Grain Carbide
- MC — Ultra-Fine Grain Carbide

OPTIONAL MATERIAL:
- P20 — PM-M4
- M40 — PM-M48
- T15 — PM-T15

L1
L2 +.050" -.000"
D2 +.002" -.002"
A +1° -1°
D1 +.0000" -.0005"

SELECT COATING:
- TiN — (Titanium Nitride)
- TiCN — (Titanium Carbon Nitride)
- TiAlN-X — (Titanium Aluminum Nitride)
- AlTiN-X — (Aluminum Titanium Nitride)
- AlTiN-S2N4 — (Aluminum Chromium Nitride Nano)
- AlCrN-S2N4 — (Aluminum Titanium Nitride/Silicon Nitride)
- ZrN — (Zirconium Nitride)
- TiB2 — (Titanium Diboride)

TOOL DIMENSIONS

DIMENSION	DESCRIPTION	MEASUREMENT	NON-STANDARD TOLERANCE
D1	Shank Diameter		
D2	Tip Diameter		
L1	Overall Length		
L2	Length of Cut		
R	*Radius		
A	Angle Per Side		
	# of Flutes		

*Corner radius measurement only. If square, leave blank. If ball end, write "ball end".

TOOL DESIGN

Workpiece Material: Application:
Customer Part Number:
Helix Angle: ☐Straight ☐Slow ☐Standard ☐High ☐Customer Specified: °
Helix Options: ☐Variable Index ☐Variable Helix ☐Variable Pitch ☐Chip Breakers
Helix Spiral: ☐*RH Spiral, RH Cut ☐*LH Spiral, RH Cut ☐*LH Spiral, LH Cut *LH = Left Hand *RH = Right Hand
Shank Options: ☐Plain Shank ☐Single Weldon ☐Double Weldon ☐Full Flat

*QUANTITY: _____ *DUE DATE: _____
*Minimum order may apply *Rush delivery options available

Notes: _____

END USER / SHIPPING INFORMATION

Contact: _____
Company: _____
Address: _____
Phone / Fax: _____
Email: _____

DISTRIBUTOR / BILLING INFORMATION

Contact: _____
Company: _____
Address: _____
Phone / Fax: _____
Email: _____

INTERNAL USE ONLY

REVISIONS	DIMENSIONS	OLD	NEW	REASON/DESCRIPTION	DATE	BY
A						
B						
C						

Received By:	Quoted By:	Returned By:
Price / Piece:	Delivery Date:	Shipped Date:
Estimate #:	Purchase #:	Sales Order #:

3890 Buchanan Ave SW • Grand Rapids, MI 49548 • T: 888.531.8500 P: 616.531.8500 F: 616.531.7742 • www.conicalendmills.com • quotes@conicaltool.com

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REQUEST FOR QUOTE

We can modify our standard tools or manufacture a highly specialized tool to your exact specifications. Request for Quote documents for custom tools are on the following pages. We cannot process your quote without this form. RFQ's are typically returned within 24 hours. A full list of definitions and acronyms can be found on pages 80-81. If you need assistance with your custom tool design or have any questions, please contact us.

MANUFACTURING FOR OVER 70 YEARS 1944 - 2014

11 RAW MATERIALS

PREMIUM CARBIDE GRADES AND TABLES

The raw material that is used to manufacture your tool is just as important as the design of the tool itself. By using inferior materials, the tool life will be significantly decreased.

We will never try to profit by using sub-par materials. We put 100% into every tool and the results speak for themselves.

RESOURCE

We offer a variety of carbide for you to purchase directly from us, which is yet another way we strive to be your preferred go to resource. We would be happy to discuss your purchase and help you determine the grade of carbide needed.

VALUE

We offer only the highest quality carbide available on the market today. We won't waste your time with inferior materials. We understand the value of quality and performance, and use these grades to manufacture our own high performance cutting tools.

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PREMIUM CARBIDE SELECTION CHARTS

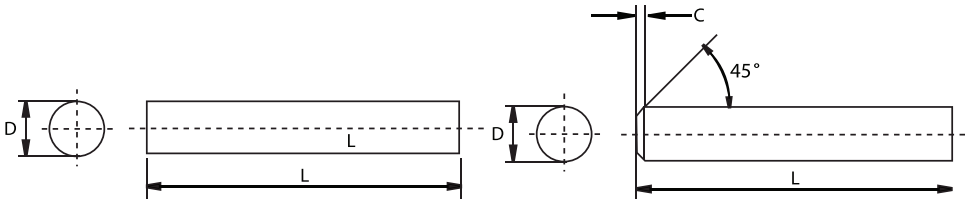
PRECISION GROUND ROD, CUT TO LENGTH

INCH SIZES 1/16" TO 1-1/4" DIAMETER, H6 TOLERANCE

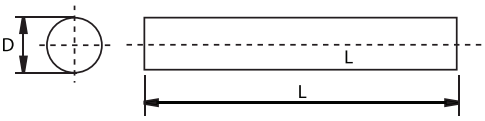
FRACTIONAL SIZE	DIMENSIONS (INCHES)			DESCRIPTION	SUBMICRON / 10% COBALT		COMPLEMENTARY GRADES W/ CHAMFER		
D X L	D	L	C		W/ CHAMFER	W/O CHAMFER	ULTRAFINE / 8% CO	SUBMICRON / 6% CO	ULTRAFINE / 12% CO
1/16 x 1-1/2	0.0625	1.5000		0.0625 x 1.5000		505058			
5/64 x 1-3/4	0.0781	1.7500		0.0781 x 1.7500		505068			
3/32 x 2	0.0937	2.0000		0.0937 x 2.0000		505069			
3/32 x 3	0.0937	3.0000		0.0937 x 3.0000		505039			
3/32 x 4	0.0937	4.0000		0.0937 x 4.0000		505040			
7/64 x 2-1/4	0.1093	2.2500		0.1093 x 2.2500		505070			
1/8 x 1-1/2	0.1250	1.5000	0.015	0.1250 x 1.5000	505115	505000	503095		
1/8 x 2	0.1250	2.0000	0.015	0.1250 x 2.0000	505109	505001	503096	505305	505511
1/8 x 2-1/4	0.1250	2.2500	0.015	0.1250 x 2.2500	503075	505087			
1/8 x 2-1/2	0.1250	2.5000	0.015	0.1250 x 2.5000	505101	505002			505541
1/8 x 3	0.1250	3.0000	0.015	0.1250 x 3.0000	505154	505004			505514
1/8 x 4	0.1250	4.0000	0.015	0.1250 x 4.0000	505111	505005			
1/8 x 6	0.1250	6.0000		0.1250 x 6.0000		505010			
9/64 x 2-1/2	0.1406	2.5000		0.1406 x 2.5000		505071			
9/64 x 3	0.1406	3.0000		0.1406 x 3.0000		503009			
5/32 x 2	0.1562	2.0000		0.1562 x 2.0000		503008			
5/32 x 2-1/2	0.1562	2.5000		0.1562 x 2.5000		505146			
5/32 x 3	0.1562	3.0000		0.1562 x 3.0000		505011			
5/32 x 3-1/2	0.1562	3.5000		0.1562 x 3.5000		505033			
5/32 x 4	0.1562	4.0000		0.1562 x 4.0000		505021			
11/64 x 2-3/4	0.1718	2.7500		0.1718 x 2.7500		505072			
11/64 x 6-1/2	0.1718	6.5000		0.1718 x 6.5000		505220			
3/16 x 1-1/2	0.1875	1.5000		0.1875 x 1.5000		505012			
3/16 x 2	0.1875	2.0000	0.015	0.1875 x 2.0000	505123	505013			505515
3/16 x 2-1/2	0.1875	2.5000	0.015	0.1875 x 2.5000	503182	505014		505396	505517
3/16 x 2-3/4	0.1875	2.7500	0.015	0.1875 x 2.7500	505141				
3/16 x 3	0.1875	3.0000	0.015	0.1875 x 3.0000	503183	505016			505165
3/16 x 4	0.1875	4.0000		0.1875 x 4.0000		505076			
3/16 x 6	0.1875	6.0000		0.1875 x 6.0000		505015			
13/64 x 3	0.2031	3.0000		0.2031 x 3.0000		505149			
7/32 x 2-1/2	0.2187	2.5000		0.2187 x 2.5000		505405			
7/32 x 3	0.2187	3.0000		0.2187 x 3.0000		505150			
15/64 x 3-1/4	0.2343	3.2500		0.2343 x 3.2500		505094			
1/4 x 1-1/2	0.2500	1.5000	0.015	0.2500 x 1.5000	505103	505003			
1/4 x 2	0.2500	2.0000	0.015	0.2500 x 2.0000	505107	505007		505307	505507
1/4 x 2-1/2	0.2500	2.5000	0.015	0.2500 x 2.5000	505124	505009	503185	505324	505524
1/4 x 3	0.2500	3.0000	0.015	0.2500 x 3.0000	505125	50517	503186	505325	505519
1/4 x 3-1/4	0.2500	3.2500	0.015	0.2500 x 3.2500	505197				
1/4 x 3-1/2	0.2500	3.5000	0.015	0.2500 x 3.5000	502024	505098		505326	
1/4 x 4	0.2500	4.0000	0.015	0.2500 x 4.0000	505163	505075	503187	505350	505549
1/4 x 6	0.2500	6.0000	0.015	0.2500 x 6.0000	505212	505073	503189	505352	
1/4 x 6-1/2	0.2500	6.5000		0.2500 x 6.5000		505221			
17/64 x 3-1/2	0.2656	3.5000		0.2656 x 3.5000		505097			
9/32 x 3-1/2	0.2812	3.5000		0.2812 x 3.5000		505152			
19/64 x 3-3/4	0.2968	3.7500		0.2968 x 3.7500		505037			
5/16 x 1-1/4	0.3125	1.2500		0.3125 x 1.2500		505027			
5/16 x 2	0.3125	2.0000	0.015	0.3125 x 2.0000	505126	505077			505526
5/16 x 2-1/2	0.3125	2.5000	0.015	0.3125 x 2.5000	505127	505018	503190	505353	505520
5/16 x 2-3/4	0.3125	2.7500		0.3125 x 2.7500		505026			
5/16 x 3	0.3125	3.0000	0.015	0.3125 x 3.0000	505142	505019	503191	505354	505521
5/16 x 3-3/4	0.3125	3.7500		0.3125 x 3.7500		505085			
5/16 x 4	0.3125	4.0000	0.015	0.3125 x 4.0000	505117	505054	503192	505355	505522
5/16 x 6	0.3125	6.0000	0.015	0.3125 x 6.0000	505178	505078	503193	505356	
21/64 x 4	0.3281	4.0000		0.3281 x 4.0000		505048			
11/32 x 4	0.3437	4.0000		0.3437 x 4.0000		505049			
23/64 x 4-1/4	0.3593	4.2500		0.3593 x 4.2500		505043			
3/8 x 2	0.3750	2.0000	0.015	0.3750 x 2.0000	505128	505025			505525
3/8 x 2-1/2	0.3750	2.5000	0.015	0.3750 x 2.5000	505129	505020	503194	505357	505529
3/8 x 3	0.3750	3.0000	0.015	0.3750 x 3.0000	505130	505023	503195	505330	505523

