

AUTOMOTIVE



AEROSPACE



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MEDICAL

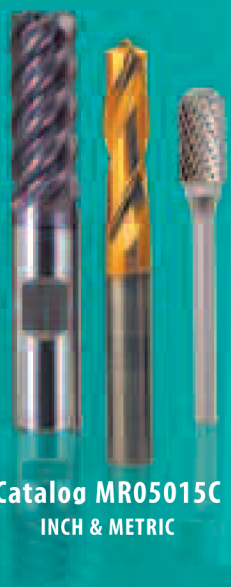


MACHINE TOOL INDUSTRY

CUTTING TOOLS

CARBIDE END MILLS • DRILLS • BURS

METAL REMOVAL
A PRODUCT OF KENNAMETAL INC.



Catalog MR05015C
INCH & METRIC

PRESENTING A *NEW* METAL REMOVAL



METAL REMOVAL
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The Metal Removal Cutting Tool Philosophy

QUALITY

From raw material to final inspection, our state-of-the-art equipment and methods deliver products that will significantly boost your productivity and profitability!

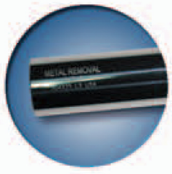
PERFORMANCE

Our carbide technology is simply unsurpassed – as is our commitment to always provide you the grades and technologies to maximize your output!

SERVICE

Our field staff – fully backed by a team of in-house technical experts – has one prime objective: to give you the best tool for the job!





***NEW* Submicron Grain Carbide Substrate**
Now a component of every tool within the Metal Removal line!

***NEW* Sizes, Lengths, and Coatings**
If we don't have it, we'll modify a standard – or we'll custom-build a tool to your exact requirements!



***NEW* Tool Styles**
We've greatly expanded the metalcutting industry's widest array of drills, end mills, burs, and reamers!

***NEW* Easy-Identification Packaging**
Our securely protected white tubes, with UPC code, series number, EDP number, tool dimensions, and a complete description of package contents, virtually guarantee you'll install the right tool in your spindle!



***NEW* Smart Series Numbers**
Now, size, length, finish, and coating are shown within one number!



Kennametal Global Headquarters; Latrobe, Pennsylvania, USA

OUR KENNAMETAL CONNECTION
Metal Removal is a proud brand of Kennametal Inc., the world's premier tooling solutions supplier. You can be assured Kennametal stands behind each and every Metal Removal product – with a promise to do everything possible to reduce your manufacturing lead times and operating costs.

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Coating Application Chart

MATERIALS	EXAMPLES	GOOD	BETTER	BEST
CARBON, ALLOY, AND TOOL STEELS	1018, 1108, 12L13, 12L14, 4140, 4150, A2, D2, P20, P21	TiN	TiCN	TiAlN
STAINLESS STEELS	410, 416, 15-5, 17-4, 303, 304	TiN	TiCN	TiAlN
GRAY, DUCTILE AND MALLEABLE CAST IRONS	**ASTM A48:** 20, 25, 30 **SAE J431:** G1800, G3000, **ASTM A536:** 60-40-18, 65-45-12, **ASTM A47**: 32510, 35018	TiN	TiCN	TiAlN
LOW-SILICON ALUMINUM AND OTHER FREE-MACHINING, NON-FERROUS MATERIALS	2024, 6061, 7075	TiCN	DLC	PCD
HIGH-SILICON ALUMINUM	A380, A360, 383, 390	TiCN	DLC	PCD
HEAT-RESISTANT ALLOYS; NICKEL, IRON, AND COBALT BASE	Inconel, Monel , Waspaloy, A-286, Stellite		TiCN	TiAlN
TITANIUM, AND TITANIUM ALLOYS	Commercially Pure: Ti98.8, Ti99.9. Ti-6Al-4V, Ti-6Al-2Sn-4Zr-2Mo		TiCN	TiAlN
HARDENED STEELS OVER 50 RC	4140, 4150, H10, H11, P20, P21			TiAlN

PVD Coatings

Titanium Nitride (TiN)



- Color: gold
- General-purpose coating
- Coefficient of friction .4 against steel
- Less friction provides freer chip flow and reduces built-up edge (BUE)
- Hardness 2300 Hv
- Mono-layer
- Coating thickness 1-4 microns
- Oxidation onset temperature 1100°F

Titanium Carbonitride (TiCN)



- Color: gray
- Hardness 3000 Hv
- Higher hardness over TiN provides good abrasion resistance
- Coefficient of friction .4 against steel
- Mono-layer
- Coating thickness 1-4 microns
- Oxidation onset temperature 750°F

Titanium Aluminum Nitride (TiAlN)



- Color: gray black
- Hardness 3300 Hv
- Maintains hardness at high temperatures
- Oxidizes at high speeds forming a protective layer of AL203
- Enables dry machining
- Coefficient of friction .3 - .35 against steel
- Mono-layer
- Coating thickness 1-5 microns
- Oxidation onset temperature 1650°F

Chromium Nitride (CrN)



- Color: silver gray
- Copper, brass, non-ferrous materials
- Non-galling, chemically inert
- Hardness 1750 Hv
- Coefficient of friction .5 against steel
- Oxidation onset temperature 1300°F

Diamond Coatings

Amorphous, diamond-like coating (DLC)



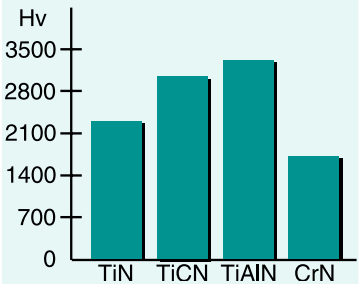
- Color: black gray
- Hardness 2000 Hv
- Thickness 1-3 microns
- Coefficient of friction .1 - .2

Polycrystalline Diamond (PCD)



- Color: silver gray
- Can only be applied to 6% cobalt carbide
- Hardness 8000 Hv
- Thickness 3-12 microns
- Coefficient of friction .1 - .2

Coating Hardness Comparison



Group	Group Description	Hardness	
	**Low-Carbon Steel** *AISI: 1008, 1010, 1018, 1020, 1026, 10L18, 10L45, 10L50, 1108, 1117, 11L44, 1200 Series, 12L14*	**< 220 HB**	
	Free-Machining Steels *AISI: 1109, 1111, 1112, 1113, 1114, 1115, 1116, 1132, 1137, 1138, 1140, 1141, 1144, 1145, 1151*	**< 275 HB**	**≤ 28 HRc**
	Medium and High Plain Carbon, Alloy and Tool Steels *Medium and High Carbon Steels: AISI: 1035, 1040, 1045, 1055, 1080, 1090, 1095, 1525, 1541, 1548, 1551, 1561, 1572* *Alloy Steels: AISI: 1300 series, 2000 series, 3000 series, 4012, 4023, 4140, 4150, 4320, 4422, 5120, E51100, E52100, 6118, 6150, 7000 series, 8620, 8622, 86540, 8822, E-9310, 94B15, Rycut 40, Cr-Mo alloy, Super-Kut steels* *Tool Steels: high-speed classes M and T; hot and cold work SAE classes A, D, H, O and S; wrought high carbon/low alloy W1, W2, L2, P1, P6, P20*	**≤ 330 HRc**	**≤ 35 HRc**
	Medium and High Plain Carbon, Alloy and Alloy Steels *Alloy Steels: AISI: 1335, 4140, 4330, 5046, 5140, 52100, 8625, 8640, 300-M, EDT-180, Hy Tuff steel and stress-proof steel* *Tool Steels: SAE class M and T, hot and cold work SAE classes A, D, H, O and S; wrought high carbon/low alloy W1, W2, L2, P1, P6, P20*	**340-450 HB**	**36-48 HRc**
	Ferritic, Martensitic, and PH Stainless Steels *400 and 500 series AISI: 410, 416, 416F, 416Se, 420Fm, 4389F, Se, 440, 440C, 502, 504 and precipitation hardening (PH) 17-4PH, PH 13-8 Mo, 15-5 PH*	**< 330 HB**	**≤ 40 HRc**
	**Austenitic Stainless Steels** 200 and 300 series, Duplex AISI: 210, 209, 302, 303, 304, 304L, 310, 316, 316L, 321, 329, 347, 384 ASTM: XM-1, SM-5, XM-7, XM-21, CF-8M	**135-275 HB**	**≤ 28 HRc**
	**Ductile (Nodular) and Malleable Cast Irons** nodular/ductile, ferritic/pearlitic, pearlitic/martensitic ASTM A536, 60-40-18, 65-45-12, 80-55-06, 100-70-03 SAE: J434, D4018, D4512, D5506, D7003	**120-320 HB**	
	Gray Cast Irons ASTM: A48, class 20, 25, 30, 35, 40, 45, 50, 55, 60 SAE: J431: grade G1800, G3000, G3500, G4000	**120-320 HB**	
	**Free-Machining and Low-Silicon Aluminum Alloys** AA: 2024-T4, 2014-T6, 2011-T3, 3003-H18, A2, Alcoa 510, Duralumin aluminum, 6061-T4, 6061-T6, 7075-T4, 7075-T-6	**Hypoeutectic <12.2% Si**	
	High-Silicon Aluminum Alloys AA: A380, A390, A38 AA: A380, A390, A380-1, A390-1, A380-2, Duralcan	**Hypereutectic >12.2% Si**	
	Miscellaneous Non-ferrous Workpiece Materials Non-ferrous machining alloys, copper, brass, zinc	**—**	
	**Iron-Base Heat-Resistant Alloys** Wrought: A-286, Discaloy, Incoloy 801, N-155, 16-25-6, 19-9 DL Cast: ASTM A297, A351, A608, A567	**135-320 HB**	**≤ 34 HRc**
	Cobalt-Base Heat-Resistant Alloys Wrought: AiResist 213, Haynes 25 (L605), Haynes 188, J-1570, Stellite Cast: Ai Resist 13, Haynes 21, MAR-M509, NASA Co-W-Re, WI-52	**150-425 HB**	**≤ 45 HRc**
	Nickel-Base Heat-Resistant Alloys Astroloy, Hastelloy, B/C/C0276/X, Inconel 601/ 617/ 625/ 700/ 706/718, IN 102, Incoloy 901, MAR-M200, Nimonic, Rene 41, Udimet, Waspaloy, Monel	**140-475 HB**	**≤ 48 HRc**
	Titanium and Titanium Alloys pure: Ti98.8, Ti99.9 alloyed: Ti5Al2.5Sn, Ti-5Al-4V, Ti6Al2Sn-4Zr-2Mo, Ti3Al-8V-6Cr-4Mo-4Zr, Ti10V-2Fe-3Al, Ti-13V-11Cr-3Al	**110-450 HB**	**≤ 48 HRc**
	**Hardened Materials** steels, stainless steels, and irons	**48-65 HRc**	

There are many reasons to trust your special requirements to Metal Removal…

Metal Removal (MR) provides a wide range of specials capabilities in North America, offering many tool styles.

- End mills – roughing and finishing
- Drills – standard and high-performance
- Reamers – solid carbide or steel shanks
- Burs – wide range of shapes, shanks, and cuts

MR offers the best service for all your specials needs.

- Fast quotation response from dedicated quotation specialists
- Excellent delivery
- Consistent tool performance
- Focused factory procedures mean your specials are not "lost" on the plant floor

MR covers the whole spectrum of specials, from simple modifications to highly detailed specifications.

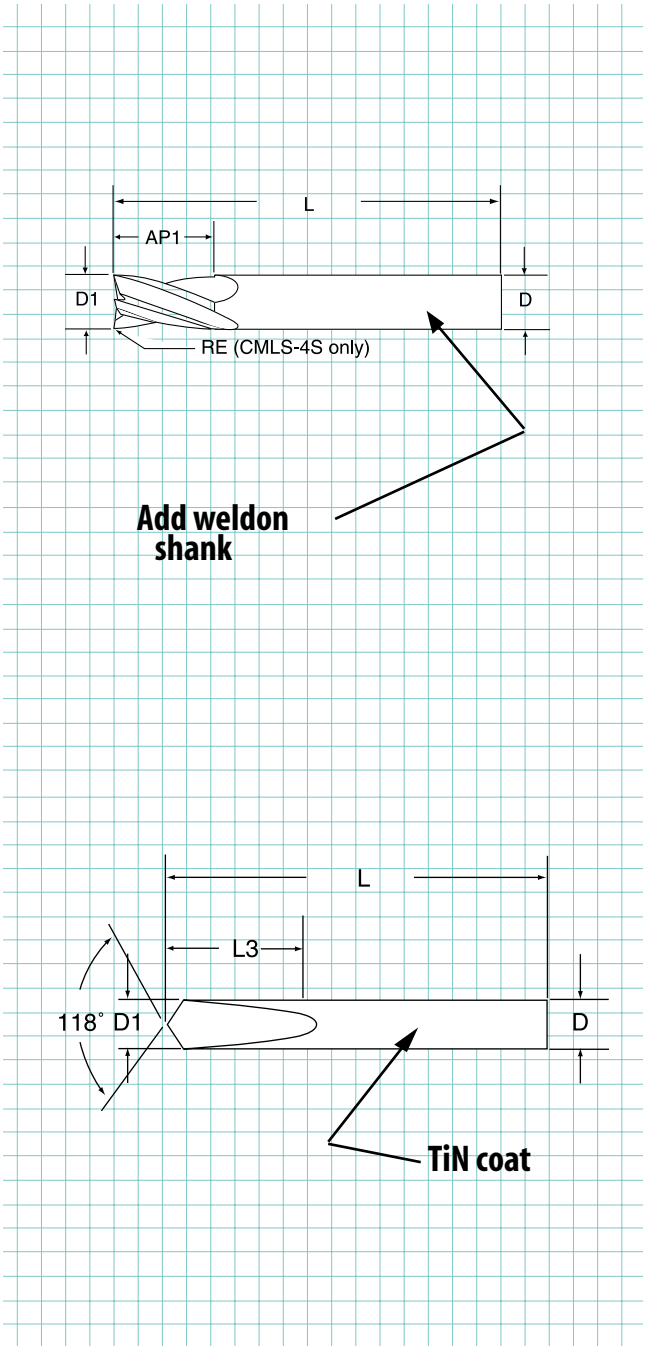
- Simple specials:
  - Outstanding quality!
  - Fast delivery!
  - Great prices!
- Blueprint specials:
  - Analysis at the spindle!
  - Outstanding engineering support!
  - Quality you can count on!

MR provides the best technical support.

- Engineering and design services
- Design services
- In-house PVD coating capabilities
- Application problem solving by in-house technical staff and field application specialists
- R & D resources unmatched by any other North American cutting tool company

Special drills and end mills are our specialty.

- All materials – HSS, M42, powdered metal, and carbide
- Solid or with coolant hole
- All end geometries, point angles, and styles
- Spiral or straight flutes
- Single or multiple-step
- Regrinding and reconditioning services



CARBIDE END MILLS





AUTOMOTIVE



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DIE & MOLD



MEDICAL



MACHINE TOOL INDUSTRY

METAL REMOVAL

A PRODUCT OF KENNAMETAL INC.

CARBIDE END MILLS

- wide selection of tool styles for virtually every roughing, semi-finishing, and finishing application
- featuring top-quality submicrongrain carbide substrates for unparalleled performance
- wide array of cutting diameters, tool lengths, and coatings



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Single-End, General-Purpose, Solid Carbide End Mills

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2-Flute, CC, Miniature	CGM-2	14
2-Flute, CC	CG-2	15-17
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2-Flute, CC – Metric DIN Sizes	CG-2MD	18
2-Flute, CC, with Corner Radius	CG-2R	19
2-Flute, CC, with Plus NC Tolerance	CPNC-2	20
2-Flute, CC, with Ball Nose	CG-2B	21-22
2-Flute, CC, with Ball Nose – Standard Metric Sizes	CG-2MB	23
2-Flute, CC, with Ball Nose – Metric DIN Sizes	CG-2MDB	23
2-Flute, CC, Long Reach	CGL-2	24
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3-Flute, CC – Standard Metric Sizes	CG-3M	26
3-Flute, CC – Metric DIN Sizes	CG-3MD	26
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Double-End, General-Purpose, Solid Carbide End Mills

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CG-2M 18
CG-2MD 18



CG-2R 19



CPNC-2 20



CG-2B 21-22
CG-2MB 23
CG-2MDB 23



CGL-2 24



CGL-2B 24

Single-End, 3-Flute



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CG-3M 26
CG-3MD 26



CG-3B 27

Single-End, 4-Flute



CG-4 28-30



CG-4R 31



CG-4M 32
CG-4MD 32



CPNC-4 33



CG-4B 34-35
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CG-4MDB 36



CGL-4 37



CGL-4B 37

Single-End, 6-Flute



CG-6 38

double end on next page

Double-End, 2-Flute



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CGDS-2B 39



CGD-2 40



CGD-2B 40

Double-End, 4-Flute



CGDS-4 41

CGDS-4M 41



CGDS-4B 42

CGDS-4MB 42



CGD-4 43



CGD-4B 43

This Catalog Includes:

23 NEW end mill styles

available from stock for more application flexibility

General-Purpose — 7 new styles

- 2- and 4-flute with corner radius
- 2- and 4-flute with long shanks and short flute lengths, in both square end and ball nose
- 6-flute finishing end mills

Double-End — 3 new styles

- 2-flute with ball nose
- 4-flute with ball nose
- 4-flute metric miniature stub with ball nose, bright

High-Performance — 5 new styles

- Maestro™ 4-flute offset flute for chatter-free machining in both regular and long-reach styles
- 2-flute for long-reach applications in aluminum, with and without neck clearance
- 2-flute for long-reach applications in aluminum with ball nose for 3D milling
- 6-flute high helix superfinisher

Special Application — 8 new styles

- 2-flute chamfer mill, single and double end
- 4-flute chamfer mill, single and double end
- Tapered end mills, square end, and ball nose
- 2-flute small-diameter engraving tools
- 90° drill point end mill

AVAILABLE IN BOTH BRIGHT AND COATED VERSIONS

Series CG Single End, Series CGD Double End, General Purpose

Features

- 10% cobalt submicron grain carbide substrate
- 30° right-hand spiral, right-hand cut helix designed for maximum chip clearance
- Two-, three-, four-, and six-flute configurations available
- Available in square, corner radius, and ball nose end geometries
- Available in multiple lengths
- Offered in inch, standard metric, and DIN metric sizes

Applications

- Use in general milling applications in cast iron, non-ferrous light metals, and plastics, as well as medium- to low-carbon steels.
- Double-end mills offer an economical way to increase productivity.
- Two-flute end mills are generally used for plunging, slotting, and heavy peripheral cuts.
- Three-flute end mills provide a good compromise between the chip clearance of a two-flute end mill with the rigidity and wear resistance of a four-flute tool; they are especially suited for many slotting operations.
- Four-flute end mills are most commonly used in profiling applications and harder materials than two-flute end mills. Stiffer construction results in minimal deflection. Four flutes provide good surface finishes and wear-resistant characteristics for excellent size control.
- Feed and speed recommendations are listed on pages 12 and 13.

Use Series CG end mills for finishing applications in these materials:

CAST IRON	**Ductile (Nodular) and Malleable Cast Irons** *nodular/ductile, ferritic/pearlitic, pearlitic/martensitic* *ASTM A536, 60-40-18, 65-45-12, 80-55-06, 100-70-03* *SAE: J434, D4018, D4512, D5506, D7003*	**120-320 HB**	
	Gray Cast Irons *ASTM: A48, class 20, 25, 30, 35, 40, 45, 50, 55, 60* *SAE: J431: grade G1800, G3000, G3500, G4000*	**120-320 HB**	
NON-FERROUS MATERIAL	**Free-Machining and Low-Silicon Aluminum Alloys** *AA: 2024-T4, 2014-T6, 2011-T3, 3003-H18, A2, Alcoa 510, Duralumin aluminum, 6061-T4, 6061-T6, 7075-T4, 7075-T-6*	**Hypoeutectic <12.2% Si**	
	High-Silicon Aluminum Alloys AA: A380, A390, A38 *AA: A380, A390, A380-1, A390-1, A380-2, Duralcan*	**Hypereutectic >12.2% Si**	
	Miscellaneous Non-ferrous Workpiece Materials *Non-ferrous machining alloys, copper, brass, zinc*	**—**	
STEEL	**Low-Carbon Steel** *AISI: 1008, 1010, 1018, 1020, 1026, 10L18, 10L45, 10L50, 1108, 1117, 11L44, 1200 Series, 12L14*	**< 220 HB**	
	Free-Machining Steels *AISI: 1109, 1111, 1112, 1113, 1114, 1115, 1116, 1132, 1137, 1138, 1140, 1141, 1144, 1145, 1151*	**< 275 HB**	**≤ 28 HRc**
	Medium and High Plain Carbon, Alloy and Tool Steels *Medium and High Carbon Steels: AISI: 1035, 1040, 1045, 1055, 1080, 1090, 1095, 1525, 1541, 1548, 1551, 1561, 1572* *Alloy Steels: AISI: 1300 Series, 2000 Series, 3000 Series, 4012, 4023, 4140, 4150, 4320, 4422, 4520, E51100, E52100, 6118, 6150, 7000 Series, 8620, 8622, 86540, 8822, E-9310, 94B15, Rycut 40, Cr-Mo alloy, Super-Kut steels* *Tool Steels: high-speed classes M and T; hot and cold work SAE classes A, D, H, O and S; wrought high carbon/low alloy W1, W2, L2, P1, P6, P20*	**≤ 330 HRc**	**≤ 35 HRc**
	Medium and High Plain Carbon, Alloy and Alloy Steels *Alloy Steels: AISI: 1335, 4140, 4330, 5046, 5140, 52100, 8625, 8640, 300-M, EDT-180, Hy Tuff steel and stress-proof steel* *Tool Steels: SAE classes M and T, hot and cold work SAE classes Ad, D, H, O and S; wrought high carbon/low alloy Wq, W2, L2, P1, P6, P20*	**340-450 HB**	**36-48 HRc**
	Ferritic, Martensitic, and PH Stainless Steels *400 and 500 series AISI: 410, 416, 416F, 416Se, 420Fm, 4389F, Se, 440, 440C, 502, 504 and precipitation hardening (PH) 17-4PH, PH 13-8 Mo, 15-5 PH*	**< 330 HB**	**≤ 40 HRc**

Suggested Feeds for General-Purpose Carbide End Mills *(see page 181 for metric recommendations)*

These recommendations are for profiling operations; reduce speeds 20% for slotting operations.



Material	Hardness Brinell	Hardness HRc	Preferred Coating	Alternate Coating	Surface Feet per Minute (SFM) Speed Range	Uncoated	TiN Coated	TiCN Coated	TiAlN Coated
Low and Plain Carbon, Alloy and Tool Steels	< 220 HB	<19	TiCN	TiN	Low	270	300	320	—
					High	360	430	500	—
Plain Carbon, Alloy and Tool Steels	225-286	20-30	TiCN	TiAlN or TiN	Low	180	200	220	250
					High	270	320	380	430
Plain Carbon, Alloy and Tool Steels	294-371	31-40	TiCN	TiAlN or TiN	Low	150	170	180	210
					High	200	240	280	320
Ferritic, Martensitic 400, 500, and PH Stainless Steels	135-330	<35	TiAlN	TiCN or TiN	Low	160	180	190	220
					High	270	320	380	430
Austenitic Stainless Steels 200 and 300 Series	135-275	<28	TiAlN	TiCN or TiN	Low	180	200	220	250
					High	275	330	390	440
Ductile and Malleable Cast Irons	120-320	<35	TiAlN	TiCN or TiN	Low	160	180	190	220
					High	270	320	380	430
Cast Iron (Gray)	120-220	<18	TiAlN	TiCN or TiN	Low	315	350	380	440
					High	450	540	630	720
Cast Iron (Gray)	220-320	19-34	TiAlN	TiCN or TiN	Low	225	250	270	320
					High	315	380	440	500
Low-Silicon Aluminum and Other Non-Ferrous Alloys	50-150	—	TiCN	TiN	Low	720	790	860	—
					High	900	1080	1260	—
High-Silicon Aluminum	—	—	TiCN	TiN	Low	540	590	650	—
					High	720	860	1010	—
Cobalt-Based High-Temperature Alloys	150-425	<45	TiAlN	TiCN	Low	30	—	40	40
					High	45	—	60	70
Nickel-Based High-Temperature Alloys	140-300	<32	TiAlN	TiCN or TiN	Low	45	50	50	60
					High	90	110	130	140
Nickel Based High-Temperature Alloys	300-475	32-50	TiAlN	TiCN	Low	40	—	50	60
					High	70	—	100	110
Titanium, Pure	—	—	NONE	NONE	Low	180	—	—	—
					High	270	—	—	—
Titanium, Alloyed	300-440	32-43	TiAlN	TiCN	Low	90	—	110	130
					High	135	—	190	220

The higher values for surface speed should be used for radial depths of cut less than 25% of the diameter. Lower values for surface speed should be used for radial depths of cut greater than 25% of the diameter. The above recommendations are for axial lengths of cut not to exceed 1 times the cutter diameter for profiling and .5 times the diameter for slotting. The above speeds are a recommended starting point only. Ultimate speeds will depend upon setup conditions. Higher or lower parameters may be required to achieve optimum conditions.

Tech Tip:

Establish a secure and rigid workpiece setup – cutting efficiency and a quality surface finish are dependent on it.

Use end mills with the largest possible diameter, shortest possible flute length, and shortest possible overall length.

Use the correct speeds and feeds for the application and the material being machined; carbide end mills require much higher speeds than HSS.

Suggested Feeds for General-Purpose Carbide End Mills *(see page 182 for metric recommendations)*

These recommendations are for profiling operations; reduce chip load per tooth 20% for slotting operations.



Material	Hardness Brinell	Hardness HRc	Chip Load Per Tooth 1/16"	1/8"	3/16"	1/4"	5/16"	3/8"	1/2"	5/8"	3/4"	1"
Low and Plain Carbon, Alloy and Tool Steels	< 220 HB	<19	0.0004	0.0006	0.0010	0.0015	0.0020	0.0025	0.0030	0.0035	0.0040	0.0045
Plain Carbon, Alloy and Tool Steels	225-286	20-30	0.0004	0.0006	0.0010	0.0015	0.0020	0.0025	0.0030	0.0035	0.0040	0.0045
Plain Carbon, Alloy and Tool Steels	294-371	31-40	0.0003	0.0004	0.0007	0.0011	0.0014	0.0018	0.0021	0.0025	0.0028	0.0032
Ferritic, Martensitic 400, 500, and PH Stainless Steels	135-330	<35	0.0004	0.0006	0.0008	0.0015	0.0020	0.0025	0.0030	0.0035	0.0040	0.0045
Austenitic Stainless Steels 200 and 300 Series	135-275	<28	0.0002	0.0004	0.0006	0.0010	0.0015	0.0020	0.0025	0.0030	0.0035	0.0040
Ductile and Malleable Cast Irons	120-320	<35	0.0003	0.0004	0.0007	0.0011	0.0014	0.0018	0.0021	0.0025	0.0028	0.0032
Cast Iron (Gray)	120-220	<18	0.0008	0.0012	0.0020	0.0030	0.0040	0.0050	0.0060	0.0070	0.0080	0.0090
Cast Iron (Gray)	220-320	19-34	0.0005	0.0007	0.0012	0.0018	0.0024	0.0030	0.0036	0.0042	0.0048	0.0055
Low-Silicon Aluminum and Other Non-Ferrous Alloys	50-150	—	0.0006	0.0010	0.0016	0.0024	0.0032	0.0040	0.0048	0.0056	0.0064	0.0072
High-Silicon Aluminum	—	—	0.0006	0.0010	0.0016	0.0024	0.0032	0.0040	0.0048	0.0056	0.0064	0.0072
Cobalt-Based High-Temperature Alloys	150-425	<45	0.0002	0.0004	0.0006	0.0009	0.0012	0.0015	0.0018	0.0021	0.0024	0.0027
Nickel-Based High-Temperature Alloys	140-300	<32	0.0002	0.0004	0.0006	0.0009	0.0012	0.0015	0.0018	0.0021	0.0024	0.0027
Nickel-Based High-Temperature Alloys	300-475	32-50	0.0002	0.0004	0.0006	0.0009	0.0012	0.0015	0.0018	0.0021	0.0024	0.0027
Titanium, Pure	—	—	0.0002	0.0004	0.0006	0.0009	0.0012	0.0015	0.0018	0.0021	0.0024	0.0027
Titanium, Alloyed	300-440	32-43	0.0002	0.0004	0.0006	0.0009	0.0012	0.0015	0.0018	0.0021	0.0024	0.0027

The above recommendations are for axial lengths of cut not to exceed 1 times the cutter diameter for profiling and .5 times the diameter for slotting. The above feeds are a recommended starting point only. Ultimate speeds and feeds will depend upon setup conditions. Higher or lower parameters may be required to achieve optimum conditions.

Tech Tip:

Watch for signs of wear; replace or regrind the end mill at the first sign of dulling to avoid damaging the tool beyond repair.

Use the proper end mill holder for the tool and the application.

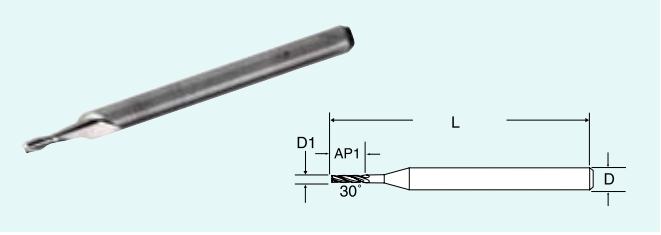
To minimize runout, clean the holder with a spindle wiper periodically to remove chips, lint, oil, sludge, and coolants.

Series CGM-2 Miniature

Features

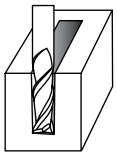
- 2-flute
- Center cutting
- 10% cobalt submicron grain carbide substrate
- Miniature sizes
- Uncoated standard; coated tools available as a modification

Old List Number 164-27



Applications

- Designed for precision slotting applications.
- Provides adequate core strength and sufficient flute volume for milling small slots.
- Speed and feed recommendations are listed on pages 12-13.





Series CGM-2 Miniature

D1 inch	D inch	AP1 inch	L inch	Uncoated EDP No.
0.0050	1/8	0.0075	1-1/2	M31230
0.0060	1/8	0.0090	1-1/2	M31231
0.0070	1/8	0.0105	1-1/2	M31232
0.0080	1/8	0.0120	1-1/2	M31240
0.0090	1/8	0.0140	1-1/2	M31241
0.0100	1/8	0.0150	1-1/2	M31242
0.0100	1/8	0.0300	1-1/2	M31250
0.0110	1/8	0.0170	1-1/2	M31251
0.0110	1/8	0.0330	1-1/2	M31252
0.0120	1/8	0.0180	1-1/2	M31260
0.0120	1/8	0.0360	1-1/2	M31261
0.0130	1/8	0.0200	1-1/2	M31262
0.0130	1/8	0.0390	1-1/2	M31270
0.0140	1/8	0.0210	1-1/2	M31271
0.0140	1/8	0.4200	1-1/2	M31272
0.0150	1/8	0.0230	1-1/2	M31280
0.0150	1/8	0.4500	1-1/2	M31281
0.0160	1/8	0.0240	1-1/2	M31282
0.0160	1/8	0.0480	1-1/2	M31290
0.0170	1/8	0.0260	1-1/2	M31291
0.0170	1/8	0.0510	1-1/2	M31292
0.0180	1/8	0.0270	1-1/2	M31300
0.0180	1/8	0.0540	1-1/2	M31301
0.0190	1/8	0.0280	1-1/2	M31302
0.0190	1/8	0.0570	1-1/2	M31310
0.0200	1/8	0.0300	1-1/2	M31311
0.0200	1/8	0.0600	1-1/2	M31312

D1 inch	D inch	AP1 inch	L inch	Uncoated EDP No.
0.0210	1/8	0.0320	1-1/2	M31320
0.0210	1/8	0.0630	1-1/2	M31321
0.0220	1/8	0.0330	1-1/2	M31322
0.0220	1/8	0.0660	1-1/2	M31330
0.0230	1/8	0.0350	1-1/2	M31331
0.0230	1/8	0.0690	1-1/2	M31332
0.0240	1/8	0.0360	1-1/2	M31340
0.0240	1/8	0.0720	1-1/2	M31341
0.0250	1/8	0.0380	1-1/2	M31342
0.0250	1/8	0.0750	1-1/2	M31350
0.0260	1/8	0.0390	1-1/2	M31351
0.0260	1/8	0.0780	1-1/2	M31352
0.0270	1/8	0.0410	1-1/2	M31360
0.0270	1/8	0.0810	1-1/2	M31361
0.0280	1/8	0.0420	1-1/2	M31362
0.0280	1/8	0.0840	1-1/2	M31370
0.0290	1/8	0.0440	1-1/2	M31371
0.0290	1/8	0.8700	1-1/2	M31372
0.0300	1/8	0.0450	1-1/2	M31380
0.0300	1/8	0.0900	1-1/2	M31381
0.0350	1/8	0.1050	1-1/2	M31382
0.0400	1/8	0.1200	1-1/2	M31390
0.0450	1/8	0.1350	1-1/2	M31391
0.0500	1/8	0.1500	1-1/2	M31392
0.0550	1/8	0.1650	1-1/2	M31400
0.0600	1/8	0.1800	1-1/2	M31401

Tech Tip:

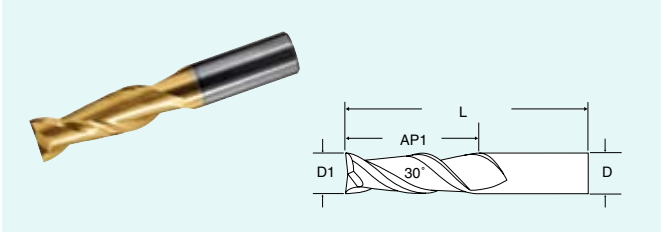
The machine tool must have sufficient rigidity to minimize spindle deflection and sufficient horsepower to perform at recommended feeds and speeds.
Verify adequate flute chip clearance for the type of workpiece material being cut, and take appropriate action to avoid recutting chips that can dull the cutting edge of the mill.

Series CG-2

Features

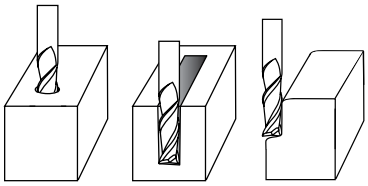
- 2-flute, 30° right-hand spiral, right-hand cut
- Center cutting
- 10% cobalt submicron grain carbide substrate
- Large flute area enables excellent chip evacuation
- Uncoated and TiCN coated standard in all sizes
  TiN coated and TiAlN coated standard in specific sizes;
  other sizes available as a modification

Old List Numbers 155-27, 161-27, 162-27, 163-27



Applications

- Effective for general milling applications in cast iron, non-ferrous light metals and plastics.
- Excellent for plunging, slotting, and heavy peripheral cuts.
- Feed and speed recommendations are listed on page 12-13.