TOLERANCES (INCH)

SIZES INCH	D,H6	L
1/16 to 7/64	+0, -.00024	+ 1/16, -0
1/8 to 3/16	+0, -.00031	
1/4 to 3/8	+0, -.00035	
7/16 to 5/8	+0, -.00043	
3/4 to 1	+0, -.00051	
1-1/4	+0, -.00063	



FRACTIONAL SIZE	DIMENSIONS (INCHES)			DESCRIPTION	SUBMICRON / 10% COBALT		COMPLEMENTARY GRADES W/ CHAMFER		
D X L	D	L	C		W/ CHAMFER	W/O CHAMFER	ULTRAFINE / 8% CO	SUBMICRON / 6% CO	ULTRAFINE / 12% CO
3/8 x 3-1/4	0.3750	3.2500		0.3750 x 3.2500		505227			
3/8 x 3-1/2	0.3750	3.5000	0.015	0.3750 x 3.5000	505143	505022		505329	
3/8 x 4	0.3750	4.0000	0.015	0.3750 x 4.0000	505144	505024	503196	505328	
3/8 x 4-1/4	0.3750	4.2500		0.3750 x 4.2500		505082			
3/8 x 4-1/2	0.3750	4.5000	0.015	0.3750 x 4.5000	505190				
3/8 x 5	0.3750	5.0000	0.015	0.3750 x 5.0000	505213		503197	505358	
3/8 x 6	0.3750	6.0000	0.015	0.3750 x 6.0000	505214	5037512	503198	505306	
25/64 x 4-1/2	0.3906	4.5000		0.3906 x 4.5000		505044			
13/32 x 4-1/2	0.4062	4.5000		0.4062 x 4.5000		503000			
27/64 x 4-1/2	0.4218	4.5000		0.4218 x 4.5000		503001			
7/16 x 2-1/2	0.4375	2.5000	0.031	0.4375 x 2.5000	505131				
7/16 x 2-3/4	0.4375	2.7500	0.031	0.4375 x 2.7500	505132	505066			505542
7/16 x 4	0.4375	4.0000	0.031	0.4375 x 4.0000	505177	505050			505543
7/16 x 4-1/4	0.4375	4.2500		0.4375 x 4.2500		505153			
7/16 x 6	0.4375	6.0000		0.4375 x 6.0000		505051			
29/64 x 4-3/4	0.4531	4.7500		0.4531 x 4.7500		503002			
15/32 x 4-3/4	0.4687	4.7500		0.4687 x 4.7500		503003			
31/64 x 4-3/4	0.4843	4.7500		0.4843 x 4.7500		503004			
1/2 x 10	0.5000	10.0000		0.5000 x 10.0000		505031			
1/2 x 2	0.5000	2.0000		0.5000 x 2.0000		505052			
1/2 x 2-1/2	0.5000	2.5000	0.031	0.5000 x 2.5000	505133	505053			505533
1/2 x 3	0.5000	3.0000	0.031	0.5000 x 3.0000	505134	505006	503199	505334	505506
1/2 x 3-1/2	0.5000	3.5000	0.031	0.5000 x 3.5000	505140	505074		505340	505513
1/2 x 4	0.5000	4.0000	0.031	0.5000 x 4.0000	505135	505038	503200	505335	505538
1/2 x 4-3/4	0.5000	4.7500		0.5000 x 4.7500		505083			
1/2 x 5	0.5000	5.0000	0.031	0.5000 x 5.0000	505138		503201	505383	
1/2 x 6	0.5000	6.0000	0.031	0.5000 x 6.0000	505136	505056	503215	505395	505209
1/2 x 7	0.5000	7.0000		0.5000 x 7.0000		505029			
1/2 x 8	0.5000	8.0000		0.5000 x 8.0000		505030			
9/16 x 3-1/2	0.5625	3.5000	0.031	0.5625 x 3.5000	505113	505057			
5/8 x 10	0.6250	10.0000		0.6250 x 10.0000		503020			
5/8 x 3	0.6250	3.0000	0.031	0.6250 x 3.0000	505100				505548
5/8 x 3-1/2	0.6250	3.5000	0.031	0.6250 x 3.5000	505102	503013	503202	505384	
5/8 x 4	0.6250	4.0000	0.031	0.6250 x 4.0000	505104	505046		505341	505528
5/8 x 5	0.6250	5.0000	0.031	0.6250 x 5.0000	505106				505530
5/8 x 6	0.6250	6.0000	0.031	0.6250 x 6.0000	505137	505065	503203	505385	505531
5/8 x 7	0.6250	7.0000		0.6250 x 7.0000		503018			
5/8 x 8	0.6250	8.0000		0.6250 x 8.0000		503019			
3/4 x 10	0.7500	10.0000		0.7500 x 10.0000		503006			
3/4 x 3	0.7500	3.0000	0.031	0.7500 x 3.0000	505108		503204	505386	505532
3/4 x 4	0.7500	4.0000	0.031	0.7500 x 4.0000	505110	505060	503205	505342	505534
3/4 x 5	0.7500	5.0000	0.031	0.7500 x 5.0000	505112	505061			505535
3/4 x 6	0.7500	6.0000	0.031	0.7500 x 6.0000	505114	505062	503206	505343	505536
3/4 x 7	0.7500	7.0000		0.7500 x 7.0000		505064			
3/4 x 8	0.7500	8.0000		0.7500 x 8.0000		503005			
7/8 x 4	0.8750	4.0000	0.031	0.8750 x 4.0000	503218	505063			
7/8 x 6	0.8750	6.0000		0.8750 x 6.0000		505067			
1 x 10	1.0000	10.0000		1.0000 x 10.0000		505096			
1 x 3	1.0000	3.0000	0.031	1.0000 x 3.0000	505116		503207	505387	505516
1 x 4	1.0000	4.0000	0.031	1.0000 x 4.0000	505118	503014	503208	505388	505518
1 x 4-1/2	1.0000	4.5000	0.031	1.0000 x 4.5000	505162	503030			
1 x 5	1.0000	5.0000	0.031	1.0000 x 5.0000	505120	503011	503209	505389	505537
1 x 6	1.0000	6.0000	0.031	1.0000 x 6.0000	505122	503010	503210	505390	505539
1 x 7	1.0000	7.0000		1.0000 x 7.0000		505079			
1 x 8	1.0000	8.0000		1.0000 x 8.0000		505047			
1-1/4 x 4	1.2500	4.0000		1.2500 x 4.0000		503021			
1-1/4 x 4-1/2	1.2500	4.5000	0.031	1.2500 x 4.5000	505217		503213	505393	
1-1/4 x 6	1.2500	6.0000	0.031	1.2500 x 6.0000	505218	503022	503214	505394	



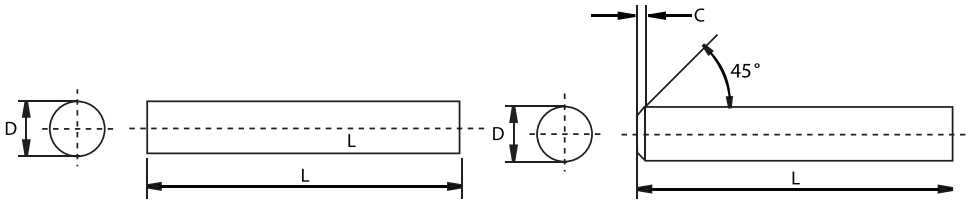
PRECISION GROUND ROD, CUT TO LENGTH

METRIC SIZES 3 TO 25 DIAMETER, H6 TOLERANCE

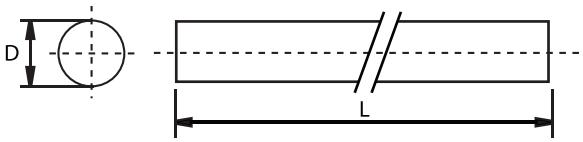
FRACTIONAL SIZE	DIMENSIONS (MM)			DESCRIPTION	SUBMICRON / 10% COBALT		COMPLEMENTARY GRADES W/ CHAMFER		
D X L	D	L	C		W/ CHAMFER	W/O CHAMFER	ULTRAFINE / 8% CO	SUBMICRON / 6% CO	ULTRAFINE / 12% CO
3 x 38	3	38	0.4	3 MM x 38 MM	505139	505088			
3 x 40	3	40		3 MM x 40 MM		505093			
3 x 50	3	50	0.4	3 MM x 50 MM	503025				
3 x 51	3	51	0.4	3 MM x 51 MM	503125	503078	505359		
3 x 53	3	53		3 MM x 53 MM		505089			
3 x 57	3	57	0.4	3 MM x 57 MM	503126				
3 x 64	3	64	0.4	3 MM x 64 MM	503127				
3 x 66	3	66		3 MM x 66 MM		505090			
3 x 76	3	76	0.4	3 MM x 76 MM	503128	503032			
3 x 78	3	78		3 MM x 78 MM		505091			
3 x 92	3	92		3 MM x 92 MM		505092			
4 x 50	4	50	0.4	4 MM x 50 MM	505164				
4 x 51	4	51	0.4	4 MM x 51 MM	503129	503033	505360		
4 x 57	4	57		4 MM x 57 MM		505147			
4 x 63.5	4	63.5		4 MM x 63.5 MM		505161			
4 x 64	4	64	0.4	4 MM x 64 MM	503130				
4 x 76	4	76	0.4	4 MM x 76 MM	503131		503016		
4 x 100	4	100	0.4	4 MM x 100 MM	503132	503034			
5 x 51	5	51	0.4	5 MM x 51 MM	503133	503101	505361		
5 x 64	5	64	0.4	5 MM x 64 MM	505180				
5 x 76	5	76		5 MM x 76 MM		505148			
5 x 100	5	100	0.4	5 MM x 100 MM	503134				
6 x 50	6	50	0.4	6 MM x 50 MM	505095	505206			
6 x 51	6	51	0.4	6 MM x 51 MM	503135	503035	505362		
6 x 55	6	55	0.4	6 MM x 55 MM	503102		505363		
6 x 58	6	58	0.4	6 MM x 58 MM	503103		505364		
6 x 60	6	60	0.4	6 MM x 60 MM	503221				
6 x 63	6	63	0.4	6 MM x 63 MM	503172	503076	505365		
6 x 64	6	64	0.4	6 MM x 64 MM	505155			505347	
6 x 71	6	71	0.4	6 MM x 71 MM	503052				
6 x 75	6	75		6 MM x 75 MM		503027			
6 x 76	6	76	0.4	6 MM x 76 MM	505181			505348	
6 x 82.5	6	82.5	0.4	6 MM x 82.5 MM	505151				
6 x 100	6	100	0.4	6 MM x 100 MM	503026				
6 x 101.6	6	101.6	0.4	6 MM x 101.6 MM	505156				
6 x 150	6	150	0.4	6 MM x 150 MM	503136				
7 x 61	7	61	0.4	7 MM x 61 MM	503137				
7 x 64	7	64	0.4	7 MM x 64 MM	503138				
8 x 50	8	50	0.4	8 MM x 50 MM	503139				
8 x 59	8	59	0.4	8 MM x 59 MM	503104		505366		
8 x 60	8	60	0.4	8 MM x 60 MM	503105				
8 x 63	8	63	0.4	8 MM x 63 MM	505157	503028			
8 x 64	8	64	0.4	8 MM x 64 MM	505182	503037	505367		
8 x 71	8	71	0.4	8 MM x 71 MM	503174				
8 x 75	8	75	0.4	8 MM x 75 MM	503168				
8 x 76	8	76	0.4	8 MM x 76 MM	505183				
8 x 81	8	81	0.4	8 MM x 81 MM	503054				
8 x 100	8	100	0.4	8 MM x 100 MM	503169				
8 x 101.6	8	101.6	0.4	8 MM x 101.6 MM	505158				
8 x 200	8	200	0.4	8 MM x 200 MM	503141				
9 x 64	9	64		9 MM x 64 MM		503039			
10 x 50	10	50	0.4	10 MM x 50 MM	503041				
10 x 64	10	64	0.4	10 MM x 64 MM	503117	503092		505344	
10 x 67	10	67	0.4	10 MM x 67 MM	503106		505369		
10 x 70	10	70	0.4	10 MM x 70 MM	503107	505198			
10 x 73	10	73	0.4	10 MM x 73 MM	503142				
10 x 74	10	74	0.4	10 MM x 74 MM	503108		505370		
10 x 75	10	75	0.4	10 MM x 75 MM	505199	503029			
10 x 76	10	76	0.4	10 MM x 76 MM	505184			505345	
10 x 81	10	81	0.4	10 MM x 81 MM	503175		505371		

TOLERANCES (METRIC)

SIZES (MM)	D,H6	L
3	+0, -.006	+ 1.6, -0
4 to 6	+0, -.008	
7 to 10	+0, -.009	
11 to 16	+0, -.011	
16 to 18	+0, -.011	
20 to 25	+0, -.013	



FRACTIONAL SIZE	DIMENSIONS (MM)			DESCRIPTION	SUBMICRON / 10% COBALT		COMPLEMENTARY GRADES W/ CHAMFER		
D X L	D	L	C		W/ CHAMFER	W/O CHAMFER	ULTRAFINE / 8% CO	SUBMICRON / 6% CO	ULTRAFINE / 12% CO
10 x 88	10	88	0.4	10 MM x 88 MM	503023				
10 x 95	10	95	0.4	10 MM x 95 MM	503055				
10 x 100	10	100	0.4	10 MM x 100 MM	503144				
10 x 150	10	150	0.4	10 MM x 150 MM	503145				
10 x 200	10	200	0.4	10 MM x 200 MM	503146				
11 x 71	11	71	0.4	11 MM x 71 MM	503056				
11 x 84	11	84	0.4	11 MM x 84 MM	503147				
11 x 101.6	11	101.6	0.4	11 MM x 101.6 MM	503077				
12 x 63	12	63	0.8	12 MM x 63 MM	503148				
12 x 74	12	74	0.8	12 MM x 74 MM	503109		505372		
12 x 75	12	75		12 MM x 75 MM		503409			
12 x 76	12	76	0.8	12 MM x 76 MM	505185			505346	
12 x 84	12	84	0.8	12 MM x 84 MM	503110		505373		
12 x 88	12	88	0.8	12 MM x 88 MM	505186				
12 x 94	12	94	0.8	12 MM x 94 MM	503177		505374		
12 x 100	12	100	0.8	12 MM x 100 MM	503024			503012	
12 x 125	12	125	0.8	12 MM x 125 MM	503149				
12 x 127	12	127		12 MM x 127 MM		505160			
12 x 150	12	150	0.8	12 MM x 150 MM	503150				
12 x 200	12	200	0.8	12 MM x 200 MM	503151				
14 x 76	14	76	0.8	14 MM x 76 MM	503111		505375		
14 x 84	14	84	0.8	14 MM x 84 MM	503112		503038	505376	
14 x 89	14	89	0.8	14 MM x 89 MM	503170				
14 x 100	14	100	0.8	14 MM x 100 MM	503217		503046		
14 x 110	14	110	0.8	14 MM x 110 MM	505187				
14 x 125	14	125	0.8	14 MM x 125 MM	503152				
14 x 150	14	150	0.8	14 MM x 150 MM	503153				
16 x 75	16	75	0.8	16 MM x 75 MM	503113				
16 x 83	16	83	0.8	16 MM x 83 MM	503114		505377		
16 x 89	16	89	0.8	16 MM x 89 MM	503154				
16 x 93	16	93	0.8	16 MM x 93 MM	503115		505378		
16 x 95	16	95		16 MM x 95 MM		505188			
16 x 100	16	100	0.8	16 MM x 100 MM	503155				
16 x 109	16	109	0.8	16 MM x 109 MM	503178		505379		
16 x 110	16	110	0.8	16 MM x 110 MM	503156				
16 x 125	16	125	0.8	16 MM x 125 MM	503157				
16 x 126	16	126	0.8	16 MM x 126 MM	503179				
16 x 127	16	127	0.8	16 MM x 127 MM	503216				
16 x 150	16	150	0.8	16 MM x 150 MM	503158				
18 x 85	18	85	0.8	18 MM x 85 MM	503116		503042		
18 x 93	18	93	0.8	18 MM x 93 MM	503119		503043		
18 x 100	18	100	0.8	18 MM x 100 MM	503159				
18 x 102	18	102	0.8	18 MM x 102 MM	503070				
18 x 125	18	125	0.8	18 MM x 125 MM	503160				
18 x 127	18	127	0.8	18 MM x 127 MM	503171				
18 x 150	18	150	0.8	18 MM x 150 MM	503161				
20 x 93	20	93	0.8	20 MM x 93 MM	503120		505380		
20 x 100	20	100	0.8	20 MM x 100 MM	503121				
20 x 105	20	105	0.8	20 MM x 105 MM	503122		505381		
20 x 115	20	115	0.8	20 MM x 115 MM	503067				
20 x 125	20	125	0.8	20 MM x 125 MM	503162				
20 x 127	20	127	0.8	20 MM x 127 MM	503180		505382		
20 x 135	20	135	0.8	20 MM x 135 MM	503118				
20 x 136	20	136	0.8	20 MM x 136 MM	503181				
20 x 150	20	150	0.8	20 MM x 150 MM	503163				
25 x 100	25	100	0.8	25 MM x 100 MM	503164				
25 x 121	25	121	0.8	25 MM x 121 MM	503165				
25 x 150	25	150	0.8	25 MM x 150 MM	503166				
25 x 151	25	151	0.8	25 MM x 151 MM	503069				
25 x 200	25	200	0.8	25 MM x 200 MM	503167				