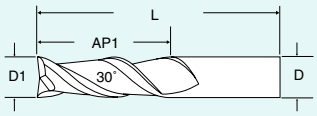
Series CG-2

D1 inch	D inch	AP1 inch	L inch	Uncoated EDP No.	TiN Coated EDP No.	TiCN Coated EDP No.	TiAlN Coated EDP No.
1/64	1/8	1/32	1-1/2	M30900		M30914	
1/32	1/8	5/64	1-1/2	M30901		M30915	M30526
3/64	1/8	1/8	1-1/2	M35492		M34974	
1/16	1/8	1/8	1-1/2	M30902		M30925	M30536
1/16	1/8	3/16	1-1/2	M30910		M30934	M30546
1/16	1/8	1/2	2	M30911		M30935	
5/64	1/8	3/16	1-1/2	M30912		M30944	
3/32	1/8	3/16	1-1/2	M30920		M30945	
3/32	1/8	3/8	1-1/2	M30921		M30804	M30556
3/32	1/8	5/8	2	M30922		M30954	
7/64	1/8	3/8	1-1/2	M30930		M30955	
1/8	1/8	1/4	1-1/2	M30931	M30033	M30964	M30566
1/8	1/8	1/2	1-1/2	M30932	M30043	M30965	M30576
1/8	1/8	3/4	2-1/4	M30940		M30974	M30586
1/8	1/8	3/4	3	M31171		M34404	M30906
1/8	1/8	1	3	M30941		M30975	
9/64	3/16	9/16	2	M30942		M30984	
5/32	3/16	5/16	2	M30950		M30985	
5/32	3/16	9/16	2	M30951		M30805	M30596
11/64	3/16	5/8	2	M30952		M30994	
3/16	3/16	5/16	1-1/2	M30960	M30053	M30995	M30606
3/16	3/16	5/8	2	M30961	M30063	M31004	M30616
3/16	3/16	3/4	2-1/2	M30962		M31005	M30626
3/16	3/16	1	4	M31172		M34405	M30916
3/16	3/16	1-1/8	3	M30970		M31014	
13/64	1/4	5/8	2-1/2	M30971		M31015	
7/32	1/4	7/16	2	M30972		M31025	
7/32	1/4	5/8	2-1/2	M30980		M31024	M30646
15/64	1/4	3/4	2-1/2	M30981		M31034	
1/4	1/4	1/2	2	M30982	M30073	M31035	M30656
1/4	1/4	3/4	2-1/2	M30990	M30083	M31044	M30666
1/4	1/4	1	4	M31180		M34414	M30926
1/4	1/4	1-1/8	3	M30991		M31045	M30676
1/4	1/4	1-1/2	4	M30992		M31054	
1/4	1/4	1-1/2	6	M31181		M34415	M30936
17/64	5/16	3/4	2-1/2	M31000		M31055	
9/32	5/16	3/4	2-1/2	M31001		M31064	

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(continued) Series CG-2





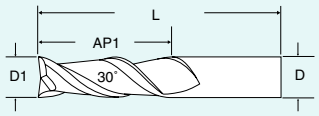
Series CG-2 (continued)

D1 inch	D inch	AP1 inch	L inch	Uncoated EDP No.	TiN Coated EDP No.	TiCN Coated EDP No.	TiAlN Coated EDP No.
19/64	5/16	13/16	2-1/2	M31002		M31065	
5/16	5/16	1/2	2	M31011	M30093	M31074	M30686
5/16	5/16	13/16	2-1/2	M31012	M30113	M31075	M30696
5/16	5/16	1	4	M31182		M34424	M30946
5/16	5/16	1-1/2	6	M31190		M34425	M30956
5/16	5/16	1-1/8	3	M31020		M31084	M30706
5/16	5/16	1-5/8	4	M31021		M31085	
21/64	3/8	1	2-1/2	M31022		M31094	
11/32	3/8	1	2-1/2	M31030		M31095	
23/64	3/8	1	2-1/2	M31031		M31114	
3/8	3/8	5/8	2	M31032	M30123	M31115	M30716
3/8	3/8	7/8	2-1/2	M31040	M35140	M31125	M35496
3/8	3/8	1	4	M31191		M34434	M30966
3/8	3/8	1-1/8	3	M31041		M31124	M30726
3/8	3/8	1-1/2	6	M31192		M34435	M30976
3/8	3/8	1-3/4	4	M31042		M31134	
3/8	3/8	3	6	M31200		M34444	M30986
25/64	7/16	1	2-3/4	M31050		M31135	
13/32	7/16	1	2-3/4	M31051		M31144	
27/64	7/16	1	2-3/4	M31052		M31145	
7/16	7/16	5/8	2-1/2	M31060		M31155	M30746
7/16	7/16	1	2-1/2	M31061	M30143	M31154	M30736
7/16	7/16	1	4	M31201		M34445	M30996
7/16	7/16	2	4	M31062		M31164	
7/16	7/16	3	6	M31202		M34454	M31006
29/64	1/2	1	3	M31070		M31165	
15/32	1/2	1	3	M31071		M31174	
31/64	1/2	1	3	M31072		M31175	
1/2	1/2	5/8	2-1/2	M31080	M30153	M31184	M30756
1/2	1/2	1	3	M31081	M30163	M31185	M30766
1/2	1/2	1	4	M31210		M34455	M31016
1/2	1/2	1-1/4	3	M31082	M30183	M31194	M30776
1/2	1/2	1-1/2	6	M31211		M34464	M31026
1/2	1/2	2	4	M31090		M31195	M30786
1/2	1/2	3	6	M31091		M31204	
9/16	9/16	3/4	3	M31092		M31214	
9/16	9/16	1-1/4	3-1/2	M31100	M30213	M31205	
9/16	9/16	2-1/4	5	M31110		M31215	
5/8	5/8	3/4	3	M31111	M30223	M31224	M30796
5/8	5/8	1-1/4	3-1/2	M31112	M30233	M31225	M30806
5/8	5/8	2	6	M31212		M34465	M31036
5/8	5/8	2-1/4	5	M31120		M31234	M30816
5/8	5/8	3	6	M31220		M34474	M31046
5/8	5/8	4	7	M31121		M31235	
11/16	3/4	1-3/8	4	M31122		M31244	

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(continued) Series CG-2





Series CG-2 (continued)

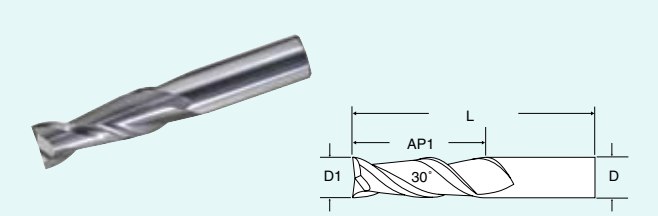
D1 inch	D inch	AP1 inch	L inch	Uncoated EDP No.	TiN Coated EDP No.	TiCN Coated EDP No.	TiAlN Coated EDP No.
3/4	3/4	1	3	M31130	M30243	M31245	M30826
3/4	3/4	1-1/2	4	M31131	M30263	M31254	M30836
3/4	3/4	2	6	M31221		M34475	M31056
3/4	3/4	2-1/4	5	M31132		M31255	M30846
3/4	3/4	3	6	M31140		M31264	M30856
3/4	3/4	4	7	M31141		M31265	
7/8	7/8	1-1/2	4	M31142		M31274	M30866
7/8	7/8	2-1/4	5	M31150		M31275	
1	1	1-1/2	4	M31151		M31285	M30886
1	1	2	6	M31222		M34484	M31066
1	1	2-1/4	5	M31152	M30273	M31284	M30876
1	1	3	6	M31160		M31294	M30896
1	1	4	7	M31161		M31295	
1-1/8	1	2	4-1/2	M31162		M31304	
1-1/4	1-1/4	2	4-1/2	M31170		M31305	

Series CG-2M Standard Metric, CG-2MD DIN Metric

Features

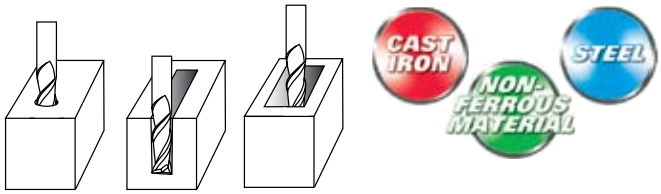
- 2-flute
- Center cutting
- 10% cobalt submicron grain carbide substrate
- Series CG-2M standard metric sizes;
  Series CG-2MD made to DIN specifications
- Uncoated standard; coatings available as a modification

Old List Number 155-27M



Applications

- Effective for general milling applications in cast iron, non-ferrous light metals, and plastics.
- Excellent for plunging, slotting, and heavy peripheral cuts.
- Feed and speed recommendations are listed on pages 12-13.



Series CG-2M Standard Metric

D1 mm	D mm	AP1 mm	L mm	Uncoated EDP No.
1,0	3	3	38	M31870
1,5	3	5	38	M31872
2,0	3	6,3	38	M31880
2,5	3	6,3	38	M31881
3,0	3	9,5	38	M31882
3,5	4	12	50	M31890
4,0	4	12	50	M31891
4,0	4	14	51	M39961
4,5	5	14	51	M39962
4,5	6	14	50	M31892
5,0	5	16	51	M39970
5,0	6	14	50	M31900
6,0	6	16	50	M31901
6,0	6	19	64	M39971
7,0	7	20	63	M31902
8,0	8	20	63	M31910
9,0	9	20	63	M31911
10,0	10	22	76	M31912
11,0	11	25	70	M31920
12,0	12	25	76	M31921
14,0	14	32	89	M31922
16,0	16	32	89	M31930
18,0	18	38	104	M31931
20,0	20	38	104	M31932
22,0	22	38	102	M31940
25,0	25	38	102	M31941

Series CG-2MD DIN Metric

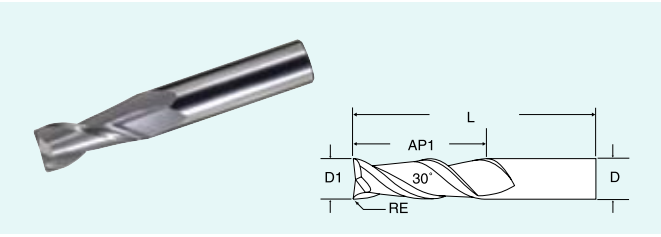
D1 mm	D mm	AP1 mm	L mm	Uncoated EDP No.
2,0	6	6	57	M31451
2,5	6	6	57	M31452
3,0	6	7	57	M31460
3,0	3	19	63	M31461
3,0	3	25	75	M31462
4,0	6	8	57	M31470
4,0	4	19	63	M31471
4,0	4	31	75	M31472
5,0	6	10	57	M31480
5,0	5	20	63	M31481
5,0	5	31	100	M31482
6,0	6	10	57	M31490
6,0	6	28	76	M31491
6,0	6	38	100	M31492
8,0	8	16	63	M31500
8,0	8	28	76	M31501
8,0	8	41	100	M31502
10,0	10	19	72	M31510
10,0	10	32	86	M31511
10,0	10	45	100	M31512
12,0	12	22	83	M31520
12,0	12	45	100	M31521
12,0	12	75	150	M31522
14,0	14	22	83	M31530
16,0	16	26	92	M31531
16,0	16	56	110	M31532
16,0	16	75	150	M31540
18,0	18	26	92	M31541
20,0	20	32	104	M31542
20,0	20	56	125	M31551
20,0	20	75	150	M31552

Series CG-2R Corner Radius

NEW STYLE

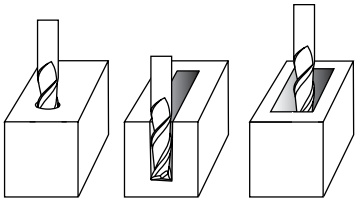
Features

- 2-flute
- Center cutting
- 10% cobalt submicron grain carbide substrate
- Corner radius provides stronger corners
- Uncoated and TiCN coated standard; others available as special



Applications

- Effective for general milling applications in cast iron, non-ferrous light metals and plastics, but with corner radius for applications that require it.
- Excellent for plunging, slotting and heavy peripheral cuts.
- Feed and speed recommendations are listed on pages 12-13.





Series CG-2R Corner Radius Offering

D1 inch	D inch	AP1 inch	L inch	RE inch	Uncoated EDP No.	TiCN Coated EDP No.
1/8	1/8	1/2	1-1/2	0.020	M34960	M34274
3/16	3/16	5/8	2	0.020	M34961	M34275
3/16	3/16	5/8	2	0.030	M34962	M34284
1/4	1/4	3/4	2-1/2	0.020	M34970	M34285
1/4	1/4	3/4	2-1/2	0.030	M34971	M34294
5/16	5/16	13/16	2-1/2	0.020	M34972	M34295
5/16	5/16	13/16	2-1/2	0.030	M34980	M34304
3/8	3/8	1	2-1/2	0.020	M34981	M34305
3/8	3/8	1	2-1/2	0.030	M34982	M34314
1/2	1/2	1	3	0.020	M34990	M34315
1/2	1/2	1	3	0.030	M34991	M34324
1/2	1/2	1	3	0.060	M34992	M34325
5/8	5/8	1-1/4	3-1/2	0.020	M35000	M34334
5/8	5/8	1-1/4	3-1/2	0.030	M35001	M34335
5/8	5/8	1-1/4	3-1/2	0.060	M35002	M34344
5/8	5/8	1-1/4	3-1/2	0.090	M35010	M34345
3/4	3/4	1-1/2	4	0.020	M35011	M34354
3/4	3/4	1-1/2	4	0.030	M35012	M34355
3/4	3/4	1-1/2	4	0.060	M35020	M34364
3/4	3/4	1-1/2	4	0.090	M35021	M34365
3/4	3/4	1-1/2	4	0.125	M35022	M34374
1	1	1-1/2	4	0.020	M35030	M34375
1	1	1-1/2	4	0.030	M35031	M34384
1	1	1-1/2	4	0.060	M35032	M34385
1	1	1-1/2	4	0.090	M35040	M34394
1	1	1-1/2	4	0.125	M35041	M34395



Tech Tip:

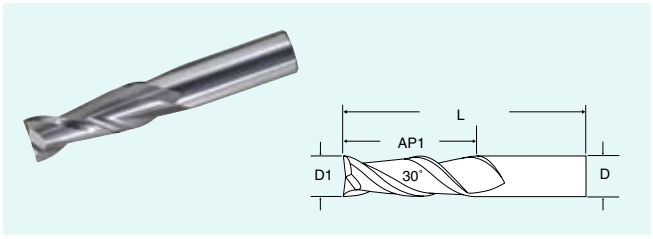
Radius edge provides stronger corners in applications where corner chipping may be a concern.

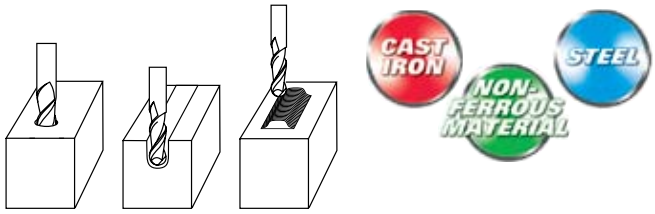
Series CPNC-2 Plus Tolerances

Features

- 2-flute
- Center cutting
- 10% cobalt submicron grain carbide substrate
- Cutter diameter plus tolerance +.001/–.000
- Uncoated standard; coatings available as a modification

Old List Number 150-27





Applications

- Machining characteristics are similar to the CG-2 series; however, the cutter diameter tolerance is on the plus side for use in tight tolerance applications
- Feed and speed recommendations are listed on pages 12-13.

Series CPNC-2

D1 inch	D inch	AP1 inch	L inch	Uncoated EDP No.
1/16	1/8	3/16	1-1/2	M31402
3/32	1/8	3/8	1-1/2	M31410
1/8	1/8	1/2	1-1/2	M31411
5/32	3/16	9/16	2	M31412
3/16	3/16	5/8	2	M31420
7/32	1/4	5/8	2-1/2	M31421
1/4	1/4	3/4	2-1/2	M31422
5/16	5/16	13/16	2-1/2	M31430
3/8	3/8	7/8	2-1/2	M31431
7/16	7/16	1	2-3/4	M31432
1/2	1/2	1	3	M31440
5/8	5/8	1-1/4	3-1/2	M31441
3/4	3/4	1-1/2	4	M31442
1	1	1-1/2	4	M31450

The NEW submicron grain carbide material featured in Metal Removal general-purpose end mills gives improved performance and longer tool life.

Take a look at the new Metal Removal end mill and you'll notice a difference. The new, high polish finish shows off our outstanding geometries on new proprietary submicron grain substrate material. In the past, material of this caliber was used only in high-performance tools. Metal Removal now uses this new substrate on all general-purpose end mills.





10% Cobalt Submicron Grain

Our new substrate material is made exclusively for Metal Removal in our own facilities. Usually reserved for high-performance tools, this premium material is now used in most Metal Removal end mills.

Better Performance

Our test results show improved performance in all applications run with general-purpose geometries. With the addition of many new styles of tools specifically designed for optimizing performance in certain applications, Metal Removal will provide superior performance over its competition throughout the line. Ask your applied product specialist about testing our tools in your spindles.

Faster Machining – Longer Tool Life

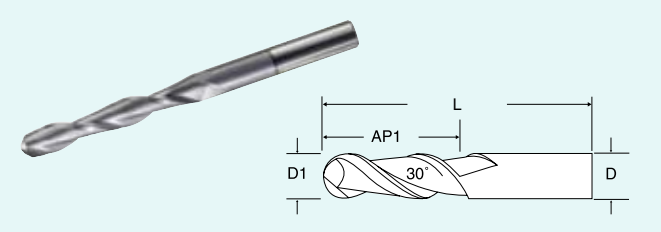
The combination of smaller grain size, more consistent density, and less porosity of the material gives it edge strength that most carbides can't match. Tools can be run faster and/or provide significantly longer tool life.

Series CG-2B Ball Nose

Features

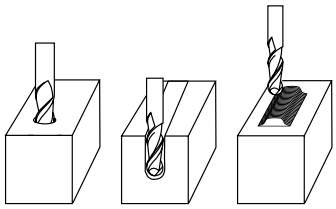
- 2-flute, 30° right-hand spiral, right-hand cut
- Center cutting
- 10% cobalt submicron grain carbide substrate
- Ball nose
- Uncoated and TiCN coated standard in all sizes; TiAlN coated standard in specific sizes; others available as a modification

Old List Numbers 155-24, 161-24, 162-24, 163-24



Applications

- Effective for general milling applications in cast iron, non-ferrous light metals, and plastics, but use whenever a ball-nose geometry is required.
- Excellent for plunging, slotting, and heavy peripheral cuts.
- Also ideal for contouring operations.
- Feed and speed recommendations are listed on pages 12-13.





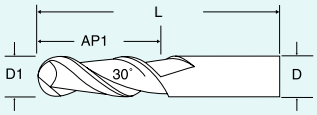
Series CG-2B Ball Nose Offering

D1 inch	D inch	AP1 inch	L inch	Uncoated EDP No.	TiCN Coated EDP No.	TiAlN Coated EDP No.
1/32	1/8	5/64	1-1/2	M30591	M30544	
3/64	1/8	1/8	1-1/2	M30592	M30545	
1/16	1/8	3/16	1-1/2	M30600	M30554	M36616
5/64	1/8	3/16	1-1/2	M30601	M30555	
3/32	1/8	3/16	1-1/2	M30602	M30564	
3/32	1/8	3/8	1-1/2	M30610	M30565	M36626
7/64	1/8	3/8	1-1/2	M30611	M30574	
1/8	1/8	1/4	1-1/2	M30612	M30575	M30026
1/8	1/8	1/2	1-1/2	M30620	M30585	M30036
1/8	1/8	3/4	2-1/4	M30621	M30584	
1/8	1/8	3/4	3	M30771	M34485	M30336
9/64	3/16	9/16	2	M30622	M30594	
5/32	3/16	5/16	2	M30631	M30595	
5/32	3/16	9/16	2	M30632	M30604	M36646
11/64	3/16	5/8	2	M30640	M30605	
3/16	3/16	5/16	1-1/2	M30641	M30614	M30046
3/16	3/16	5/8	2	M30642	M30624	M30056
3/16	3/16	3/4	2-1/2	M30650	M30615	
3/16	3/16	1	4	M30772	M34494	M30356
13/64	1/4	5/8	2-1/2	M30651	M30625	
7/32	1/4	7/16	2	M30652	M30634	
7/32	1/4	5/8	2-1/2	M30660	M30644	
15/64	1/4	3/4	2-1/2	M30661	M30645	
1/4	1/4	1/2	2	M30662	M30654	M30066
1/4	1/4	3/4	2-1/2	M30670	M30664	M30076
1/4	1/4	1	3	M30780	M34495	M30366
1/4	1/4	1-1/8	3	M30671	M30655	
1/4	1/4	1-1/2	6	M30781	M34504	M30376
9/32	5/16	3/4	2-1/2	M30672	M30665	
5/16	5/16	1/2	2	M30680	M30674	M30086
5/16	5/16	13/16	2-1/2	M30681	M30684	M30096
5/16	5/16	1	4	M30782	M34505	M30386
5/16	5/16	1-1/8	3	M30682	M30675	
5/16	5/16	1-1/2	6	M30790	M34514	M30396

continued on next page

(continued) Series CG-2B Ball Nose





Series CG-2B Ball Nose Offering (continued)

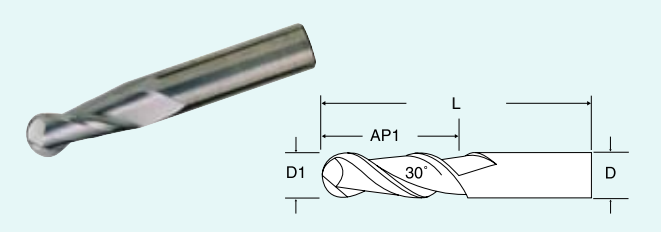
D1 inch	D inch	AP1 inch	L inch	Uncoated EDP No.	TiCN Coated EDP No.	TiAlN Coated EDP No.
11/32	3/8	1	2-1/2	M30690	M30685	
3/8	3/8	5/8	2	M30691	M30694	M30106
3/8	3/8	7/8	2-1/2	M30692	M30705	M30116
3/8	3/8	1	4	M30791	M34515	M30406
3/8	3/8	1-1/8	3	M30701	M30695	M30146
3/8	3/8	1-1/2	6	M30792	M34524	M30416
3/8	3/8	1-3/4	4	M30700	M30704	
3/8	3/8	3	6	M30800	M34525	M30426
13/32	7/16	1	2-1/2	M30702	M30714	
7/16	7/16	5/8	2-1/2	M30710	M30715	
7/16	7/16	1	2-1/2	M30711	M30724	
7/16	7/16	1	4	M30801	M34534	M30436
7/16	7/16	3	6	M30802	M34535	M30446
15/32	1/2	1	3	M30712	M30725	
1/2	1/2	5/8	2-1/2	M30720	M30734	M30156
1/2	1/2	1	3	M30721	M30754	M30186
1/2	1/2	1	4	M30810	M34544	M30456
1/2	1/2	1-1/4	3	M30722	M30735	M30206
1/2	1/2	1-1/2	6	M30811	M34545	M30466
1/2	1/2	2	4	M30730	M30744	M30216
1/2	1/2	3	6	M30731	M30745	M30236
9/16	9/16	1-1/4	3-1/2	M30732	M30755	
5/8	5/8	3/4	3	M30740	M30764	M30246
5/8	5/8	1-1/4	3-1/2	M30741	M30774	M30266
5/8	5/8	2	6	M30812	M34554	M30476
5/8	5/8	2-1/4	5	M30742	M30765	
5/8	5/8	3	6	M30820	M34555	M30486
3/4	3/4	1	3	M30750	M30775	M30276
3/4	3/4	1-1/2	4	M30751	M30784	M30296
3/4	3/4	2	6	M30821	M34564	M30496
3/4	3/4	2-1/4	5	M30752	M30785	
7/8	7/8	1-1/2	4	M30760	M30794	
7/8	7/8	2-1/4	5	M30761	M30795	
1	1	1-1/2	4	M30762	M34984	M30306
1	1	2	6	M30822	M34565	M30506
1	1	2-1/4	5	M30770	M34985	M30326
1	1	3	6	M30830	M34574	M30516

Series CG-2MB Standard Metric, CG-2MDB DIN Metric

Features

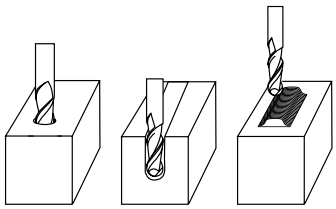
- 2-flute, 30° right-hand spiral, right-hand cut
- Center cutting
- Ball nose
- Weldon flats on shank
- Series CG-2MB standard metric sizes; Series CG-2MDB made to DIN specifications
- Uncoated standard; coated tools available as a modification

Old List Numbers 155-24M, 600-20, 155-25



Applications

- Effective for general milling applications in cast iron, non-ferrous light metals, and plastics, but use whenever a ball-nose geometry or metric sizes are required.
- Excellent for plunging, slotting, and heavy peripheral cuts.
- Also ideal for contouring operations.
- Feed and speed recommendations are listed on pages 12-13.





Series CG-2MB Standard Metric Offering

D1 mm	D mm	AP1 mm	L mm	Uncoated EDP No.
2,0	3	6,3	38	M30831
2,5	3	7	37	M30832
3,0	3	9,5	38	M30840
3,5	4	12	51	M30841
4,0	4	12	50	M30842
4,0	4	14	51	M39951
4,5	5	14	51	M30850
5,0	5	16	51	M30851
6,0	6	16	50	M30852
6,0	6	19	64	M39952
7,0	8	19	64	M30860
8,0	8	20	63	M30861
9,0	10	22	70	M30862
10,0	10	22	76	M30870
11,0	11	25	70	M30871
12,0	12	25	76	M30872
14,0	14	32	89	M30880
16,0	16	32	89	M30881
18,0	18	35	104	M30882
20,0	20	38	104	M30890
22,0	22	38	102	M30891

Series CG-2MDB DIN Metric Offering

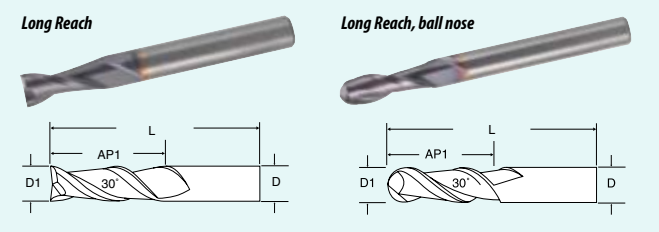
D1 mm	D mm	AP1 mm	L mm	Uncoated EDP No.
3,0	6	7	57	M31560
3,0	6	9,5	58	M31561
4,0	6	8	57	M31562
4,0	6	12	76	M31570
5,0	6	10	57	M31571
5,0	6	14	76	M31572
6,0	6	10	57	M31580
6,0	6	16	100	M31581
8,0	8	16	63	M31582
8,0	8	20	100	M31590
10,0	10	19	72	M31591
10,0	10	22	100	M31592
12,0	12	22	83	M31600
12,0	12	25	125	M31601
14,0	14	22	83	M31602
14,0	14	32	125	M31610
16,0	16	26	92	M31611
16,0	16	32	150	M31612
18,0	18	26	92	M31620
18,0	18	38	150	M31621
20,0	20	32	104	M31622
20,0	20	38	150	M31630
25,0	25	38	102	M30892

Series CGL-2,CGL-2B Long Reach

NEW STYLE

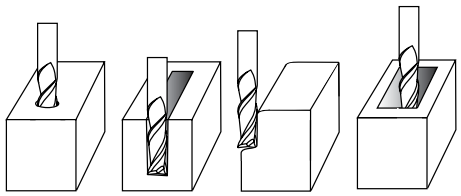
Features

- 2-flute, 30° right-hand spiral, right-hand cut
- Center cutting
- 10% cobalt submicron grain carbide substrate
- Long shank for long-reach applications
- Uncoated, TiCN coated, and TiAlN coated standard; others available as a modification
- CGL-2 has square end; CGL-2B has ball-nose geometry



Applications

- Effective for general milling applications in cast iron, non-ferrous light metals, and plastics.
- Excellent for plunging, slotting, and heavy peripheral cuts in long-reach applications with more rigidity than a long-length end mill.
- Feed and speed recommendations are listed on pages 12-13.





Series CGL-2 Long-Reach Offering

D1 inch	D inch	AP1 inch	L inch	Uncoated EDP No.	TiCN Coated EDP No.	TiAlN Coated EDP No.
1/8	1/8	3/4	3	M31171	M34404	M30906
3/16	3/16	1	4	M31172	M34405	M30916
1/4	1/4	1	4	M31180	M34414	M30926
1/4	1/4	1-1/2	6	M31181	M34415	M30936
5/16	5/16	1	4	M31182	M34424	M30946
5/16	5/16	1-1/2	6	M31190	M34425	M30956
3/8	3/8	1	4	M31191	M34434	M30966
3/8	3/8	1-1/2	6	M31192	M34435	M30976
3/8	3/8	3	6	M31200	M34444	M30986
7/16	7/16	1	4	M31201	M34445	M30996
7/16	7/16	3	6	M31202	M34454	M31006
1/2	1/2	1	4	M31210	M34455	M31016
1/2	1/2	1-1/2	6	M31211	M34464	M31026
5/8	5/8	2	6	M31212	M34465	M31036
5/8	5/8	3	6	M31220	M34474	M31046
3/4	3/4	2	6	M31221	M34475	M31056
1	1	2	6	M31222	M34484	M31066

Series CGL-2B Long-Reach Ball Nose Offering

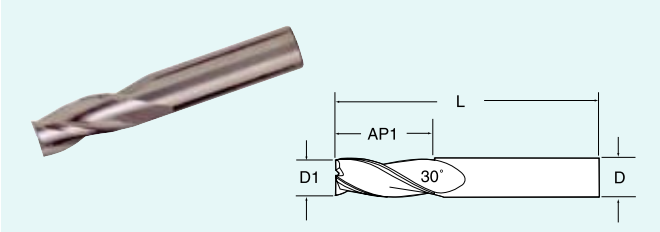
D1 inch	D inch	AP1 inch	L inch	Uncoated EDP No.	TiCN Coated EDP No.	TiAlN Coated EDP No.
1/8	1/8	3/4	3	M30771	M34485	M30336
3/16	3/16	1	4	M30772	M34494	M30356
1/4	1/4	1	3	M30780	M34495	M30366
1/4	1/4	1-1/2	6	M30781	M34504	M30376
5/16	5/16	1	4	M30782	M34505	M30386
5/16	5/16	1-1/2	6	M30790	M34514	M30396
3/8	3/8	1	4	M30791	M34515	M30406
3/8	3/8	1-1/2	6	M30792	M34524	M30416
3/8	3/8	3	6	M30800	M34525	M30426
7/16	7/16	1	4	M30801	M34534	M30436
7/16	7/16	3	6	M30802	M34535	M30446
1/2	1/2	1	4	M30810	M34544	M30456
1/2	1/2	1-1/2	6	M30811	M34545	M30466
5/8	5/8	2	6	M30812	M34554	M30476
5/8	5/8	3	6	M30820	M34555	M30486
3/4	3/4	2	6	M30821	M34564	M30496
1	1	2	6	M30822	M34565	M30506
1	1	3	6	M30830	M34574	M30516

Series CG-3 Three Flute

Features

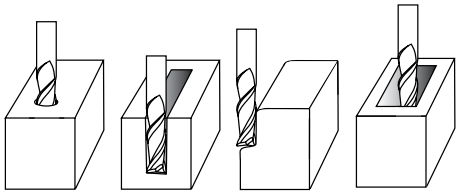
- 3-flute, 30° right-hand spiral, right-hand cut
- Center cutting
- 10% cobalt submicron grain carbide substrate
- Uncoated standard; coated tools available as a modification

Old List Number 155-37



Applications

- The three-flute design allows heavier feed rates with less chatter.
- Ideally suited for many slotting operations.
- Feed and speed recommendations are listed on pages 12-13.





Series CG-3 Three-Flute Offering

D1 inch	D inch	AP1 inch	L inch	Uncoated EDP No.
1/16	1/8	3/16	1-1/2	M32191
3/32	1/8	3/8	1-1/2	M32192
1/8	1/8	1/2	1-1/2	M32200
5/32	3/16	9/16	2	M32201
3/16	3/16	5/8	2	M32202
7/32	1/4	5/8	2-1/2	M32210
1/4	1/4	3/4	2-1/2	M32211
9/32	5/16	3/4	2-1/2	M32212
5/16	5/16	13/16	2-1/2	M32220
11/32	3/8	1	2-1/2	M32221
3/8	3/8	7/8	2-1/2	M32222
3/8	3/8	1-1/8	3	M32230
13/32	7/16	1	2-3/4	M32231
7/16	7/16	1	2-1/2	M32232
15/32	1/2	1	3	M32241
7/16	7/16	7/8	2-1/2	M32240
1/2	1/2	1	3	M32242
1/2	1/2	2	4	M32250
9/16	9/16	1-1/8	3-1/2	M32251
5/8	5/8	1-1/4	3-1/2	M32252
5/8	5/8	2-1/4	5	M32261
11/16	3/4	1-3/8	4	M32262
3/4	3/4	1	3	M32270
3/4	3/4	1-1/2	4	M32271
3/4	3/4	2-1/4	5	M32272
7/8	7/8	1-1/2	4	M32280
1	1	1-1/2	4	M32281
1	1	2-1/4	5	M32282

Metric sizes listed on next page

Tech Tip:

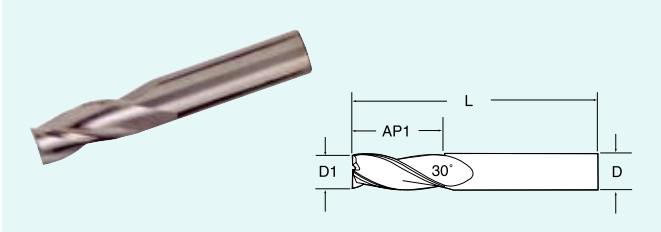
Three-flute end mills provide a good compromise between the chip clearance of a two-flute end mill and the rigidity and wear resistance of a four-flute tool. Great for slotting.

Series CG-3M Standard Metric, CG-3MD DIN Metric

Features

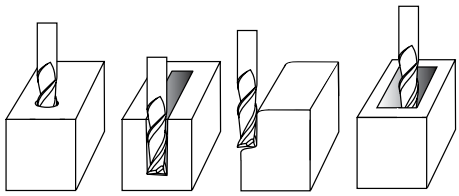
- 3-flute
- Center cutting
- Weldon flats on shanks
- 10% cobalt submicron grain carbide substrate
- Uncoated standard; coated tools available as a modification
- Series CG-3M metric sizes;
  Series CG-3MD made to DIN specifications

Old List Numbers 155-37M, 155-30



Applications

- The three-flute design allows heavier feed rates with less chatter; use whenever metric sizes are required.
- Ideally suited for many slotting operations.
- Feed and speed recommendations are listed on pages 12-13.





Series CG-3M Standard Metric Offering

D1 mm	D mm	AP1 mm	L mm	Uncoated EDP No.
1,0	3	3	38	M32681
1,5	3	5	38	M32682
2,0	3	7	38	M32690
2,5	3	7	38	M32691
3,0	3	9	38	M32692
3,0	3	19	63	M32821
3,5	4	12	51	M32700
4,0	4	14	51	M32701
4,0	4	19	63	M32822
4,5	5	14	51	M32702
5,0	5	16	51	M32710
5,0	5	20	63	M32830
6,0	6	19	64	M32711
6,0	6	28	76	M32831
7,0	8	19	64	M32712
8,0	8	21	64	M32720
8,0	8	28	76	M32832
9,0	10	22	70	M32721
10,0	10	22	70	M32722
10,0	10	32	86	M32840
11,0	11	25	70	M32730
12,0	12	25	76	M32731
12,0	12	45	100	M32841
14,0	14	30	89	M32732
16,0	16	32	89	M32740
16,0	16	56	110	M32842
18,0	18	35	102	M32741
20,0	20	38	102	M32742
20,0	20	56	125	M32850
22,0	22	38	102	M32750
25,0	25	38	102	M32751

Series CG-3MD DIN Metric Offering

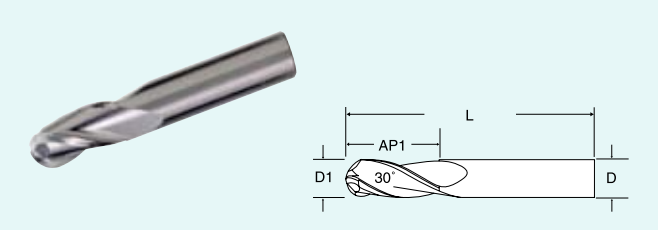
D1 mm	D mm	AP1 mm	L mm	Uncoated EDP No.
2,0	6	6	57	M32752
2,5	6	6	57	M32760
3,0	6	7	57	M32761
4,0	6	8	57	M32762
5,0	6	10	57	M32770
6,0	6	10	57	M32771
8,0	8	16	63	M32772
10,0	10	19	72	M32780
12,0	12	22	83	M32781
14,0	14	22	83	M32782
16,0	16	26	92	M32790
18,0	18	26	92	M32791
20,0	20	32	104	M32792

Series CG-3B Ball Nose

Features

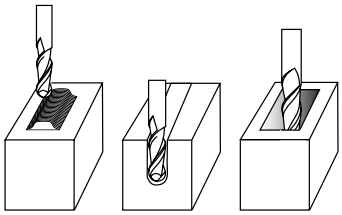
- 3-flute, 30° right-hand spiral, right-hand cut
- Center cutting
- Weldon flats on shank
- 10% cobalt submicron grain carbide substrate
- Ball nose
- Uncoated standard; coated tools available as a modification

Old List Numbers 155-34, 155-30



Applications

- Excellent for tracer or three-dimensional milling applications such as mold or die making.
- The three-flute design allows heavier feed rates with less chatter, in ball-nose geometry applications.
- Ideally suited for many slotting operations.
- Feed and speed recommendations are listed on pages 12-13.





Series CG-3B Ball Nose Offering

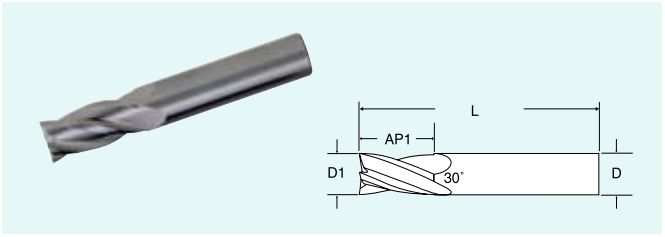
D1 inch	D inch	AP1 inch	L inch	Uncoated EDP No.
1/16	1/8	3/16	1-1/2	M32130
3/32	1/8	3/8	1-1/2	M32131
1/8	1/8	1/2	1-1/2	M32132
5/32	3/16	9/16	2	M32140
3/16	3/16	5/8	2	M32141
7/32	1/4	5/8	2-1/2	M32142
1/4	1/4	3/4	2-1/2	M32150
9/32	5/16	3/4	2-1/2	M32151
5/16	5/16	13/16	2-1/2	M32152
11/32	3/8	1	2-1/2	M32160
3/8	3/8	7/8	2-1/2	M32161
13/32	7/16	1	2-3/4	M32162
7/16	7/16	1	2-3/4	M32170
15/32	1/2	1	3	M32171
1/2	1/2	1	3	M32172
5/8	5/8	1-1/4	3-1/2	M32180
3/4	3/4	1-1/2	4	M32181
7/8	7/8	1-1/2	4	M32182
1	1	1-1/2	4	M32190

Series CG-4

Features

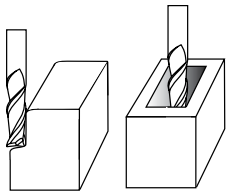
- 4-flute, 30° right-hand spiral, right-hand cut
- Center cutting
- 10% cobalt submicron grain carbide substrate
- Uncoated and specific sizes of TiN coated, TiCN coated and TiAlN coated standard; others available as a modification

Old List Numbers 155-47, 161-47, 162-47, 163-47



Applications

- Most commonly used in profiling and finishing applications.
- Stiffer construction results in minimal deflection.
- Four flutes provide good wear resistance for excellent size control.
- Feed and speed recommendations are listed on pages 12-13.





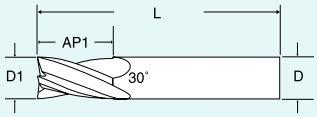
Series CG-4 Offering

D1 inch	D inch	AP1 inch	L inch	Uncoated EDP No.	TiN Coated EDP No.	TiCN Coated EDP No.	TiAlN Coated EDP No.
1/64	1/8	1/32	1-1/2	M33372		M32904	
1/32	1/8	5/64	1-1/2	M33380		M32905	M32536
3/64	1/8	1/8	1-1/2	M33381			
1/16	1/8	1/8	1-1/2	M33382		M32924	M32546
1/16	1/8	3/16	1-1/2	M33390		M32925	M32556
1/16	1/8	1/2	2	M33391		M32934	
5/64	1/8	3/16	1-1/2	M33392			
3/32	1/8	3/16	1-1/2	M33400		M32945	
3/32	1/8	3/8	1-1/2	M33401		M32944	M32566
3/32	1/8	5/8	2	M33402		M32954	
7/64	1/8	3/8	1-1/2	M33410			
1/8	1/8	1/4	1-1/2	M33411	M30593	M32974	M32576
1/8	1/8	1/2	1-1/2	M33412	M30603	M32975	M32586
1/8	1/8	3/4	2-1/4	M33420		M32984	M32596
1/8	1/8	3/4	3	M33702		M31624	
1/8	1/8	1	3	M33421		M32985	M32606
9/64	3/16	9/16	2	M33422		M32994	
5/32	3/16	5/16	2	M33430		M33004	
5/32	3/16	9/16	2	M33431		M32995	M32616
11/64	3/16	5/8	2	M33432			
3/16	3/16	5/16	1-1/2	M33440	M30613	M33014	M32626
3/16	3/16	5/8	2	M33441	M30633	M33015	M32636
3/16	3/16	3/4	2-1/2	M33442		M33024	M32646
3/16	3/16	1	4	M33710		M31625	
3/16	3/16	1-1/8	3	M33450		M33025	
13/64	1/4	5/8	2-1/2	M33451			
7/32	1/4	7/16	2	M33452	M30643	M33044	
7/32	1/4	5/8	2-1/2	M33460	M30653	M33035	M32656
7/32	1/4	1-1/8	3	M33461		M33045	
15/64	1/4	3/4	2-1/2	M33462			
1/4	1/4	1/2	2	M33470	M30663	M33055	M32666
1/4	1/4	3/4	2-1/2	M33471	M30673	M33064	M32676
1/4	1/4	1	4	M33472		M30814	M32696
1/4	1/4	1-1/8	3	M33480		M33065	M32686
1/4	1/4	1-1/2	4	M33481		M33074	
1/4	1/4	1-1/2	6	M33482		M30815	M32706
17/64	5/16	3/4	2-1/2	M33490		M33075	
9/32	5/16	3/4	2-1/2	M33491		M33084	

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(continued) Series CG-4





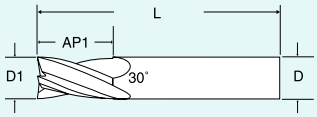
Series CG-4 Offering (continued)

D1 inch	D inch	AP1 inch	L inch	Uncoated EDP No.	TiN Coated EDP No.	TiCN Coated EDP No.	TiAlN Coated EDP No.
19/64	5/16	13/16	2-1/2	M33492			
5/16	5/16	1/2	2	M33500	M30683	M33094	M32716
5/16	5/16	13/16	2-1/2	M33742	M30693	M33095	M32726
5/16	5/16	1	4	M33711		M31634	
5/16	5/16	1-1/8	3	M33502		M33104	M32736
5/16	5/16	1-1/2	6	M33712		M31635	
5/16	5/16	1-5/8	4	M33510		M33105	
21/64	3/8	1	2-1/2	M33511			
11/32	3/8	1	2-1/2	M33512		M33115	
23/64	3/8	1	2-1/2	M33520		M33124	
3/8	3/8	5/8	2	M33521	M30703	M33125	M32746
3/8	3/8	7/8	2-1/2	M33522	M30713	M33134	M32756
3/8	3/8	1	4	M33530		M30824	M32776
3/8	3/8	1-1/8	3	M33531		M33135	M32766
3/8	3/8	1-1/2	6	M33532		M30825	M32786
3/8	3/8	1-3/4	4	M33540		M33144	
3/8	3/8	3	6	M33720		M31644	
25/64	7/16	1	2-3/4	M33541			
13/32	7/16	1	2-3/4	M33542		M33154	
27/64	7/16	1	2-3/4	M33550			
7/16	7/16	5/8	2-1/2	M33551		M33165	M32806
7/16	7/16	1	2-3/4	M33560	M30723	M33164	M32796
7/16	7/16	1	4	M33721		M31645	
7/16	7/16	2	4	M33552		M33174	
7/16	7/16	3	6	M33722		M31654	
29/64	1/2	1	3	M33561			
15/32	1/2	1	3	M33562		M33184	
31/64	1/2	1	3	M33570			
1/2	1/2	5/8	2-1/2	M33571	M30733	M33194	M32816
1/2	1/2	1	3	M33572	M30743	M33195	M32826
1/2	1/2	1	4	M33580		M30834	M32856
1/2	1/2	1-1/4	3	M33581	M30753	M33204	M32836
1/2	1/2	1-1/2	6	M33730		M31655	
1/2	1/2	2	4	M33590		M33205	M32846
1/2	1/2	3	6	M33582		M33214	
9/16	9/16	3/4	3	M33591		M33224	
9/16	9/16	1-1/8	3-1/2	M33751			
9/16	9/16	1-1/4	3-1/2	M33592	M30763	M33215	
9/16	9/16	2-1/4	5	M33600		M33225	
5/8	5/8	3/4	3	M33601	M30773	M33234	M32866
5/8	5/8	1-1/4	3-1/2	M33602	M30783	M33235	M32876
5/8	5/8	2	6	M33731		M31664	
5/8	5/8	2-1/4	5	M33610		M33244	M32886
5/8	5/8	3	6	M33732		M31665	
5/8	5/8	4	7	M33611		M33245	
11/16	3/4	1-3/8	4	M33612		M33254	

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(continued) Series CG-4





Series CG-4 Offering (continued)

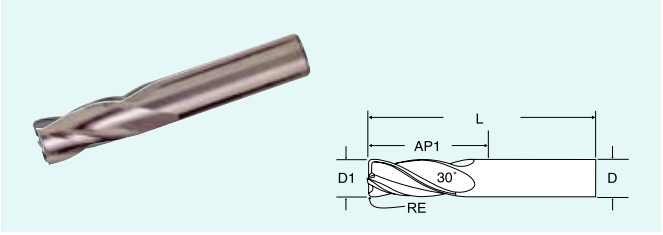
D1 inch	D inch	AP1 inch	L inch	Uncoated EDP No.	TiN Coated EDP No.	TiCN Coated EDP No.	TiAlN Coated EDP No.
3/4	3/4	1	3	M33620	M30793	M33255	M32896
3/4	3/4	1-1/2	4	M33621	M30803	M33264	M32916
3/4	3/4	2	6	M33740		M31674	
3/4	3/4	2-1/4	5	M33622		M33265	M32926
3/4	3/4	3	6	M33631		M33274	M32936
3/4	3/4	4	7	M33630		M33275	
13/16	7/8	1-1/2	4	M33632		M33284	
7/8	7/8	1-1/2	4	M33640	M30813	M33285	M32946
7/8	7/8	2-1/4	5	M33641		M33294	
7/8	7/8	3	6	M33642		M33295	
1	1	1-1/2	4	M33650		M33305	M32966
1	1	2	6	M33741		M31675	
1	1	2-1/4	5	M33651	M30823	M33304	M32956
1	1	3	6	M33660		M33314	M32976
1	1	4	7	M33652		M33315	
1-1/8	1	2	4-1/2	M33661		M33324	
1-1/4	1-1/4	2	4-1/2	M33662		M33325	

Series CG-4R Corner Radius

NEW STYLE

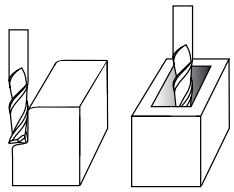
Features

- 4-flute
- Center cutting
- 10% cobalt submicron grain carbide substrate
- Corner radius for stronger corners
- Uncoated and TiN coated standard; others available as a modification



Applications

- Most commonly used in profiling and finishing applications that require radius finish in the workpiece.
- Stiffer construction results in minimal deflection.
- Four flutes provide good wear resistance for excellent size control.
- Feed and speed recommendations are listed on pages 12-13.





Series CG-4R Corner Radius Offering

D1 inch	D inch	AP1 inch	L inch	RE inch	Uncoated EDP No.	TiCN Coated EDP No.
1/8	1/8	1/2	1-1/2	0.020	M35051	M31484
3/16	3/16	5/8	2	0.020	M35060	M31494
3/16	3/16	5/8	2	0.030	M35052	M31485
1/4	1/4	3/4	2-1/2	0.020	M35062	M31504
1/4	1/4	3/4	2-1/2	0.030	M35061	M31495
5/16	5/16	13/16	2-1/2	0.020	M35071	M31514
5/16	5/16	13/16	2-1/2	0.030	M35070	M31505
3/8	3/8	1	2-1/2	0.020	M35080	M31524
3/8	3/8	1	2-1/2	0.030	M35072	M31515
1/2	1/2	1	3	0.020	M35082	M31534
1/2	1/2	1	3	0.030	M35090	M31535
1/2	1/2	1	3	0.060	M35081	M31525
5/8	5/8	1-1/4	3-1/2	0.020	M35092	M31545
5/8	5/8	1-1/4	3-1/2	0.030	M35100	M31554
5/8	5/8	1-1/4	3-1/2	0.060	M35101	M31555
5/8	5/8	1-1/4	3-1/2	0.090	M35091	M31544
3/4	3/4	1-1/2	4	0.020	M35110	M31574
3/4	3/4	1-1/2	4	0.030	M35111	M31575
3/4	3/4	1-1/2	4	0.060	M35112	M31584
3/4	3/4	1-1/2	4	0.090	M35120	M31585
3/4	3/4	1-1/2	4	0.125	M35102	M31564
1	1	1-1/2	4	0.020	M35122	M31595
1	1	1-1/2	4	0.030	M35130	M31604
1	1	1-1/2	4	0.060	M35131	M31605
1	1	1-1/2	4	0.090	M35132	M31615
1	1	1-1/2	4	0.125	M35121	M31594



Tech Tip:

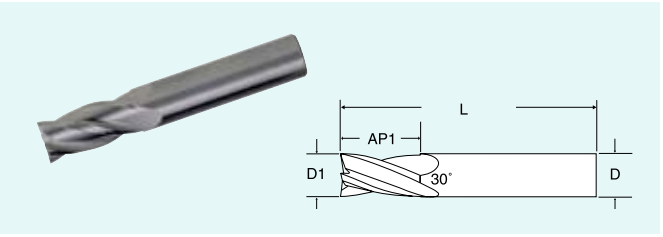
Radius edge provides stronger corners in applications where corner chipping may be a concern.

Series CG-4M Standard Metric, CG-4MD DIN Metric

Features

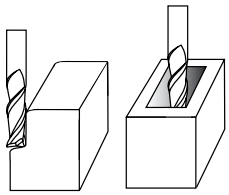
- 4-flute, 30° right-hand spiral, right-hand cut
- Center cutting
- 10% cobalt submicron grain carbide substrate
- Uncoated standard; coated tools available as a modification
- Series CG-4M standard metric size;
  Series CG-4MD made to DIN specifications

Old List Numbers 155-47M, 161-47M



Applications

- Most commonly used in profiling and finishing applications where metric sizes are required.
- Stiffer construction results in minimal deflection.
- Four flutes provide good wear resistance for excellent size control.
- Feed and speed recommendations are listed on pages 12-13.





Series CG-4M Standard Metric Offering

D1 mm	D mm	AP1 mm	L mm	Uncoated EDP No.
1,0	3	3	38	M33810
1,5	3	5	38	M33811
2,0	3	4	38	M34012
2,0	3	6	38	M33812
2,5	3	5	38	M34020
2,5	3	6	38	M33820
3,0	3	6	38	M34021
3,0	3	10	38	M33821
3,5	4	7	51	M34022
3,5	4	12	50	M33822
4,0	4	8	51	M34030
4,0	4	12	50	M33830
4,0	4	14	51	M39982
4,5	5	9	51	M34031
4,5	5	14	51	M39990
4,5	6	14	50	M33831
5,0	5	10	51	M34032
5,0	5	16	51	M39991
5,0	6	14	50	M33832
6,0	6	12	51	M34040
6,0	6	16	50	M33840
6,0	6	19	64	M39992
7,0	8	12	51	M34041
7,0	8	20	63	M33841
8,0	8	12	51	M34042
8,0	8	20	63	M33842
9,0	9	20	63	M33850
9,0	10	14	51	M34050
10,0	10	14	51	M34051
10,0	10	22	76	M33851
11,0	11	16	64	M34052
11,0	11	25	70	M33852
12,0	12	16	64	M34060
12,0	12	25	76	M33860
14,0	14	32	89	M33861
16,0	16	32	89	M33862
18,0	18	38	104	M33870
20,0	20	38	104	M33871
22,0	22	38	102	M33872
25,0	25	38	102	M33880

Series CG-4MD DIN Metric Offering

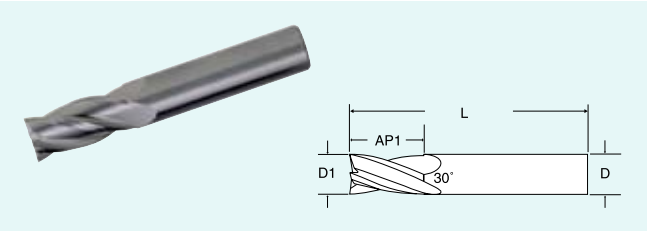
D1 mm	D mm	AP1 mm	L mm	Uncoated EDP No.
2,0	6	6	57	M34061
2,5	6	6	57	M34062
3,0	6	7	57	M34070
3,0	3	19	63	M34071
3,0	3	25	75	M34072
4,0	6	8	57	M34080
4,0	4	19	63	M34081
4,0	4	31	75	M34082
5,0	6	10	57	M34090
5,0	5	20	63	M34091
5,0	5	31	100	M34092
6,0	6	10	57	M34100
6,0	6	28	76	M34101
6,0	6	38	100	M34102
8,0	8	16	63	M34110
8,0	8	28	76	M34111
8,0	8	41	100	M34112
10,0	10	19	72	M34120
10,0	10	32	86	M34121
10,0	10	45	100	M34122
12,0	12	22	83	M34130
12,0	12	45	100	M34131
12,0	12	75	150	M34132
14,0	14	22	83	M34140
16,0	16	26	92	M34141
16,0	16	56	110	M34142
16,0	16	75	150	M34150
18,0	18	26	92	M34151
20,0	20	38	104	M34152
20,0	20	56	125	M34160
20,0	20	75	150	M34161

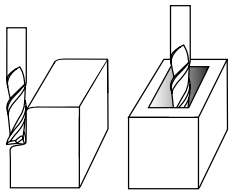
Series CPNC-4 Plus Tolerances

Features

- 4-flute, 30° right-hand spiral, right-hand cut
- Center cutting
- 10% cobalt submicron grain carbide substrate
- Cutter diameter plus tolerance +.001/–.000
- Uncoated standard; coated tools available as a modification

Old List Number 150-47







Applications

- Most commonly used in profiling and finishing applications; however, the cutter diameter tolerance is on the plus side for use in tight tolerance applications.
- Stiffer construction results in minimal deflection.
- Four flutes provide good wear resistant characteristics for excellent size control.
- Feed and speed recommendations are listed on pages 12-13.

Series CPNC-4 Plus Tolerance Offering

D1 inch	D inch	AP1 inch	L inch	Uncoated EDP No.
1/16	1/8	3/16	1-1/2	M33881
3/32	1/8	3/8	1-1/2	M33882
1/8	1/8	1/2	1-1/2	M33890
5/32	3/16	9/16	2	M33891
3/16	3/16	5/8	2	M33892
7/32	1/4	5/8	2-1/2	M33900
1/4	1/4	3/4	2-1/2	M33901
9/32	5/16	3/4	2-1/2	M33902
5/16	5/16	13/16	2-1/2	M33910
3/8	3/8	7/8	2-1/2	M33911
7/16	7/16	1	2-3/4	M33912
1/2	1/2	1	3	M33920
9/16	9/16	1-1/8	3-1/2	M33921
5/8	5/8	1-1/4	3-1/2	M33922
11/16	3/4	1-3/8	4	M33930
3/4	3/4	1-1/2	4	M33931
7/8	7/8	1-1/2	4	M33932
1	1	1-1/2	4	M33940

Metal Removal products are now shipped in improved packaging for easy identification

Our new marking and packaging reflect our pride in product. Every Metal Removal tool is packaged individually in a square white tube with the series number, EDP number, tool dimensions, and complete description on the label. We've even added UPC bar codes to our label for easier inventory management. The tools are also laser marked with our brand and size. These changes provide better protection of our tools and help our customers more easily identify the tools, resulting in fewer mistakes using the wrong tool in the spindle.

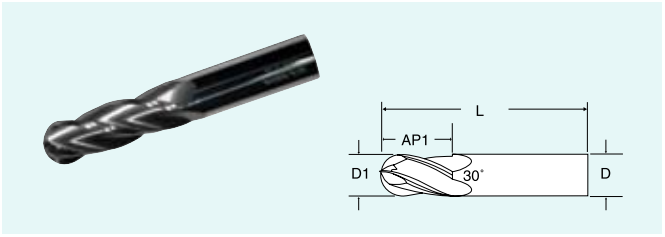


Series CG-4B Ball Nose

Features

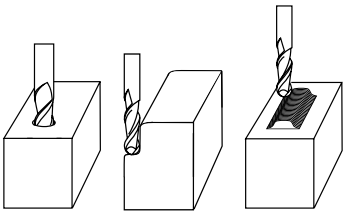
- 4-flute, 30° right-hand spiral, right-hand cut
- Center cutting
- 10% cobalt submicron grain carbide substrate
- Ball nose
- Uncoated and specific sizes TiCN coated and TiAlN coated standard; other coatings and sizes available as a modification

Old List Numbers 155-44, 161-44, 162-44, 163-44



Applications

- Most commonly used in profiling and finishing applications where a ball nose geometry is required.
- Stiffer construction results in minimal deflection.
- Four flutes provide good wear resistance for excellent size control.
- Excellent for plunging, profiling, and heavy peripheral cuts.
- Ideal for contouring operations.
- Feed and speed recommendations are listed on pages 12-13.





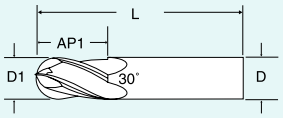
Series CG-4B Ball Nose Offering

D1 inch	D inch	AP1 inch	L inch	Uncoated EDP No.	TiCN Coated EDP No.	TiAlN Coated EDP No.
1/32	1/8	1/16	1-1/2	M33062	M32524	
1/32	1/8	5/64	1-1/2	M33070		
3/64	1/8	1/8	1-1/2	M33071	M32525	
1/16	1/8	3/16	1-1/2	M33072	M32534	
5/64	1/8	3/16	1-1/2	M33080		
3/32	1/8	3/16	1-1/2	M33081	M32544	
3/32	1/8	3/8	1-1/2	M33082	M32545	M36636
7/64	1/8	3/8	1-1/2	M33090		
1/8	1/8	1/4	1-1/2	M33091	M32555	M32146
1/8	1/8	1/2	1-1/2	M33092	M32564	M32156
1/8	1/8	3/4	2-1/4	M33100	M32565	
1/8	1/8	3/4	3	M33251	M34805	
9/64	3/16	9/16	2	M33101		
5/32	3/16	5/16	2	M33102	M32575	
5/32	3/16	9/16	2	M33110	M32585	M36656
11/64	3/16	5/8	2	M33111		
3/16	3/16	5/16	1-1/2	M33112	M32595	M32166
3/16	3/16	5/8	2	M33120	M32604	M32176
3/16	3/16	3/4	2-1/2	M33121	M32605	
3/16	3/16	1	4	M33252	M34575	
13/64	1/4	5/8	2-1/2	M33122		
7/32	1/4	7/16	2	M33130	M32615	
7/32	1/4	5/8	2-1/2	M33131	M32624	
15/64	1/4	3/4	2-1/2	M33132		
1/4	1/4	1/2	2	M33140	M32634	M32186
1/4	1/4	3/4	2-1/2	M33141	M32635	M32196
1/4	1/4	1	4	M33260	M34584	
1/4	1/4	1-1/8	3	M33142	M32644	
1/4	1/4	1-1/2	6	M33261	M34585	
5/16	5/16	13/16	2-1/2	M33152	M32655	M32216
9/32	5/16	3/4	2-1/2	M33150	M32645	
5/16	5/16	1/2	2	M33151	M32654	M32206
5/16	5/16	1	4	M33262	M34594	
5/16	5/16	1-1/8	3	M33160	M32664	
5/16	5/16	1-1/2	6	M33270	M34595	

continued on next page

(continued) Series CG-4B Ball Nose





Series CG-4B Ball Nose Offering (continued)

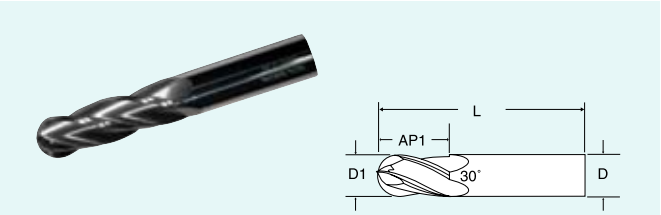
D1 inch	D inch	AP1 inch	L inch	Uncoated EDP No.	TiCN Coated EDP No.	TiAlN Coated EDP No.
11/32	3/8	1	2-1/2	M33161	M32665	
3/8	3/8	5/8	2	M33162	M32674	M32226
3/8	3/8	7/8	2-1/2	M33170	M32675	M32236
3/8	3/8	1	4	M33271	M34604	
3/8	3/8	1-1/8	3	M33171	M32684	M32246
3/8	3/8	1-1/2	6	M33272	M34605	
3/8	3/8	1-3/4	4	M33172	M32685	
3/8	3/8	3	6	M33280	M34614	
13/32	7/16	1	2-1/2	M33180	M32694	
7/16	7/16	5/8	2-1/2	M33181	M32695	
7/16	7/16	1	2-1/2	M33182	M32704	
7/16	7/16	1	4	M33281	M34615	
7/16	7/16	3	6	M33282	M34624	
15/32	1/2	1	3	M33190	M32705	
1/2	1/2	5/8	2-1/2	M33191	M32714	M32256
1/2	1/2	1	3	M33192	M32715	M32266
1/2	1/2	1	4	M33290	M34625	
1/2	1/2	1-1/4	3	M33200	M32724	M32276
1/2	1/2	1-1/2	6	M33291	M34634	
1/2	1/2	2	4	M33201	M32725	M32286
1/2	1/2	3	6	M33202	M32734	
9/16	9/16	1-1/8	3-1/2	M33750		
9/16	9/16	1-1/4	3-1/2	M33210	M32735	
5/8	5/8	3/4	3	M33211	M32744	M32296
5/8	5/8	1-1/4	3-1/2	M33212	M32745	M32306
5/8	5/8	2	6	M33292	M34635	
5/8	5/8	2-1/4	5	M33220	M32754	M32316
5/8	5/8	3	6	M33300	M34644	
3/4	3/4	1	3	M33221	M32755	M32326
3/4	3/4	1-1/2	4	M33222	M32764	M32336
3/4	3/4	2	6	M33301	M34645	
3/4	3/4	2-1/4	5	M33230	M32765	
3/4	3/4	3	6	M33231	M32774	
7/8	7/8	1-1/2	4	M33232	M32775	
7/8	7/8	2-1/4	5	M33240	M32784	
1	1	1-1/2	4	M33241	M32785	M32346
1	1	2	6	M33302	M34654	
1	1	2-1/4	5	M33242	M32794	M32356
1	1	3	6	M33250	M32795	

Series CG-4MB Standard Metric, CG-4MDB DIN Metric

Features

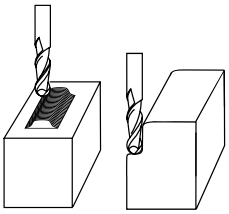
- 4-flute
- Center cutting
- Ball nose
- Weldon flats on shanks
- 10% cobalt submicron grain carbide substrate
- Uncoated standard; coated tools available as a modification
- Series CG-4MB metric sizes;
  Series CG-4MDB made to DIN specifications

Old List Numbers 155-44M, 155-45



Applications

- Most commonly used in profiling and finishing applications where metric ball-nose geometry is required.
- Stiffer construction results in minimal deflection.
- Four flutes provide good wear resistance for excellent size control.
- Excellent for plunging, profiling and heavy peripheral cuts.
- Ideal for contouring operations.
- Feed and speed recommendations are listed on pages 12-13





Series CG-4MB Standard Metric Offering

D1 mm	D mm	AP1 mm	L mm	Uncoated EDP No.
2,0	3	6.3	38	M33310
2,5	3	7	38	M33311
3,0	3	9.5	38	M33312
3,5	4	12	51	M33320
4,0	4	12	50	M33321
4,0	4	15	51	M39972
4,5	5	14	51	M33322
5,0	5	16	51	M33330
6,0	6	16	50	M33331
6,0	6	19	64	M39980
7,0	8	19	64	M33332
8,0	8	20	63	M33340
9,0	10	22	70	M33341
10,0	10	22	76	M33342
11,0	11	25	70	M33350
12,0	12	25	76	M33351
14,0	14	30	89	M39981
14,0	14	32	89	M33352
16,0	16	32	89	M33360
18,0	18	35	102	M33361
20,0	20	38	104	M33362
22,0	22	38	102	M33370
25,0	25	38	102	M33371

Series CG-4MDB DIN Metric Offering

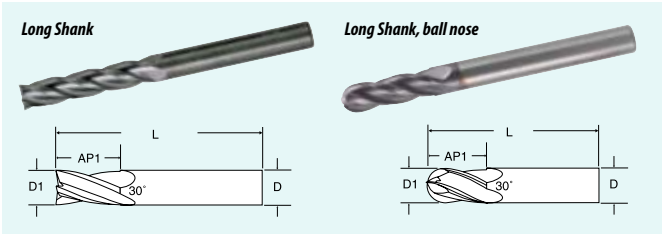
D1 mm	D mm	AP1 mm	L mm	Uncoated EDP No.
3,0	6	7	57	M34162
4,0	6	8	57	M34170
5,0	6	10	57	M34171
6,0	6	10	57	M34172
8,0	8	16	63	M34180
10,0	10	19	72	M34181
12,0	12	22	83	M34182
14,0	14	22	83	M34190
16,0	16	26	92	M34191
18,0	18	26	92	M34192
20,0	20	38	104	M34200

Series CGL-4, CGL-4B Long Shank

NEW STYLE

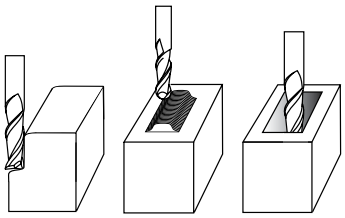
Features

- 4-flute, right-hand spiral, right-hand cut
- Center cutting
- Series CGL-4 has square end
  Series CGL-4B has ball nose
- Long shank
- 10% cobalt submicron grain carbide substrate
- Uncoated and TiCN coated standard;
  others available as a modification



Applications

- Most commonly used in profiling and finishing applications where a longer shank is required.
- Stiffer construction results in minimal deflection.
- Four flutes provide good wear resistance for excellent size control.
- Excellent for plunging, profiling and heavy peripheral cuts.
- Ideal for contouring operations.
- Feed and speed recommendations are listed on pages 12-13.





Series CGL-4 Long Shank Offering

D1 inch	D inch	AP1 inch	L inch	Uncoated EDP No.	TiCN Coated EDP No.
1/8	1/8	3/4	3	M33702	M31624
3/16	3/16	1	4	M33710	M31625
5/16	5/16	1	4	M33711	M31634
5/16	5/16	1-1/2	6	M33712	M31635
3/8	3/8	3	6	M33720	M31644
7/16	7/16	1	4	M33721	M31645
7/16	7/16	3	6	M33722	M31654
1/2	1/2	1-1/2	6	M33730	M31655
5/8	5/8	2	6	M33731	M31664
5/8	5/8	3	6	M33732	M31665
3/4	3/4	2	6	M33740	M31674
1	1	2	6	M33741	M31675

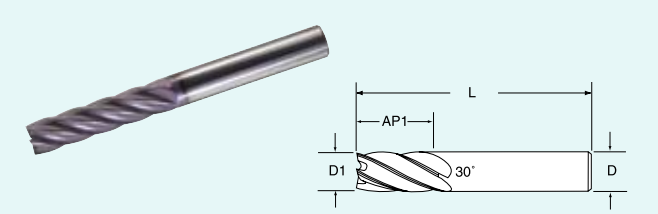
Series CGL-4B Long Shank Ball Nose Offering

D1 inch	D inch	AP1 inch	L inch	Uncoated EDP No.	TiCN Coated EDP No.
1/8	1/8	3/4	3	M33251	M34805
3/16	3/16	1	4	M33252	M34575
1/4	1/4	1	4	M33260	M34584
1/4	1/4	1-1/2	6	M33261	M34585
5/16	5/16	1	4	M33262	M34594
5/16	5/16	1-1/2	6	M33270	M34595
3/8	3/8	1	4	M33271	M34604
3/8	3/8	1-1/2	6	M33272	M34605
3/8	3/8	3	6	M33280	M34614
7/16	7/16	1	4	M33281	M34615
7/16	7/16	3	6	M33282	M34624
1/2	1/2	1	4	M33290	M34625
1/2	1/2	1-1/2	6	M33291	M34634
5/8	5/8	2	6	M33292	M34635
5/8	5/8	3	6	M33300	M34644
3/4	3/4	2	6	M33301	M34645
1	1	2	6	M33302	M34654

Series CG-6

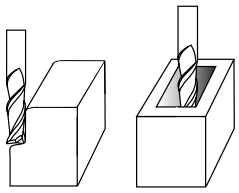
Features

- 6-flute, right-hand spiral, right-hand cut
- Center cutting
- Square end
- 10% cobalt submicron grain carbide substrate
- Uncoated, and specific sizes TiCN coated and TiAlN coated standard; other coatings and sizes available as a modification



Applications

- 6-flute end mills are excellent for harder materials and higher feeds and speeds.
- Excellent for finishing operations.
- Feed and speed recommendations are listed on pages 12-13.





Series CG-6 Six-Flute Offering

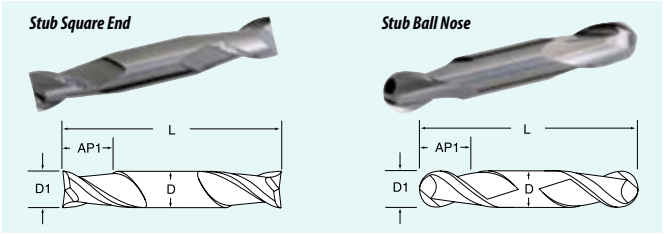
D1 inch	D inch	AP1 inch	L inch	Uncoated EDP No.	TiCN Coated EDP No.	TiAlN Coated EDP No.
1/4	1/4	3/4	2-1/2	M34610	M33755	M33746
5/16	5/16	13/16	2-1/2	M34611	M33764	
3/8	3/8	7/8	2-1/2	M34612	M33774	
3/8	3/8	1-1/8	3	M34620	M33765	M33756
7/16	7/16	7/8	2-1/2	M34621	M33784	
7/16	7/16	1	2-3/4	M34622		
7/16	7/16	2	4-1/2	M34630	M33775	M33766
1/2	1/2	1	3	M34631	M33785	M33776
1/2	1/2	2	4-1/2	M34632	M33794	M33786
9/16	9/16	1-1/4	3	M34640	M33795	
5/8	5/8	1-1/4	3-1/2	M34641	M33804	M33796
5/8	5/8	2-1/4	5	M34642	M33805	
11/16	3/4	1-3/8	4	M34650	M33814	M33806
3/4	3/4	1-1/2	4	M34651	M33815	M33816
3/4	3/4	2-1/4	5	M34652	M33824	M33826
3/4	3/4	4	6-1/4	M34660	M33825	
1	1	1-1/2	4	M34661	M33834	M33836
1	1	2-1/4	5	M34662	M33835	M33846
1	1	4	6-1/2	M34670	M33844	

Series CGDS-2 Stub Square End, CGDS-2B Stub Ball Nose

Features

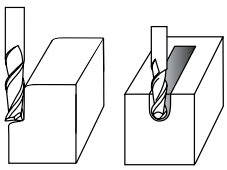
- 2-flute, right-hand helix, right-hand cut
- Center cutting
- Series CGDS-2 has square end;
  Series CGDS-2B has ball nose
- Uncoated standard; coated tools available as a modification
- Stub sizes

Old List Numbers 160-27, 160-24



Applications

- Suitable for shallow slotting applications.
- Use where precision finishing and sizing are required.
- Stub lengths offer rigidity and reduce deflection.
- Feed and speed recommendations are listed on pages 12-13.





Series CGDS-2 Stub Square End Offering

D1 inch	D inch	AP1 inch	L inch	Uncoated EDP No.
1/32	1/8	1/16	1-1/2	M35042
3/64	1/8	3/32	1-1/2	M35050
1/16	1/8	1/8	1-1/2	M31631
5/64	1/8	1/8	1-1/2	M31632
3/32	1/8	3/16	1-1/2	M31640
7/64	1/8	3/16	1-1/2	M31641
1/8	1/8	1/4	1-1/2	M31642
1/8	1/8	3/8	2	M31651
9/64	3/16	5/16	2	M31652
5/32	3/16	5/16	2	M31660
11/64	3/16	5/16	2	M31662
3/16	3/16	3/8	2	M31670
13/64	1/4	1/2	2-1/2	M31672
7/32	1/4	1/2	2-1/2	M31680
15/64	1/4	1/2	2-1/2	M31682
1/4	1/4	1/2	2-1/2	M31690
1/4	1/4	5/8	2-1/2	M31700
9/32	5/16	1/2	2-1/2	M31701
5/16	5/16	1/2	2-1/2	M31711
3/8	3/8	9/16	2-1/2	M31720
7/16	7/16	9/16	3	M31722
1/2	1/2	5/8	3	M31731

Series CGDS-2B Stub Ball Nose Offering

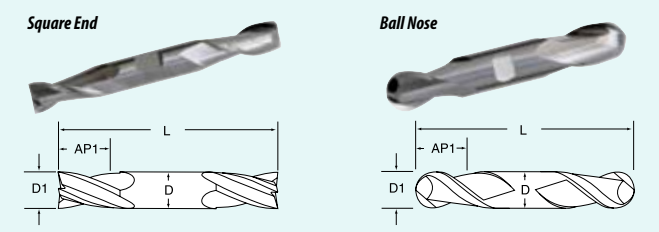
D1 inch	D inch	AP1 inch	L inch	Uncoated EDP No.
3/64	1/8	3/32	1-1/2	M31942
1/16	1/8	1/8	1-1/2	M31950
5/64	1/8	1/8	1-1/2	M31951
3/32	1/8	3/16	1-1/2	M31952
7/64	1/8	3/16	1-1/2	M31960
1/8	1/8	1/4	1-1/2	M31961
1/8	1/8	3/8	2	M31962
9/64	3/16	5/16	2	M31970
5/32	3/16	5/16	2	M31971
11/64	3/16	5/16	2	M31972
3/16	3/16	3/8	2	M31980
3/16	3/16	1/2	2-1/2	M31981
13/64	1/4	1/2	2-1/2	M31982
7/32	1/4	7/16	2-1/2	M31990
15/64	1/4	1/2	2-1/2	M31991
1/4	1/4	1/2	2-1/2	M31992
1/4	1/4	5/8	2-1/2	M32001
9/32	5/16	1/2	2-1/2	M32002
5/16	5/16	1/2	2-1/2	M32010
5/16	5/16	3/4	3-1/2	M32011
3/8	3/8	9/16	2-1/2	M32020
7/16	7/16	9/16	3	M32022
1/2	1/2	5/8	3	M32030

Series CGD-2 Square End, CGD-2B Ball Nose

Features

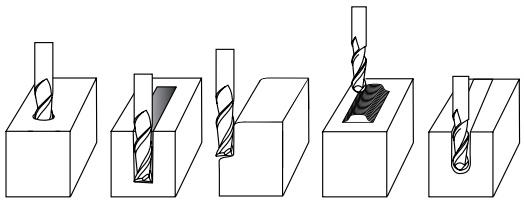
- 2-flute, right-hand spiral, right-hand cut
- Center cutting
- Series CGD-2 has square end; Series CGD-2B has ball nose
- Weldon flat on shank
- Uncoated and TiCN coated standard; other coatings available as a modification

Old List Number 165-27



Applications

- General-purpose double-end end mill comparable in performance to Series CG-2 end mills, but with additional tool life per tool.
- Designed with large flute area for maximum chip clearance.
- Use to plunge, slot, and take heavy peripheral cuts.
- Use where precision finishing and sizing are required.
- Feed and speed recommendations are listed on pages 12-13.





Series CGD-2 Square End Offering

D1 inch	D inch	AP1 inch	L inch	Uncoated EDP No.	TiCN Coated EDP No.
1/8	3/8	3/8	3-1/16	M31650	M33485
5/32	3/8	7/16	3-1/8	M31661	M33494
3/16	3/8	1/2	3-1/4	M31671	M33495
7/32	3/8	9/16	3-1/2	M31681	M33504
1/4	3/8	5/8	3-1/2	M31691	M33505
9/32	3/8	11/16	3-1/2	M31702	M33514
5/16	3/8	3/4	3-1/2	M31712	M33515
3/8	3/8	3/4	3-1/2	M31721	M33525
7/16	1/2	7/8	4	M31730	M33534
1/2	1/2	1	4	M31732	M33535

Series CGD-2B Ball Nose Offering



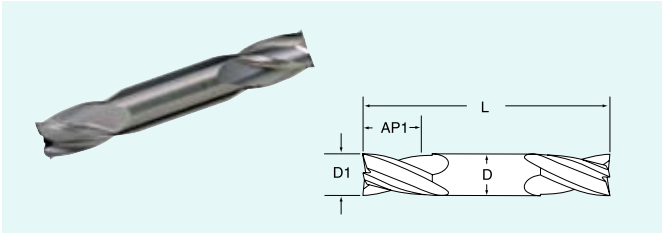
D1 inch	D inch	AP1 inch	L inch	Uncoated EDP No.	TiCN Coated EDP No.
1/8	3/8	3/8	3-1/16	M31740	M34655
5/32	3/8	7/16	3-1/8	M31741	M34664
3/16	3/8	1/2	3-1/4	M31742	M34665
7/32	3/8	9/16	3-3/8	M31750	M34674
1/4	3/8	5/8	3-1/2	M31751	M34675
9/32	3/8	11/16	3-3/8	M31752	M34684
5/16	3/8	3/4	3-1/2	M31760	M34685
3/8	3/8	3/4	3-1/2	M31762	M34694
7/16	1/2	7/8	4	M31770	M34695
1/2	1/2	1	4	M31771	M34704

Series CGDS-4 Stub, CGDS-4M Standard Metric Stub Length

Features

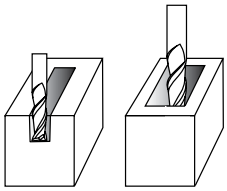
- 4-flute, right-hand spiral, right-hand cut
- Center cutting
- Stub length
- Series CGDS-4 inch sizes;
  Series CGDS-4M metric sizes
- Uncoated standard; coated tools available as a modification

Old List Numbers 160-47, 160-47M



Applications

- 4-flute geometry offers added strength and excellent rigidity.
- Typically used for light profiling operations.
- Shorter flute length offers greater strength, ideal for machining harder materials.
- Feed and speed recommendations are listed on pages 12-13.





Series CGDS-4 Stub Length Offering

D1 inch	D inch	AP1 inch	L inch	Uncoated EDP No.
1/32	1/8	1/16	1-1/2	M35401
3/64	1/8	3/32	1-1/2	M34201
1/16	1/8	1/8	1-1/2	M34202
5/64	1/8	1/8	1-1/2	M34210
3/32	1/8	3/16	1-1/2	M34211
7/64	1/8	3/16	1-1/2	M34212
1/8	1/8	1/4	1-1/2	M34220
1/8	1/8	3/8	2	M34222
9/64	3/16	5/16	2	M34230
5/32	3/16	5/16	2	M34231
11/64	3/16	5/16	2	M34240
3/16	3/16	3/8	2	M34241
13/64	1/4	1/2	2-1/2	M34250
7/32	1/4	1/2	2-1/2	M34251
15/64	1/4	1/2	2-1/2	M34260
1/4	1/4	1/2	2-1/2	M34261
1/4	1/4	5/8	2-1/2	M34270
9/32	5/16	1/2	2-1/2	M34271
5/16	5/16	1/2	2-1/2	M34280
3/8	3/8	9/16	2-1/2	M34282
7/16	1/2	9/16	3	M34291
1/2	1/2	5/8	3	M34300

Series CGDS-4M Standard Metric Stub Offering

D1 mm	D mm	AP1 mm	L mm	Uncoated EDP No.
2,0	3	4	38	M31772
2,5	3	5	38	M31780
3,0	4	6	51	M31781
3,5	4	7	51	M31782
4,0	4	8	51	M31790
4,5	5	9	51	M31791
5,0	5	10	51	M31792
6,0	6	12	64	M31800
7,0	8	12	64	M31801
8,0	8	12	64	M31802
9,0	10	12	70	M31810
10,0	10	12	70	M31811
11,0	11	14	70	M31820
12,0	12	16	76	M31812

Ball-nose style on page 42

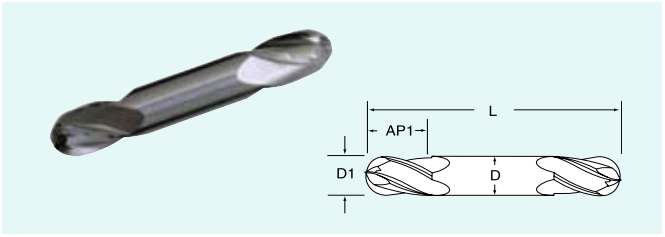
Series CGDS-4B Ball Nose Stub, CGDS-4MB Standard Metric Ball Nose Stub

NEW STYLE

Features

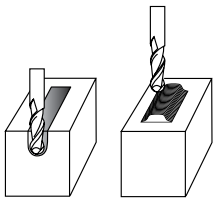
- 4-flute
- Center cutting
- Stub length
- Ball nose
- Uncoated standard; coated tools available as a modification

Old List Numbers 160-44, 160-44M



Applications

- 4-flute geometry offers added strength and excellent rigidity where a ball-nose end geometry is required.
- Typically used for light profiling operations.
- Shorter flute length offers greater strength; ideal for machining harder materials.
- Feed and speed recommendations are listed on pages 12-13.