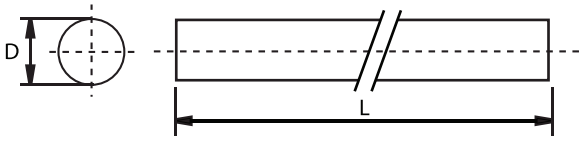


TOLERANCES (METRIC)		
SIZES (MM)	D,H6	L
ALL	+0.015, -0	+ 1/2, -0

PRECISION GROUND ROD, RANDOM LENGTHS

INCH SIZES 1/16" TO 1-1/4" DIAMETER, H6 TOLERANCE

FRACTIONAL SIZE	DIMENSIONS (INCHES)		DESCRIPTION	SUBMICRON / 10%	COMPLEMENTARY GRADES W/ CHAMFER		
D	D	L		W/O CHAMFER	ULTRAFINE / 8% CO	SUBMICRON / 6% CO	ULTRAFINE / 12% CO
1/16	0.0625	13-1/4	.0625 x 13.25 Centerless Grd	GRR-4			
3/32	0.0937	13-1/4	.09375 x 13.25 Centerless Grd	GRR-6			
7/64	0.1093	13-1/4	.109375 x 13.25 Centerless Grd	GRR-7			
1/8	0.1250	13-1/4	.125 x 13.25 Centerless Grd	GRR-8			
9/64	0.1406	13-1/4	.140625 x 13.25 Centerless Grd	GRR-9			
5/32	0.1562	13-1/4	.15625 x 13.25 Centerless Grd	GRR-10			
11/64	0.1718	13-1/4	.171875 x 13.25 Centerless Grd	GRR-11			
3/16	0.1875	13-1/4	.1875 x 13.25 Centerless Grd	GRR-12			
13/64	0.2031	13-1/4	.203125 x 13.25 Centerless Grd	GRR-13			
7/32	0.2187	13-1/4	.21875 x 13.25 Centerless Grd	GRR-14			
1/4	0.2500	13-1/4	.250 x 13.25 Centerless Grd	GRR-16			
5/16	0.3125	12-1/4	.3125 x 12.25 Centerless Grd	GRR-20			
3/8	0.3750	12-1/4	.375 x 12.25 Centerless Grd	GRR-24			
7/16	0.4375	12-1/4	.4375 x 12.25 Centerless Grd	GRR-28			
1/2	0.5000	12-1/4	.500 x 12.25 Centerless Grd	GRR-32			
9/16	0.5625	12-1/4	.5625 x 12.25 Centerless Grd	GRR-36			
5/8	0.6250	12-1/4	.625 x 12.25 Centerless Grd	GRR-40			
3/4	0.7500	12-1/4	.750 x 12.25 Centerless Grd	GRR-48			
7/8	0.8750	12-1/4	.875 x 12.25 Centerless Grd	GRR-56			
1	1.0000	12-1/4	1.000 x 12.25 Centerless Grd	GRR-64			
1-1/4	1.2500	12-1/4	1.250 x 12.25 Centerless Grd	GRR-80			

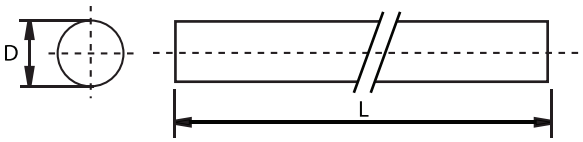


TOLERANCES (METRIC)		
SIZES (MM)	D,H6	L
ALL	+0.015, -0	+ 1/2, -0

PRECISION GROUND ROD, RANDOM LENGTHS

METRIC SIZES 5 MM TO 24 MM DIAMETER, H6 TOLERANCE

FRACTIONAL SIZE	DIMENSIONS (MM)		DESCRIPTION	SUBMICRON / 10%	COMPLEMENTARY GRADES W/ CHAMFER		
D	D	L		W/O CHAMFER	ULTRAFINE / 8% CO	SUBMICRON / 6% CO	ULTRAFINE / 12% CO
5	5.000	330	5 MM x 330 MM Centerless Grd	GRR-5MM			
6	6.000	330	6 MM x 330 MM Centerless Grd	GRR-6MM			
8	8.000	330	8 MM x 330 MM Centerless Grd	GRR-8MM			
9	9.000	330	9 MM x 330 MM Centerless Grd	GRR-9MM			
10	10.000	330	10 MM x 330 MM Centerless Grd	GRR-10MM			
12	12.000	330	12 MM x 330 MM Centerless Grd	GRR-12MM			
13	13.000	330	13 MM x 330 MM Centerless Grd	GRR-13MM			
14	14.000	330	14 MM x 330 MM Centerless Grd	GRR-14MM			
15	15.000	330	15 MM x 330 MM Centerless Grd	GRR-15MM			
16	16.000	330	16 MM x 330 MM Centerless Grd	GRR-16MM			
18	18.000	330	18 MM x 330 MM Centerless Grd	GRR-18MM			
20	20.000	330	20 MM x 330 MM Centerless Grd	GRR-20MM			
24	24.000	330	24 MM x 330 MM Centerless Grd	GRR-24MM			

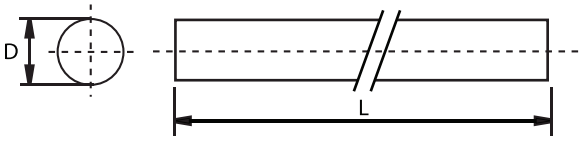


TOLERANCES (METRIC)		
SIZES (MM)	D,H6	L
ALL	+0.015, -0	+ 1/2, -0

UNGROUND ROD, RANDOM LENGTHS RR

INCH SIZES 1/16" TO 27/64" DIAMETER

NOMINAL FRACTIONAL SIZE	DIMENSIONS (INCHES)		DESCRIPTION	SUBMICRON / 10% COBALT	COMPLEMENTARY GRADES W/ CHAMFER		
D	D	L		W/O CHAMFER	ULTRAFINE / 8% CO	SUBMICRON / 6% CO	ULTRAFINE / 12% CO
1/16	0.073	13-1/4	1/16 x 13.25 Rod Blank	RR-4		RR-4-326	
5/64	0.088	13-1/4	5/64 x 13.25 Rod Blank	RR-5		RR-5-326	
3/32	0.104	13-1/4	3/32 x 13.25 Rod Blank	RR-6		RR-6-326	
7/64	0.119	13-1/4	7/64 x 13.25 Rod Blank	RR-7		RR-7-326	
1/8	0.135	13-1/4	1/8 x 13.25 Rod Blank	RR-8		RR-8-326	
9/64	0.151	13-1/4	9/64 x 13.25 Rod Blank	RR-9		RR-9-326	
5/32	0.166	13-1/4	5/32 x 13.25 Rod Blank	RR-10		RR-10-326	
11/64	0.182	13-1/4	11/64 x 13.25 Rod Blank	RR-11		RR-11-326	
3/16	0.198	13-1/4	3/16 x 13.25 Rod Blank	RR-12		RR-12-326	
13/64	0.213	13-1/4	13/64 x 13.25 Rod Blank	RR-13		RR-13-326	
7/32	0.229	13-1/4	7/32 x 13.25 Rod Blank	RR-14		RR-14-326	
15/64	0.244	13-1/4	15/64 x 13.25 Rod Blank	RR-15		RR-15-326	
1/4	0.260	13-1/4	1/4 x 13.25 Rod Blank	RR-16		RR-16-326	
17/64	0.276	12-1/4	17/64 x 12.25 Rod Blank	RR-17		RR-17-326	
9/32	0.291	12-1/4	9/32 x 12.25 Rod Blank	RR-18		RR-18-326	
19/64	0.307	12-1/4	19/64 x 12.25 Rod Blank	RR-19		RR-19-326	
5/16	0.323	12-1/4	5/16 x 12.25 Rod Blank	RR-20		RR-20-326	
21/64	0.338	12-1/4	21/64 x 12.25 Rod Blank	RR-21		RR-21-326	
11/32	0.354	12-1/4	11/32 x 12.25 Rod Blank	RR-22		RR-22-326	
23/64	0.369	12-1/4	23/64 x 12.25 Rod Blank	RR-23		RR-23-326	
3/8	0.385	12-1/4	3/8 x 12.25 Rod Blank	RR-24		RR-24-326	
25/64	0.401	12-1/4	25/64 x 12.25 Rod Blank	RR-25		RR-25-326	
13/32	0.416	12-1/4	13/32 x 12.25 Rod Blank	RR-26		RR-26-326	
27/64	0.432	12-1/4	27/64 x 12.25 Rod Blank	RR-27		RR-27-326	