Series CGDS-4B Stub Ball Nose Offering

D1 inch	D inch	AP1 inch	L inch	Uncoated EDP No.
3/64	1/8	3/32	1-1/2	M34302
1/16	1/8	1/8	1-1/2	M34310
5/64	1/8	1/8	1-1/2	M34311
3/32	1/8	3/16	1-1/2	M34312
7/64	1/8	3/16	1-1/2	M34320
1/8	1/8	1/4	1-1/2	M34321
9/64	3/16	5/16	2	M34330
5/32	3/16	5/16	2	M34331
11/64	3/16	5/16	2	M34340
3/16	3/16	3/8	2	M34341
13/64	1/4	1/2	2-1/2	M34350
7/32	1/4	7/16	2-1/2	M34352
15/64	1/4	1/2	2-1/2	M34360
1/4	1/4	1/2	2-1/2	M34361
1/4	1/4	5/8	2-1/2	M34362
9/32	5/16	1/2	2-1/2	M34371
5/16	5/16	1/2	2-1/2	M34380
5/16	5/16	3/4	3-1/2	M34381
3/8	3/8	9/16	2-1/2	M34390
7/16	7/16	9/16	3	M34392
1/2	1/2	5/8	3	M34401

Series CGDS-4MB Metric Stub Ball Nose Offering

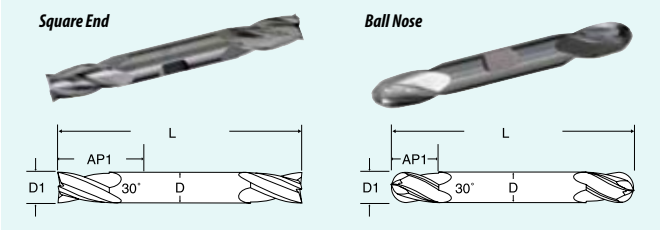
D1 mm	D mm	AP1 mm	L mm	Uncoated EDP No.
2,0	3	3	38	M33752
2,5	3	5	38	M33760
3,0	4	6	51	M33761
3,5	4	7	51	M33762
4,0	4	8	51	M33770
4,5	5	9	51	M33771
5,0	5	10	51	M33772
6,0	6	12	64	M33780
7,0	8	12	64	M33781
8,0	8	12	64	M33782
9,0	10	12	70	M33790
10,0	10	12	70	M33791
12,0	12	16	76	M33792

Series CGD-4 Square End, CGD-4B Ball Nose

Features

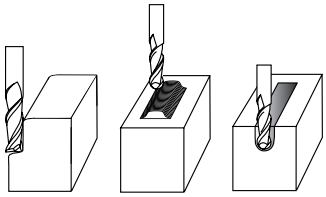
- 4-flute
- Center cutting
- Weldon flat on shank
- CGD-4 with square end; CGD-4B with ball nose
- Uncoated and TiCN coated standard; other coatings available as a modification

Old List Number 165-47



Applications

- General-purpose double-end mill comparable in performance to Series CG-4 end mills.
- Use in profiling operations and finishing passes.
- Feed and speed recommendations are listed on pages 12-13.





Series CGD-4 Square End Offering

D1 inch	D inch	AP1 inch	L inch	Uncoated EDP No.	TiCN Coated EDP No.
1/8	3/8	3/8	3-1/16	M34221	M34705
5/32	3/8	7/16	3-1/8	M34232	M34714
3/16	3/8	1/2	3-1/4	M34242	M34715
7/32	3/8	9/16	3-1/2	M34252	M34724
1/4	3/8	5/8	3-1/2	M34262	M34725
9/32	3/8	11/16	3-1/2	M34272	M34734
5/16	3/8	3/4	3-1/2	M34281	M34735
3/8	3/8	3/4	3-1/2	M34290	M34744
7/16	1/2	7/8	4	M34292	M34745
1/2	1/2	1	4	M34301	M34754

Series CGD-4B Ball Nose Offering

NEW STYLE

D1 inch	D inch	AP1 inch	L inch	Uncoated EDP No.	TiCN Coated EDP No.
1/8	3/8	3/8	3-1/16	M34322	M34755
5/32	3/8	7/16	3-1/8	M34332	M34764
3/16	3/8	1/2	3-1/4	M34342	M34765
7/32	3/8	9/16	3-3/8	M34351	M34774
1/4	3/8	5/8	3-1/2	M34370	M34775
9/32	3/8	11/16	3-3/8	M34372	M34784
5/16	3/8	3/4	3-1/2	M34382	M34785
3/8	3/8	3/4	3-1/2	M34391	M34794
7/16	1/2	7/8	4	M34400	M34795
1/2	1/2	1	4	M34402	M34804

Specialty Application End Mills

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High-Shear Solid Carbide End Mills

3-Flute, CC, Single End	CPHS-3	49
3-Flute, CC, Single End – Metric Sizes	CPHS-3M	49

Specialty Solid Carbide End Mills

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3-Flute, Tapered with Ball Nose	CPT-3B	51
4-Flute, Left-Hand Spiral, Right-Hand Cut	CPLH-4	52
2-Flute, CC, Straight Flutes	CPST-2	53
2-Flute, CC, Straight Flutes with Ball Nose	CPST-2B	53
4-Flute, CC, Straight Flutes	CPST-4	53
2-Flute, Engraving Tool	CPEG-2	54
2-Flute, Drill Mill	CPDM-2	54

Solid Carbide Chamfer Mills

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2-Flute, Single End	CPCH-2	55
4-Flute, Double End	CPCH-4D	55
4-Flute, Single End	CPCH-4	55

High-Strength End Mills for Steel and Stainless Steel







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Tapered End Mills





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Left-Hand End Mills



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Straight Flute End Mills







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CPST-4	53

Engraving Tool



Series Number	Page Number
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Drill Mill



Series Number	Page Number
CPDM-2	54

Chamfer Mill





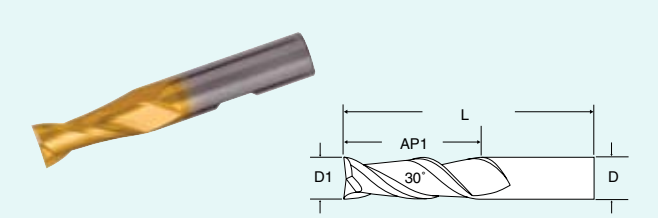
Series Number	Page Number
CPCH-2D	55
CPCH-2	55
CPCH-4D	55
CPCH-4	55

Series CH-2 High-Strength, CH-2M Standard Metric High-Strength

Feature

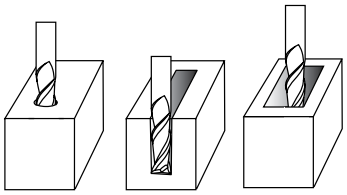
- 2-flute, right-hand spiral, right-hand cut
- Center cutting
- 30° helix
- High-strength flute geometry
- 16% cobalt submicron grain carbide substrate
- TiN, TiCN, and TiAlN coated tools standard in inch sizes; uncoated tools standard in metric sizes; others available as a modification
- CH-2 inch sizes; CH-2M metric sizes

Old List Numbers 159-27, 159-27M



Applications

- Geometry designed to provide added strength in harder-to-machine materials.
- Excellent for plunge cuts, slotting and deep-pocketing operations.
- Cutting speeds and feeds shown on pages 12-13.





Series CH-2 High-Strength Offering

D1 inch	D inch	AP1 inch	L inch	Uncoated EDP No.	TiN Coated EDP No.	TiCN Coated EDP No.	TiAlN Coated EDP No.
1/16	1/8	3/16	1-1/2	M35532		M34034	M34296
3/32	1/8	3/8	1-1/2	M35540		M34035	M34306
1/8	1/8	1/2	1-1/2	M35681	M30293	M34044	M34316
5/32	3/16	9/16	2	M35682		M34045	M34326
3/16	3/16	5/8	2	M35690	M30323	M34054	M34336
7/32	1/4	5/8	2-1/2	M35691		M34055	M34346
1/4	1/4	3/4	2-1/2	M35692	M30353	M34064	M34356
5/16	5/16	13/16	2-1/2	M35700	M30363	M34065	M34366
3/8	3/8	7/8	2-1/2	M35701	M30373	M34074	M34376
7/16	7/16	1	2-3/4	M35702		M34075	M34386
1/2	1/2	1	3	M35710	M30393	M34084	M34396

Series CH-2M High-Strength Standard Metric Offering

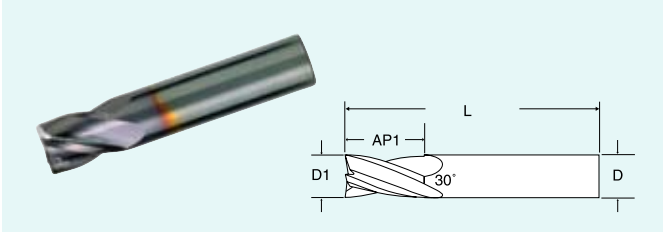
D1 mm	D mm	AP1 mm	L mm	TiN Coated EDP No.
2,0	3	7	38	M31693
2,5	3	7	38	M31193
3,0	3	9	38	M31203
3,5	4	12	51	M31213
4,0	4	14	51	M31223
4,5	5	14	51	M31233
5,0	5	16	51	M31243
6,0	6	19	64	M31253
7,0	8	18	64	M31263
8,0	8	21	64	M31273
9,0	10	22	70	M31283
10,0	10	22	70	M31293
11,0	11	25	70	M31303
12,0	12	25	76	M31313

Series CH-4 High Strength

Features

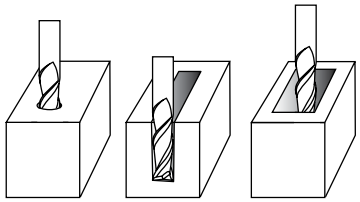
- 4-flute, right-hand spiral, right-hand cut
- Center cutting
- 30° helix
- High-strength flute geometry
- 16% cobalt submicron grain carbide substrate
- CH-4 inch sizes; CH-4M metric sizes; CH-4MB ball-nose metric sizes
- TiN, TiCN, and TiAlN standard in selected inch sizes; other sizes available as specials; metric sizes and ball-nose uncoated standard; other coatings available as a modification

Old List Numbers 147-47, 159-47



Applications

- High-strength configuration for conditions requiring increased substrate toughness.
- Excellent for plunge cuts, slotting, and deep-pocketing operations where a 4-flute tool is required.
- Cutting speeds and feeds shown on pages 12-13.





Series CH-4 High Strength Offering

D1 inch	D inch	AP1 inch	L inch	TiN Coated EDP No.	TiCN Coated EDP No.	TiAlN Coated EDP No.
3/64	1/8	3/32	1-1/2		M34164	
1/16	1/8	1/8	1-1/2		M34165	
1/16	1/8	3/16	1-1/2	M34136	M34094	
3/32	1/8	3/16	1-1/2		M34174	
3/32	1/8	3/8	1-1/2	M34146	M34095	
1/8	1/8	1/4	1-1/2		M34175	M34056
1/8	1/8	1/2	1-1/2	M34156	M34104	M31723
5/32	3/16	9/16	2			M34215
3/16	3/16	3/8	2		M34184	M34066
3/16	3/16	5/8	2	M34176	M34114	M34224
7/32	1/4	5/8	2-1/2	M34186	M34115	M34225
1/4	1/4	1/2	2		M34185	M34076
1/4	1/4	3/4	2-1/2	M34196	M34124	M34234
9/32	5/16	3/4	2-1/2	M34206	M34125	M34235
5/16	5/16	1/2	2		M34194	M34086
5/16	5/16	13/16	2-1/2	M34216	M34134	M34244
3/8	3/8	5/8	2		M34195	M34096
3/8	3/8	7/8	2-1/2	M34226	M34135	M34245
7/16	7/16	1	2-3/4	M34236	M34144	M34254
1/2	1/2	5/8	2-1/2		M34204	M34106
1/2	1/2	1	3	M34246	M34145	M34255
5/8	5/8	3/4	3		M34876	M34116
5/8	5/8	1-1/4	3-1/2	M34256	M34154	M34264
3/4	3/4	1	3		M34214	M34126
3/4	3/4	1-1/2	4	M34266	M34155	M34265
1	1	1-1/2	4	M34276	M30835	M34205

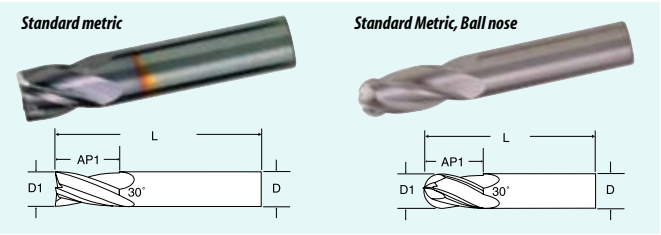
CH-4M and CH-4MB metric sizes listed on next page.

Series CH-4M Standard Metric High-Strength, CH-4MB Standard Metric Ball Nose High-Strength

Features

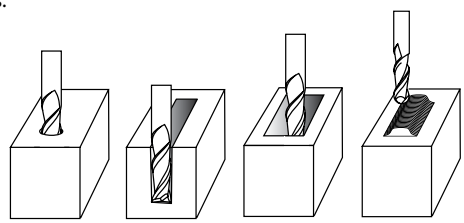
- 4-flute, right-hand spiral, right-hand cut
- Center cutting
- High-strength flute geometry
- 16% cobalt submicron grain carbide substrate
- Metric sizes
- Series CH-4M has square end; Series CH-4MB has ball nose

Old List Numbers 159-47M, 159-44M



Applications

- Series CH-4MB ball nose excellent for contouring operations.
- High-strength configuration for conditions requiring increased substrate toughness.
- Excellent for plunge cuts, slotting, and deep pocketing operations where metric specifications are required.
- Cutting speeds and feeds shown on pages 12-13.





Series CH-4M Standard High-Strength Metric Offering

D1 mm	D mm	AP1 mm	L mm	TiN Coated EDP No.
2,0	3	7	38	M30843
2,5	3	7	38	M30853
3,0	3	9	38	M30863
3,5	4	12	51	M30873
4,0	4	14	51	M30883
4,5	5	14	51	M30893
5,0	5	16	51	M30903
6,0	6	19	64	M30913
7,0	8	19	64	M30923
8,0	8	21	64	M30933
9,0	10	22	70	M30943
10,0	10	22	70	M30953
11,0	11	25	70	M30963
12,0	12	25	76	M30973
14,0	14	30	89	M30983
16,0	16	32	89	M30993
18,0	18	35	102	M31003
20,0	20	38	102	M31023

Series CH-4MB Metric Ball Nose High-Strength Offering

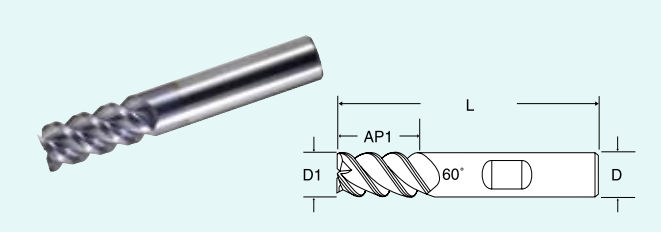
D1 mm	D mm	AP1 mm	L mm	TiN Coated EDP No.
2,0	3	7	38	M31033
2,5	3	7	38	M31043
3,0	3	9	38	M31053
3,5	4	12	51	M31063
4,0	4	14	51	M31073
4,5	5	14	51	M31083
5,0	5	16	51	M31093
6,0	6	19	64	M31103
8,0	8	21	64	M31113
9,0	10	22	70	M31123
10,0	10	22	70	M31133
11,0	11	25	70	M31143
12,0	12	25	76	M31153
14,0	14	30	89	M31163
16,0	16	32	89	M31173
18,0	18	35	102	M31183

Series CPHS-3, CPHS-3M Standard Metric

Features

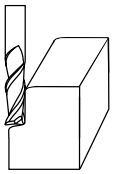
- 3-flute, 60° right-hand helix, right-hand cut
- Center cutting
- High-shear geometry
- 10% cobalt submicron grain carbide substrate
- Uncoated and TiCN coated standard in inch sizes; uncoated standard in metric sizes; other coatings available as a modification
- Inch and metric sizes

Old list numbers 170-37, 170-37M



Applications

- High-shear geometry produces superior chip evacuation in high-machinability materials.
- Greater metal removal rates can be achieved because the geometry enables a flute to always be engaged in the part.
- Excellent results in profiling operations.
- Cutting speeds and feed shown on pages 12-13.





Series CPHS-3 Offering

D1 inch	D inch	AP1 inch	L inch	Uncoated EDP No.	TiCN Coated EDP No.
3/16	1/4	5/8	2-1/2	M32591	M32224
1/4	1/4	3/4	2-1/2	M32592	M32225
5/16	5/16	13/16	2-1/2	M32600	M32234
3/8	3/8	7/8	2-1/2	M32601	M32235
7/16	7/16	1	2-3/4	M32602	M32244
1/2	1/2	1	3	M32610	M32245
5/8	5/8	1-1/4	3-1/2	M32611	M32254
3/4	3/4	1-1/2	4	M32612	M32255
1	1	1-1/2	4	M32620	M32264

Series CPHS-3M Standard Metric Offering

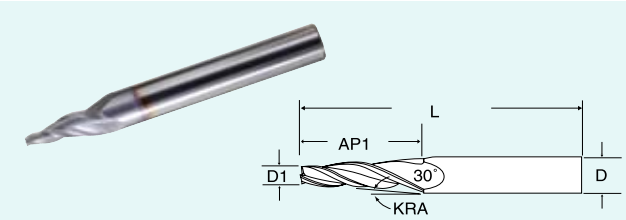
D1 mm	D mm	AP1 mm	L mm	Uncoated EDP No.
6,0	6	12	64	M32621
8,0	8	19	64	M32622
10,0	10	22	70	M32630
12,0	12	26	76	M32631
16,0	16	32	89	M32632
20,0	20	38	102	M32640
25,0	25	38	102	M32641

Series CPT-3 Tapered

NEW STYLE

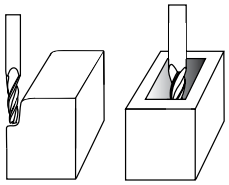
Features

- 3-flute
- Center cutting
- Tapered flutes, square end
- 10% cobalt submicron grain carbide substrate



Applications

- Effective in die and mold machining.
- Enables milling of extrusion dies on 4-axes machines.
- Feed and speed recommendations are listed on pages 12-13.



STEEL STAINLESS STEEL

Series CPT-3 Tapered Offering

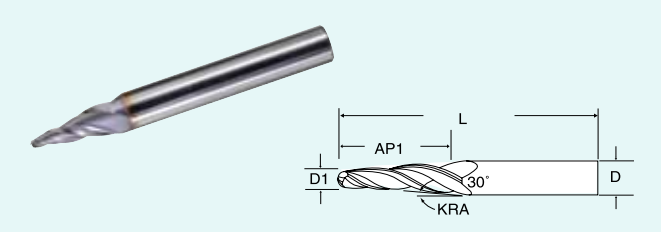
D1 inch	D inch	AP1 inch	L inch	KRA	Uncoated EDP No.	TiCN Coated EDP No.
1/8	1/4	1-1/2	3	1°	M32972	M32464
3/16	3/8	1-3/4	3-1/2	1°	M32991	M32485
1/4	3/8	2	3-1/2	1°	M33002	M32505
1/8	1/4	1-1/2	3	1°	M32980	M32465
3/16	3/8	1-3/4	3-1/2	1.5°	M32992	M32494
1/8	1/4	1-1/4	3	2°	M32971	M32455
3/16	3/8	1-3/4	3-1/2	2°	M33000	M32495
1/4	1/2	2	4	2°	M33010	M32514
1/8	1/4	1	3	3°	M32960	M32444
5/32	3/8	1-3/4	3-1/2	3°	M32982	M32475
1/4	1/2	2	4	3°	M33011	M32515
1/8	1/4	3/4	3	5°	M32951	M32434
1/8	3/8	1-1/2	3-1/2	5°	M32981	M32474
1/4	1/2	1-1/4	4	5°	M33001	M32504
1/8	1/4	1/2	3	7°	M32950	M32425
1/8	3/8	1	3-1/2	7°	M32962	M32445
3/16	1/2	1-1/4	4	7°	M32990	M32484
3/32	1/4	1/2	3	10°	M32942	M32424
1/8	3/8	3/4	3-1/2	10°	M32952	M32435
1/8	1/2	1	4	10°	M32970	M32454

Series CPT-3B Tapered Ball Nose

NEW STYLE

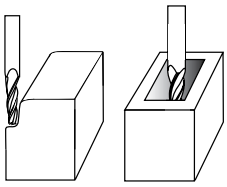
Features

- 3-flute
- Center cutting
- Tapered flutes, ball nose
- 10% cobalt submicron grain carbide substrate



Applications

- Effective in die and mold machining where a ball-nose geometry is required.
- Enables milling of extrusion dies on 4-axes machines.
- Excellent results in contouring operations.
- Feed and speed recommendations are listed on pages 12-13.



STEEL STAINLESS STEEL

Series CPT-3B Tapered Ball Nose Offering

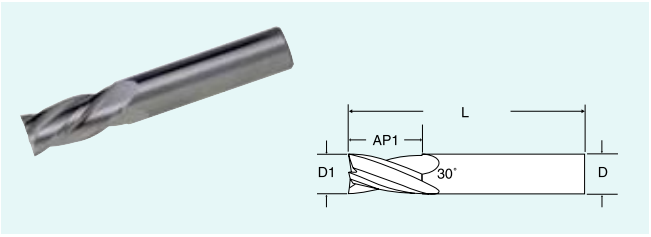
D1 inch	D inch	AP1 inch	L inch	KRA	Uncoated EDP No.	TiCN Coated EDP No.
1/8	1/4	1-1/2	3	1°	M32901	M32364
3/16	3/8	1-3/4	3-1/2	1°	M32920	M32385
1/4	3/8	2	3-1/2	1°	M32932	M32405
1/8	1/4	1-1/2	3	1.5°	M32902	M32365
3/16	3/8	1-3/4	3-1/2	1.5°	M32922	M32394
1/8	1/4	1-1/4	3	2°	M32900	M32355
3/16	3/8	1-3/4	3-1/2	2°	M32930	M32395
1/4	1/2	2	4	2°	M32940	M32414
1/8	1/4	1	3	3°	M32890	M32344
5/32	3/8	1-3/4	3-1/2	3°	M32911	M32375
1/4	1/2	2	4	3°	M32941	M32415
1/8	1/4	3/4	3	5°	M32881	M32334
1/8	3/8	1-1/2	3-1/2	5°	M32910	M32374
1/4	1/2	1-1/4	4	5°	M32931	M32404
1/8	1/4	1/2	3	7°	M32880	M32325
1/8	3/8	1	3-1/2	7°	M32891	M32345
3/16	1/2	1-1/4	4	7°	M32912	M32384
3/32	1/4	1/2	3	10°	M32872	M32324
1/8	3/8	3/4	3-1/2	10°	M32882	M32335
1/8	1/2	1	4	10°	M32892	M32354

Series CPLH-4 Left Hand Flutes

Features

- 4-flute
- Left-hand spiral, right-hand cut
- Center cutting
- 10% cobalt submicron grain carbide substrate

Old List Number 155-64





Applications

- For profiling operations.
- Excellent when working on thin floors held by vacuum chucks.
- Creates a downward cutting force that holds the workpiece firmly in place and forces chips.
- Cutting speeds and feed shown on pages 12-13.

Series CPLH-4 Left Hand Flutes Offering

D1 inch	D inch	AP1 inch	L inch	Uncoated EDP No.
1/16	1/8	3/16	1-1/2	M34411
1/8	1/8	1/2	1-1/2	M34412
3/16	3/16	5/8	2	M34420
1/4	1/4	3/4	2-1/2	M34421
5/16	5/16	13/16	2-1/2	M34422
3/8	3/8	7/8	2-1/2	M34430
7/16	7/16	1	2-3/4	M34431
1/2	1/2	1	3	M34432
5/8	5/8	1-1/4	3-1/2	M34440
3/4	3/4	1-1/2	4	M34441

Metal Removal now features NEW smart series numbers that make it easier to find the tool you're looking for!

All sizes, lengths, finishes, and coatings are listed on ONE series number. New intelligent series nomenclature tells you what the series contains.

C P L H - 4

1st Position
Material
C = Carbide
H = HSS

2nd Position
Performance/Application
G = General Purpose
A = Aluminum
S = Steels
LH = Left Hand
P = Special Application
R = Rougher
X = Long Reach

Optional Positions
Unique to the Design
D = Double End
LH = Left Hand
S = Stub Only
ST = Straight Flutes

3rd Position
Number of Flutes

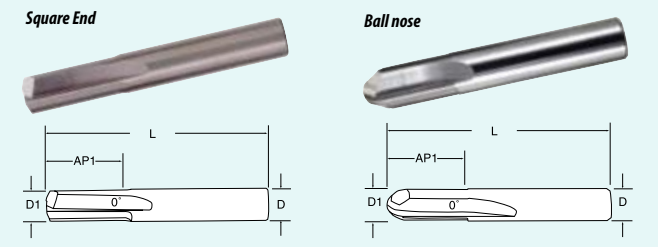
4th Position (Optional)
Other Descriptions
About the Geometry
M = Standard Metric
MD = DIN Metric
B = Ball Nose

Series CPST-2 Straight Flutes, CPST-2B Ball Nose Straight Flutes

Features

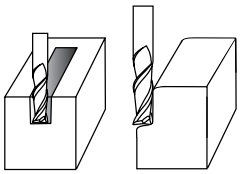
- 2 straight flutes, right-hand cut
- Center cutting
- Series CPST-2 has square end;
  Series CPST-2B has ball nose
- 10% cobalt submicron grain carbide substrate
- Uncoated tools standard; coated tools available as a modification

Old List Numbers 155-12, 155-12B



Applications

- For cutting even, parallel cuts often essential in holding tight tolerance slots or keyways.
- Normally used in finishing milling slots and keyways.
- Ball-nose tool is excellent for contouring operations.
- The two-fluted tool allows maximum flute volume for efficient chip removal.
- Feed and speed recommendations are listed on pages 12-13.





Series CPST-2 Straight Flutes Offering

D1 inch	D inch	AP1 inch	L inch	Uncoated EDP No.
1/16	1/8	3/16	1-1/2	M32031
1/8	1/8	1/2	1-1/2	M32032
3/16	3/16	5/8	2	M32040
1/4	1/4	3/4	2-1/2	M32041
5/16	5/16	13/16	2-1/2	M32050
3/8	3/8	7/8	2-1/2	M32051
7/16	7/16	1	2-3/4	M32052
1/2	1/2	1	3	M32060
5/8	5/8	1-1/4	3-1/2	M32061
3/4	3/4	1-1/2	4	M32062
1	1	1-1/2	4	M32070

Series CPST-2B Straight Flutes Ball Nose Offering

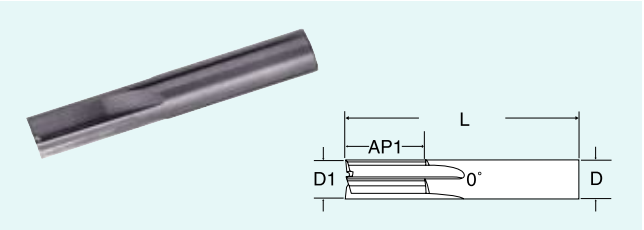
D1 inch	D inch	AP1 inch	L inch	Uncoated EDP No.
1/16	1/8	3/16	1-1/2	M32071
1/8	1/8	1/2	1-1/2	M32080
3/16	3/16	5/8	2	M32082
1/4	1/4	3/4	2-1/2	M32090
5/16	5/16	13/16	2-1/2	M32091
3/8	3/8	1	2-1/2	M32092
7/16	7/16	1	2-3/4	M32100
1/2	1/2	1	3	M32101

Series CPST-4 Straight Flutes

Features

- 4 Straight flutes, right-hand cut
- Center cutting
- Square end
- 10% cobalt submicron grain carbide substrate
- Uncoated tools standard; coated tools available as a modification

Old List Number 155-14



Applications

- For cutting even, parallel cuts often essential in holding tight tolerance slots or keyways.
- Normally used in finishing work.
- The four-fluted tool offers the strongest tooth profile available.
- Recommended for applications involving moderate to heavy stock with a rigid setup.



Series CPST-4 Straight Flutes Offering

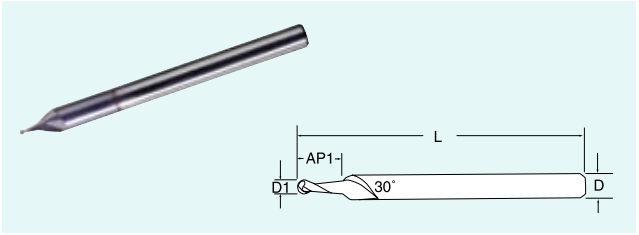
D1 inch	D inch	AP1 inch	L inch	Uncoated EDP No.
1/16	1/8	3/16	1-1/2	M33980
1/8	1/8	1/2	1-1/2	M33981
3/16	3/16	5/8	2	M33982
1/4	1/4	3/4	2-1/2	M33990
5/16	5/16	13/16	2-1/2	M33991
3/8	3/8	7/8	2-1/2	M33992
7/16	7/16	1	2-3/4	M34000
1/2	1/2	1	3	M34001
5/8	5/8	1-1/4	3-1/2	M34002
3/4	3/4	1-1/2	4	M34010
1	1	1-1/2	4	M34011

Series CPEG-2 Engraving Tool

NEW STYLE

Features

- 2-flute
- Ball nose
- 10% cobalt submicron grain carbide substrate
- TiCN coated standard; uncoated or other coatings available as a modification





Applications

- For engraving in metal and plastic.
- Feed and speed recommendations are listed on pages 12-13.

Series CPEG-2 Engraving Tool Offering

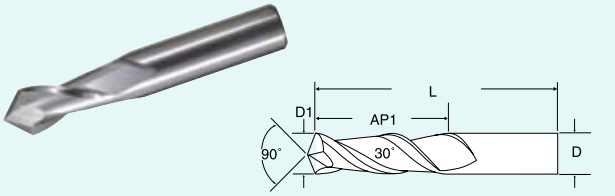
D1 inch	D inch	AP1 inch	L inch	TiCN Coated EDP No.
0.021	1/8	0.040	1-1/2	M33954
0.025	1/8	0.040	1-1/2	M33955
0.030	1/8	0.040	1-1/2	M33964

Series CPDM-2 Drill Mill

NEW STYLE

Features

- 2-flute
- 90° point
- 10% cobalt submicron grain carbide substrate
- Uncoated tools standard; coated tools available as a modification





Applications

- For drilling and chamfer milling.
- Feed and speed recommendations are listed on pages 12-13.

Series CPDM-2 Drill Mill Offering

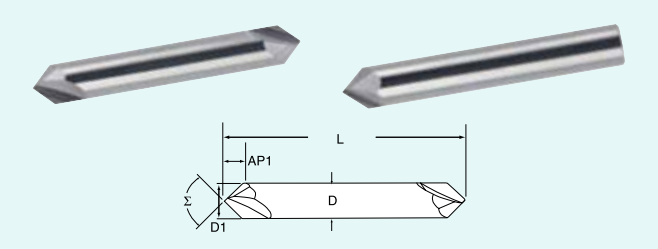
D1 inch	D inch	AP1 inch	L inch	Uncoated EDP No.
1/8	1/8	1/2	1-1/2	M30030
3/16	3/16	5/8	2	M30031
1/4	1/4	3/4	2-1/2	M30032
5/16	5/16	13/16	2-1/2	M30040
3/8	3/8	1	2-1/2	M30041
7/16	7/16	1	2-3/4	M30042
1/2	1/2	1	3	M30050
5/8	5/8	1-1/4	3-1/2	M30051
3/4	3/4	1-1/2	4	M30052

Series CPCH-2D, CPCH-2 Chamfer Mill

NEW STYLE

Features

- 2-flute chamfer mill
- CPCH-2D double end; CPCH-2 single end
- 10% micrograin carbide construction
- Uncoated tools standard; coated tools available as a modification



Applications

- For creating chamfer on milled workpiece.
- Feed and speed recommendations are listed on pages 12-13.



Series CPCH-2D Double-End Offering

D1 inch	D inch	L inch	Σ	Uncoated EDP No.
1/8	1/8	1-1/2	90°	M30101
3/16	3/16	2	90°	M30121
1/4	1/4	2-1/2	90°	M30142
3/8	3/8	2-1/2	90°	M30161
1/2	1/2	3	90°	M30182
3/4	3/4	4	90°	M30212

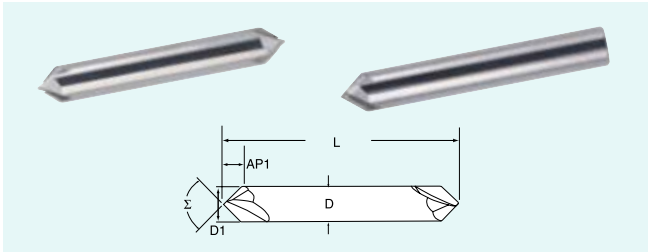
Series CPCH-2 Offering

D1 inch	D inch	L inch	Σ	Uncoated EDP No.
1/8	1/8	1-1/2	82°	M30120
1/8	1/8	1-1/2	90°	M30112
3/16	3/16	2	90°	M30121
1/4	1/4	2-1/2	60°	M30150
1/4	1/4	2-1/2	82°	M30151
1/4	1/4	2-1/2	90°	M30152
3/8	3/8	2-1/2	60°	M30172
3/8	3/8	2-1/2	82°	M30180
3/8	3/8	2-1/2	90°	M30181
1/2	1/2	3	60°	M30190
1/2	1/2	3	82°	M30191
1/2	1/2	3	90°	M30210
1/2	1/2	3	120°	M30211

Series CPCH-4D, CPCH-4 Chamfer Mill

Features

- 4-flute chamfer mill
- CPCH-4D double end; CPCH-4 single end
- 10% micrograin carbide construction
- Uncoated tools standard; coated tools available as a modification



Applications

- For creating chamfer on milled workpiece.
- Feed and speed recommendations are listed on pages 12-13.



Series CPCH-4D Double-End Offering

D1 inch	D inch	L inch	Σ	Uncoated EDP No.
1/4	1/4	2-1/2	90°	M33012
3/8	3/8	2-1/2	90°	M33030
1/2	1/2	3	90°	M33041
3/4	3/4	4	90°	M33060

Series CPCH-4 Offering

D1 inch	D inch	L inch	Σ	Uncoated EDP No.
1/4	1/4	2-1/2	60°	M33020
1/4	1/4	2-1/2	82°	M33021
1/4	1/4	2-1/2	90°	M33022
3/8	3/8	2-1/2	60°	M33031
3/8	3/8	2-1/2	82°	M33032
3/8	3/8	2-1/2	90°	M33040
1/2	1/2	3	60°	M33042
1/2	1/2	3	82°	M33050
1/2	1/2	3	90°	M33051
1/2	1/2	3	120°	M33052
3/4	3/4	4	90°	M33061

Maestro™ Solid Carbide End Mills for Chatter-Free Machining

	Series Number	Page Number
4-flute, Single End, Chamfered Corners	CM-4	60
4-flute, Single End, Square Corners	CM-4S	60
4-flute, Single End, Chamfered Corners for Long Reach	CMLS-4	61
4-flute, Single End, Square Corners for Long Reach	CMLS-4S	61

MASTERmill™ Solid Carbide Finishers

3-flute, CC, Single End for Stainless Steels	CS-3	64
3-flute, CC, Single End with Ball Nose for Stainless Steels	CS-3B	65
5-flute, CC, Single End for Stainless Steels	CS-5	66-67
6-flute, CC, Single End for Steels and Harder Materials	CSF-6	67
2-flute, CC, Single End for Aluminum	CA-2	69
2-flute, CC, Single End — Metric Sizes for Aluminum	CA-2M	70
2-flute, CC, Single End with Ball Nose for Aluminum	CA-2B	71
2-flute, CC, Single End for Long Reach in Aluminum	CXA-2	72
2-flute, CC, Single End for Long Reach in Aluminum	CXA-2P	72
2-flute, CC, Single End, with Ball Nose for Long Reach in Aluminum	CXA-2B	73
3-flute, CC, Single End for Aluminum	CA-3	74
3-flute, CC, Single End — Metric DIN for Aluminum	CA-3M	75

Carbide Roughers

3-flute, CC, Single End for Aluminum	CRA	77
Multi-Flute, CC, Single End for Steels and Harder Materials	CRS	78

Technical Information

Maestro™ end mills technical data	58-59
Recommended chip loads for Maestro™ end mills	62-63
MASTERmill™ Series CS technical data	66
MASTERmill™ Series CA technical data	68
MASTERmill™ Series CRA, CRS technical data	76

Maestro™ Solid Carbide End Mills for Chatter-Free Machining

Series Number	Page Number
CM-4	60
CM-4S	60
CMLS-4	61
CMLS-4S	61

MASTERmill™ Solid Carbide Finishers for Steels and Stainless Steels

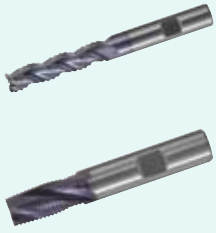


CS-3	64
CS-3B	65
CS-5	66-67
CSF-6	67

MASTERmill™ Solid Carbide Finishers for Aluminum and Non-Ferrous Materials

Series Number	Page Number
CA-2	69
CA-2M	70
CA-2B	71
CXA-2	72
CXA-2P	72
CXA-2B	73
CA-3	74
CA-3M	75

MASTERmill™ Solid Carbide Roughers for Steels and Aluminum



CRA	77
CRS	78

Give your milling applications the ONE-TWO punch!

NEW STYLE

Use ONE tool instead of TWO in universal milling applications. No need for a rougher *and* a finisher with Maestro end mills.

With chatter-free machining, you can significantly increase your cutting parameters at lower costs per part *without* sacrificing tool life.

Maestro Series CM and CMLS

Maestro end mills give ***chatter-free machining*** thanks to the patent-pending flute design featuring unequal flute spacing. This design ***reduces resonance vibration*** on your machine and results in ***smooth, silent machining operations***.

Maestro end mills enable you to get the most out of your tool budget. They are ***easy to resharpen*** for extended use. The TiAlN (titanium aluminum nitride) coating protects the tool surface, and enables higher feeds and speeds. Tests show these finishers can deliver ***up to 200% more tool life*** than conventional high-performance tools.

Maestro end mills give ***outstanding surface finishes*** at ***high machining speeds*** in stainless steels, cast irons, high-temperature alloys, low carbon steels < 35HRc, and titanium.

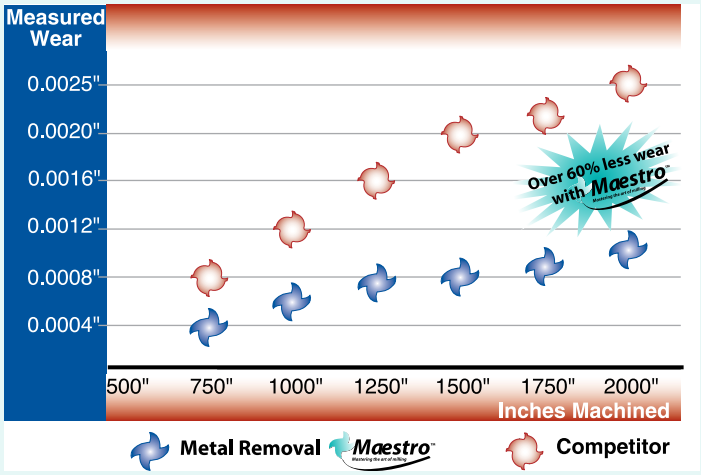
Maestro end mills can machine at more than 40% higher speed and feed rates than conventional high-performance tools in extreme conditions. The result? Faster throughput!

Maestro end mills are available in regular lengths and long-reach styles for hard-to-reach machining applications.

Wear Test:

Test Parameters:

Maestro:	CM4 4-flute solid carbide drill
Competitor:	Conventional 4-flute solid carbide drill
Material:	D2 steel
Operation:	profiling
Tool diameter:	5/8" x 1-1/4 LOC
Cutting speed:	190 SFM
RPM:	1,200
Feed rate:	14.8 IPM
Failure criteria:	wear above 1%



In performance testing, the Maestro end mill showed markedly less wear on the tool, even up to 2100" milled.

Universal milling in:



Constant, unequal flute spacing for chatter-free machining



Cutting Speeds and Feed Rates *(see page 183 for metric recommendations)*

Workpiece Material	Cutting Speed SFM		Feed Rates 1/4" RPM	1/4" IPM	5/16" RPM	5/16" IPM	3/8" RPM	3/8" IPM	1/2" RPM	1/2" IPM	5/8" RPM	5/8" IPM	3/4" RPM	3/4" IPM	1" RPM	1" IPM
Gray	Low	450	6870	28.0	5500	27.0	4580	30.0	3430	34.0	2750	33.0	2300	32.0	1720	31.0
	High	550	8400	34.0	6720	32.0	5600	36.0	3200	32.0	3360	40.0	2800	39.0	2100	38.0
Soft Steels	Low	500	7640	30.0	6100	29.0	5100	32.0	3800	38.0	3050	36.0	2500	35.0	1900	34.0
(1018-1060)	High	600	9200	37.0	7300	35.0	6100	39.0	4580	46.0	3650	44.0	3050	43.0	2300	41.0
Alloy Steels >36Rc	Low	350	5348	34.23	4285	34.28	3565	35.65	2674	33.16	2139	29.95	1783	26.38	1337	21.39
(4140-4340)	High	450	6876	44.01	5510	44.08	4584	45.84	3438	42.63	2750	38.51	2292	33.92	1719	27.5
Alloy Steels <37Rc	Low	250	3820	24.45	3061	24.49	2547	25.47	1910	23.68	1528	21.39	1273	18.85	955	15.28
(4140-4340)	High	300	4584	29.34	3673	29.38	3056	30.56	2292	28.42	1834	25.67	1528	22.61	1146	18.34
Alloy Steels >35Rc	Low	250	3820	21.39	3061	23.26	2547	20.37	1910	19.1	1528	18.95	1273	16.3	955	13.37
(4140-4340)	High	300	4584	25.67	3673	27.92	3056	24.45	2292	29.92	1834	22.74	1528	19.56	1146	16.04
Tool Steels <36Rc	Low	159	2430	13.61	1947	14.8	1620	12.96	1215	12.15	972	12.05	810	10.37	607	8.5
(A2, D2, S7)	High	200	3056	17.11	2449	18.61	2037	16.3	1528	15.28	1222	15.16	1019	13.04	754	10.7
Tool Steels >36Rc	Low	350	5348	34.23	4285	34.28	3565	35.65	2674	33.16	2139	29.95	1783	26.38	1337	21.39
(A2, D2, S7)	High	450	6876	44.01	5510	44.08	4584	45.84	3438	42.63	2750	38.51	2292	33.92	1719	27.5
Die Steels <37Rc	Low	250	3820	24.45	3061	24.49	2547	25.47	1910	23.68	1528	21.39	1273	18.85	955	15.28
(P20,H13)	High	300	4584	29.34	3673	29.38	3056	30.56	2292	28.42	1834	25.67	1528	22.61	1146	18.34
Easy-to-Cut	Low	300	4540	15.0	3670	13.0	3050	17.0	2300	20.0	1830	19.0	1530	19.0	1150	18.0
Stainless Steel (303)	High	380	5800	19.0	4650	17.0	3870	22.0	2900	25.0	2320	24.0	1940	24.0	1450	23.0
Moderately	Low	260	3970	9.0	3180	9.0	2650	14.0	1990	16.0	1590	15.0	1320	15.0	990	13.0
difficult-to-cut	High	290	4430	11.0	3550	10.0	2950	15.0	2220	18.0	1780	17.0	1480	17.0	1110	15.0
Stainless Steels																
(304, Invar, Kovar)																
Difficult-to-Cut	Low	250	3820	9.0	3060	9.0	2550	13.0	1910	15.0	1530	14.0	1270	14.0	960	12.0
Stainless Steel	High	280	4280	10.0	3420	10.0	2850	15.0	2140	17.0	1700	16.0	1430	16.0	1070	13.0
(316L, 304L, 13-8 PH, etc.)																
High Temperature Alloys	Low	75	1150	2.5	920	2.5	780	3.1	570	3.6	460	3.1	380	3.0	290	2.8
(718 inconel, A286, Haynes)	High	90	1380	3.0	1100	3.0	920	3.7	690	4.4	550	3.7	460	3.7	350	3.4
Titanium Alloys	Low	160	2450	7.0	1950	6.2	1630	9.0	1220	10.0	980	9.4	820	9.2	610	9.0
(6Al-4V, 6-2222)	High	190	2900	8.0	2300	7.5	1940	11.0	1450	11.6	1160	11.0	970	11.0	720	10.5

• Recommendations are for slotting conditions with depth of cut equal to the diameter of the end mill.
• For profiling operations, increase the table feed by 20%
The feeds and speeds shown on this table are based on providing a combination of high metal removal rates with a long tool life and avoiding tool breakage. The low rates are more appropriate for 40 taper machines and weak fixturing. The high rates are more suitable for 50-taper machines and rigid setups.

Recommended Chip Loads *(see page 183 for metric recommendations)*

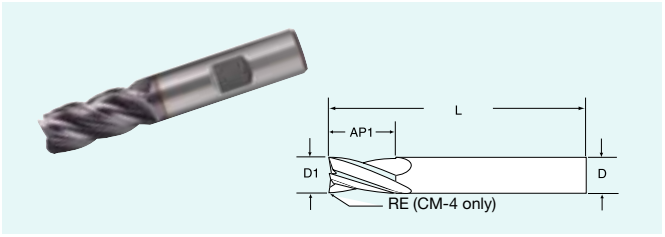
Workpiece Material	Cutting Speed SFM	Chip Load Per Tooth 1/8"	3/16"	1/4"	5/16"	3/8"	1/2"	5/8"	3/4"	1"	Profiling Axial Depth	Profiling Radial Depth	Slotting
Gray Cast Iron	450-550	0.0008	0.0010	0.0015	0.0020	0.0023	0.0026	0.0029	0.0033	0.0036	1 x Dia.	.5 x Dia.	1 x Dia.
Tool Steels (A2,D2,S7)	300-400	0.0008	0.0010	0.0016	0.0020	0.0022	0.0030	0.0032	0.0035	0.0040	1 x Dia.	.5 x Dia.	1 x Dia.
Die Steels (P20, H13)	250-300	0.0006	0.0008	0.0014	0.0018	0.0020	0.0028	0.0030	0.0033	0.0038	2 x Dia.	.5 x Dia.	1 x Dia.
Soft Steels (1018-1060) >36Rc	500-600	0.0008	0.0010	0.0016	0.0020	0.0022	0.0030	0.0032	0.0035	0.0040	1 x Dia.	.5 x Dia.	1 x Dia.
Easy-to-cut Stainless Steels (303 etc.)	300-380	0.0007	0.0011	0.0015	0.0018	0.0021	0.0024	0.0027	0.0030	0.0033	1 x Dia.	.5 x Dia.	1 x Dia.
Moderately difficult Stainless Steels (304,Invar, Kovar)	260-290	0.0005	0.0009	0.0013	0.0016	0.0018	0.0022	0.0025	0.0028	0.0031	1 x Dia.	.5 x Dia.	1 x Dia.
Difficult Stainless Steels (316L, 304L, 13-8 PH etc.)	150-210	0.0004	0.0007	0.0011	0.0014	0.0016	0.0020	0.0023	0.0026	0.0029	1 x Dia.	.5 x Dia.	1 x Dia.
Alloy Steels (4140-4340)	250-320	0.0006	0.0010	0.0016	0.0020	0.0025	0.0031	0.0035	0.0037	0.0040	1 x Dia.	.5 x Dia.	1 x Dia.
High-Temp Alloys (718 Inconel, A286, Haynes)	75-90	0.0004	0.0007	0.0009	0.0012	0.0014	0.0016	0.0018	0.0020	0.0022	1 x Dia.	.2 x Dia.	.3 x Dia.
Titanium Alloys (6Al-4V, 6-2222)	120-160	0.0007	0.0010	0.0013	0.0016	0.0020	0.0023	0.0026	0.0029	0.0033	1 x Dia.	.3 x Dia.	.5 x Dia.

Series CM-4, CM-4S

NEW STYLE

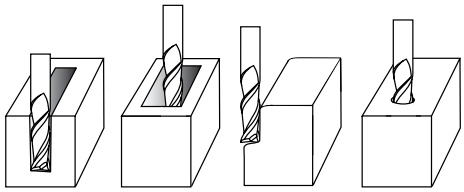
Features

- 4-flute, right-hand spiral, right-hand cut
- Patented flute form with constant rake and unequal flute division
- Tools 1/2" and larger supplied with Weldon flats on shank
- Can be run at 40% higher speed rates than conventional high-performance tools
- Metric sizes available as specials
- Square end:
  - Series CM-4 with corner chamfer for heavier cuts
  - Series CM-4S with square corners for lighter cuts and finishing operations
- 10% submicron grain carbide substrate
- TiAlN coated standard



Applications

- Universal chatter-free machining in a wide variety of materials.
- Use as both rougher and finisher.
- Outstanding surface finishes at high machining speeds.
- Feed and speed recommendations are listed on page 59.





Series CM-4, CM-4S Offering

D1 inch	D inch	AP1 inch	L inch	Series CM-4 with corner chamfer TiAlN Coated RE	Series CM-4 with corner chamfer TiAlN Coated EDP No.	Series CM-4S with square corners TiAlN Coated EDP No.
1/4	1/4	3/8	2	.016	M34406	M34916
1/4	1/4	3/4	2-1/2	.016	M34416	M34526
5/16	5/16	3/4	2-1/2	.016	M34426	M34536
3/8	3/8	7/8	2-1/2	.020	M34436	M34546
1/2	1/2	5/8	2-1/2	.020	M34446	M34556
1/2	1/2	1	3	.020	M34456	M34566
1/2	1/2	1-1/4	3	.020	M34466	M34576
5/8	5/8	3/4	3	.020	M34476	M34586
5/8	5/8	1-1/4	3-1/2	.020	M34486	M34926
3/4	3/4	7/8	3-1/2	.020	M34496	M34596
3/4	3/4	1-1/2	4	.020	M34506	M34606
1	1	1-1/2	4	.020	M34516	M34616

Maestro end mills… save time – save money – work better – last longer

Save time – No need to convert from rougher to finisher; the Maestro end mill does both. It removes as much material as a conventional rougher and can provide the fine surface finish of a finisher.

Save money – Why buy two tools when one can do the job better? The Maestro series provides true universal milling cutters that will work effectively in stainless steels, cast irons, high-temperature alloys, low-carbon steels (<35 HRc), and titanium.

Work better – TiAlN-coated Maestro end mills can be run at higher feeds and speeds than conventional high-performance tools. The patented flute form, which features constant rake and unequal flute spacing, results in faster machining capability.

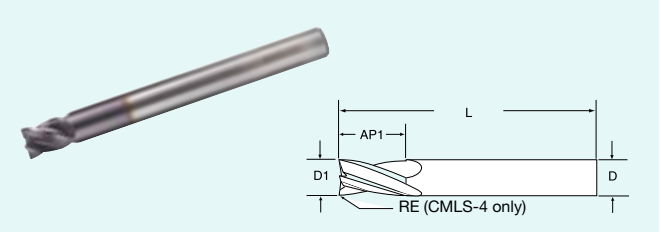
Last longer – The chatter-free machining environment created by the Maestro end mill reduces wear during use and extends tool life up to 200% compared to traditional high-performance tools.

Series CMLS-4, CMLS-4S

NEW STYLE

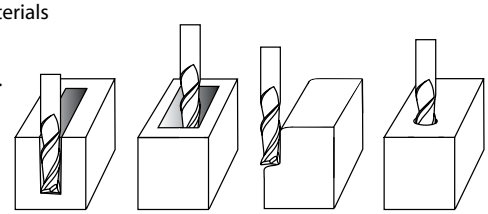
Features

- 4-flute, right-hand spiral, right-hand cut
- Patented flute form with constant rake and unequal flute division
- Shank for long, difficult-to-reach applications
- Square end:
  - Series CMLS-4 with corner chamfer for helical cuts
  - Series CMLS-4S with square corners for lighter cuts and finishing operations
- TiAlN coated standard



Applications

- Universal chatter-free machining in a wide variety of materials with a long shank for difficult-to-reach applications.
- Feed and speed recommendations are listed on page 59.





Series CMLS-4, CMLS-4S Offering

D1 inch	D inch	AP1 inch	L inch	Series CMLS-4 with corner chamfer TiAlN Coated RE	Series CMLS-4 with corner chamfer TiAlN Coated EDP No.	Series CMLS-4S with square corners TiAlN Coated EDP No.
1/2	1/2	5/8	6	.020	M34626	M34696
5/8	5/8	3/4	5	.020	M34636	M34936
5/8	5/8	3/4	6	.020	M34646	M34706
3/4	3/4	1	5	.020	M34656	M34946
3/4	3/4	1	6	.020	M34666	M34716
1	1	1-1/8	6	.020	M34676	M34726
1	1	1-1/8	7	.020	M34686	M34956

Note: Run at slower speeds than regular length.

Use Maestro for roughing and finishing applications in these materials



Low-Carbon Steel	< 220 HB
Free-Machining Steels	< 275 HB≤ 28 HRc
Medium and High Plain Carbon, Alloy, and Tool Steels	≤330 HB ≤ 35 HRc
Medium and High Plain Carbon, Alloy, and Tool Steels	340-350 HB36-48 HRc
Ferritic, Martensitic, and PH Stainless Steels	< 330 HB ≤ 40 HRc



Austenitic Stainless Steels	135-275 HB ≤ 28 HRc



Ductile (Nodular) and Malleable Cast Irons	120-320 HB
Gray Cast Irons	120-320 HB



Iron-Base Heat-Resistant Alloys	135-320 HB≤ 34 HRc
Cobalt-Base Heat-Resistant Alloys	150-425 HB≤ 45 HRc
Nickel-Base Heat-Resistant Alloys	140-475 HB ≤48 HRc
Titanium and Titanium Alloys	110-450 HB ≤ 48 HRc

MASTERmill™ Series CS

If you're serious about improving tool performance in your spindles, Metal Removal's Series CS end mills will help you reach your goal.

These finishers are designed to enable **higher chip loads and feed rates** when machining stainless steels to provide significantly higher metal-removal rates and increase productivity.

In addition to stainless steels, **Series CS** also provides users excellent results in other difficult-to-machine workpiece materials, like Hastalloy, Waspalloy and Inconel.

Ideal for pocketing, slotting, roughing, profiling, and finishing, **Series CS** end mills offer a wide selection of diameters and tool lengths.

They are available as standard in TiCN and TiAlN coatings.

- 3-flute for slotting and roughing operations (Series CS-3, CS-3B)
- 5-flute for profiling and finishing operations (Series CS-5)
- Medium helix for freer cutting and better chip control
- Reinforced core diameter for added strength
- Special end geometry enables rapid chip evacuation in plunge cutting and ramping
- Achieve greater than 50% increase in chip loads
- Run at 20% to 40% heavier feed rates
- Produce excellent surface finishes
- 6-flute high-helix superfinisher for hard materials (Series CSF-6)

Use Series CS end mills for finishing applications in these materials

	**Austenitic Stainless Steels** *200 and 300 series, Duplex* *AISI: 210, 209, 302, 303, 304, 304L, 310, 316, 316L, 321, 329, 347, 384* *ASTM: XM-1, SM-5, XM-7, XM-21, CF-8M* *Wrought: A-286, Discaloy, Incoloy 801, N-155, 16-25-6, 19-9 DL* *Cast: ASTM A297, A351, A608, A567*	**135-275 HB**	**≤ 28 HRc**
	**Iron-Base Heat-Resistant Alloys** *Wrought: A-286, Discaloy, Incoloy 801, N-155, 16-25-6, 19-9 DL* *Cast: ASTM A297, A351, A608, A567*	**135-320 HB**	**≤ 34 HRc**
	Cobalt-Base Heat-Resistant Alloys *Wrought: AiResist 213, Haynes 25 (L605), Haynes 188, J-1570, Stellite* *Cast: Ai Resist 13, Haynes 21, MAR-M509, NASA Co-W-Re, WI-52*	**150-425 HB**	**≤ 45 HRc**
	Nickel-Base Heat-Resistant Alloys *Astroloy, Hastelloy, B/C/C0276/X, Inconel 601/ 617/ 625/ 700/ 706/718, IN 102, Incoloy 901, MAR-M200, Nimonic, Rene 41, Udimet, Waspaloy, Monel*	**140-475 HB**	**≤ 48 HRc**
	Titanium and Titanium Alloys *pure: Ti98.8, Ti99.9* *alloyed: Ti5Al2.5Sn, Ti-5Al-4V, Ti6Al2Sn-4Zr-2Mo, Ti3Al-8V-6Cr-4Mo-4Zr, Ti10V-2Fe-3Al, Ti-13V-11Cr-3Al*	**110-450 HB**	**≤ 48 HRc**
	**Low-Carbon Steel** *AISI: 1008, 1010, 1018, 1020, 1026, 10L18, 10L45, 10L50, 1108, 1117, 11L44, 1200 Series, 12L14*	**< 220 HB**	
	Free-Machining Steels *AISI: 1109, 1111, 1112, 1113, 1114, 1115, 1116, 1132, 1137, 1138, 1140 1141, 1144, 1145, 1151*	**< 275 HB**	**≤ 28 HRc**
	Medium and High Plain Carbon, Alloy and Tool Steels *Medium and High Carbon Steels: AISI: 1035, 1040, 1045, 1055, 1080, 1090, 1095, 1525, 1541, 1548, 1551, 1561, 1572* *Alloy Steels: AISI: 1300 Series, 2000 Series, 3000 Series, 4012, 4023, 4140, 4150, 4320, 4422, 5120, E51100, E52100, 6118, 6150, 7000 Series, 8620, 8622, 86540, 8822, E-9310, 94B15, Rycut 40, Cr-Mo alloy, Super-Kut steels* *Tool Steels: high-speed classes M and T; hot and cold work SAE classes A, D, H, O and S; wrought high carbon/low alloy W1, W2, L2, P1, P6, P20*	**≤ 330 HB**	**≤ 35HRc**
	Medium and High Plain Carbon, Alloy and Alloy Steels *Alloy Steels: AISI: 1335, 4140, 4330, 5046, 5140, 52100, 8625, 8640, 300-M, EDT-180, Hy Tuff steel and stress-proof steel* *Tool Steels: SAE class M and T, hot and cold work SAE classes Ad, D, H, O and S; wrought high carbon/low allow Wq, W2, L2, P1, P6, P20*	**340-450 HB**	**36-48 HRc**
	Ferritic, Martensitic, and PH Stainless Steels *400 and 500 series AISI: 410, 416, 416F, 416Se, 420Fm, 4389F, Se, 440, 440C, 502, 504 and precipitation hardening (PH) 17-4PH, PH 13-8 Mo, 15-5 PH*	**< 330 HB**	**≤ 40 HRc**

Suggested Speeds for Series CS End Mills

SFM for MASTERmill™ Series CS-3, CS-3B, CS-5, CSF-6

(see page 184 for metric recommendations)



Material	Hardness Brinell	Hardness HRc	Preferred Coating	Alternate Coating	Speed Range	Surface Feet per Minute (SFM) Uncoated	TiCN Coated	TiAlN Coated
Low and Plain Carbon, Alloy & Tool Steels	< 220	<19	TiCN	TiN or TiAlN	Low	270	325	430
					High	360	500	575
Plain Carbon, Alloy & Tool Steels	225-286	20-30	TiAlN	TiN or TiCN	Low	180	215	350
					High	270	375	430
Plain Carbon, Alloy & Tool Steels	294-371	31-40	TiAlN	TiN or TiCN	Low	150	180	210
					High	200	280	320
Ferritic, Martensitic 400, 500, & PH Stainless Steels	135-330	<35	TiAlN	TiCN	Low	160	190	225
					High	270	375	430
Austenitic Stainless Steels 200 and 300 Series	135-275	<28	TiAlN	TiCN	Low	180	215	250
					High	315	440	500
Cobalt-Based High Temperature Alloys	150-425	<45	TiAlN	TiCN	Low	30	35	45
					High	45	65	75
Nickel-Based High Temperature Alloys	140-300	<32	TiAlN	TiCN	Low	45	55	65
					High	90	125	145
Nickel-Based High Temperature Alloys	300-475	32-50	TiAlN	TiCN	Low	40	50	55
					High	70	100	110
Titanium - Pure	—	—	NONE	NONE	Low	180	—	—
					High	270		
Titanium - Alloyed	300-440	32-43	TiAlN	TiCN	Low	90	110	125
					High	135	190	215

Suggested Feeds for Series CS End Mills

Chip Load per Tooth for MASTERmill Series CS-3, CS-3B, CS-5, CSF-6

(see page 184 for metric recommendations)



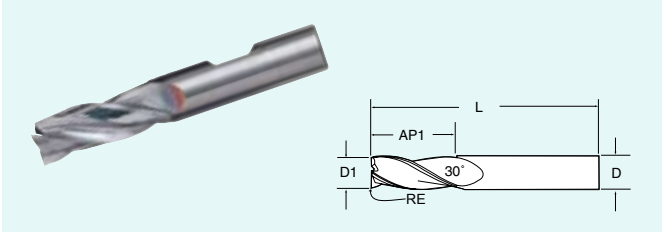
Material	Hardness Brinell	Hardness HRc	Chip Load per Tooth 1/16"	1/8"	3/16"	1/4"	5/16"	3/8"	1/2"	5/8"	3/4"	1"
Low and Plain Carbon, Alloy & Tool Steels	< 220	<19	0.0004	0.0006	0.0010	0.0015	0.0020	0.0025	0.0030	0.0035	0.0040	0.0045
Plain Carbon, Alloy & Tool Steels	225-286	20-30	0.0004	0.0006	0.0010	0.0015	0.0020	0.0025	0.0030	0.0035	0.0040	0.0045
Plain Carbon, Alloy & Tool Steels	294-371	31-40	0.0003	0.0004	0.0007	0.0011	0.0014	0.0018	0.0021	0.0025	0.0028	0.0032
Ferritic, Martensitic 400, 500, & PH Stainless Steels	135-330	<35	0.0004	0.0006	0.0008	0.0015	0.0020	0.0025	0.0030	0.0035	0.0040	0.0045
Austenitic Stainless Steels 200 and 300 Series	135-275	<28	0.0002	0.0004	0.0006	0.0010	0.0015	0.0020	0.0025	0.0030	0.0035	0.0040
Cobalt-Based High Temperature Alloys	150-425	<45	0.0002	0.0004	0.0006	0.0009	0.0012	0.0015	0.0018	0.0021	0.0024	0.0027
Nickel-Based High Temperature Alloys	140-300	<32	0.0002	0.0004	0.0006	0.0009	0.0012	0.0015	0.0018	0.0021	0.0024	0.0027
Nickel-Based High Temperature Alloys	300-475	32-50	0.0002	0.0004	0.0006	0.0009	0.0012	0.0015	0.0018	0.0021	0.0024	0.0027
Titanium Pure	—	—	0.0002	0.0004	0.0006	0.0009	0.0012	0.0015	0.0018	0.0021	0.0024	0.0027
Titanium-alloyed	300-440	32-43	0.0002	0.0004	0.0006	0.0009	0.0012	0.0015	0.0018	0.0021	0.0024	0.0027

Series CS-3

Features

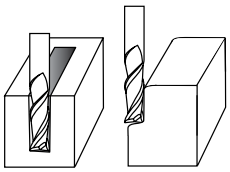
- 3-flute, right-hand spiral, right-hand cut
- Medium helix for freer cutting and better chip control
- Reinforced core diameter for added strength
- Special end geometry for rapid chip evacuation in plunge cutting
- Center cutting
- Square end with corner radius
- Uncoated, TiCN coated, and TiAlN coated standard; other coatings available as a modification

Old Series 400, 405



Applications

- For slotting and roughing operations.
- Achieve greater than 50% increase in chip loads while running at 20%-40% heavier feed rates.
- Provides excellent surface finishes.
- Feed and speed recommendations are listed on page 63.





Series CS-3 Offering

D1 inch	D inch	AP1 inch	L inch	RE	Uncoated EDP No.	TiCN Coated EDP No.	TiAlN Coated EDP No.
1/8	1/8	1/4	1-1/2	0.010	M32462	M32025	M31726
1/8	1/8	1/2	1-1/2	0.010	M32470	M32034	M31736
5/32	3/16	9/16	2	0.010	M32471	M32035	M31746
3/16	3/16	5/16	2	0.020	M32502	M32094	M31856
3/16	3/16	5/8	2	0.020	M32472	M32044	M31756
7/32	1/4	3/4	2-1/2	0.020	M32510	M32095	M31866
1/4	1/4	1/2	2	0.020	M32480	M32045	M31766
1/4	1/4	3/4	2-1/2	0.020	M32481	M32054	M31786
9/32	5/16	13/16	2-1/2	0.020	M32511	M32104	M31876
5/16	5/16	1/2	2	0.020	M32482	M32055	M31796
5/16	5/16	13/16	2-1/2	0.020	M32490	M32064	M31806
11/32	3/8	7/8	2-1/2	0.020	M32512	M32105	M31886
3/8	3/8	1/2	2	0.020	M32491	M32065	M31816
3/8	3/8	7/8	2-1/2	0.020	M32492	M32074	M31826
7/16	7/16	5/8	2-1/2	0.020	M32500	M32075	M31836
7/16	7/16	1	2-1/2	0.020	M32501	M32085	M31846
1/2	1/2	5/8	2-1/2	0.035	M32520	M32114	M31896
1/2	1/2	1	3	0.035	M32521	M32115	M31906
1/2	1/2	1-1/4	3	0.035	M32522	M32124	M31916
5/8	5/8	3/4	3	0.035	M32530	M32125	M31926
5/8	5/8	1-1/4	3-1/2	0.035	M32531	M32134	M31936
5/8	5/8	1-5/8	4	0.035	M36300	M35275	M35526
3/4	3/4	1	3	0.035	M32532	M32135	M31946
3/4	3/4	1-1/2	4	0.035	M32540	M32144	M31956
1	1	1-1/8	3	0.035	M32542	M32154	M31976
1	1	1-1/2	4	0.035	M32541	M32145	M31966
1	1	2	4	0.035	M36301	M35284	M35536

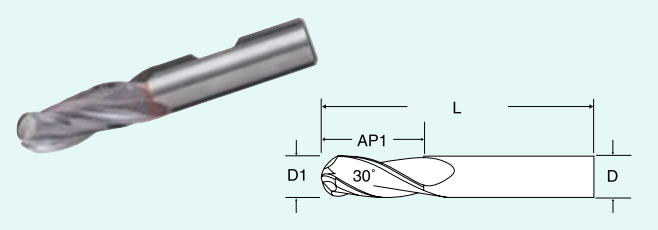
Modifications, including sizes and lengths, adding whistle flats, custom chamfers, etc., are available. Call the Special Quotations department at 888-434-4370 (option 4), or fax your requirements to 888-434-4001.

Series CS-3B Ball Nose

Features

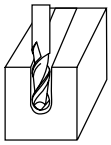
- 3-flute, right-hand spiral, right-hand cut
- Medium helix for freer cutting and better chip control
- Reinforced core diameter for added strength
- Center cutting
- Ball-nose end geometry for rapid chip evacuation in plunge cutting
- Uncoated, TiCN coated, and TiAlN coated standard; other coatings available as a modification

Old Series 410, 415



Applications

- For slotting and roughing operations where a ball-nose geometry is required.
- Achieve greater than 50% increase in chip loads while running at 20%-40% heavier feed rates.
- Provides excellent surface finishes.
- Feed and speed recommendations are listed on page 63.





Series CS-3B Offering

D1 inch	D inch	AP1 inch	L inch	Uncoated EDP No.	TiCN Coated EDP No.	TiAlN Coated EDP No.
1/8	1/8	1/4	1-1/2	M32550	M32155	M31986
1/8	1/8	1/2	1-1/2	M32431	M31964	M31626
3/16	3/16	5/16	2	M32551	M32164	M31996
3/16	3/16	9/16	2	M32432	M31965	M31636
1/4	1/4	3/8	2	M32552	M32165	M32016
1/4	1/4	3/4	2-1/2	M32440	M31974	M31646
5/16	5/16	7/16	2	M32560	M32174	M32026
5/16	5/16	13/16	2-1/2	M32441	M31975	M31656
3/8	3/8	1/2	2	M32561	M32175	M32046
3/8	3/8	7/8	2-1/2	M32442	M31984	M31666
7/16	7/16	9/16	2-1/2	M32562	M32184	M32056
7/16	7/16	1	2-1/2	M32450	M31985	M31676
1/2	1/2	5/8	2-1/2	M32570	M32185	M32076
1/2	1/2	1-1/4	3	M32451	M31994	M31686
5/8	5/8	3/4	3	M32571	M32194	M32086
5/8	5/8	1-1/4	3-1/2	M32452	M32005	M31696
5/8	5/8	1-5/8	4	M36352	M35364	M35606
3/4	3/4	7/8	3	M32572	M32195	M32096
3/4	3/4	1-5/8	4	M32460	M32014	M31706
1	1	1-1/8	3	M32580	M32204	M32106
1	1	2	4	M32461	M32015	M31716

Tech Tip:

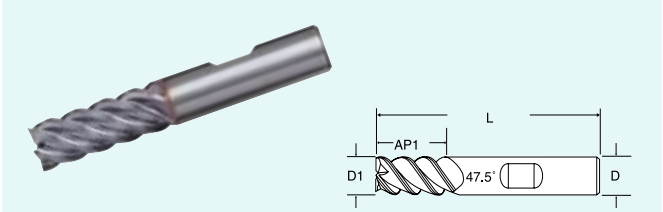
Three-flute end mills provide more chip space and a much stronger core size that make them ideal for slotting and roughing operations. The three cutting teeth take a bigger bite with every revolution, and the wider flute spacing enables faster dispersal of the chips.

Series CS-5

Features

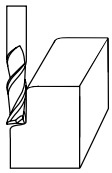
- 5-flute, right-hand spiral, right-hand cut
- Medium helix for freer cutting and better chip control
- Center cutting
- Excellent for finishing and profiling operations
- Uncoated, TiCN coated, and TiAlN coated standard; other coatings available as a modification

Old Series 420, 430, 435



Applications

- For profiling and finishing operations.
- Achieve greater than 50% increase in chip loads while running at 20%-40% heavier feed rates.
- Provides excellent surface finishes.
- Feed and speed recommendations are listed on page 63.





Series CS-5 Offering

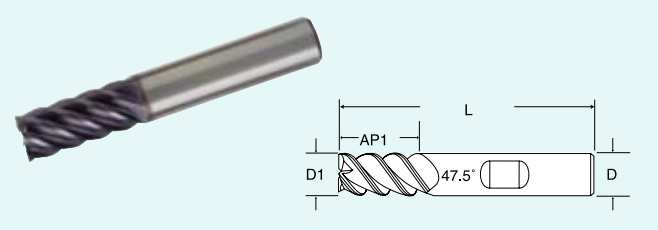
D1 inch	D inch	AP1 inch	L inch	Uncoated EDP No.	TiCN Coated EDP No.	TiAlN Coated EDP No.
1/8	1/8	1/4	1-1/2	M34470	M33554	M33336
1/8	1/8	1/2	1-1/2	M34471	M33555	M33346
5/32	3/16	9/16	2	M34472	M33564	M33356
3/16	3/16	5/16	2	M34480	M33565	M33366
3/16	3/16	5/8	2	M34481	M33574	M33376
7/32	1/4	3/4	2-1/2	M34482	M33575	M33386
1/4	1/4	1/2	2	M34490	M33584	M33396
1/4	1/4	3/4	2-1/2	M34491	M33585	M33406
1/4	1/4	1-1/4	4	M34492	M33594	M33416
9/32	5/16	13/16	2-1/2	M34500	M33595	M33426
5/16	5/16	1/2	2	M34501	M33604	M33436
5/16	5/16	13/16	2-1/2	M34502	M33605	M33446
5/16	5/16	1-1/4	4	M34510	M33614	M33456
11/32	3/8	7/8	2-1/2	M34511	M33615	M33466
3/8	3/8	5/8	2	M34512	M33624	M33476
3/8	3/8	7/8	2-1/2	M34520	M33625	M33486
3/8	3/8	1-1/2	4	M34521	M33634	M33496
13/32	7/16	1	2-1/2	M34522	M33635	M33506
7/16	7/16	5/8	2-1/2	M34530	M33644	M33516
7/16	7/16	7/8	2-1/2	M34531	M33645	M33526
7/16	7/16	1	2-1/2	M35961	M35195	
7/16	7/16	2	4	M34532	M33654	M33536
15/32	1/2	1-1/4	3	M34540	M33655	M33546
1/2	1/2	5/8	2-1/2	M34541	M33664	M33556
1/2	1/2	1	3	M34542	M33665	M33566
1/2	1/2	1-1/4	3	M34550	M33674	M33576
1/2	1/2	2	4	M36302	M35285	M35546
9/16	9/16	1-1/2	3-1/2	M34552	M33684	M33596
5/8	5/8	3/4	3	M34560	M33685	M33606
5/8	5/8	1-5/8	4	M36310	M35294	M35556
5/8	5/8	1-1/4	3-1/2	M34561	M33694	M33616
5/8	5/8	2-1/4	5	M34562	M33695	M33626
5/8	5/8	2-1/2	5	M36311	M35295	M35566
3/4	3/4	1	3	M34570	M33704	M33636
3/4	3/4	1-1/2	4	M34571	M33705	M33646
3/4	3/4	2-1/4	5	M34572	M33714	M33656
3/4	3/4	3-1/4	5	M36312	M35304	M35576
7/8	7/8	2	4	M34580	M33715	M33666
1	1	1-1/8	3	M34581	M33724	M33676
1	1	1-1/2	4	M34582	M33725	M33686
1	1	2	4	M36320	M36305	M35586
1	1	2-1/4	5	M34590	M33734	M33696
1	1	3-1/4	6	M36321	M35314	M35596
1-1/4	1-1/4	2	4-1/2	M34591	M33735	M33706
1-1/4	1-1/4	3-1/4	6	M34592	M33744	M33716

Series CSF-6 Superfinisher

NEW STYLE

Features

- 4- or 6-flute, right-hand spiral, right-hand cut
- High helix for better chip control and less heat wearing of workpiece
- Provides finishes ≥ 24 Ra
- Center cutting
- Square end
- Uncoated, TiCN coated, and TiAlN coated standard; other coatings available as a modification

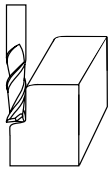


Applications

For light peripheral finishing cuts with a super-fine finish to the workpiece.

High-performance coatings can run at faster feeds and speeds and provide longer life than uncoated tools.

Feed and speed recommendations are listed on page 63.





Series CSF-6 Superfinisher Offering

D1 inch	D inch	AP1 inch	L inch	Uncoated EDP No.	TiCN Coated EDP No.	TiAlN Coated EDP No.
1/8*	1/8	1/2	1-1/2	M33670	M33334	M32986
3/16*	3/16	5/8	2	M33671	M33335	M32996
1/4	1/4	3/8	2	M34671	M33845	M33856
1/4	1/4	3/4	2-1/2	M34672	M33854	M33866
1/4	1/4	1-1/8	3	M34680	M33855	M33876
5/16	5/16	13/16	2-1/2	M34681	M33864	M33886
5/16	5/16	1-1/8	3	M34682	M33865	M33896
3/8	3/8	1/2	2	M34690	M33874	M33906
3/8	3/8	7/8	2-1/2	M34691	M33875	M33916
3/8	3/8	1-1/8	3	M34692	M33884	M33926
7/16	7/16	7/8	2-1/2	M34700	M33885	M33936
7/16	7/16	2	4	M34701	M33894	M33946
1/2	1/2	5/8	2-1/2	M34702	M33895	M33956
1/2	1/2	1	3	M34710	M33904	M33966
1/2	1/2	2	4-1/2	M34711	M33905	M33976
5/8	5/8	3/4	3	M34712	M33914	M33986
5/8	5/8	1-1/4	3-1/2	M34720	M33915	M33996
5/8	5/8	2-1/4	5	M34721	M33924	M34286
3/4	3/4	1	3-1/2	M34722	M33925	M34006
3/4	3/4	1-1/2	4	M34730	M33934	M34016
3/4	3/4	2-1/4	5	M34731	M33935	M34026
1	1	1-1/2	4	M34732	M33944	M34036
1	1	2-1/4	5	M34740	M33945	M34046
1	1	3	5-1/2	M34741		
1	1	4	6-1/2	M34742		

**4 flutes; all others 6 flutes*

MASTERmill™ Series CA

With the availability of higher spindle speeds from today's machines, choosing the right end mills becomes increasingly important. Metal Removal's **Series CA** tools can help you achieve the productivity you want from your machines. Conventional tools just don't do the job!