TOLERANCES (METRIC)		
SIZES (MM)	D,H6	L
ALL	+0.015, -0	+ 1/2, -0

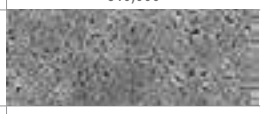
UNGROUND ROD, RANDOM LENGTHS RR

INCH SIZES 1/16" TO 27/64" DIAMETER

NOMINAL FRACTIONAL SIZE	DIMENSIONS (INCHES)		DESCRIPTION	SUBMICRON / 10% COBALT	COMPLEMENTARY GRADES W/ CHAMFER		
D	D	L		W/O CHAMFER	ULTRAFINE / 8% CO	SUBMICRON / 6% CO	ULTRAFINE / 12% CO
7/16	0.448	12-1/4	7/16 x 12.25 Rod Blank	RR-28		RR-28-326	
29/64	0.463	12-1/4	29/64 x 12.25 Rod Blank	RR-29		RR-29-326	
15/32	0.479	12-1/4	15/32 x 12.25 Rod Blank	RR-30		RR-30-326	
31/64	0.494	12-1/4	31/64 x 12.25 Rod Blank	RR-31		RR-31-326	
1/2	0.510	12-1/4	1/2 x 12.25 Rod Blank	RR-32			
17/32	0.541	12-1/4	17/32 x 12.25 Rod Blank	RR-34			
9/16	0.573	12-1/4	9/16 x 12.25 Rod Blank	RR-36			
5/8	0.635	12-1/4	5/8 x 12.25 Rod Blank	RR-40			
11/16	0.698	12-1/4	11/16 x 12.25 Rod Blank	RR-44			
3/4	0.760	12-1/4	3/4 x 12.25 Rod Blank	RR-48			
13/16	0.823	12-1/4	13/16 x 12.25 Rod Blank	RR-52			
7/8	0.885	12-1/4	7/8 x 12.25 Rod Blank	RR-56			
1	1.010	12-1/4	1 x 12.25 Rod Blank	RR-64			

CARBIDE GRADES

PRIMARY GRADES

TMK-320	First-choice grade, offering outstanding performance in a broad range of materials and applications. Especially well-suited for drilling and milling grey cast iron, stainless steels and heat-resistant alloys. TMK-320 is a 10% cobalt micrograin tungsten carbide grade.						
ANSI Classification	ISO Classification	WC %	Co %	TaC %	Hardness (HRA	Density (g/cm3)	TRS, min (psi)
C-2/10	K20	90	10	-	92.0	14.45	500,000
TMK-3028	High hardness and wear resistance characteristics, suitable for machining higher hard- ness materials. Can be used to offer extended tool life with proper application. Used extensively for micro drills, circuit board drills and abrasive applications. TMK-3028 is an 8% cobalt ultrafine grain tungsten carbide grade.						
ANSI Classification	ISO Classification	WC %	Co %	TaC %	Hardness (HRA	Density (g/cm3)	TRS, min (psi)
C-4/9	K05	92	8	-	93.5	14.60	610,000
TMK-326	Superior wear resistance in composite materials and abrasive applications. Often used for drilling and reaming with high cutting speeds. Well-suited for the light cuts used with high speed machining techniques in hardened steels and heat-resistant alloys. TMK-326 is a 6% cobalt micrograin tungsten carbide grade.						
ANSI Classification	ISO Classification	WC %	Co %	TaC %	Hardness (HRA	Density (g/cm3)	TRS, min (psi)
C-3/9	K10	94	6	-	93.2	14.85	410,000
TMK-3012	Offers an excellent combination of high hardness, high strength and wear resistance. Suitable for titanium and heat-resistant alloys and hardened steels. Often used for larger diameter milling applications. TMK-3012 is a 12% cobalt ultrafine grain tungsten carbide grade.						
ANSI Classification	ISO Classification	WC %	Co %	TaC %	Hardness (HRA	Density (g/cm3)	TRS, min (psi)
C-3	K20	86.8	12	1.2	92.7	14.10	650,000

SPECIALTY GRADES

GRADE	ANSI CLASSIFICATION	ISO CLASSIFICATION	WC %	CO %	TIC %	TAC %	HARDNESS (HRA)	DENSITY (G/CM3)	TRS, MIN (PSI)	CHARACTERISTICS
TMK-3	C-3	K20	96	3	–	1	93.3	15.20	250,000	Medium grain size. Excellent wear and corrosion resistance.
TMK-7	C-3/9	K10	95.6	4.4	–	–	92.7	15.10	300,000	Medium grain size. Used for light finishing applications. Good wear resistance.
TMK-10	C-11/12	K40	87	13	–	–	88.5	14.20	450,000	Coarse grain size. For wear and medium shock applications.
TMK-11	C-13	K40	85	15	–	–	87.5	14.00	470,000	Coarse grain size. Light wear and medium shock resistance applications.
TMK-15	C-1/10	K40	94	6	–	–	91.0	14.95	410,000	Coarse grain size. Used for roughing.
TMK15B	C-1/10	K40	92 (min)	6 (min)	0.5 (max)	0.5 (max)	90.8	14.60	300,000	Medium/coarse grain size. Used for bur blanks and non-critical wear applications.
TMK-22	C-2/10	K20/30	94	6	–	–	92.1	14.95	400,000	Medium grain size. For general purpose non-ferrous applications.
TMK-3026	C-4/9	K05	94	6	–	–	93.7	14.85	400,000	Ultra-fine grain size. Offers very high wear resistance.
TMP-810	C-7/8	P10	84	6	6	3	93.0	13.00	275,000	Fine grain size. Excellent wear and corrosion resistance.
TMP-820	C-6	P20/30	72	8	8	12	92.2	12.55	325,000	Medium grain size. For general purpose turning and finishing of ferrous materials.
TMP-821	C-5/6	P20/30	75.8	8	6.2	10	91.5	12.90	350,000	Medium grain size. For general purpose machining of ferrous materials.
TMP-825	C-6	P25/30	69	10.5	6	14.5	91.5	12.80	350,000	Fine grain size. Used for milling and turning of ferrous materials.
TMP-840	C-5	P30/40	80	10	5	5	90.5	13.10	350,000	Medium/coarse grain size. For g eneral purpose roughing of ferrous materials.
TMP-845	C-5	P40/50	71	13	4	12	90.4	13.10	380,000	Medium grain size. Premium roughing grade for ferrous materials.

NOMINAL GRAIN SIZE RANGES

ultra-fine	micro	fine	medium	coarse
0.4 to 0.6 µ	0.8 to 1.0 µ	> 1 to 2 µ	> 2 to 4 µ	> 4 µ

12 GENERAL INFORMATION

The metalworking industry is developing more rapidly now than ever before and business requires inventive strategies to succeed.

The tables that follow will help you assess your desired tapers, angles, hardness and evaluate tool performance. Plus, our policies are provided for the sake of transparency.

TECHNICAL SUPPORT

We support our customers through every step of the process; from purchasing the correct tool, to set up and application challenges. We are leaders in the industry because we maintain vigorous research and development processes, resulting in significant benefits to our customers. Our experience is passed along to you, as well as a superior tool, when you choose Global Cutting Tools.

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TAPERS & ANGLES TABLE

THE TABLE BELOW WILL GUIDE YOU TO THE TAPER YOU'LL NEED

TAPER CALCULATOR

TAPER PER FOOT	INCLUDED				PER SIDE (FROM CENTER LINE)			
	TAPER PER INCH	DEGREE	MINUTE	SECOND	TAPER PER INCH	DEGREE	MINUTE	SECOND
1/8	0.010416	0	35	47	0.005208	0	17	54
1/4	0.020833	1	11	38	0.010416	0	35	49
3/8	0.031250	1	47	25	0.015625	0	53	42
1/2	0.041667	2	23	12	0.020833	1	11	36
5/8	0.052084	2	59	3	0.026042	1	29	31
3/4	0.062500	3	34	48	0.031250	1	47	24
7/8	0.072917	4	10	32	0.036456	2	5	16
1	0.083330	4	46	19	0.041667	2	23	10
1 1/4	0.104166	5	57	45	0.052084	2	58	53
1 1/2	0.125000	7	9	10	0.062500	3	34	35
1 3/4	0.145833	8	20	28	0.072917	4	10	14
2	0.166666	9	31	37	0.083332	4	45	49
2 1/2	0.208333	11	53	38	0.104166	5	56	49
3	0.250000	14	2	0	0.125000	7	1	0
3 1/2	0.291666	16	35	39	0.145833	8	17	49
4	0.333333	18	55	31	0.166666	9	27	44
4 1/2	0.375000	21	14	20	0.187500	10	37	10
5	0.416666	23	32	12	0.208333	11	46	6
6	0.500000	28	4	20	0.250000	14	2	10

HARDNESS CONVERSION CHART

THESE TABLES WERE DESIGNED FOR QUICK AND EASY REFERENCE

BRINELL HARDNESS, ROCKWELL HARDNESS, TENSILE STRENGTH

BRINELL HARDNESS	ROCKWELL HARDNESS			TENSILE STRENGTH
BHN (TUNGSTEN CARBIDE BALL 3000 KG)	HRA TUNGSTEN CARBIDE	HRB ALUMINUM, BRASS & SOFT STEELS	HRC HARD STEELS >B100	(PSI)
111	-	66	-	56,000
116	-	68	-	58,000
121	-	70	-	60,000
126	-	72	-	63,000
131	-	74	-	65,000
137	-	76	-	67,000
143	-	79	-	71,000
149	-	81	-	73,000
156	-	83	-	76,000
163	-	85	-	79,000
167	-	86	-	81,000
170	-	87	-	83,000
174	-	88	-	85,000
179	-	89	-	87,000
183	-	90	-	89,000
187	-	91	-	90,000
192	-	92	-	93,000
197	-	93	-	95,000
201	-	94	15	98,000
207	-	95	16	100,000
212	-	96	17	102,000
217	-	96	18	105,000
223	-	97	20	109,000
229	61	98	20	111,000
235	61	99	22	115,000
241	62	100	23	118,000
248	62	-	24	122,000
255	63	-	25	126,000
262	64	-	27	129,000
269	64	-	28	133,000
277	65	-	29	137,000
285	65	-	30	141,000
293	66	-	31	145,000
302	66	-	32	150,000
311	67	-	33	155,000
321	68	-	34	160,000
331	68	-	36	166,000
341	69	-	37	170,000
352	69	-	38	176,000
363	70	-	39	182,000
375	71	-	40	188,000
388	71	-	42	195,000
401	72	-	43	202,000
415	73	-	44	210,000
429	73	-	46	217,000
444	74	-	47	225,000
461	75	-	48	235,000
477	76	-	50	243,000
495	76	-	51	253,000
514	77	-	52	263,000
534	78	-	54	274,000
555	78	-	55	285,000
578	79	-	56	297,000
601	80	-	57	309,000
627	80	-	59	323,000
630	81	-	59	324,000
638	81	-	59	329,000
647	81	-	60	-
653	81	-	60	-
656	81	-	60	-
670	82	-	61	-
684	82	-	62	-
698	83	-	62	-
710	83	-	63	-
722	83	-	64	-
733	84	-	65	-
745	84	-	65	-
767	85	-	66	-

DECIMAL CONVERSION CHART

CONVERT FRACTIONS TO DECIMALS AND MILLIMETERS AND REVERSE

QUICK MEASUREMENT GUIDE

FRACTION	MM	DECIMAL	FRACTION	MM	DECIMAL	FRACTION	MM	DECIMAL
	0.0059	0.15	9/64	0.1406	3.57	25/64	0.3906	9.92
	0.0079	0.20		0.1417	3.60		0.3937	10.00
	0.0098	0.25		0.1457	3.70	13/32	0.4063	10.32
	0.0118	0.30		0.1496	3.80		0.4134	10.50
	0.0138	0.35		0.1535	3.90	27/64	0.4219	10.72
1/64	0.0156	0.40	5/32	0.1563	3.97		0.4331	11.00
	0.0177	0.45		0.1575	4.00	7/16	0.4375	11.11
	0.0197	0.50		0.1654	4.20		0.4528	11.50
	0.0217	0.55		0.1693	4.30	29/64	0.4531	11.51
	0.0236	0.60	11/64	0.1719	4.37	15/32	0.4688	11.91
	0.0256	0.65		0.1732	4.40		0.4724	12.00
	0.0276	0.70		0.1772	4.50	31/64	0.4844	12.30
	0.0295	0.75		0.1811	4.60		0.4921	12.50
1/32	0.0313	0.79	3/16	0.1875	4.76	1/2	0.5000	12.70
	0.0335	0.85		0.1882	4.78		0.5118	13.00
	0.0354	0.90		0.1890	4.80	33/64	0.5156	13.10
	0.0374	0.95		0.1909	4.85	17/32	0.5313	13.49
	0.0394	1.00		0.1929	4.90		0.5315	13.50
	0.0413	1.05		0.1949	4.95	35/64	0.5469	13.89
	0.0433	1.10		0.1969	5.00		0.5512	14.00
	0.0453	1.15		0.2008	5.10	9/16	0.5625	14.29
3/64	0.0469	1.19	13/64	0.2031	5.16		0.5709	14.50
	0.0492	1.25		0.2047	5.20	37/64	0.5781	14.68
	0.0512	1.30		0.2087	5.30		0.5906	15.00
	0.0531	1.35		0.2165	5.50	19/32	0.5938	15.08
	0.0551	1.40	7/32	0.2188	5.56	39/64	0.6094	15.48
	0.0571	1.45		0.2205	5.60		0.6102	15.50
	0.0591	1.50		0.2224	5.65	5/8	0.6250	15.88
	0.0610	1.55		0.2244	5.70		0.6299	16.00
1/16	0.0625	1.59		0.2283	5.80	41/64	0.6406	16.27
	0.0630	1.60	15/64	0.2344	5.95		0.6496	16.50
	0.0669	1.70		0.2362	6.00	21/32	0.6563	16.67
	0.0689	1.75		0.2441	6.20		0.6693	17.00
	0.0709	1.80		0.2480	6.30	43/64	0.6719	17.07
	0.0728	1.85	1/4	0.2500	6.35	11/16	0.6875	17.46
	0.0748	1.90		0.2520	6.40		0.6890	17.50
	0.0768	1.95		0.2539	6.45	45/64	0.7031	17.86
5/64	0.0781	1.98		0.2559	6.50		0.7087	18.00
	0.0787	2.00		0.2598	6.60	23/32	0.7188	18.26
	0.0807	2.05	17/64	0.2656	6.75		0.7283	18.50
	0.0846	2.15		0.2677	6.80	47/64	0.7344	18.65
	0.0866	2.20		0.2717	6.90		0.7480	19.00
	0.0886	2.25		0.2756	7.00	3/4	0.7500	19.05
	0.0906	2.30	9/32	0.2813	7.14	49/64	0.7656	19.45
	0.0925	2.35		0.2835	7.20		0.7677	19.50
3/32	0.0938	2.38		0.2874	7.30	25/32	0.7813	19.84
	0.0945	2.40		0.2913	7.40		0.7874	20.00
	0.0965	2.45		0.2953	7.50	51/64	0.7969	20.24
	0.0984	2.50	19/64	0.2969	7.54		0.8071	20.50
	0.1024	2.60		0.2992	7.60	13/16	0.8125	20.64
	0.1043	2.65		0.3071	7.80		0.8268	21.00
	0.1063	2.70	5/16	0.3125	7.94	53/64	0.8281	21.03
	0.1083	2.75		0.3150	8.00	27/32	0.8438	21.43
7/64	0.1094	2.78		0.3189	8.10		0.8465	21.50
	0.1102	2.80		0.3228	8.20	55/64	0.8594	21.83
	0.1122	2.85		0.3248	8.25		0.8661	22.00
	0.1142	2.90		0.3268	8.30	7/8	0.8750	22.23
	0.1161	2.95	21/64	0.3281	8.33		0.8858	22.50
	0.1181	3.00		0.3307	8.40	57/64	0.8906	22.62
	0.1201	3.05		0.3346	8.50		0.9055	23.00
	0.1220	3.10		0.3386	8.60	29/32	0.9063	23.02
	0.1240	3.15		0.3425	8.70	59/64	0.9219	23.42
1/8	0.1250	3.18	11/32	0.3438	8.73		0.9252	23.50
	0.1260	3.20		0.3465	8.80	15/16	0.9375	23.81
	0.1299	3.30		0.3543	9.00		0.9449	24.00
	0.1319	3.35	23/64	0.3594	9.13	61/64	0.9531	24.21
	0.1339	3.40		0.3622	9.20		0.9646	24.50
	0.1358	3.45		0.3661	9.30	31/32	0.9688	24.61
	0.1378	3.50		0.3701	9.40	63/64	0.9843	25.00
	0.1398	3.55	3/8	0.3750	9.53	1	1.0000	25.40

100% SATISFACTION GUARANTEE

EVERY ITEM PURCHASED HAS A 30 DAY 100% SATISFACTION GUARANTEE

If for any reason you are not 100% satisfied with your purchase, you have 30 Days from the receipt to contact us and we will fix, replace or exchange any item(s), no questions asked.

Since 1944, Conical Tool Company has always replaced, free of charge, any end mill or cutting tool which did not perform satisfactorily, because of defective workmanship or material. This warranty is limited to replacement of defective tools; and excludes any liability resulting from use of our tools. Customer is responsible for inspection of all tools before use. If any errors are suspected or tools are not what customer expected, customer should contact Conical Tool before using. We cannot be held responsible for incorrect parts made with our products, due to mislabeling or defects. We will, however, replace or correct tools if the error was ours; just as we have always done.

Upon proper authorization, any product believed to be unsatisfactory may be sent back to the Returns Department for inspection. Any product determined to be defective by Conical Tool Company will be replaced. Replacement of a defective product constitutes the full and complete warranty of Conical Tool Company, with respect to the products sold by Conical to a Distributor or Customer. There are no other warranties, expressed or implied, oral or written, with respect to such products.

In no event will Conical Tool Company be responsible to a distributor, its dealer's customers or end users, for any losses (whether direct, incidental or consequential) caused by any defect in, or dissatisfaction with such products. Under no circumstances will Conical Tool Company be liable to a distributor, its dealers, customers or end users for any lost profits, whether caused by "down time," delays in production, lost orders or other circumstances attributable to such products. Under no circumstances shall a distributor be authorized to extend on behalf of Conical Tool Company or bind Conical Tool Company to any warranty.

RETURN MERCHANDISE AUTHORIZATION FORM

To submit a Return Merchandise Authorization (RMA) request, complete the following form. In order to expedite your request, please complete all information requested below. Use the tab button to easily move to the next data field or use your pointing device to place the cursor in the desired data field. Email the completed form to returns@conicaltool.com or fax to (616) 531-7742. You will be notified with an RMA number if your return request has been approved.

Shipping information for sending the product to Conical Tool Company ("CTC") will be provided once the RMA is issued. For any questions concerning completion of the form please contact Conical Tool Company's customer service by email to sales@conicaltool.com or telephone to (616) 531-8500. The full RMA process and other RMA details are described at the bottom of this form.

PRIMARY CONTACT INFORMATION

First Name:	Last Name:
Email:	Company:
Telephone:	Extension:

WHAT ADDRESS WAS THE PRODUCT SHIPPED TO?

Company Name:	
Address:	
City:	State/Province:
Country:	Zip Code:

WHAT ADDRESS WAS THE PRODUCT BILLED TO?

Company Name:	
Address:	
City:	State/Province:
Country:	Zip Code:

WHAT ADDRESS SHOULD THE PRODUCT BE RETURNED TO?