Specifically designed for machining aluminum, **Series CA** tools provide superior performance in slotting, profiling, and ramping operations while running at high SFM and feed rates. Using special substrate material and unique geometries, **Series CA** tools offer greater resistance to chipping compared to conventional carbide tools. This enables the tool and machine to achieve much higher overall metal removal rates.

Ideal for contouring aluminum, copper, and other non-ferrous materials, **Series CA** end mills ensure precision, enhance performance, and boost productivity. All inch size **Series CA** end mills are available in bright or TiCN coatings.

- 2-flute styles for deep pocketing
- 3-flute styles for high-volume metal removal rates and close tolerance slotting
- High rake angle for faster chip flow
- Concentric margins for stability during the machining process
- Reduces chatter at high spindle speeds
- Achieves excellent surface finishes
- Provides extended tool life

Suggested Speeds for Series CA End Mills *(see page 185 for metric recommendations)*

SFM for End Mills Series CA-2, CA-2M, CA-2B, CA-3, CA-3M

Reduce Speeds and CLPT 20 % for Slotting Operations

						Surface Feet per Minute (SFM)		
Material	Preferred Coating	Alternate Coating	Hardness Brinell	HRc	Speed Range	Uncoated	TiN Coated	TiCN Coated
Low-Silicon Aluminum & Other Non-Ferrous Alloys	TiCN	TiN	50-150	—	Low	800	880	960
					High	4000	4800	5600
High-Silicon Aluminum	TiCN	TiN	—	—	Low	600	660	720
					High	2000	2400	2800

The higher values for surface speed should be used for radial depths of cut less than 25% of the diameter. Lower values for surface speed should be used for radial depths of cut greater than 25% of the diameter. The above recommendations are for axial lengths of cut not to exceed 1 times the cutter diameter for profiling and .5 times the cutter diameter for slotting.

Suggested Feeds for Series CA End Mills *(see page 185 for metric recommendations)*

Chip Load per Tooth for End Mills Series CA-2, CA-2M, CA-2B, CA-3, CA-3M

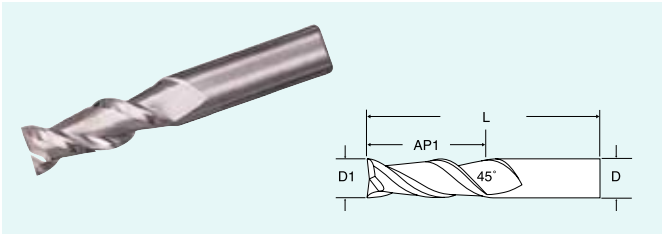
			Chip Load per Tooth									
Material	Hardness Brinell	HRc	1/16"	1/8"	3/16"	1/4"	5/16"	3/8"	1/2"	5/8"	3/4"	1"
Low-Silicon Aluminum & Other Non-Ferrous Alloys	50-150	—	0.0007	0.0011	0.0018	0.0025	0.0034	0.0040	0.0048	0.0060	0.0072	0.0096
High-Silicon Aluminum	—	—	0.0006	0.0010	0.0016	0.0023	0.0031	0.0037	0.0044	0.0056	0.0067	0.0089

Note: The above speeds and feeds are recommended starting points only and depend upon setup conditions; higher or lower parameters may be required to achieve optimum conditions.

Series CA-2

Features

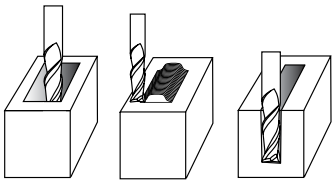
- 2-flute, right-hand helix, right-hand cut
- Center cutting
- Square end
- High helix angle for faster chip flow
- Concentric margins for stability during machining and superior finishes on parts
- Uncoated and TiCN coated standard; other coatings available as a modification



Old Series 560, 570, 580, 585

Applications

- For deep pocketing and contouring applications in non-ferrous materials.
- Feed and speed recommendations are listed on page 68.



NON-FERROUS MATERIAL

Series CA-2 Offering

D1 inch	D inch	AP1 inch	L inch	Uncoated EDP No.	TiCN Coated EDP No.
1/8	1/8	1/4	1-1/2	M30532	M30455
1/8	1/8	3/8	1-1/2	M30240	M30095
1/8	1/8	3/4	2-1/4	M30241	M30105
5/32	3/16	9/16	2	M30242	M30114
3/16	3/16	5/16	2	M30540	M30464
3/16	3/16	9/16	2	M30250	M30115
3/16	3/16	3/4	2-1/2	M30251	M30124
7/32	1/4	3/4	2-1/2	M30252	M30125
1/4	1/4	3/8	2-1/2	M30541	M30465
1/4	1/4	3/4	2-1/2	M30262	M30144
1/4	1/4	1-1/8	3	M30270	M30145
1/4	1/4	1-1/2	4	M30271	M30154
5/16	5/16	13/16	2-1/2	M30272	M30155
5/16	5/16	1-1/8	3	M30292	M30164
11/32	3/8	1	2-1/2	M30301	M30165
3/8	3/8	1/2	2-1/2	M30542	M30474
3/8	3/8	7/8	2-1/2	M30302	M30175
3/8	3/8	1-1/8	3	M30312	M30184
3/8	3/8	1-3/4	4	M30322	M30185
7/16	7/16	9/16	2-1/2	M30550	M30475
7/16	7/16	7/8	2-1/2	M30330	M30205
7/16	7/16	1	2-1/2	M35970	M35205
7/16	7/16	2	4-1/2	M30331	M30214
1/2	1/2	5/8	3	M30551	M30484
1/2	1/2	1	3	M30332	M30215
1/2	1/2	1-1/4	3	M36322	M35315
1/2	1/2	2	4-1/2	M30350	M30235
1/2	1/2	3	5	M30351	M30244
1/2	1/2	3-1/8	6	M36330	M35324
5/8	5/8	3/4	3-1/2	M30552	M30485
5/8	5/8	1-1/4	3-1/2	M30352	M30245
5/8	5/8	1-5/8	4	M35365	M36360
5/8	5/8	2-1/4	5	M30360	M30254
5/8	5/8	3-3/4	6	M30361	M30255
3/4	3/4	1	4	M30560	M30494
3/4	3/4	1-1/2	4	M30362	M30264
3/4	3/4	2-1/4	5	M30370	M30265
3/4	3/4	4	6-1/4	M30371	M30274
1	1	1-1/4	5	M30561	M30495
1	1	1-1/2	4	M30372	M30275
1	1	2-1/4	5	M30380	M30284
1	1	2-5/8	6	M36331	M35325
1	1	3-1/4	6	M36332	M35334
1	1	4	6-1/2	M30381	M30294

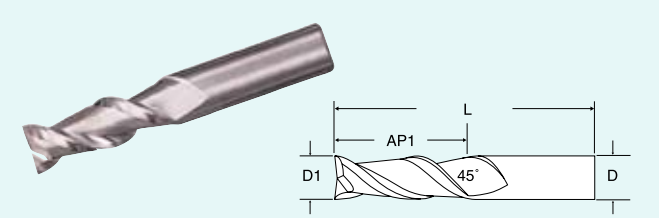
Metric sizes listed on next page

Series CA-2M Standard Metric

Features

- 2-flute, right-hand helix, right-hand cut
- Center cutting
- Square end
- High helix angle for faster chip flow
- Concentric margins for stability during machining and superior finishes on parts
- Uncoated tools standard; coatings available as a modification

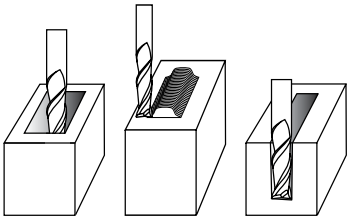
Old Series 572-20



Applications

- For deep pocketing and contouring applications in non-ferrous materials.

  where metric specifications are required.
- Feed and speed recommendations are listed on page 68.



Series CA-2M Standard Metric Offering

D1 mm	D mm	AP1 mm	L mm	Uncoated EDP No.
3	3	12	38	M30411
4	4	12	50	M30412
5	5	14	50	M30420
6	6	16	50	M30421
8	8	20	63	M30422
10	10	22	76	M30430
12	12	25	76	M30431
14	14	32	83	M30432
16	16	32	89	M30440

Use Series CA end mills for finishing applications in these materials

Free-Machining and Low-Silicon Aluminum Alloys *AA: 2024-T4, 2014-T6, 2011-T3, 3003-H18, A2, Alcoa 510, Duralumin aluminum, 6061-T4, 6061-T6, 7075-T4, 7075-T-6*	**Hypoeutectic <12.2% Si**
High-Silicon Aluminum Alloys AA: A380, A390, A38 *AA: A380, A390, A380-1, A390-1, A380-2, Duralcan*	**Hypereutectic >12.2% Si**
Miscellaneous Non-ferrous Work Materials *Non-ferrous machining alloys, copper, brass, zinc*	—

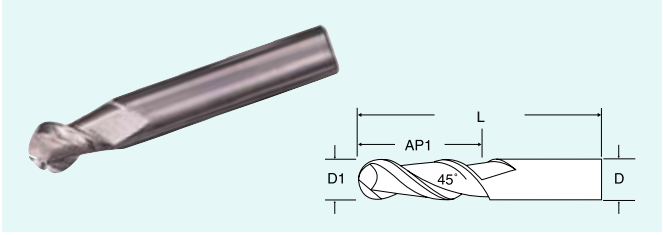
18	18	38	100	M30441
20	20	38	104	M30442

Series CA-2B Ball Nose

Features

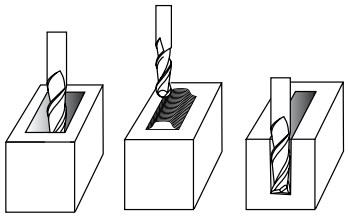
- 2-flute, right-hand helix, right-hand cut
- Center cutting
- Ball nose
- High helix angle for faster chip flow
- Concentric margins for stability during machining and superior finishes on parts
- Uncoated tools standard; coated tools available as a modification

Old Series 565, 575



Applications

- For deep pocketing and controuring applications in non-ferrous materials where a ball-nose end geometry is required.
- Feed and speed recommendations are listed on page 68.



NON-FERROUS MATERIAL

Series CA-2B Ball Nose Offering

D1 inch	D inch	AP1 inch	L inch	Uncoated EDP No.	TiCN Coated EDP No.
1/4	1/4	3/8	2-1/2	M30562	M35044
1/4	1/4	3/4	2-1/2	M30382	M35045
5/16	5/16	7/16	2-1/2	M30570	M35054
5/16	5/16	13/16	2-1/2	M30390	M35055
3/8	3/8	1/2	2-1/2	M30571	M35064
3/8	3/8	1	2-1/2	M30391	M35065
7/16	7/16	9/16	2-1/2	M30572	M35074
7/16	7/16	7/8	2-1/2	M30392	M35075
1/2	1/2	5/8	3	M30580	M35084
1/2	1/2	1-1/4	3	M30400	M35085
5/8	5/8	3/4	3-1/2	M30581	M35094
5/8	5/8	1-1/4	3-1/2	M30401	M35095
3/4	3/4	1	4	M30582	M35104

3/4	3/4	1-5/8	4		M30402	M35105
1	1	1-1/4	5		M30590	M35114
1	1	2	5		M30410	M35115

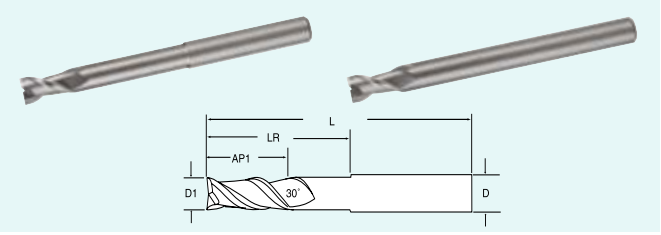
Series CXA-2, CXA-2P Long Reach

NEW STYLE

Features

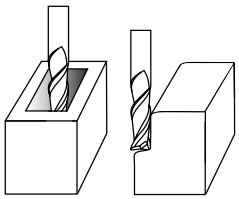
- 2-flute
- Center cutting
- CXA-2 features with neck clearance;
- CXA-2P features without neck clearance
- 10% micron grain
- Uncoated and TiCN coated standard; other coatings available as a modification

Old List Numbers 590, 599



Applications

- For long-reach and step-down milling applications.
- Feed and speed recommendations are listed on page 68.



NON-FERROUS MATERIAL

Series CXA-2 Long Reach with Neck Clearance Offering

D1 inch	D inch	AP1 inch	LR inch	L inch	Uncoated EDP No.	TiCN Coated EDP No.
1/4	1/4	3/8	2-1/4	4	M34911	M33965
3/8	3/8	1/2	2-1/4	4	M34912	M33974
1/2	1/2	5/8	2-1/4	5	M34920	M33975
1/2	1/2	5/8	3-1/4	6	M34921	M33984
1/2	1/2	5/8	4	6	M34922	M33985
5/8	5/8	3/4	2-1/4	5	M34930	M33994
5/8	5/8	3/4	3-1/4	6	M34931	M33995
5/8	5/8	3/4	4	6	M34932	M34004
3/4	3/4	1	2-1/4	5	M34940	M34005
3/4	3/4	1	3-1/4	6	M34941	M34014
3/4	3/4	1	4	6	M34942	M34015
1	1	1-1/8	2-1/4	5	M34950	M34024
1	1	1-1/8	3-1/4	6	M34951	M34025
1	1	1-1/8	4-1/4	7	M34952	M31713

Series CXA-2P Long Reach without Neck Clearance Offering

D1 inch	D inch	AP1 inch	L inch	Uncoated EDP No.	TiCN Coated EDP No.
1/8	1/8	1/4	3	M30060	M30034
3/16	3/16	1/4	3	M30061	M30035
1/4	1/4	3/8	4	M30062	M30044
5/16	5/16	7/16	4	M30070	M30045
3/8	3/8	1/2	4	M30071	M30054
1/2	1/2	5/8	5	M30072	M30055
5/8	5/8	3/4	5	M30080	M30064
5/8	5/8	3/4	8	M30081	M30065
3/4	3/4	1	6	M30082	M30074
3/4	3/4	1	8	M30090	M30075
1	1	1-1/8	6	M30091	M30084
1	1	1-1/8	8	M30092	M30085

1-1/4	1-1/4	1-1/2	8	M30100	M30094

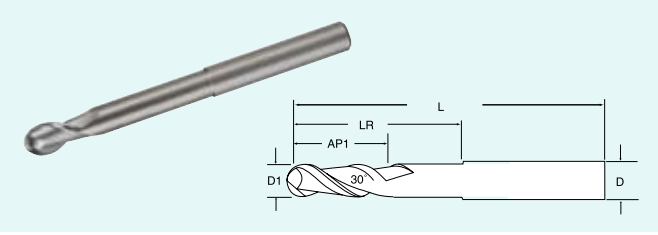
Series CXA-2B Long Reach Ball Nose

NEW STYLE

Features

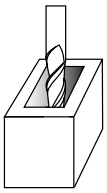
- 2-flute
- Center cutting
- Long reach with neck clearance
- Ball nose
- Uncoated and TiCN coated standard; other coatings available as a modification

Old List Number 591



Applications

- For long-reach, step-down, and Z-axis milling applications.
- Feed and speed recommendations are listed on page 68.



NON-FERROUS MATERIAL

Series CXA-2B Long Reach Ball Nose Offering

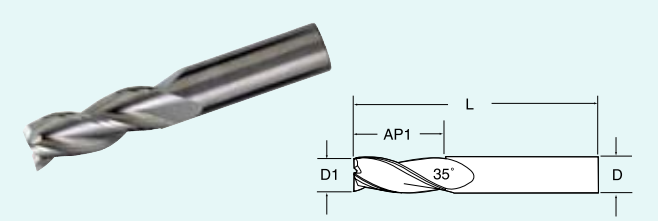
D1 inch	D inch	AP1 inch	LR inch	L inch	Uncoated EDP No.	TiCN Coated EDP No.
1/4	1/4	3/8	2-1/4	4	M30510	M30415
3/8	3/8	1/2	2-1/4	4	M30511	M30424
1/2	1/2	5/8	2-1/4	5	M30512	M30425
5/8	5/8	3/4	2-1/4	5	M30520	M30434
3/4	3/4	1	2-1/4	6	M30521	M30435
3/4	3/4	1	3-1/4	6	M30522	M30444
1	1	1-1/8	2-1/4	6	M30530	M30445
1	1	1-1/8	3-1/4	6	M30531	M30454

Series CA-3

Features

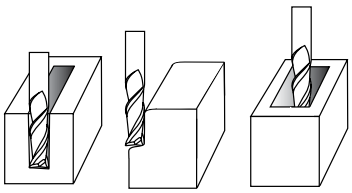
- 3-flute, right-hand helix, right-hand cut
- Center cutting
- Square end
- High rake angle for faster chip flow
- Concentric margins for stability during machining and superior finishes on parts
- Uncoated or TiCN coated standard; other coatings available as a modification

Old Series 500, 545, 550, 555



Applications

- For high-volume metal removal rates and close tolerance slotting.
- Reduces chatter at high spindle speeds.
- Provides excellent surface finishes.
- Feed and speed recommendations are listed on page 68.



NON-FERROUS MATERIAL

Series CA-3 Offering

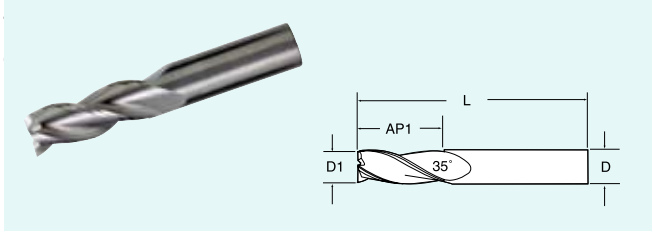
D1 inch	D inch	AP1 inch	L inch	Uncoated EDP No.	TiCN Coated EDP No.
1/8	1/8	1/4	1-1/2	M32290	M31744
1/8	1/8	3/8	1-1/2	M32291	M31745
3/16	3/16	5/16	2	M32292	M31754
3/16	3/16	9/16	2	M32300	M31755
1/4	1/4	3/8	2	M32301	M31764
1/4	1/4	3/4	2-1/2	M32302	M31765
1/4	1/4	1-1/4	3	M32310	M31774
5/16	5/16	7/16	2	M32311	M31775
5/16	5/16	13/16	2-1/2	M32312	M31784
5/16	5/16	1-1/8	4	M32320	M31785
3/8	3/8	1/2	2	M32321	M31794
3/8	3/8	7/8	2-1/2	M32322	M31795
3/8	3/8	1-1/8	3	M32330	M31804
7/16	7/16	9/16	2-1/2	M32331	M31805
7/16	7/16	7/8	2-1/2	M32332	M31815
7/16	7/16	1	2-1/2	M35971	M35214
7/16	7/16	2	4	M32340	M31824
1/2	1/2	5/8	2-1/2	M32341	M31825
1/2	1/2	1	3	M32342	M31834
1/2	1/2	1-1/4	3	M36340	M35335
1/2	1/2	2	4-1/2	M32350	M31835
1/2	1/2	3-1/8	6	M32351	M31844
5/8	5/8	3/4	3	M32352	M31845
5/8	5/8	1-1/4	3-1/2	M32360	M31854
5/8	5/8	1-5/8	4	M36341	M35344
5/8	5/8	2-1/4	5	M32361	M31855
5/8	5/8	3-3/4	6	M32362	M31864
3/4	3/4	1	3	M32370	M31865
3/4	3/4	1-1/2	4	M32371	M31874
3/4	3/4	2-1/4	5	M32372	M31875
3/4	3/4	4	6-1/2	M32380	M31884
1	1	1-1/4	4	M32381	M31885
1	1	1-1/2	4	M32382	M31894
1	1	2-1/4	5	M32390	M31895
1	1	2-5/8	6	M36342	M35345
1	1	3-1/4	6	M36350	M35354

Series CA-3M DIN Metric Sizes

M32391 M31904

Features

- 3-flute, right-hand helix, right-hand cut
- Center cutting
- Square end
- High rake angle for faster chip flow
- Concentric margins for stability during machining and superior finishes on parts
- Uncoated standard; coated tools available as a modification



NON-FERROUS MATERIAL

Applications

- For high-volume metal removal rates and close tolerances where
- DIN metric specifications are required.
- Feed and speed recommendations are listed on page 174.

Series CA-3M DIN Metric Offering

D1 mm	D mm	AP1 mm	L mm	Uncoated EDP No.
3	3	12	38	M32642
4	4	12	50	M32650
5	5	14	50	M32651
6	6	16	50	M32652
8	8	20	63	M32660
10	10	22	76	M32661
12	12	25	76	M32662
14	14	32	83	M32670

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Our value proposition:

The best tool for the job

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A quality product that provides superior performance

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Metal Removal maintains a wide inventory of styles, sizes, lengths, and coatings on the shelf for immediate delivery. Call us first for a stock check, and you'll find what you need.

Highly skilled application, technical, and sales support

From our field applications sales force, to our centralized technical service staff, through our in-plant engineering support, to our customer service team, we can answer your questions, make recommendations, and save you money in your operations.

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A competitive price

Call for a quote. You'll find the best prices in end mills and carbide rounds come from Metal Removal.

MASTERmill™ Carbide Roughers

Put strength, speed, and raw power behind your machining with Metal Removal solid carbide roughers for steel and aluminum. These tools, proven to outperform conventional roughing methods, can raise productivity levels at the spindle and significantly lower production costs.

Made from a unique sub-micron grain carbide substrate, these roughers are designed to provide maximum metal removal rates with minimal chipping. A center cutting design and a special end geometry enable efficient plunging and ramping performance. The unique helix and rake form assure freer cutting and cleaner chip evacuation. Performance is improved by the form-ground eccentric relief that enables better edge strength and increased number of regrinds.

MASTERmill™ Series CRA

Series CRA is designed with a special ground profile, a higher helix, and an appropriate flute form and core diameter for optimum chip evacuation in non-ferrous materials. These cutters provide excellent performance in aluminum, cast aluminum with high silicon content, brass, copper and light alloys.

- 4-flute, square end
- Regular and long lengths
- Uncoated and TiCN-coated styles

MASTERmill™ Series CRS

The unique sinusoidal fine profile and tool geometry provide excellent machinability, and the capability to run machines at much higher spindle speeds than conventional HSS cutters in a wide range of hard materials. Excellent performance is assured on medium to high tensile strength steels, die and mold steels, stainless steels, and high-temperature alloys

- 4-flutes for most roughing applications
- Available in stub and regular lengths
- Available in TiCN or TiAlN coating

MASTERmill™ Series CRS Recommended Speed and Chip Load *(see page 186 for metric recommendations)*

Material	Hardness Brinell	Hardness HRc	Coatings Preferred Coating	Coatings Alternate Coating	Speed Range TIN Low High	Speed Range TICN Low High	Speed Range TiAlN Low High	Chip Load Per Tooth 1/4" - 1/2"	Chip Load Per Tooth 1/2" - 1"
Low and Plain Carbon, Alloy & Tool Steels	< 220 HB	<19	TiCN	TiN/TiAlN	270 360	325 500	430 575	0.0015 - 0.0030	0.0030 - 0.0045
Plain Carbon, Alloy, & Tool Steels	225-286	20-30	TiAlN	TiN/TiCN	180 270	215 375	350 430	0.0015 - 0.0030	0.0030 - 0.0045
Plain Carbon, Alloy, & Tool Steels	294-371	31-40	TiAlN	TiN/TiCN	150 200	180 280	210 320	0.0011 - 0.0021	0.0021 - 0.0032
Austenitic Stainless Steels 200 and 300 Series135-275	135-275	<28	TiAlN	TiN/TiCN	180 315	215 440	250 500	0.0010 - 0.0025	0.0025 - 0.0040
Ferritic, Martensitic 400, 500, & PH Stainless Steels	135-330	<35	TiAlN	TiN/TiCN	160 270	190 375	225 430	0.0015 - 0.0030	0.0030 - 0.0045
Titanium Alloys	300-440	32-43	TiAlN	TiN/TiCN	90 135	110 190	125 215	0.0009 - 0.0018	0.0018 - 0.0027
Nickel-Based High-Temperature Alloys	140-300	<32	TiAlN	TiN/TiCN	45 90	55 125	65 145	0.0009 - 0.0018	0.0018 - 0.0027
Nickel-Based High-Temperature Alloys	300-475	32-50	TiAlN	TiN/TiCN	40 70	50 100	55 110	0.0009 - 0.0018	0.0018 - 0.0027
Cobalt-Based High-Temperature Alloys	150-425	<45	TiAlN	TiN/TiCN	30 45	35 65	45 75	0.0009 - 0.0018	0.0018 - 0.0027

MASTERmill™ Series CRA Recommended Speed and Chip Load *(see page 186 for metric recommendations)*

Material	Coating	Hardness Brinell	Hardness HRc	(SFM)	Speed Range 1/16"	Chip Load Per Tooth 1/8" - 1/4"	Chip Load Per Tooth 1/4" - 1/2"	Chip Load Per Tooth 1/2" - 1"
Low-Silicon Alumunum & Other Non-Ferrous Alloys	TiCN	50-150	600	2000	0.00056	0.0009 - 0.0020	0.0020 - 0.0038	0.0038 - 0.0077
High-Silicon Aluminum	TiCN			600-2000	0.00048	0.0008 - 0.0018	0.0018 - 0.0035	0.0035 - 0.0071

The above speeds and feeds are a recommended starting point only. Ultimate speeds and feeds will depend upon setup conditions, and chip formation. See application notes on page 20.

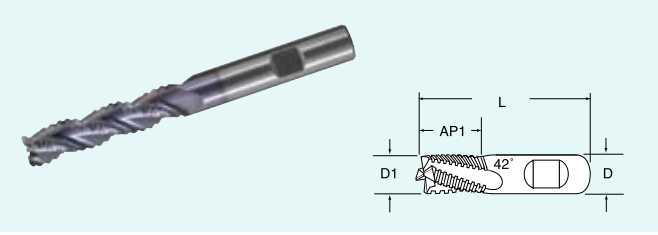
16	16	32	89	M32671
18	18	38	100	M32672
20	20	38	104	M32680

Series CRA

Features

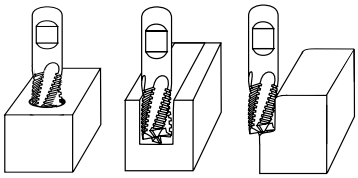
- 3-flute, right-hand helix, right-hand cut
- Center cutting
- Square end
- Extra coarse profile for aluminum
- Uncoated or TiCN coated standard; others available as a modification

Old Series 300, 302



Applications

- For profiling, plunging, and ramping roughing operations.
- Excellent performance in aluminum, high SI cast aluminum, brass, copper, and light alloys.
- Feed and speed recommendations are listed on page 76.



NON-FERROUS MATERIAL

Series CRA Offering

D1 inch	D inch	AP1 inch	L inch	Uncoated EDP No.	TiCN Coated EDP No.
1/4	1/4	3/4	2-1/2	M32392	M31905
5/16	5/16	3/4	2-1/2	M32400	M31914
3/8	3/8	7/8	2-1/2	M32401	M31915
1/2	1/2	1	3	M32402	M31924
1/2	1/2	2	4-1/2	M32410	M31925
5/8	5/8	1-1/4	3-1/2	M32411	M31934
5/8	5/8	2-1/4	5	M32412	M31935
3/4	3/4	1-1/2	4	M32420	M31944

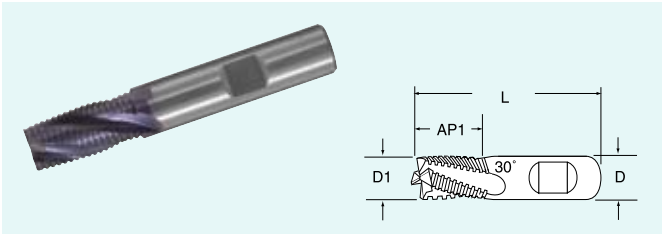
3/4	3/4	2-1/4	5	M32421	M31945
1	1	1-1/2	4	M32422	M31954
1	1	2-1/4	5	M32430	M31955

Series CRS

Features

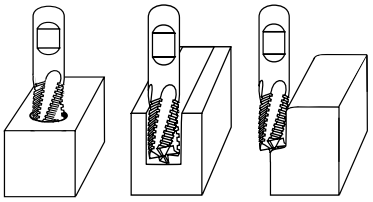
- Multi-flute, right-hand helix, right-hand cut
- Fine profile
- Center cutting
- Square end
- Solid carbide construction
- TiN coated, TiCN coated or TiAlN coated standard; uncoated available as specials

Old Series 304, 306



Applications

- For profiling, plunging, and ramping roughing operations in
- a wide range of hard materials.
- Run at much higher spindle speeds than conventional HSS cutters.
- Excellent performance in medium to high tensile strength steels, die and mold steels, stainless steels, and high-temperature alloys.
- Feed and speed recommendations are listed on page 76.





Series CRS Offering

D1 inch	D inch	AP1 inch	L inch	No. of Flutes	TiN Coated EDP No.	TiCN Coated EDP No.	TiAlN Coated EDP No.
1/4	1/4	1/4	2	3	M32581	M32205	M32116
1/4	1/4	3/4	2-1/2	3	M32582	M32214	M32126
5/16	5/16	13/16	2-1/2	3	M32590	M32215	M32136
3/8	3/8	3/8	2	4	M33672	M33344	M33006
3/8	3/8	7/8	2-1/2	4	M33680	M33345	M33016
1/2	1/2	1/2	2-1/2	4	M33681	M33354	M33026
1/2	1/2	1	3	4	M33682	M33355	M33036
5/8	5/8	5/8	3	4	M33690	M33364	M33046
5/8	5/8	1-1/4	3-1/2	4	M33691	M33365	M33056
3/4	3/4	3/4	3-1/2	4	M33692	M33374	M33066
3/4	3/4	1-1/2	4	4	M33700	M33375	M33076
1	1	1	3-1/2	4	M34601	M33745	M33726
1	1	1	3-1/2	5	M32453	M35385	M36666
1	1	1-1/2	4	4	M34602	M33754	M33736
1	1	1-1/2	4	5	M32463	M35394	M36676

CARBIDE DRILLS & REAMERS





AUTOMOTIVE



AEROSPACE



DIE & MOLD



MEDICAL



MACHINE TOOL INDUSTRY

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Solid Carbide General-Purpose Drills

	Series Number	Page Number
2-Flute, 118° Point, Jobbers Drills	DGJ	85-86
2-Flute, 135° Split Point, Slow Spiral Stub Drills	DSS-ST	87-90
2-Flute, 140° Point, Straight Flute Stub Drills	DSF-ST	91-92

Solid Carbide Special-Application Drills

2-Flute, 118° Point, Spade Drills	DSD-ST	93
2-Flute, 90° or 120° Point, General-Purpose Spotting Drills	DSPT	93

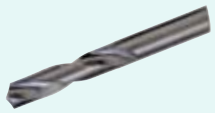
High Performance Drills

2-Flute, 140° HQS Point, Solid Drills	283, 285	98-103
3-Flute, 150° Point, Stub Solid Drills	270	104-106
2-Flute, 135° BT4 Point, Coolant Hole Drills	258	107-108
2-Flute, 140° SE Point, Coolant Hole Drills	D	109-110
2-Flute, 140° HQS Point, Short Coolant Hole Drills	383, 385	111-116
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Conventional Solid Carbide General-Purpose Drills



DGJ 85-86



DSS-ST 87-90



DSF-ST 91-92

Conventional Solid Carbide Special-Application Drills



DSD-ST 93



DSPT 93

High-Performance Drills For Steel and Cast Iron

Without Coolant Holes



283 98-103
285 98-103



270 104-106

With Coolant Holes



258 107-108



D 109-110



383 111-116
385 111-116

More high-performance drills on the next page

See the feature comparison on page 83 for complete descriptions of these tools.

High-Performance Drills For Aluminum and Non-ferrous Materials



Series Number		Page Number
A		117-119

High-Performance Drills For Special Applications











H		120-121
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"ONE SHOT"		129-130

Designed for your specific applications

Technical Contents

	Page Number
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Drill Nomenclature	133-134

Series No.	Through Coolant	Length Group	Point Characteristics	Flute Characteristics	Surface Treatment	Shank Type	For Workpiece Materials
GENERAL-PURPOSE CONVENTIONAL DRILLS							
DGJ	non-coolant	jobbers	118°	2 rhs/rhc	Bright	parallel	non-ferrous alloys, cast irons, and aluminum
SPECIAL-APPLICATION CONVENTIONAL DRILLS							
DSS	non-coolant -ST	stub	135°	2 rhs/rhc self-centering	Bright or	parallel TiN coated	work hardening, titanium, cast iron, and stainless steel
DSF	non-coolant -ST	stub	140°	2 straight flutes	Bright	parallel	hardened materials, stainless steels, and cryogenic alloys
DSD	non-coolant -ST	stub	118°	spade point	Bright	parallel	thin sheet applications/ shallow hole drilling
DSPT	non-coolant	stub	90° or 120°	2 rhs/rhc	Bright	parallel	spotting
HIGH-PERFORMANCE DRILLS FOR STEELS							
283 285	non-coolant	short long	140° 6-facet HQS	2 rhs/rhc	TiAlN	common	hardened steels >30 Rc
270	non-coolant	stub	150° B3S	3 rhs/rhc	Bright or TiN	parallel	low carbon or alloy steels and cast irons
258	coolant	stub jobber	135° BT4	2 rhs/rhc	TiAlN	parallel	medium to hard steels and cast irons
D	coolant	regular	140° SE	2 rhs/rhc	TiN	common	medium to hard steels
383 385	coolant	short long	140° 6-facet HQS	2 rhs/rhc	TiAlN	common	harder steels >30 Rc
HIGH-PERFORMANCE DRILLS FOR ALUMINUMS							
A	non-coolant	regular	130° TF	3 flutes	Bright	common	aluminum alloys, non-ferrous material, cast irons
HIGH-PERFORMANCE DRILLS FOR SPECIALTY APPLICATIONS							
H	coolant	regular	140° SE	2 rhs/rhc	TiN	common	stainless steels and high-temp alloys
295	non-coolant	short	145°	2 rhs/rhc	Bright or TiAlN	comon	spotting
238	coolant	regular	130° 4-facet, TX	2 straight	Bright	common	aluminum alloys and gray cast irons
265	non-coolant	regular	135° BRN	2 parabolic	Bright or TiN	parallel	deep hole drilling in Al-Si, cast irons, steels
ONE SHOT	optional	regular	135° self-centering for tight tolerances	2 flutes	TiN or TiAlN	parallel	for single-pass finished size

Technical Data — GP Drill Speeds & Feeds

(see page 176 for metric recommendations)



Material Group	Drill Series	Recommended Speed* (SFM)	Feed (IPR) Drill Diameter 1/16	1/8	1/4	1/2	3/4	1
Low-Carbon Steel Annealed	235	85-150	.0005	.0010	.0020	.0040	.0050	.0060
	240		.0015	.0030	.0050	.0090	.0100	.0120
Medium Carbon Steel 275-425 BHN	235	65-120	.0005	.0010	.0020	.0030	.0040	.0040
	240		.0010	.0020	.0040	.0080	.0090	.0100
Hardened Steel 48-52 Rc "C"	235	30-90	.0005	.0010	.0020	.0030	.0040	.0040
	240		.0010	.0030	.0030	.0050	.0060	.0070
Stainless Steel Soft 135-275 BHN	235	50-150	.0005	.0005	.0020	.0040	.0050	.0060
	240		.0010	.0030	.0060	.0060	.0080	.0100
Stainless Steel Hard 275-425 BHN	235	30-90	.0005	.0005	.0010	.0015	.0020	.0025
	240		.0010	.0020	.0030	.0040	.0060	.0070
Cast Iron (Soft)120-220 BHN	225	100-300	.0010	.0020	.0040	.0050	.0070	.0090
	235		.0020	.0040	.0080	.0100	.0120	.0140
Cast Iron (Hard) 220-320 BHN	235	60-200	.0015	.0010	.0020	.0030	.0040	.0050
	240		.0020	.0030	.0040	.0070	.0080	.0100
Ductile Iron	235	70-250	.0010	.0020	.0030	.0050	.0060	.0070
	240		.0020	.0040	.0060	.0080	.0090	.0150
Malleable Iron	235	80-250	.0010	.0020	.0030	.0050	.0060	.0070
	240		.0020	.0050	.0060	.0120	.0140	.0150
Aluminum/Aluminum Alloys	225	150-400	.0010	.0020	.0030	.0050	—	—
	240		.0020	.0040	.0070	.0130	—	—
Brass/Bronze	225	100-300	.0005	.0010	.0020	.0040	—	—
	235		.0015	.0030	.0040	.0100	—	—
Copper/Copper Alloys	225	150-400	.0010	.0030	.0050	.0060	—	—
	240		.0030	.0050	.0120	.0140	—	—
Magnesium/Magnesium Alloys	225	200-650	.0015	.0030	.0050	.0080	—	—
	240		.0030	.0070	.0120	.0150	—	—
Plastics–Glass Filled	225	150-300	.0010	.0020	.0030	.0050	—	—
	240		.0020	.0040	.0060	.0120	—	—
Plastics	225	250-600	.0015	.0030	.0040	.0060	—	—
	240		.0030	.0050	.0120	.0160	—	—
High-Temp Alloys–Nickel Base	235	30-90	.0005	.0005	.0010	.0015	.0020	.0025
	240		.0010	.0030	.0040	.0050	.0060	.0070
Monel-High Nickel Steels	235	30-90	.0005	.0005	.0010	.0015	.0020	.0025
	240		.0010	.0020	.0030	.0040	.0050	.0060
Titanium (soft)	235	60-200	.0005	.0020	.0040	.0050	.0060	.0070
	240		.0010	.0030	.0060	.0060	.0080	.0100
Titanium (hard)	235	45-200	.0005	.0010	.0020	.0040	.0040	.0050
	240		.0020	.0040	.0070	.0090	.0100	.0120
Refractory Alloys	235	50-200	.0005	.0005	.0020	.0040	.0050	.0050
	240		.0010	.0030	.0060	.0100	.0120	.0120

*TiN -and TiCN-coated drills may be operated at 50% higher speeds.
TiAlN-coated drills can be operated at 100% higher speeds.

Speeds and feeds for high-performance drills can be found on page 98-129.

General Machining Guidelines

Higher feed and speed values should be favored for softer materials; lower feed and speed values should be used for harder materials.

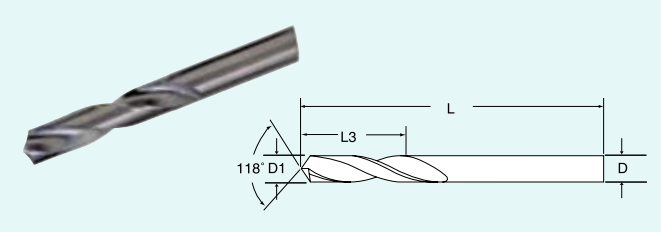
The above recommendations are for hole depths up to 2 drill diameters. When hole depths run 3 to 6 diameters, speeds should be reduced 10% to 35% respectively, and feeds should be reduced 10% to 20%, respectively.