Billing Address:	
Shipping Address:	
City:	State/Province:
Country:	Zip Code:

PRODUCT INFORMATION

Product #:	Purchase Date:	PO Number #:
Description of Issue:		

Additional Comments:

RMA PROCESS & WARRANTY

GENERAL

1 – **RMA REQUEST:** A customer with product that does not meet specifications should request a Return Merchandise Authorization (RMA) number by filling out this form and submitting it to CTC via email to returns@conicaltool.com or fax (616) 531-7742.

2 – **RMA REVIEW:** The appropriate RMA Administrator will review the request and, before proceeding, may request additional information, or suggest additional diagnostic steps to ensure that the product is not returned unnecessarily.

3 – **RMA CHARGES:** For Out-of-Specification ("OOS") claims which resulted from an error by CTC, there will be no charges. OOS RMA returns which resulted from a customer error will require a charge. Prior to the RMA being issued the RMA Administrator will inform the customer of the charge for repair or replacement of the product and request the customer to provide a Purchase Order (PO) for the RMA to be issued. A formal quote for the associated RMA charges can be provided upon request.

4 – **P.O. REQUIREMENTS:** A PO must be provided for all OOS RMA returns. Additional details on PO requirements can be provided upon request.

5 – **RMA ISSUED:** When the RMA Administrator has confirmed a repair is necessary and all other requirements have been satisfied a reply will be sent to the customer with an RMA number including packaging and shipping instructions.

6 – **SHIPMENT OF RMA TO CTC:** The customer is responsible for the safe shipment of the product in appropriate packaging. Any product arriving on our receiving dock without an RMA issued is subject to return to the customer without being internally processed.

7 – **TEST/REPAIR: CTC** will make a best effort to repair all returned products. Product that cannot be repaired with reasonable effort will be replaced at no charge to the customer if it is determined the result of an error caused by CTC.

8 – **RMA TURN-AROUND TIME:** Average RMA turn-around time is 1-4 weeks from the date the RMA arrives on the CTC dock thru the date of reshipment from CTC.

ADDITIONAL RETURN POLICIES

NO TROUBLE FOUND RMA's
If an RMA is determined to be No Trouble Found ("NTF"), CTC will request additional information from the customer in an attempt to replicate the observed failure. If no additional information is available or the observed failure cannot be reproduced, CTC will return the RMA to the customer as NTF. The policy applies to all product, both standard and custom. Full technician and shipping charges do apply.

UNREPAIRABLE PRODUCT
Product returned to CTC within 30 days that is determined to be unrepairable as a result of fault that has not been induced by customer misuse will be replaced for no charge to the customer.

UNREPAIRABLE OOS
Product returned to CTC determined to be unrepairable for any reason will not be automatically replaced. OOS product found to be unrepairable due to customer error can either be returned to the customer 'as is' for final disposition or scrapped at CTC upon customer request. CTC will request final instructions from the customer when a product is determined to be unrepairable. Unrepairable products are subject to a reduced RMA charge of 75% of the original quoted cost to cover the replacement. A revised PO will be requested from the customer for the reduced charge amount.

SHIPPING OF RMA's TO CONICAL TOOL COMPANY
Shipping of all RMA's from the customer to CTC is at customer's expense after the RMA is issued unless there is an agreement in advance for CTC to pay for the shipment via collect shipping on a CTC shipper account. Customers are encouraged to notify CTC when RMA's are shipped and to provide shipment tracking details.

RMA's are to be appropriately packaged to ensure the safe transit of the product to CTC and with observance of proper UPS requirements for the packing materials used. Any damage or subsequent failure of the product related to inappropriate packaging will result in additional charges for the repair of the product.

SHIPPING OF RMA's FROM CONICAL TOOL COMPANY
Shipping of all RMA's to the customer from CTC is at customer's expense after the RMA is issued unless there is an agreement in advance for CTC to pay for the shipment on a CTC shipper account. Customers are encouraged to notify CTC when RMA's are shipped and to provide shipment tracking details.

RMA's are to be appropriately packaged to ensure the safe transit of the product to CTC and with observance of proper UPS requirements for the packing materials used. Any damage or subsequent failure of the product related to inappropriate packaging will result in additional charges for the repair of the product.

SHIPPING OF OOS RMA's TO/FROM CONICAL TOOL COMPANY
Shipping of all OOS RMA's determined to be from customer error is at customer's expense. The cost of shipping from CTC is not included in the quoted OOS RMA alteration charge

ADVANCE REPLACEMENT OF OOS RMA's
CTC may provide an Advance Replacement of a failed product on a case by case basis. Only standard product will be considered for Advance Replacement upon request or at CTC's discretion. Advance Replacements are only considered for Dead on Arrival (DOA) products that are reported to CTC within 90 days of original shipment or for mission critical installations. Advance Replacements are subject to hardware product availability.

EXPEDITED RMA PROCESSING
CTC can provide expedited testing and repair of RMA's on a case by case basis for an additional charge. A quotation for expedited processing can be provided upon request.

RETURN POLICY
A restocking fee of 25% will be charged on all standard products returned after 30 days. A restocking fee of 50% will be charged on all standard products, regardless of defect, returned after 90 days and a credit memo will be issued for the difference. A restocking fee of 75% will be charged on all standard products returned after 180 days. Any product returned after 60 days and found to have no defects in workmanship or deviations in specifications is excepted for return at the sole discretion and approval of Conical Tool Company. No returns will be accepted on used, altered, coated or special / custom products, unless a defect in workmanship / the product is Out-of-Specifications and is returned within 20 days.

CONICAL™ CUTTING TOOLS

GLOBAL™ CUTTING TOOLS

TOOL PERFORMANCE REPORT

☐ SUCCESS

☐ FAILURE

In order to serve you better, please print out this form, fill in the information completely and fax it to: 616.531.7742. We are always striving for excellence in everything we do. By filling out this form, we will continue to do everything we can to make your experience with Conical Tool as efficient and effective as possible.

Internal Sales Rep: _____ Scheduled Test Date: _____

Distributor: _____ End User: _____

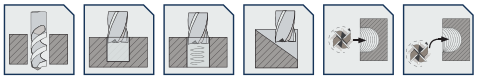
Distributor Rep: _____ End User Rep: _____

Phone: _____ Phone: _____

Distributor PO #: _____ End User PO #: _____

Invoice #: _____ RGA #: _____

TOOL ENTRY METHOD
(CIRCLE ONLY ONE)



MATERIAL REMOVAL METHOD
(CIRCLE ONLY ONE)

MILLING CONDITIONS
(CIRCLE ALL THAT APPLY)

TOOL INFORMATION

	OUR TOOL	COMPETITOR
End Mill Manufacturer / Brand of Tool:		
Style of Tool & EDP #:		
Tool Cost:		
Tool Coating:		
Tool Diameter (D):		
Number of Flutes (Z):		
Helix Angle:		
Length of Cut (LOC):		
Neck Length (LBS):		
Projection Length (From Holder):		
Corner Radius:		
Shank Flat:		

MACHINE INFORMATION

Machine Model: _____

Machine Type: _____

Maximum RPM's: _____

Horsepower: _____

Spindle Type: _____

Coolant Type (%): _____

Tool Holder: _____

Static Runout: _____

Holder Condition: _____

Balancing: _____

Coolant Deliver: _____

Machine Rate / Hour: _____

PROGRAMMING INFORMATION

	OUR TOOL	COMPETITOR
Surface Feet / Minute (SFM):		
Revolutions Per Minute (RPM) ((SFM x 3.82) / D):		
Chip Load Per Tooth (CLPT):		
Inches Per Minute (IPM) (RPM x CLPT x Z):		
Axial Depth of Cut (ADOC):		
Radial Depth of Cut (RDOC):		
Metal Removal Rate (CIM) (RDOC x ADOC x IPM):		

PROJECT INFORMATION

Project Name: _____

Part Name & Number: _____

Material Type / Grade: _____

Machinability: _____

Hardness: _____

Condition: _____

Tensile Strength: _____

OBSERVED PERFORMANCE RESULTS

	OUR TOOL	COMPETITOR
(L1) Number of Parts Annually:		
(L2) Number of Parts Per Tool:		
(L3) Number of Inches Per Tool:		
(L4) Number of Minutes Per Tool:		
(L5) Number of Minutes to Change Tool:		
(L6) Cycle-Time Per Part (Minutes):		
Surface Finish (RA):		

PERFORMANCE REQUIREMENTS

	REQUIRED	IMPROVEMENT	VS COMPETITOR
Tool Life (# of Parts / Tool):			
Tool Life (# of Inches / Tool):			
Tool Life (# of Minutes / Tool):			
Cycle Time Reduction / Part (Minutes):			
Surface Finish (Ra):			

CALCULATED PERFORMANCE SUMMARY

	OUR TOOL	COMPETITOR	
(L7) New Tools Required to Complete Lot (L1 / L2):			Total New Tools Required Saved Annually:
(L8) Total Hours of Machine Time ((L6 / 60) x L1):			→ Total Machine Time Saved Annually:
(L9) Total Hours of Tool Change Time ((L7 / 60) x L5):			→ Total Hours of Tool Change Saved Annually:
(L10) Cost / Part - Tooling (Tool Cost / L2):			
(L11) Cost / Part - Tool Changes ((L9 * Machine Cost) / L1):			
(L12) Cost / Part - Machine Time:			
(L13) Total Cost / Part (L10+ L11 + L12):			→ Total Cost Per Part Saved:
(L14) Total Cost - Tooling (L7 x Tool Cost):			→ Total Annual Tooling Cost Savings:
(L15) Total Cost - Tool Change:			→ Total Annual Tool Change Cost Savings:
(L16) Total Cost - Machine Time:			→ Total Annual Machine Time Cost Savings:
Total Cost / Lot:			→ **TOTAL ANNUAL COST SAVINGS:**

3890 Buchanan Ave SW • Grand Rapids, MI 49548 • T: 888.531.8500 P: 616.531.8500 F: 616.531.7742 • www.conicalendmills.com • quotes@conicaltool.com

TERMS AND CONDITIONS

1. **PRICE:** The price shall be set in the initial quotation or the order confirmation. In the case of a discrepancy, the order confirmation shall prevail.

2. **WARRANTY:** Global warrants that all products sold hereunder shall conform to the applicable drawings and specifications and that such products shall be free from defects in material and workmanship for a period of one year following shipment by Global. In the even that any products are discovered not to conform to the applicable drawing and specifications, Purchaser shall give written notice to Global promptly upon receipt of the goods. In the event that any of the products do not comply with the warranty against defects in material and workmanship, Purchaser shall give Global a reasonable opportunity to inspect the goods and may only return such products to Global upon receipt of Global's direction, at Purchaser's expense and risk. Purchaser's exclusive remedy for breach of warranties, to be determined by Global, at its option, shall be either (i) the replacement of the products with new products with the delivery of same, shipping charges prepaid, to Purchaser, or (ii) the receipt of full credit for the returned products plus shipping charges paid thereon by Purchaser. Global shall reimburse Purchaser for all shipping charges to Global with respect to defective products. If no defect in the returned products is found after inspection by Global, such products will be returned to Purchaser, at Purchaser's expense. This warranty does not apply to defects not caused by Global (such as accidents, abuse, improper installation, misuse, etc.) nor to products on which the serial numbers, manufacture or shipment dates have been altered or removed. THE WARRANTIES PROVIDED FOR HEREIN ARE IN LIEU OF ALL OTHER WARRANTIES, EXPRESS OR IMPLIED, INCLUDING THE IMPLIED WARRANTIES OF THE MERCHANTIBILITY AND FITNESS FOR A PARTICULAR PURPOSE, ALL OF WHICH OTHER WARRANTIES ARE HEREBY DISCLAIMED..

3. **PATENTS:** Purchaser shall hold Global harmless against any expense for loss resulting from infringement of patents or trademarks arising from compliance with Purchaser's designs, specifications or instructions. Except as provided in the preceding sentence, in the event that a claim is asserted against Purchaser alleging that any product or part thereof furnished hereunder constitutes an infringement of any United States patent, then if notified promptly in writing and given authority, information and assistance, Global may at its sole option and expense, defend against such claim and pay all damages and costs awarded against Purchaser, subject to the limitations contained herein. In lieu of such defense, Global may, at its sole option and expense, either procure the right to continue using said product or part for the Purchaser or replace or modify the product or part so that it becomes non-infringing or remove said product or part and refund the purchase price and transportation cost applicable thereto. In no event, however, shall Global be liable for Purchaser's use of a product delivered hereunder which is covered by any adversely held patent. The foregoing states Global's entire liability for patent infringement by any product or part thereof.

4. **OTHER CLAIMS:** Purchaser agrees to protect, defend, hold harmless and indemnify Global from and against any and all liability and expenses resulting from actual or alleged injury to persons or property arising from the possession or use of any product delivered hereunder that is modified in any manner or arising out of the violation by such modified products of any statute, ordinance or administrative order, rule or regulations. Purchaser agrees that any claims to bring any claims it has against Global within one (1) year of receipt of the product.

5. **SHIPMENT:** All shipments are F.O.B. Shipping Point. The method and route of shipment are to be determined by Global unless Purchaser supplied explicit instructions and said instructions are in compliance with methods used by Global. Risk of loss, title and right of possession pass to Purchaser at the time of delivery to a carrier. Prepaid shipments at Purchaser's request will not affect transfer of title. Failure to make one or more shipments shall not constitute cause for cancellation of Purchaser's order.

6. **TAXES:** Applicable federal, state or local sales, excise or use taxes and duties are not included in the price, but are Purchaser's obligation unless the Purchaser shall provide Global with a tax exempt certificate acceptable to the taxing authorities. This obligation shall survive payment of Purchaser's invoice.

7. **QUANTITY VARIATION:** Global reserves the right to over ship or under ship up to ten percent (10%) per item based on normal manufacturing variations. Orders with shipments of ninety percent (90%) or more of the ordered quantity may at Global's discretion, be considered complete and Purchaser shall be invoiced for the actual quantity shipped.

8. **RETURN OF PRODUCT:** Non-standard items cannot be canceled or returned for exchange or credit Standard items (at the time of purchase) may only be returned with Global's Return Merchandise Authorization (RMA) and only for credit to purchase other Global Cutting Tool company's products. Materials must be returned in their unbroken, original package and are subject to Global's inspection. Credit will be issued, less any applicable restocking charge, only after Global receives an offsetting purchase order. Returned material must be carefully packaged for shipment, freight prepaid by Purchaser, F.O.B. Global's plant. Global will not be liable for any returned products which are damaged or lost while en route.

9. **FORCE MAJEURE:** Global shall not be liable for any delay in the performance of its obligations, or any failure to perform its obligations hereunder in the event that such delay or failure is a result due to a cause or circumstance beyond its reasonable control, including but without limitation, acts of nature, acts of military authorities (whether official or unofficial), strikes or other labor disturbances (whether legal or illegal), flood or water damage, fire, explosion, epidemic, embargo, disruption of shipping, war (whether declared or undeclared), accidents to machinery, inability to obtain necessary parts, priorities requested or required by an instrumentality of the United States government or any state government restrictions imposed by any federal, state or municipal regulations (whether valid or invalid) or any other cause beyond Global's control. Upon occurrence of such contingency, Global shall promptly notify Purchaser of any delay or failure to perform which may be excused under this provision and shall further notify Purchaser of the date of resumption of performance as soon as practicable thereafter. In the event of any such delay, the time for performance shall be extended for a period equal to time lost by reason of the delay.

10. **DELIVERY:** Unless otherwise expressly stated, Global shall have the right to make delivery in installments. Each installment shall be separately invoices and paid as billed without regard to subsequent deliveries. Failure to pay for any installment when due shall excuse Global from making further deliveries on this or any other order from Purchaser unless Global received satisfactory assurance of payment. Any delivery accepted by Purchaser, even though made after the scheduled delivery date, shall constitute a good delivery and shall be paid for regardless of any other controversies relating to other delivered or undelivered products. Global may recover all costs incident to delays in shipment requested by Purchaser, even though agreed to by Global.

11. **TOOLING/DESIGN:** This agreement does not convey any right, title, interest in or possession of and dies, tools, gauges, fixtures, designs, drawings, software or any other item required to fill this order which is not sold and delivered with this order.

12. **LIMITATION OF LIABILITY:** Global shall not be liable for any loss, damage, cost or repair, injury to goodwill, incidental or consequential or special damages of any kind, whether based upon warranty, contract, negligence or strict liability, or in any manner arising in connection with the sale, use or repair of the products sold hereunder, Global's liability, if any, shall never exceed the contract price for products alleged to be defective or to have caused damage of any kind.

13. **GLOBAL's RIGHT of POSSESSION:** In addition to other remedies, Global shall have the right, at any time, for credit reasons or because of Purchaser's default or defaults to withhold shipments in whole or in part, to recall goods in transit ,to retake the same and to repossess all goods, which may be stored with Global for Purchaser's account without the necessity of taking any other proceedings and Purchaser agrees that all products so recalled, retaken or repossessed shall become the absolute property of Global, provided that Purchaser is promptly notified of such action and is given full credit therefor.

14. **INTEREST AND COLLECTION FEES:** : Interest will be charged on all past due accounts at Global's prevailing rates, not in excess of rates permitted by law. Any collection costs or fees incurred by Global to collect any past due accounts will be charged to Purchaser including reasonable attorney fees.

15. **MODIFICATION:** This contract represents the entire agreement between Global and Purchaser and may not be modified or terminated orally. No claimed modification, termination or waiver of any of the provisions contained herein shall be valid unless in writing, signed by Global's duly authorized representative.

16. **CHOICE OF LAW/FORUM:** This contract shall be governed by the laws of the State of Michigan. Any dispute arising under or in connection with these Terms and Conditions or related to any matter shall be subject to the exclusive jurisdiction of the state and/or federal courts located in Kent County Michigan.

17. **PRICES:** Prices quoted in the purchase confirmation or otherwise, are in U.S. Funds, unless otherwise stated. F.O.B. Shipping Point. Prices shall remain unchanged for thirty (30) days from the date of the quotation; thereafter they are subject to change without notice at any time prior to the written acceptance of Purchaser's order by Global's home office, Grand Rapids, Michigan.

18. **ACCEPTANCE:** Neither Purchaser's order and/or correspondence resulting here from, nor Global's shipment of the products listed shall be an acceptance or confirmation of the terms of Purchaser's order at variance with, or in addition to Global's terms herein set forth. The issuance by Purchaser of said order shall be deemed Purchaser's assent to the foregoing.

19. **ESTIMATED DATE OF DELIVERY:** The estimated date of delivery specified for specially made products is based on the production time required to process the order commencing with the date Global received the order or the approved drawings, which is later. All deliveries shown as stock are subject to prior sale.

The secret of success in life is for a man to be ready for his opportunity when it comes.

SPT SUNCOAST INC.
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ESTABLISHED 1963

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