Series DGJ Jobbers

Features

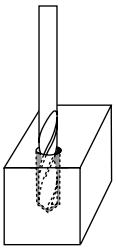
- 2-flute, right-hand spiral, right-hand cut
- 30° Helix
- 118° Point
- Jobbers Length
- Solid carbide construction

Old List # 225



Applications

- For most general-purpose drilling applications.
- Excellent results in highly abrasive materials.
- Feed and speed recommendations are listed on page 84.





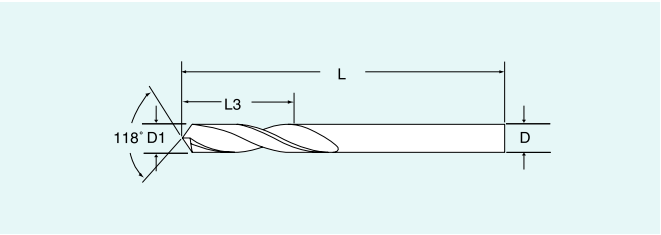
Series DGJ Jobbers Offering

D1/D inch	D1/D mm	D1/D inch	L3	L	Uncoated EDP No.
90		.0087	1/8	1	M43134
89		.0091	1/8	1	M43135
88		.0095	1/8	1	M43136
87		.0100	1/8	1	M43137
86		.0105	1/8	1	M43138
85		.0110	1/8	1	M43139
84		.0115	3/16	1	M43140
83		.0120	3/16	1	M43141
82		.0125	3/16	1	M43142
81		.0130	3/16	1	M43143
80		.0135	1/4	1-1/4	M43144
79		.0145	1/4	1-1/4	M43145
1/64		.0156	1/4	1-1/4	M43146
78		.0160	1/4	1-1/4	M43147
77		.0180	1/4	1-1/4	M43148
76		.0200	1/4	1-1/4	M43149
75		.0210	1/4	1-1/4	M43150
74		.0225	1/4	1-1/4	M43151
73		.0240	1/4	1-1/4	M43152
72		.0250	5/16	1-1/4	M43153
71		.0260	5/16	1-1/4	M43154
70		.0280	5/16	1-1/4	M43155
69		.0292	5/16	1-1/4	M43156
68		.0310	5/16	1-1/4	M43157
1/32		.0312	5/16	1-1/4	M43158
67		.0320	5/16	1-1/4	M43159
66		.0330	5/16	1-1/4	M43160
65		.0350	5/8	1-1/2	M43161
64		.0360	5/8	1-1/2	M43162
63		.0370	5/8	1-1/2	M43163
62		.0380	5/8	1-1/2	M43164
61		.0390	5/8	1-1/2	M43165
	1,00	.0394	15,9	38,1	M43166
60		.0400	5/8	1-1/2	M43167
59		.0410	3/4	1-1/2	M43168
58		.0420	3/4	1-1/2	M43169
57		.0430	3/4	1-1/2	M43170
56		.0465	3/4	1-1/2	M43171

D1/D inch	D1/D mm	D1/D inch	L3	L	Uncoated EDP No.
3/64		.0469	3/4	1-1/2	M43172
55		.0520	3/4	1-1/2	M43173
54		.0550	3/4	1-1/2	M43174
	1,50	.0591	19,1	38,1	M43175
53		.0595	3/4	1-1/2	M43176
1/16		.0625	3/4	1-1/2	M43177
52		.0635	3/4	1-1/2	M43178
51		.0670	3/4	1-1/2	M43179
50		.0700	7/8	1-3/4	M43180
49		.0730	7/8	1-3/4	M43181
48		.0760	7/8	1-3/4	M43182
	2,00	.0767	22,2	44,5	M43183
5/64		.0781	7/8	1-3/4	M43184
47		.0785	7/8	1-3/4	M43185
46		.0810	7/8	1-3/4	M43186
45		.0820	7/8	1-3/4	M43187
44		.0860	1	2	M43188
43		.0890	1	2	M43189
42		.0935	1	2	M43190
3/32		.0938	1	2	M43191
41		.0960	1	2	M43192
40		.0980	1	2	M43193
	2,50	.0984	25,4	50,8	M43194
39		.0995	1-1/4	2-1/4	M43195
38		.1015	1-1/4	2-1/4	M43196
37		.1040	1-1/4	2-1/4	M43197
36		.1065	1-1/4	2-1/4	M43198
7/64		.1094	1-1/4	2-1/4	M43199
35		.1100	1-1/4	2-1/4	M43200
34		.1110	1-1/4	2-1/4	M43201
33		.1130	1-1/4	2-1/4	M43202
32		.1160	1-1/4	2-1/4	M43203
	3,00	.1181	31,8	57,2	M43204
31		.1200	1-1/4	2-1/4	M43205
1/8		.1250	1-1/4	2-1/4	M43206
30		.1285	1-1/4	2-1/4	M43207

continued on next page

(continued) Series DGJ Jobbers



Series DGJ Jobbers Offering (continued)

D1/D inch	D1/D mm	D1/D inch	L3	L	Uncoated EDP No.
29		.1360	1-3/8	2-1/2	M43208
	3,50	.1378	34,9	63,5	M43209
28		.1405	1-3/8	2-1/2	M43210
9/64		.1406	1-3/8	2-1/2	M43211
27		.1440	1-3/8	2-1/2	M43212
26		.1470	1-3/8	2-1/2	M43213
25		.1495	1-3/8	2-1/2	M43214
24		.1520	1-3/8	2-1/2	M43215
23		.1540	1-3/8	2-1/2	M43216
5/32		.1562	1-3/8	2-1/2	M43217
22		.1570	1-3/8	2-1/2	M43218
	4,00	.1575	34,9	63,5	M43219
21		.1590	1-3/8	2-1/2	M43220
20		.1610	1-3/8	2-1/2	M43221
19		.1660	1-5/8	2-3/4	M43222
18		.1695	1-5/8	2-3/4	M43223
11/64		.1719	1-5/8	2-3/4	M43224
17		.1730	1-5/8	2-3/4	M43225
16		.1770	1-5/8	2-3/4	M43226
	4,50	.1772	41,3	69,9	M43227
15		.1800	1-5/8	2-3/4	M43228
14		.1820	1-5/8	2-3/4	M43229
13		.1850	1-5/8	2-3/4	M43230
3/16		.1875	1-5/8	2-3/4	M43231
12		.1890	1-5/8	2-3/4	M43232
11		.1910	1-5/8	2-3/4	M43233
10		.1935	1-5/8	2-3/4	M43234
9		.1960	1-3/4	3	M43235
	5,00	.1969	44,5	76,2	M43236
8		.1990	1-3/4	3	M43237
7		.2010	1-3/4	3	M43238
13/64		.2031	1-3/4	3	M43239
6		.2040	1-3/4	3	M43240
5		.2055	1-3/4	3	M43241
4		.2090	1-3/4	3	M43242
3		.2130	1-3/4	3	M43243
	5,50	.2165	44,5	76,2	M43244
7/32		.2188	1-3/4	3	M43245
2		.2210	1-3/4	3	M43246
1		.2280	1-3/4	3	M43247
A		.2340	2	3-1/4	M43248
15/64		.2344	2	3-1/4	M43249
	6,00	.2362	50,8	82,6	M43250
B		.2380	2	3-1/4	M43251
C		.2420	2	3-1/4	M43252
D		.2460	2	3-1/4	M43253
E /1/4		.2500	2	3-1/4	M43254
	6,50	.2559	50,8	82,6	M43255
F		.2570	2	3-1/4	M43256

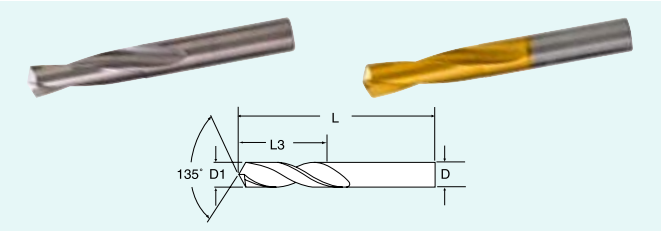
D1/D inch	D1/D mm	D1/D inch	L3	L	Uncoated EDP No.
G		.2610	2-1/8	3-1/2	M43257
17/64		.2656	2-1/8	3-1/2	M43258
H		.2660	2-1/8	3-1/2	M43259
I		.2720	2-1/8	3-1/2	M43260
	7,00	.2756	54,0	88,9	M43261
J		.2770	2-1/8	3-1/2	M43262
K		.2810	2-1/8	3-1/2	M43263
9/32		.2812	2-1/8	3-1/2	M43264
L		.2900	2-1/8	3-1/2	M43265
M		.2950	2-3/8	3-3/4	M43266
	7,50	.2953	60,3	95,3	M43267
19/64		.2969	2-3/8	3-3/4	M43268
N		.3020	2-3/8	3-3/4	M43269
5/16		.3125	2-3/8	3-3/4	M43270
	8,00	.3150	60,3	95,3	M43271
O		.3160	2-3/8	3-3/4	M43272
P		.3230	2-3/8	3-3/4	M43273
21/64		.3281	2-1/2	4	M43274
Q		.3320	2-1/2	4	M43275
	8,50	.3346	63,5	101,6	M43276
R		.3390	2-1/2	4	M43277
11/32		.3438	2-1/2	4	M43278
S		.3480	2-1/2	4	M43279
	9,00	.3543	63,5	101,6	M43280
T		.3580	2-1/2	4	M43281
23/64		.3594	2-1/2	4	M43282
U		.3680	2-3/4	4-1/4	M43283
	9,50	.3740	69,9	108,0	M43284
3/8		.3750	2-3/4	4-1/4	M43285
V		.3770	2.7/8	4-1/4	M43286
W		.3860	2.7/8	4-1/2	M43287
25/64		.3906	2.7/8	4-1/2	M43288
	10,00	.3937	73,0	114,3	M43289
X		.3970	2.7/8	4-1/2	M43290
Y		.4040	2.7/8	4-1/2	M43291
13/32		.4062	2.7/8	4-1/2	M43292
Z		.4130	2.7/8	4-1/2	M43293
	10,50	.4134	73,0	114,3	M43294
27/64		.4219	2.7/8	4-1/2	M43295
	11,00	.4331	73,0	114,3	M43296
7/16		.4375	3	4-1/2	M43297
	11,50	.4528	76,2	120,7	M43298
29/64		.4531	3	4-3/4	M43299
15/32		.4688	3	4-3/4	M43300
	12,00	.4724	76,2	120,7	M43301
31/64		.4844	3	4-3/4	M43302
1/2		.5000	3	4-3/4	M43303

Series DSS-ST Slow Spiral

Features

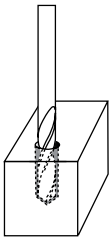
- 2-flute, right-hand spiral, right-hand cut
- 135° modified split point for faster drill penetration
- Slow spiral produces a tight, double-curl chip for excellent chip flow
- Stub length for rigid setups
- Solid carbide construction
- Uncoated standard and TiN coated available standard in selected sizes

Old Series 240, 260



Applications

- Excellent results in work hardening and gummy materials.
- Produces a very close hole size and location, often eliminating a reaming operation.
- Feed and speed recommendations are listed on page 84.



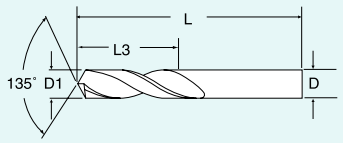


Series DSS-ST Slow Spiral Offering

D1/D inch	D1/D mm	D1/D inch	L3	L	Uncoated EDP No.	TiN Coated EDP No.
	1,00	.0394	12,7	34,9	M43686	
	1,10	.0433	12,7	34,9	M43304	
	1,20	.0472	15,9	34,9	M43305	
	1,30	.0512	15,9	34,9	M43306	
	1,40	.0551	15,9	34,9	M43307	
	1,50	.0591	12,7	38,1	M43308	
53		.0595	1/2	1-1/2	M43309	
1/16		.0625	5/8	1-5/8	M43310	M43690
	1,60	.0630	17,5	42,9	M43311	
52		.0635	11/16	1-11/16	M43312	
	1,70	.0669	17,5	42,9	M43313	
51		.0670	11/16	1-11/16	M43314	
50		.0700	11/16	1-11/16	M43315	
	1,80	.0709	17,5	42,9	M43316	
49		.0730	11/16	1-11/16	M43317	
	1,90	.0748	17.5	42,9	M43318	
48		.0760	11/16	1-11/16	M43319	
	2,00	.0787	19,1	44,5	M43320	
5/64		.0781	11/16	1-11/16	M43321	M43691
47		.0785	3/4	1-3/4	M43322	
46		.0810	3/4	1-3/4	M43323	
45		.0820	3/4	1-3/4	M43324	
	2,10	.0827	19,1	44,5	M43325	
44		.0860	3/4	1-3/4	M43326	
	2,20	.0866	19,1	44,5	M43327	
43		.0890	3/4	1-3/4	M43328	
	2,30	.0906	19,1	44,5	M43329	
42		.0935	3/4	1-3/4	M43330	
3/32		.0938	3/4	1-3/4	M43331	M43692
	2,40	.0945	19,1	44,5	M43332	
41		.0960	13/16	1-13/16	M43333	
40		.0980	13/16	1-13/16	M43334	
	2,50	.0984	20,6	30,2	M43335	
39		.0995	13/16	1-13/16	M43336	
38		.1015	13/16	1-13/16	M43337	
	2,60	.1024	20,6	30,2	M43338	

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(continued) Series DSS-ST Slow Spiral

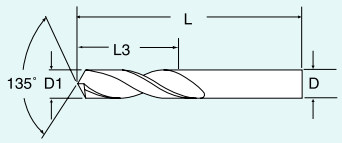


Series DSS-ST Slow Spiral Offering (continued)

D1/D Inch	D1/D Metric	D1/D Decimal	L3	L	Uncoated EDP No.	TiN Coated EDP No.
37		.1040	13/16	1-13/16	M43339	
	2,70	.1063	20,6	30,2	M43340	
36		.1065	13/16	1-13/16	M43341	
7/64		.1094	13/16	1-13/16	M43342	M43693
35		.1100	7/8	1-7/8	M43343	
	2,80	.1102	22,2	47,6	M43344	
34		.1110	7/8	1-7/8	M43345	
33		.1130	7/8	1-7/8	M43346	
	2,90	.1142	22,2	47,6	M43347	
32		.1160	7/8	1-7/8	M43348	
	3,00	.1181	22,2	47,6	M43349	
31		.1200	7/8	1-7/8	M43350	
	3,10	.1220	22,2	47,6	M43351	
1/8		.1250	7/8	1-7/8	M43352	M43694
	3,20	.1260	22,2	47,6	M43353	
30		.1285	15/16	1-15/16	M43354	
	3,30	.1299	23,8	47,6	M43355	
	3,40	.1339	23,8	47,6	M43356	
29		.1360	15/16	1-15/16	M43357	
	3,50	.1378	23,8	47,6	M43358	
28		.1405	15/16	1-15/16	M43359	
9/64		.1406	15/16	1-15/16	M43360	M43695
	3,60	.1417	23,8	47,6	M43361	
27		.1440	1	2-1/16	M43362	
	3,70	.1457	25,4	52,4	M43363	
26		.1470	1	2-1/16	M43364	
25		.1495	1	2-1/16	M43365	
	3,80	.1496	25,4	52,4	M43366	
24		.1520	1	2-1/16	M43367	
	3,90	.1535	25,4	52,4	M43368	
23		.1540	1	2-1/16	M43369	
5/32		.1563	1	2-1/16	M43370	M43696
22		.1570	1-1/16	2-1/8	M43371	
	4,00	.1575	27,0	54,0	M43372	
21		.1590	1-1/16	2-1/8	M43373	
20		.1610	1-1/16	2-1/8	M43374	
	4,10	.1614	27,0	54,0	M43375	
	4,20	.1654	27,0	54,0	M43376	
19		.1660	1-1/16	2-1/8	M43377	
	4,30	.1693	27,0	54,0	M43378	
18		.1695	1-1/16	2-1/8	M43379	
11/64		.1719	1-1/16	2-1/8	M43380	M43697
17		.1730	1-1/8	2-3/16	M43381	
	4,40	.1732	28,6	55,6	M43382	
16		.1770	1-1/8	2-3/16	M43383	
	4,50	.1772	28,6	55,6	M43384	
15		.1800	1-1/8	2-3/16	M43385	

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(continued) Series DSS-ST Slow Spiral

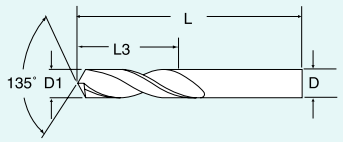


Series DSS-ST Slow Spiral Offering (continued)

D1/D Inch	D1/D mm	D1/D Inch	L3	L	Uncoated EDP No.	TiN Coated EDP No.
	4,60	.1811	28,6	55,6	M43386	
14		.1820	1-1/8	2-3/16	M43387	
13		.1850	1-1/8	2-3/16	M43388	
	4,70	.1850	28,6	55,6	M43389	
3/16		.1875	1-1/8	2-3/16	M43390	M43484
12		.1890	1-3/16	2-1/4	M43391	
	4,80	.1890	30,2	57,2	M43392	
11		.1910	1-3/16	2-1/4	M43393	
	4,90	.1929	30,2	57,2	M43394	
10		.1935	1-3/16	2-1/4	M43395	
9		.1960	1-3/16	2-1/4	M43396	
	5,00	.1969	30,2	57,2	M43397	
8		.1990	1-3/16	2-1/4	M43398	
	5,10	.2008	30,2	57,2	M43399	
7		.2010	1-3/16	2-1/4	M43400	
13/64		.2031	1-3/16	2-1/4	M43401	M43485
6		.2040	1-1/4	2-3/8	M43402	
	5,20	.2047	31,8	60,3	M43403	
5		.2055	1-1/4	2-3/8	M43404	
	5,30	.2087	31,.8	60,3	M43405	
4		.2090	1-1/4	2-3/8	M43406	
	5,40	.2126	31,8	60,3	M43407	
3		.2130	1-1/4	2-3/8	M43408	
	5,50	.2165	31,8	60,3	M43409	
7/32		.2188	1-1/4	2-3/8	M43410	M43486
	5,60	.2205	33,3	61,9	M43411	
2		.2210	1.5/16	2.7/16	M43412	
	5,70	.2244	33,3	61,9	M43413	
1		.2280	1-5/16	2-7/16	M43414	
	5,80	.2283	33,3	61,9	M43415	
	5,90	.2323	33,3	61,9	M43416	
A		.2340	1-5/16	2-7/16	M43417	
15/64		.2344	1-5/16	2-7/16	M43418	M43487
	6,00	.2362	33,3	61,9	M43419	
B		.2380	1-3/8	2-1/2	M43420	
	6,10	.2402	35,0	63,5	M43421	
C		.2420	1-3/8	2-1/2	M43422	
	6,20	.2441	35,0	63,5	M43423	
D		.2460	1-3/8	2-1/2	M43424	
	6,30	.2480	34,9	63,5	M43425	
1/4-E		.2500	1-3/8	2-1/2	M43426	M43488
	6,40	.2520	34,9	63,5	M43427	
	6,50	.2559	34,9	63,5	M43428	
F		.2570	1-7/16	2-5/8	M43429	
	6,60	.2598	36,5	66,7	M43430	
G		.2610	1-7/16	2-5/8	M43431	
	6,70	.2638	36,5	66,7	M43432	
17/64		.2656	1-7/16	2-5/8	M43433	M43489
H		.2660	1-1/2	2-11/16	M43434	

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(continued) Series DSS-ST Slow Spiral



Series DSS-ST Slow Spiral Offering (continued)

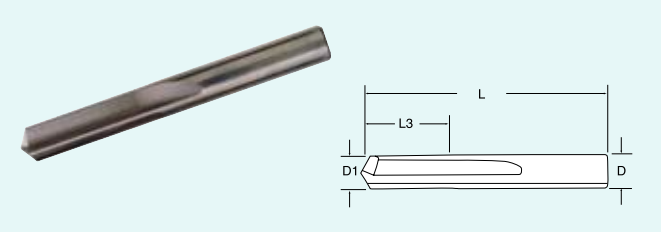
D1/D Inch	D1/D mm	D1/D Inch	L3	L	Uncoated EDP No.	TiN Coated EDP No.
	6,80	.2677	38,1	68,3	M43435	
	6,90	.2717	38,1	68,3	M43436	
I		.2720	1-1/2	2-11/16	M43437	
	7,00	.2756	38,1	68,3	M43438	
J		.2770	1-1/2	2-11/16	M43439	
K		.2810	1-1/2	2-11/16	M43440	
9/32		.2813	1-1/2	2-11/16	M43441	M43490
L		.2900	1-9/16	2-3/4	M43442	
M		.2950	1-9/16	2-3/4	M43443	
	7,50	.2953	39,7	69,9	M43444	
19/64		.2969	1-9/16	2-3/4	M43445	M43491
N		.3020	1-5/8	2-13/16	M43446	
5/16		.3125	1-5/8	2-13/16	M43447	M43492
	8,00	.3150	41,3	71,4	M43448	
O		.3160	1-11/16	2-15/16	M43449	
P		.3230	1-11/16	2-15/16	M43450	
21/64		.3281	1-11/16	2-15/16	M43451	M43493
Q		.3320	1-11/16	3	M43452	
	8,50	.3346	42,9	76,2	M43453	
R		.3390	1-11/16	3	M43454	
11/32		.3438	1-11/16	3	M43455	M43494
S		.3480	1-3/4	3-1/16	M43456	
	9,00	.3543	44,5	77,9	M43457	
T		.3580	1-3/4	3-1/16	M43458	
23/64		.3594	1-3/4	3-1/16	M43459	M43495
U		.3680	1-13/16	3-1/8	M43460	
	9,50	.3740	46,0	79,4	M43461	
3/8		.3750	1-13/16	3-1/8	M43462	M43496
V		.3770	1-7/8	3-1/4	M43463	
W		.3860	1-7/8	3-1/4	M43464	
25/64		.3906	1-7/8	3-1/4	M43465	M43497
	10,00	.3937	47,6	82,6	M43466	
X		.3970	1-15/16	3-5/16	M43467	
Y		.4040	1-15/16	3-5/16	M43468	
13/32		.4063	1-15/16	3-5/16	M43469	M43498
Z		.4130	2	3-3/8	M43470	
	10,50	.4134	50,8	85,7	M43471	
27/64		.4219	2	3-3/8	M43472	M43499
	11,00	.4331	52,4	87,3	M43473	
7/16		.4375	2-1/16	3-7/16	M43474	M43500
	11,50	.4528	54,0	90,5	M43475	
29/64		.4531	2-1/8	3-9/16	M43476	M43501
15/32		.4688	2-1/8	3-5/8	M43477	M43502
	12,00	.4724	54,0	92,1	M43478	
31/64		.4844	2-3/16	3-11/16	M43479	M43503
1/2		.5000	2-1/4	3-3/4	M43480	M43504
9/16		.5625	2-1/2	4	M43481	M43505
5/8		.6250	2-3/4	4-1/4	M43482	M43506
3/4		.7500	3-1/8	5	M43483	M43507

Series DSF-ST Straight Flute Stub

Features

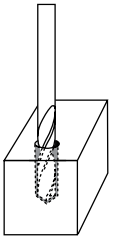
- 2 straight flutes, right-hand cut
- 140° point
- Solid submicron grain carbide construction
- Stub length
- Uncoated drills standard; coated tools available as a modification

Old List # 235



Applications

- The added web strength of the straight flutes and special point configuration easily penetrate work pieces with minimal deflection.
- Use in hardened, treated, and abrasive materials, as well as stainless steel and cryogenic alloys.
- Made for shallow holes and horizontal holes 45 HRc and below.
- Feed and speed recommendations are listed on page 84.



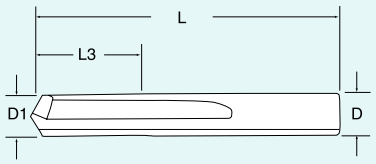


Series DSF-ST Straight Flute Stub Offering

D1/D inch	D1/D mm	D1/D inch	L3	L	Uncoated EDP No.
	1,00	.0394	12,7	38,1	M43508
60		.0400	1/2	1-1/2	M43509
59		.0410	1/2	1-1/2	M43510
58		.0420	1/2	1-1/2	M43511
57		.0430	1/2	1-1/2	M43512
56		.0465	1/2	1-1/2	M43513
3/64		.0469	1/2	1-1/2	M43514
55		.0520	1/2	1-1/2	M43515
54		.0550	1/2	1-1/2	M43516
	1,50	.0591	12,7	38,1	M43517
53		.0595	1/2	1-1/2	M43518
1/16		.0625	5/8	1-5/8	M43519
52		.0635	11/16	1-11/16	M43520
51		.0670	11/16	1-11/16	M43521
50		.0700	11/16	1-11/16	M43522
49		.0730	11/16	1-11/16	M43523
48		.0760	11/16	1-11/16	M43524
	2,00	.0767	19,1	44,5	M43525
5/64		.0781	11/16	1-11/16	M43526
47		.0785	3/4	1-3/4	M43527
46		.0810	3/4	1-3/4	M43528
45		.0820	3/4	1-3/4	M43529
44		.0860	3/4	1-3/4	M43530
43		.0890	3/4	1-3/4	M43531
42		.0935	3/4	1-3/4	M43532
3/32		.0938	3/4	1-3/4	M43533
41		.0960	13/16	1-13/16	M43534
40		.0980	13/16	1-13/16	M43535
	2,50	.0984	20,6	46,0	M43536
39		.0995	13/16	1-13/16	M43537
38		.1015	13/16	1-13/16	M43538
37		.1040	13/16	1-13/16	M43539
36		.1065	13/16	1-13/16	M43540
7/64		.1094	13/16	1-13/16	M43541
35		.1100	7/8	1-7/8	M43542
34		.1110	7/8	1-7/8	M43543
33		.1130	7/8	1-7/8	M43544
32		.1160	7/8	1-7/8	M43545
	3,00	.1181	22,2	47,6	M43546
31		.1200	7/8	1-7/8	M43547
1/8		.1250	7/8	1-7/8	M43548
30		.1285	15/16	1-15/16	M43549
29		.1360	15/16	1-15/16	M43550
	3,50	.1378	23,8	49,2	M43551
28		.1405	15/16	1-15/16	M43552
9/64		.1406	15/16	1-15/16	M43553
27		.1440	1	2-1/16	M43554
26		.1470	1	2-1/16	M43555
25		.1495	1	2-1/16	M43556
24		.1520	1	2-1/16	M43557
23		.1540	1	2-1/16	M43558
5/32		.1563	1	2-1/16	M43559
22		.1570	1-1/16	2-1/8	M43560
	4,00	.1575	27,0	54,0	M43561
21		.1590	1-1/16	2-1/8	M43562
20		.1610	1-1/16	2-1/8	M43563
19		.1660	1-1/16	2-1/8	M43564
18		.1695	1-1/16	2-1/8	M43565
11/64		.1719	1-1/16	2-1/8	M43566
17		.1730	1-1/8	2-3/16	M43567
16		.1770	1-1/8	2-3/16	M43568
	4,50	.1772	28,6	55,6	M43569
15		.1800	1-1/8	2-3/16	M43570
14		.1820	1-1/8	2-3/16	M43571
13		.1850	1-1/8	2-3/16	M43572
3/16		.1875	1-1/8	2-3/16	M43573
12		.1890	1-3/16	2-1/4	M43574
11		.1910	1-3/16	2-1/4	M43575
10		.1935	1-3/16	2-1/4	M43576
9		.1960	1-3/16	2-1/4	M43577
	5,00	.1969	30,2	57,2	M43578
8		.1990	1-3/16	2-1/4	M43579

continued on next page

(continued) Series DSF-ST Straight Flute Stub



Series DSF-ST Straight Flute Stub Offering (continued)

D1/D inch	D1/D mm	D1/D inch	L3	L	Uncoated EDP No.
7		.2010	1-3/16	2-1/4	M43580
13/64		.2031	1-3/16	2-1/4	M43581
6		.2040	1-1/4	2-3/8	M43582
5		.2055	1-1/4	2-3/8	M43583
4		.2090	1-1/4	2-3/8	M43584
3		.2130	1-1/4	2-3/8	M43585
	5,50	.2165	31,8	60,3	M43586
7/32		.2188	1-1/4	2-3/8	M43587
2		.2210	1-5/16	2-7/16	M43588
1		.2280	1-5/16	2-7/16	M43589
A		.2340	1-5/16	2-7/16	M43590
15/64		.2344	1-5/16	2-7/16	M43591
	6,00	.2362	33,3	61,9	M43592
B		.2380	1-3/8	2-1/2	M43593
C		.2420	1-3/8	2-1/2	M43594
D		.2460	1-3/8	2-1/2	M43595
1/4-E		.2500	1-3/8	2-1/2	M43596
	6,50	.2559	34,9	63,5	M43597
F		.2570	1-7/16	2-5/8	M43598
G		.2610	1-7/16	2-5/8	M43599
17/64		.2656	1-7/16	2-5/8	M43600
H		.2660	1-1/2	2-11/16	M43601
I		.2720	1-1/2	2-11/16	M43602
	7.00	.2756	38,1	68,3	M43603
J		.2770	1-1/2	2-11/16	M43604
K		.2810	1-1/2	2-11/16	M43605
9/32		.2813	1-1/2	2-11/16	M43606
L		.2900	1-9/16	2-3/4	M43607
M		.2950	1-9/16	2-3/4	M43608
	7.50	.2953	39,7	69,9	M43609
19/64		.2969	1-9/16	2-3/4	M43610
N		.3020	1-5/8	2-13/16	M43611
5/16		.3125	1-5/8	2-13/16	M43612

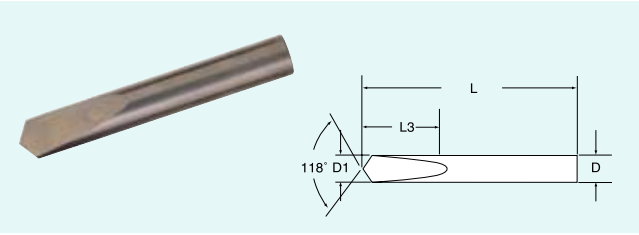
D1/D inch	D1/D mm	D1/D inch	L3	L	Uncoated EDP No.
	8.0	.3150	41,3	71,4	M43613
O		.3160	1-11/16	2.15/16	M43614
P		.3230	1-11/16	2.15/16	M43615
21/64		.3281	1-11/16	2.15/16	M43616
Q		.3320	1-11/16	3	M43617
	8,50	.3346	42,9	76,2	M43618
R		.3390	1-11/16	3	M43619
11/32		.3438	1-11/16	3	M43620
S		.3480	1-3/4	3-1/16	M43621
	9,00	.3543	44,5	77,9	M43622
T		.3580	1-3/4	3-1/16	M43623
23/64		.3594	1-3/4	3-1/16	M43624
U		.3680	1-13/16	3-1/8	M43625
	9,50	.3740	46,0	79,4	M43626
3/8		.3750	1-13/16	3.1/8	M43627
V		.3770	1-7/8	3-1/4	M43628
W		.3860	1-7/8	3-1/4	M43629
25/64		.3906	1-7/8	3-1/4	M43630
	10,00	.3937	47,6	82,6	M43631
X		.3970	1-15/16	3-5/16	M43632
Y		.4040	1-15/16	3-5/16	M43633
13/32		.4063	1-15/16	3-5/16	M43634
Z		.4130	2	3-3/8	M43635
	10,50	.4134	50,8	85,7	M43636
27/64		.4219	2	3-3/8	M43637
	11,00	.4331	52,4	87,3	M43638
7/16		.4375	2-1/16	3.7/16	M43639
	11,50	.4528	54,0	90,5	M43640
29/64		.4531	2-1/8	3-9/16	M43641
15/32		.4688	2-1/8	3-5/8	M43642
	12,00	.4724	54,0	92,1	M43643
31/64		.4844	2-3/16	3-11/16	M43644
1/2		.5000	2-1/4	3-3/4	M43645

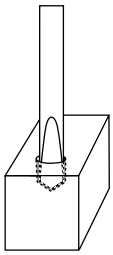
Series DSD-ST Spade Drills

Features

- 2-flute
- 118° point
- Solid carbide construction
- Uncoated drills standard; coated drills available as specials

Old Style 245-00







Applica- tions

- Massive web construction and solid carbide substrate combine for excellent tool life.
- Normally limited to drilling applications not deeper than 2 x Diameter.
- Used for shallow-hole drilling and thin-sheet applications.
- Feed and speed recommendations are listed on page 84.

Series DSD-ST Spade Drill Offering

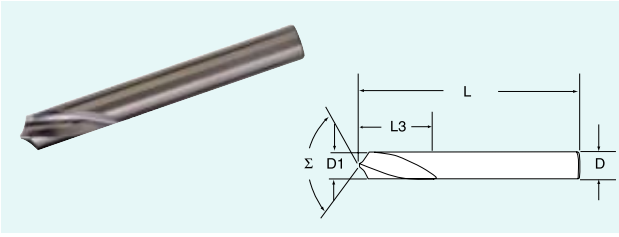
D1/D inch	D1/D inch	L3 inch	L inch	Uncoated EDP No.
1/32	.0313	3/16	1-1/2	M43646
1/16	.0625	5/16	1-1/2	M43647
3/32	.0938	7/16	1-1/2	M43648
1/8	.1250	7/16	1-1/2	M43649
5/32	.1563	15/32	2	M43650
3/16	.1875	9/16	2	M43651
7/32	.2188	19/32	2	M43652
1/4	.2500	11/16	2	M43653
9/32	.2813	3/4	2-1/2	M43654
5/16	.3125	7/8	2-1/2	M43655
11/32	.3438	15/16	2-1/2	M43656
3/8	.3750	1	2-1/2	M43657
13/32	.4063	1	2-1/2	M43658
7/16	.4375	1-1/16	2-1/2	M43659
15/32	.4688	1-1/8	2-1/2	M43660
1/2	.5000	1-1/8	2-1/2	M43661

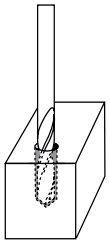
Series DSPT Spotting Drills

Features

- 2-flute, right-hand spiral, right-hand cut
- Available with 90° or 120° point angle
- Solid carbide construction
- Uncoated drills standard; coated drills available as specials

Old Styles 290-10, 292-00







Applications

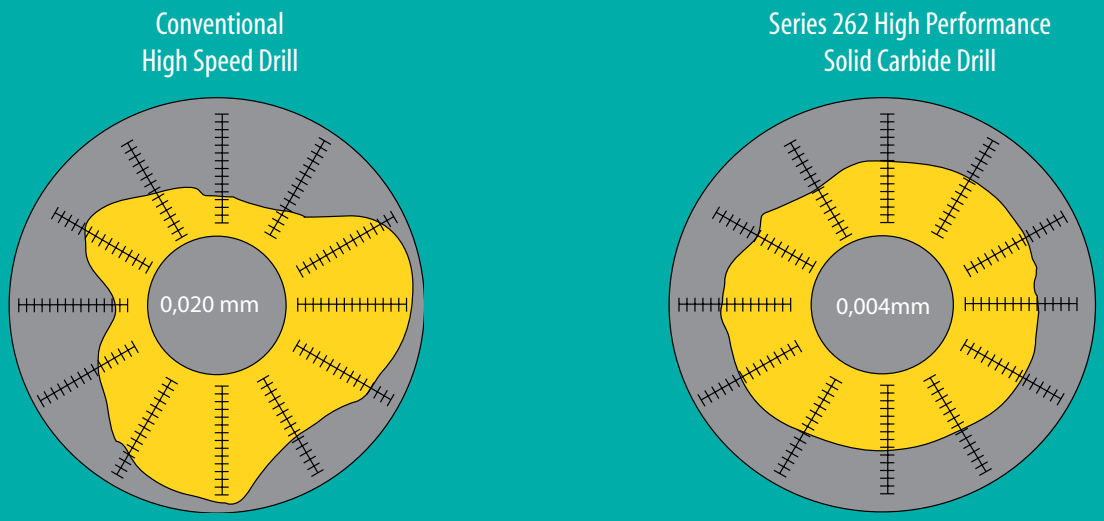
- Designed for use in general-purpose applications in a wide variety of materials.
- Provide true and accurate starting locations when used with precision equipment.
- Feed and speed recommendations are listed on page 84.

Series DSPT Offering

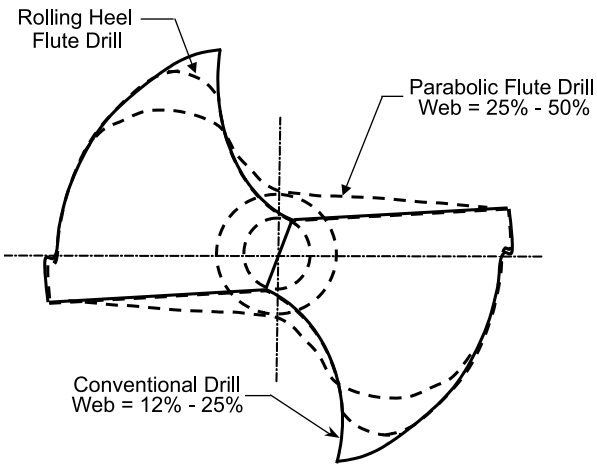
D1/D inch	D1/D inch	L3	L	Σ	Uncoated EDP No.
1/4	.2500	3/4	2-1/2	90°	M43676
1/4	.2500	3/4	2-1/2	120°	M43681
3/8	.3750	7/8	3-1/8	90°	M43677
3/8	.3750	7/8	3-1/8	120°	M43682
1/2	.5000	1-1/8	3-3/4	90°	M43678
1/2	.5000	1-1/8	3-3/4	120°	M43683
5/8	.6250	1-3/16	4-1/4	90°	M43679
5/8	.6250	1-3/16	4-1/4	120°	M43684
3/4	.7500	1-5/16	5	90°	M43680
3/4	.7500	1-5/16	5	120°	M43685

Tech Tip:
When spotting holes for 130-140° point high-performance drills, use Series 295 drills shown on page 122 to provide maximum corner strength.

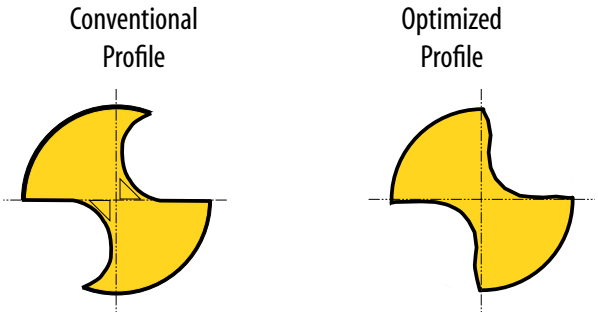
Drilled Hole Quality Comparison



Flute Design Comparison

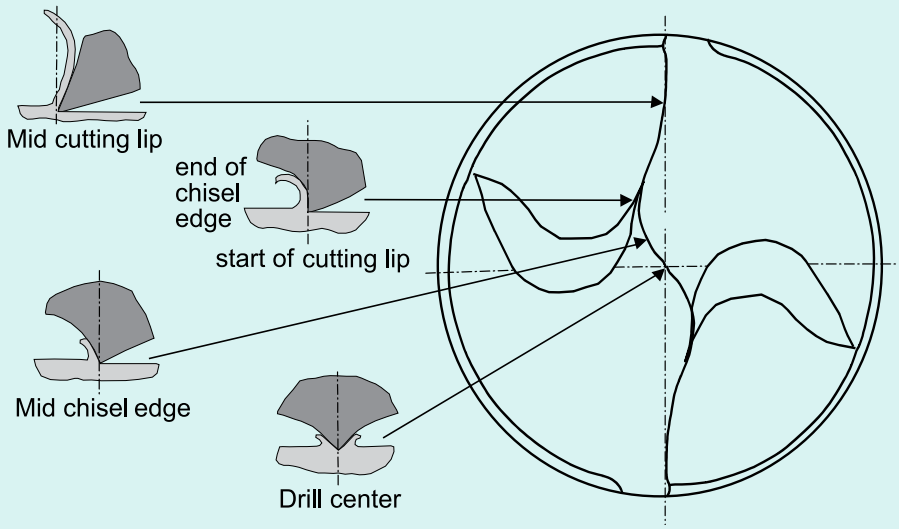


Flute Profile Comparison



- Higher rigidity
- Improved chip flow

Chip Formation Diagram





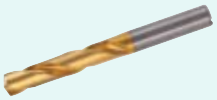
★ **Excellent Performance** ✓ **Great Performance**

Workpiece Material Group	Hardness/ Type	Drill Series 283/ 285	270	257/ 258	D	383/ 385	A	H	238	265	ONE SHOT
low-carbon steels	<220 HB	★	★	★	★	★		✓		★	
free-machining steels	<275 HB	★	★	★	★	★		✓		★	
medium and high plain carbon, alloy and tool steels	<275 HB	★	★	★	★	★		✓		★	
medium and high plain carbon, alloy and tool steels	340-450 HB	★	★	★	★	★		✓		★	★
ferritic, martensitic and PH stainless steels	<330 HB	✓		✓		★		★		✓	
austenitic stainless steels	<135-275 HB	✓		✓		★		★		✓	
ductile (nodular) and malleable cast irons	120-320 HB	★		★	★	★	★		★	★	★
gray cast irons	120-320 HB	★		★	★	★	★		★	★	★
free-machining and low-silicon aluminum alloys	hypoeutectic <12.2% Si	✓		✓		★	★		★	★	
high-silicon aluminum alloys	hypereutectic <12.2% Si	✓		✓		★			✓		
miscellaneous non-ferrous materials	–						★		★	★	
iron-base heat-resistant alloys	135-320 HB	✓				✓		★			
cobalt-base heat-resistant alloys	150-425 HB	✓				✓		★			
nickel-base heat-resistant alloys	140-475 HB	✓				✓		★			
titanium and titanium alloys	110-450 HB	✓				★					
hardened materials	>450 HB	✓		✓	✓	★					

Drills For Steels and Cast Irons Without Coolant Holes

Series Number	Page Number	Applications	Benefits
			
Series 283	98	For harder steels > 30 Rc Series 285 for deep-hole drilling applications Common shanks	HQS self-centering S-point provides superior hole quality.
Series 285	98		
			
Series 270	104	For higher speed drilling in low-carbon and alloy steels and cast iron Parallel shanks	Three flutes provide tight tolerance holes at heavy feed rates.

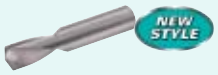
Drills For Steels and Cast Irons With Coolant Holes

		Applications	Benefits
			
Style 258	107	For medium to hard steels and cast irons Style 258 for deep-hole applications Parallel shanks	Combines high performance with economical parallel shanks.
			
Style D	109	For medium to hard steels and cast irons Common shanks	Superior performance in all steels and ductile iron.
			
Style 383	111	For harder steels > 30 Rc Style 385 for deep-hole applications Common shanks	Self-centering S-point provides superior hole quality.
Style 385	111		

Drills For Aluminum and Non-ferrous Materials

	Series Number	Page Number	Applications	Benefits
	Series A	117	For aluminum alloys, non-ferrous materials, titanium, and cast irons Common shanks	Three-flute design provides stability at high feed rates and offers better entering than two-edged drills. Highly wear-resistant carbide grade with lightly honed cutting edges for added edge strength.

For Special Applications

			Applications	Benefits
	Series H	120	For stainless steels, high-alloy steels, and high-temperature alloys Parallel shanks	SE up sharp cutting with sight hone Internal coolant holes
	Series 295	122	For spotting and centering applications Common shanks	145° point angle gives a wider predrilled spot; better centering and contact for following drill. Reduces corner chipping and premature wear in following drill.
	Style 238	123	For aluminum alloys, gray cast iron, and non-ferrous metals Common shanks	TX self-centering point eliminates need for spot drilling. Straight flute configuration gives superior diameter tolerance and hole finish without reaming. Internal coolant holes
	Style 265	126	For steels and cast irons in very deep-hole drilling applications	Drills up to eight diameters deep without pecking.
	"ONE SHOT"	129	For steels, gray cast irons, and ductile iron	Produces flat-bottom holes to reamer tolerances in one pass.

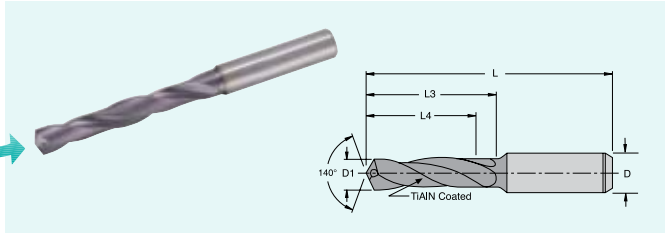
Series 283, 285

NEW STYLE

Features

- 2-flute, right-hand spiral, right-hand cut
- HQS Point –140° 6-facet "S" gash with 6 mm and above
- 283 short DIN 6537 length
- 285 long DIN 6537 length
- Common shanks
- No through coolant (see Series 383, 385, pages 111-116, for the same drill with through coolant)
- TiAlN coated standard; TiN coating available as a modification

HQS Drill Point



Applications

- Series 283 drills up to 3 x diameter; Series 285 drills up to 5 x diameter.
- Self-centering HQS point produces superior hole quality.
- Use in hardened steels > 30 Rc.
- Use hydraulic holders or precision collets.
- Use in applications where through coolant is not required; for the same drill with through coolant, see Series 383 or 385, pages 111-116.

HIGH-TEMP ALLOYS CAST IRON

Performance Results

Series 283 performance test

Tool Diameter: 5,0 mm • Hole Depth: 15 mm • External Coolant

Material:	AISI H-13	AISI P-20; 54 HRc
Cutting Speed:	267 (FTR)	100 (FTR)
Feed Per Revolution:	0,075 mm	0,075 mm
Tool Life:	1497 holes	998 holes

Recommended Speeds and Feeds: Series 283, 285 *(see page 177 for metric recommendations)*

Material	Hardness	Speed (SFM) TiAlN Coated	Feed (ipr) .125" (3 mm)	.250" (6 mm)	.375" (10 mm)	.500" (13 mm)	.625" (16 mm)	.750" (19 mm)
Alloyed Steel								
4340, 52100	<= 28-32 Rc	190-225	0.0026	0.0043	0.0072	0.0090	0.0099	0.0109
8620, 4104	<= 42 Rc	140-145	0.0020	0.0034	0.0056	0.0070	0.0077	0.0085
Mold Steel								
P-20, h-13, 180	180-320 BHN	190-225	0.0029	0.0048	0.0080	0.0100	0.0110	0.0121
D2, A2, S-5	220-250 BHN	85-105	0.0017	0.0029	0.0048	0.0060	0.0066	0.0073
	50+ Rc	50-60	0.0012	0.0019	0.0032	0.0040	0.0044	0.0048
Iron								
Gray CI 30, G25	150-220 BHN	190-450	0.0058	0.0096	0.0160	0.0200	0.0220	0.0242
Ductile	220-250 BHN	150-300	0.0035	0.0058	0.0096	0.0120	0.0132	0.0145
Nodular	251-320 BHN	165-250	0.0023	0.0038	0.0064	0.0080	0.0088	0.0097
Stainless Steels								
Free 303, 420, 416	< 330 HB <=40 HRc	200-260	0.0023	0.0038	0.0064	0.0080	0.0088	0.0097
Tough 316, 304, 15-5,13-8, 17-4	330-450 BHN, 36-48 HRc	160-195	0.0017	0.0029	0.0048	0.0060	0.0066	0.0073
Titanium Alloys	110-450 HB							
Ti-6Al 4V, 6A16V	<= 48 HRc	90-115	0.0017	0.0029	0.0048	0.0060	0.0066	0.0073
Nickel Alloys								
718, Inconel, Rene, Nimonic, Waspalloy	140-475 HB <= 48 HRc	55-80	0.0012	0.0019	0.0032	0.0040	0.0044	0.0048

Higher feed and speed values should be favored for softer material; lower feed and speed values should be used for harder materials. These recommendations should be considered only as a starting point. Ultimate speeds and feeds will depend upon setup conditions and chip formation. The above recommendations are for drilling a hole 2 x diameter deep. For other depths, multiply feed rate from above as follows:

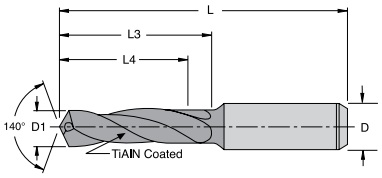
Drilling Depth (N x Diameter):	1	2	3	4	5
Multiplier:	1.2	1.0	0.9	0.75	0.65

Series 283, 285 – Without Coolant Hole

NEW STYLE

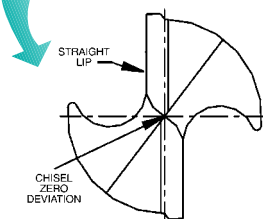
D1 inch	D1 mm	D1 inch	D2	L	L3	L4	TiAlN Coated EDP No.
—	3,0	.1181	6	62	20	14	M12463
—	3,0	.1181	6	66	28	23	M10006
—	3,1	.1220	6	62	20	14	M12473
—	3,1	.1220	6	66	28	23	M10016
1/8	—	.1250	3/16	2.600	.910	.375	M12483
1/8	—	.1250	3/16	2.910	1.060	.625	M10026
—	3,2	.1260	6	62	20	14	M12493
—	3,2	.1260	6	66	28	23	M10036
—	3,3	.1299	6	62	20	14	M12503
—	3,3	.1299	6	66	28	23	M10046
—	3,4	.1339	6	62	20	14	M12513
—	3,4	.1339	6	66	28	23	M10056
—	3,5	.1378	6	62	20	14	M12523
—	3,5	.1378	6	66	28	23	M10066
—	3,6	.1417	6	62	20	14	M12533
—	3,6	.1417	6	66	28	23	M10076
—	3,7	.1457	6	66	24	14	M12543
—	3,7	.1457	6	66	28	23	M10086
25	3,8	.1496	6	66	24	17	M12553
25	3,8	.1496	6	74	36	29	M10096
—	3,9	.1535	6	66	24	17	M12563
—	3,9	.1535	6	74	36	29	M10106
5/32	—	.1563	3/16	2.600	.910	.469	M12573
5/32	—	.1563	3/16	2.910	1.060	.781	M10116
—	4,0	.1575	6	66	24	17	M12583
—	4,0	.1575	6	74	36	29	M10126
—	4,1	.1614	6	66	24	17	M12593
—	4,1	.1614	6	74	36	29	M10136
—	4,2	.1654	6	66	24	17	M12603
—	4,2	.1654	6	74	36	29	M10146
18	4,3	.1693	6	66	24	17	M12613
18	4,3	.1693	6	74	36	29	M10156
17	4,4	.1732	6	66	24	17	M12623
17	4,4	.1732	6	74	36	29	M10166
16	4,5	.1772	6	66	24	17	M12633
16	4,5	.1772	6	74	36	29	M10176
—	4,6	.1811	6	66	24	17	M12643
—	4,6	.1811	6	74	36	29	M10186
13	4,7	.1850	6	66	24	17	M12653
13	4,7	.1850	6	82	44	35	M10196
3/16	—	.1875	3/16	2.600	1.140	.563	M12663
3/16	—	.1875	3/16	2.910	1.380	.938	M10206
12	4,8	.1890	6	66	28	20	M12673
12	4,8	.1890	6	82	44	35	M10216
—	4,9	.1929	6	66	28	20	M12683
—	4,9	.1929	6	82	44	35	M10226
—	5,0	.1969	6	66	28	20	M12693
—	5,0	.1969	6	82	44	35	M10236
7	5,1	.2008	6	66	28	20	M12703
7	5,1	.2008	6	82	44	35	M10246
13/64	—	.2031	1/4	2.910	1.340	.656	M12713
13/64	—	.2031	1/4	3.230	1.690	1.094	M10256
—	5,2	.2047	6	66	28	20	M12723
—	5,2	.2047	6	82	44	35	M10266
4	5,3	.2087	6	66	28	20	M12733
4	5,3	.2087	6	82	44	35	M10276
—	5,4	.2126	6	66	28	20	M12743
—	5,4	.2126	6	82	44	35	M10286

continued on next page



HIGH-TEMP ALLOYS CAST IRON

HQS Drill Point



Tolerances

Inch Sizes

D1	tolerance m7
>.1181 to .2362	.0002/.0006
>.2362 to .3937	.0002/.0008
>.3937 to .7087	.0003/.0010
>.7087 to .7500	.0003/.0011

D	tolerance h6
.1875	.0000/-.0003
.2500 to .6875	.0000/-.0004
.7500	.0000/-.0005

Metric Sizes

D1	tolerance m7
3	0,002/0,012
>3 to 6	0,004/0,016
>6 to 10	0,006/0,021
>10 to 18	0,007/0,025
>18 to 20	0,008/0,029

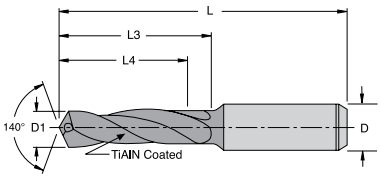
D	tolerance h6
6	0,000/-0,008
8 to 10	0,000/-0,009
12 to 18	0,000/-0,011
20	0,000/-0,013

Series 283, 285 – Without Coolant Holes (continued)

NEW STYLE

D1 inch	D1 mm	D1 inch	D	L	L3	L4	TiAlN Coated EDP No.
3	—	.2130	1/4	2.910	1.340	.656	M12753
3	—	.2130	1/4	3.230	1.690	1.094	M10296
—	5,5	.2165	6	66	28	20	M12763
—	5,5	.2165	6	82	44	35	M10306
7/32	—	.2188	1/4	2.910	1.340	.656	M12773
7/32	—	.2188	1/4	3.230	1.690	1.094	M10316
—	5,6	.2205	6	66	28	20	M12783
—	5,6	.2205	6	82	44	35	M10326
—	5,7	.2244	6	66	28	20	M12793
—	5,7	.2244	6	82	44	35	M10336
1	5,8	.2283	6	66	28	20	M12803
1	5,8	.2283	6	82	44	35	M10346
—	5,9	.2323	6	66	28	20	M12813
—	5,9	.2323	6	82	44	35	M10356
A	—	.2340	1/4	2.910	1.340	.750	M12823
A	—	.2340	1/4	3.230	1.690	1.250	M10366
—	6,0	.2362	6	66	28	20	M12833
—	6,0	.2362	6	82	44	35	M10376
—	6,1	.2402	8	79	34	24	M12843
—	6,1	.2402	8	91	53	43	M10386
—	6,2	.2441	8	79	34	24	M12853
—	6,2	.2441	8	91	53	43	M10396
D	—	.2460	1/4	2.910	1.340	.750	M12863
D	—	.2460	1/4	3.230	1.690	1.250	M10406
—	6,3	.2480	8	79	34	24	M12873
—	6,3	.2480	8	91	53	43	M10416
1/4 - E	—	.2500	1/4	2.910	1.340	.750	M12883
1/4 - E	—	.2500	1/4	3.230	1.690	1.250	M10426
—	6,4	.2520	8	79	34	24	M12893
—	6,4	.2520	8	91	53	43	M10436
—	6,5	.2559	8	79	34	24	M12903
—	6,5	.2559	8	91	53	43	M10446
F	—	.2570	5/16	3.110	1.500	.797	M12913
F	—	.2570	5/16	3.580	1.970	1.328	M10456
—	6,6	.2598	8	79	34	24	M12923
—	6,6	.2598	8	91	53	43	M10466
—	6,7	.2638	8	79	34	24	M12933
—	6,7	.2638	8	91	53	43	M10476
17/64	—	.2656	5/16	3.110	1.500	.797	M12943
17/64	—	.2656	5/16	3.580	1.970	1.328	M10486
—	6,8	.2677	8	79	34	24	M12953
—	6,8	.2677	8	91	53	43	M10496
I	6,9	.2717	8	79	34	24	M12963
I	6,9	.2717	8	91	53	43	M10506
—	7,0	.2756	8	79	34	24	M12973
—	7,0	.2756	8	91	53	43	M10516
—	7,1	.2795	8	79	41	29	M12983
—	7,1	.2795	8	91	53	43	M10526
9/32	—	.2810	5/16	3.110	1.500	.844	M12993
9/32	—	.2810	5/16	3.580	1.970	1.406	M10536
—	7,2	.2835	8	79	41	29	M13003
—	7,2	.2835	8	91	53	43	M10546
—	7,3	.2874	8	79	41	29	M13013
—	7,3	.2874	8	91	53	43	M10556
—	7,4	.2913	8	79	41	29	M13023
—	7,4	.2913	8	91	53	43	M10566
M	7,5	.2953	8	79	41	29	M13033
M	7,5	.2953	8	91	53	43	M10576

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HIGH-TEMP ALLOYS

CAST IRON

Tech Tip:

For optimum performance, set at .0008" of runout.

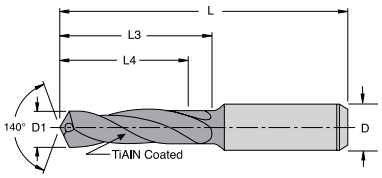
Use hydraulic holders or precision collets.

Speed and feed reductions will increase cut time, while increases to speeds and feeds will reduce tool life.

Series 283, 285 – Without Coolant Holes (continued)

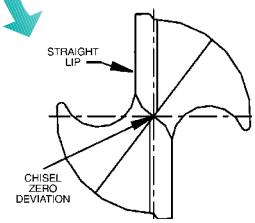
NEW STYLE

D1 inch	D1 mm	D1 inch	D	L	L3	L4	TiAlN Coated EDP No.
19/64	—	.2969	5/16	3.110	1.500	.891	M13043
19/64	—	.2969	5/16	3.580	1.970	1.563	M10586
—	7,6	.2992	8	79	41	29	M13053
—	7,6	.2992	8	91	53	43	M10596
—	7,7	.3031	8	79	41	29	M13063
—	7,7	.3031	8	91	53	43	M10606
—	7,8	.3071	8	79	41	29	M13073
—	7,8	.3071	8	91	53	43	M10616
—	7,9	.3110	8	79	41	29	M13083
—	7,9	.3110	8	91	53	43	M10626
5/16	—	.3125	5/16	3.110	1.500	.938	M13093
5/16	—	.3125	5/16	3.580	1.970	1.563	M10636
—	8,0	.3150	8	79	41	29	M13103
—	8,0	.3150	8	91	53	43	M10646
—	8,1	.3189	10	89	47	35	M13113
—	8,1	.3189	10	103	61	49	M10656
P	8,2	.3228	10	89	47	35	M13123
P	8,2	.3228	10	103	61	49	M10666
—	8,3	.3268	10	89	47	35	M13133
—	8,3	.3268	10	103	61	49	M10676
21/64	—	.3281	3/8	3.500	1.810	.984	M13143
21/64	—	.3281	3/8	4.050	2.360	1.641	M10686
—	8,4	.3307	10	89	47	35	M13153
—	8,4	.3307	10	103	61	49	M10696
Q	—	.3320	3/8	3.500	1.810	1.030	M13163
Q	—	.3320	3/8	4.050	2.360	1.719	M10706
—	8,5	.3346	10	89	47	35	M13173
—	8,5	.3346	10	103	61	49	M10716
—	8,6	.3386	10	89	47	35	M13183
—	8,6	.3386	10	103	61	49	M10726
—	8,7	.3425	10	89	47	35	M13193
—	8,7	.3425	10	103	61	49	M10736
11/32	—	.3438	3/8	3.500	1.810	1.030	M13203
11/32	—	.3438	3/8	4.050	2.360	1.719	M10746
—	8,8	.3465	10	89	47	35	M13213
—	8,8	.3465	10	103	61	49	M10756
—	8,9	.3504	10	89	47	35	M13223
—	8,9	.3504	10	103	61	49	M10766
—	9,0	.3543	10	89	47	35	M13233
—	9,0	.3543	10	103	61	49	M10776
T	9,1	.3583	10	89	47	35	M13243
T	9,1	.3583	10	103	61	49	M10786
23/64	—	.3594	3/8	3.500	1.810	1.080	M13253
23/64	—	.3594	3/8	4.050	2.360	1.797	M10796
—	9,2	.3622	10	89	47	35	M13263
—	9,2	.3622	10	103	61	49	M10806
—	9,3	.3661	10	89	47	35	M13273
—	9,3	.3661	10	103	61	49	M10816
U	—	.3680	3/8	3.500	1.810	1.125	M13283
U	—	.3680	3/8	4.050	2.360	1.875	M10826
—	9,4	.3701	10	89	47	35	M13293
—	9,4	.3701	10	103	61	49	M10836
—	9,5	.3740	10	89	47	35	M13303
—	9,5	.3740	10	103	61	49	M10846
3/8	—	.3750	3/8	3.500	1.810	1.125	M13313
3/8	—	.3750	3/8	4.050	2.360	1.875	M10856
—	9,6	.3780	10	89	47	35	M13323
—	9,6	.3780	10	103	61	49	M10866



HIGH-TEMP ALLOYS CAST IRON

HQS Drill Point

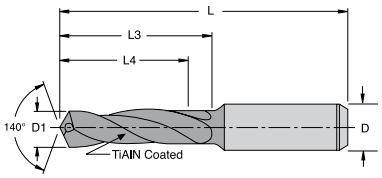


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Series 283, 285 – Without Coolant Holes (continued)

NEW STYLE

D1 inch	D1 mm	D1 inch	D	L	L3	L4	TiAlN Coated EDP No.
—	9,7	.3819	10	89	47	35	M13333
—	9,7	.3819	10	103	61	49	M10876
W	9,8	.3858	10	89	47	35	M13343
W	9,8	.3858	10	103	61	49	M10886
—	9,9	.3898	10	89	47	35	M13353
—	9,9	.3898	10	103	61	49	M10896
25/64	—	.3906	7/16	3.780	2.010	1.172	M13363
25/64	—	.3906	7/16	4.370	2.600	1.953	M10906
—	10,0	.3937	10	89	47	35	M13373
—	10,0	.3937	10	103	61	49	M10916
—	10,1	.3976	12	102	55	40	M13383
—	10,1	.3976	12	118	71	56	M10926
—	10,2	.4016	12	102	55	40	M13393
—	10,2	.4016	12	118	71	56	M10936
—	10,3	.4055	12	102	55	40	M13403
—	10,3	.4055	12	118	71	56	M10946
13/32	—	.4063	7/16	3.780	2.010	1.219	M13413
13/32	—	.4063	7/16	4.370	2.600	2.031	M10956
—	10,4	.4094	12	102	55	40	M13423
—	10,4	.4094	12	118	71	56	M10966
—	10,5	.4134	12	102	55	40	M13433
—	10,5	.4134	12	118	71	56	M10976
—	10,6	.4173	12	102	55	40	M13443
—	10,6	.4173	12	118	71	56	M10986
—	10,7	.4213	12	102	55	40	M13453
—	10,7	.4213	12	118	71	56	M10996
27/64	—	.4219	7/16	3.780	2.010	1.270	M13463
27/64	—	.4219	7/16	4.370	2.600	2.109	M11006
—	10,8	.4252	12	102	55	40	M13473
—	10,8	.4252	12	118	71	56	M11016
—	10,9	.4291	12	102	55	40	M13483
—	10,9	.4291	12	118	71	56	M11026
—	11,0	.4331	12	102	55	40	M13493
—	11,0	.4331	12	118	71	56	M11036
—	11,1	.4370	12	102	55	40	M13503
—	11,1	.4370	12	118	71	56	M11046
7/16	—	.4375	7/16	3.780	2.010	1.310	M13513
7/16	—	.4375	7/16	4.370	2.600	2.188	M11056
—	11,2	.4409	12	102	55	40	M13523
—	11,2	.4409	12	118	71	56	M11066
—	11,3	.4449	12	102	55	40	M13533
—	11,3	.4449	12	118	71	56	M11076
—	11,4	.4488	12	102	55	40	M13543
—	11,4	.4488	12	118	71	56	M11086
—	11,5	.4528	12	102	55	40	M13553
—	11,5	.4528	12	118	71	56	M11096
29/64	—	.4531	1/2	4.010	2.130	1.360	M13563
29/64	—	.4531	1/2	4.640	2.750	2.267	M11106
—	11,6	.4567	12	102	55	40	M13573
—	11,6	.4567	12	118	71	56	M11116
—	11,7	.4606	12	102	55	40	M13583
—	11,7	.4606	12	118	71	56	M11126
—	11,8	.4646	12	102	55	40	M13593
—	11,8	.4646	12	118	71	56	M11136
—	11,9	.4685	12	102	55	40	M13603
—	11,9	.4685	12	118	71	56	M11146
15/32	—	.4688	1/2	4.010	2.130	1.410	M13613
15/32	—	.4688	1/2	4.640	2.750	2.348	M11156
—	12,0	.4724	12	102	55	40	M13623



HIGH-TEMP ALLOYS

CAST IRON

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Tech Tip:

Self-centering HQS point produces superior hole quality and exceptional tool life.

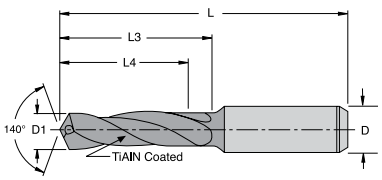
Available with coolant holes: see series 383 and 385 on page 111.

Drill up to 62 HRc.

Series 283, 285 – Without Coolant Holes (continued)

NEW STYLE

D1 inch	D1 mm	D1 inch	D	L	L3	L4	TiAlN Coated EDP No.
—	12,0	.4724	12	118	71	56	M11166
31/64	12,3	.4843	1/2	4.010	2.130	1.453	M13633
31/64	12,3	.4843	1/2	4.640	2.750	2.422	M11176
—	12,5	.4921	14	107	60	43	M13643
—	12,5	.4921	14	124	77	60	M11186
1/2	—	.5000	1/2	4.010	2.130	1.500	M13653
1/2	—	.5000	1/2	4.640	2.750	2.500	M11196
—	12,8	.5039	14	107	60	43	M13663
—	13,0	.5118	14	107	60	43	M13673
—	13,0	.5118	14	124	77	60	M11206
—	13,5	.5315	14	107	60	43	M13683
—	13,5	.5315	14	124	77	60	M11216
—	13,8	.5433	14	107	60	43	M13693
—	14,0	.5512	14	107	60	43	M13703
—	14,0	.5512	14	124	77	60	M11226
9/16	—	.5625	9/16	4.210	2.320	1.688	M13713
9/16	—	.5625	9/16	4.880	2.990	2.813	M11236
—	14,5	.5709	16	115	65	45	M13723
—	14,5	.5709	16	133	83	63	M11246
—	14,8	.5827	16	115	65	45	M13733
—	15,0	.5906	16	115	65	45	M13743
—	15,0	.5906	16	133	83	63	M11256
—	15,5	.6102	16	115	65	45	M13753
—	15,5	.6102	16	133	83	63	M11266
—	15,8	.6220	16	115	65	45	M13763
5/8	—	.6250	5/8	4.520	2.520	1.875	M13773
5/8	—	.6250	5/8	5.230	3.230	3.130	M11276
—	16,0	.6299	16	115	65	45	M13783
—	16,0	.6299	16	133	83	63	M11286
—	16,5	.6496	18	123	73	51	M13793
—	16,5	.6496	18	143	93	71	M11296
—	17,0	.6693	18	123	73	51	M13803
—	17,0	.6693	18	143	93	71	M11306
11/16	—	.6875	11/16	4.840	2.830	2.063	M13813
11/16	—	.6875	11/16	5.630	3.620	3.438	M11316
—	17,5	.6890	18	123	73	51	M13823
—	17,5	.6890	18	143	93	71	M11326
—	18,0	.7087	18	123	73	51	M13833
—	18,0	.7087	18	143	93	71	M11336
—	18,5	.7283	20	131	79	55	M13843
—	18,5	.7283	20	153	101	77	M11346
—	19,0	.7480	20	131	79	55	M13853
—	19,0	.7480	20	153	101	77	M11356
3/4	—	.7500	3/4	5.080	2.990	2.250	M13863
3/4	—	.7500	3/4	5.820	3.740	3.750	M11366
—	19,5	.7677	20	131	79	55	M13873
—	19,5	.7677	20	153	101	77	M11376
—	20,0	.7874	20	131	79	55	M13883
—	20,0	.7874	20	153	101	77	M11386



HIGH-TEMP ALLOYS
CAST IRON

Tolerances

Inch Sizes

D1	tolerance m7
>.1181 to .2362	.0002/.0006
>.2362 to .3937	.0002/.0008
>.3937 to .7087	.0003/.0010
>.7087 to .7500	.0003/.0011

D	tolerance h6
.1875	-.0003/.0000
.2500 to .6875	-.0004/.0000
.7500	-.0005/.0000

Metric Sizes

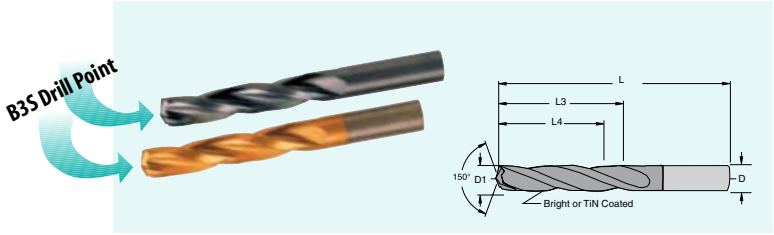
D1	tolerance m7
3	0,002/0,012
>3 to 6	0,004/0,016
>6 to 10	0,006/0,021
>10 to 18	0,007/0,025
>18 to 20	0,008/0,029

D	tolerance h6
6	-0,008/0,000
8 to 10	-0,009/0,000
12 to 18	-0,011/0,000
20	-0,013/0,000

Series 270

Features

- 3-flute, right-hand spiral, right-hand cut
- B3S point–150° self-centering, low rake, notched
- Stub DIN 1897 length
- Parallel shanks
- Bright or TiN coated standard; other coatings available as a modification



Applications

- Three flutes provide tight tolerance holes at heavy feed rates.
- Specially designed for higher speed drilling in low-carbon steel, alloy steel, and cast iron.
- Use in applications up to 2 x diameter.
- Use in applications that do not require internal coolant.
- TiN coating reduces abrasion and enhances tool life.

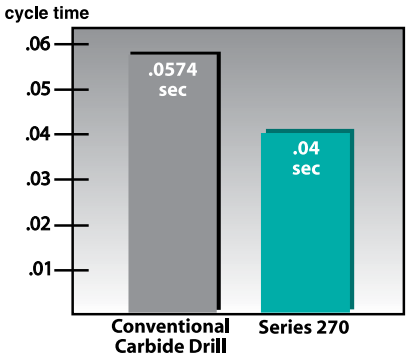
STEEL

Performance Comparison

Series 270 versus conventional carbide drill

Material: low-carbon 1018 steel
Tool Diameter: 1/2"
Hole Depth: 1"

	Series 270 Drill	Conventional Drill
Cutting Speed:	325 SFM	325 SFM
	2483 RPM	2483 RPM
Feed Rate:	.010 IPR	.007 IPR
	24.8 IPM	17.4 IPM
Cycle Time:	0.04	0.0574



Metal Removal Series 270 reduced cycle time by 44%!

Recommended Speeds and Feeds: Series 270 *(see page 177 for metric recommendations)*

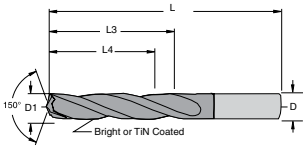
Workpiece Material	BHN	Cutting Speeds (sfm)	Feeds .125" (3 mm)	.250" (6 mm)	.375" (10 mm)	.500" (13 mm)	.625" (16 mm)	.750" (19 mm)
Alloy Steel, including	<230	200-325	0.002	0.004	0.006	0.008	0.009	0.010
low-carbon and	230-300	200-260	0.002	0.004	0.006	0.008	0.009	0.010
medium-carbon	300-426	130-260	0.002	0.003	0.005	0.006	0.007	0.009
Cast iron	—	200-350	0.003	0.005	0.007	0.009	0.010	0.012

These recommendations are for hole depths up to 2 drill diameters. On deeper holes, speeds and feeds should be reduced 10% to 20%. Higher feed and speed values should be favored for softer material; lower feed and speed values should be used for harder materials. These recommendations should be considered only as a starting point. Ultimate speeds and feeds will depend upon setup conditions and chip formation.

Series 270 – Without Coolant Holes

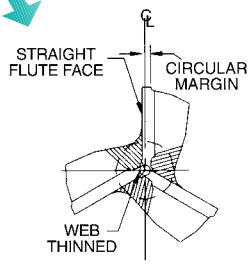
D1 inch	D1 mm	D1 inch	D	L	L3	L4	Uncoated EDP No.	TiN Coated EDP No.
1/8	—	.1250	1/8	1.929	.709	.375	M10000	M13893
30	—	.1285	.1285	1.929	.709	.386	M10001	M13903
29	—	.1360	.1360	2.047	.787	.408	M10002	M13913
—	3,5	.1378	3,5	52	20	10,5	M10010	M13923
28	—	.1405	.1405	2.047	.787	.422	M10011	M13933
9/64	—	.1406	9/64	2.047	.787	.422	M10012	M13943
27	—	.1440	.1440	2.047	.787	.432	M10020	M13953
26	—	.1470	.1470	2.047	.787	.441	M10021	M13963
25	—	.1495	.1495	2.165	.866	.449	M10022	M13973
24	—	.1520	.1520	2.165	.866	.456	M10030	M13983
23	—	.1540	.1540	2.165	.866	.462	M10031	M13993
5/32	—	.1562	5/32	2.165	.866	.469	M10032	M14003
22	—	.1570	.1570	2.165	.866	.471	M10040	M14013
—	4,0	.1575	4,0	55	22	12,0	M10041	M14023
21	—	.1590	.1590	2.165	.866	.477	M10042	M14033
20	—	.1610	.1610	2.165	.866	.483	M10050	M14043
19	—	.1660	.1660	2.165	.866	.498	M10051	M14053
18	—	.1695	.1695	2.283	.945	.509	M10052	M14063
11/64	—	.1719	11/64	2.283	.945	.516	M10060	M14073
17	—	.1730	.1730	2.283	.945	.519	M10061	M14083
16	—	.1770	.1770	2.283	.945	.531	M10062	M14093
—	4,5	.1772	4,5	58	24	13,5	M10070	M14103
15	—	.1800	.1800	2.283	.945	.540	M10071	M14113
14	—	.1820	.1820	2.283	.945	.546	M10072	M14123
13	—	.1850	.1850	2.283	.945	.555	M10080	M14133
3/16	—	.1875	3/16	2.441	1.024	.563	M10081	M14143
12	—	.1890	.1890	2.441	1.024	.567	M10082	M14153
11	—	.1910	.1910	2.441	1.024	.573	M10090	M14163
10	—	.1935	.1935	2.441	1.024	.581	M10091	M14173
9	—	.1960	.1960	2.441	1.024	.588	M10092	M14183
—	5,0	.1969	5,0	62	26	15,0	M10100	M14193
8	—	.1990	.1990	2.441	1.024	.597	M10101	M14203
7	—	.2010	.2010	2.441	1.024	.603	M10102	M14213
13/64	—	.2031	13/64	2.441	1.024	.609	M10110	M14223
6	—	.2040	.2040	2.441	1.024	.612	M10111	M14233
5	—	.2055	.2055	2.441	1.024	.617	M10112	M14243
4	—	.2090	.2090	2.598	1.102	.627	M10120	M14253
3	—	.2130	.2130	2.598	1.102	.639	M10121	M14263
—	5,5	.2165	5,5	66	28	16,5	M10122	M14273
7/32	—	.2188	7/32	2.598	1.102	.656	M10130	M14283
2	—	.2210	.2210	2.598	1.102	.663	M10131	M14293
1	—	.2280	.2280	2.598	1.102	.684	M10132	M14303
15/64	—	.2344	15/64	2.598	1.102	.703	M10140	M14313
—	6,0	.2362	6,0	66	28	18,0	M10141	M14323
1/4	—	.2500	1/4	2.756	1.220	.750	M10142	M14333
—	6,5	.2559	6,5	70	31	19,5	M10150	M14343
F	—	.2570	.2570	2.756	1.220	.771	M10151	M14353
17/64	—	.2656	17/64	2.913	1.339	.797	M10152	M14363
—	7,0	.2756	7,0	74	34	21,0	M10160	M14373
9/32	—	.2812	9/32	2.913	1.339	.844	M10161	M14383
—	7,5	.2953	7,5	74	34	22,5	M10162	M14393
19/64	—	.2969	19/64	3.110	1.457	.891	M10170	M14403
5/16	—	.3125	5/16	3.110	1.457	.938	M10171	M14413
—	8,0	.3150	8,0	79	37	24,0	M10172	M14423
21/64	—	.3281	21/64	3.110	1.457	.984	M10180	M14433
Q	—	.3320	.3320	3.110	1.457	.996	M10181	M14443
—	8,5	.3346	8,5	79	37	25,5	M10182	M14453
11/32	—	.3438	11/32	3.307	1.575	1.031	M10190	M14463
—	9,0	.3543	9,0	84	40	27,0	M10191	M14473

continued on next page



STEEL

B3S Drill Point



Tolerances

Inch Sizes

D1	tolerance h7
>.1181 to .2362	-.0005/.0000
>.2362 to .3937	-.0006/.0000
>.3937 to .7087	-.0007/.0000
>.7087 to .7500	-.0008/.0000

D	tolerance h7
>.1181 to .2362	-.0005/.0000
>.2362 to .3937	-.0006/.0000
>.3937 to .7087	-.0007/.0000
>.7087 to .7500	-.0008/.0000

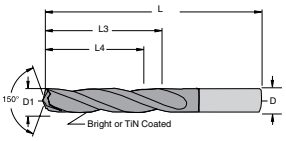
Metric Sizes

D1	tolerance h7
>3 to 6	-0,012/0,000
>6 to 10	-0,015/0,000
>10 to 18	-0,018/0,000
>18 to 20	-0,021/0,000

D	tolerance h7
>3 to 6	-0,012/0,000
>6 to 10	-0,015/0,000
>10 to 18	-0,018/0,000
>18 to 20	-0,021/0,000

Series 270 – Without Coolant Holes (continued)

D1 inch	D1 mm	D1 inch	D	L	L3	L4	Uncoated EDP No.	TiN Coated EDP No.
23/64	—	.3594	23/64	3.307	1.575	1.078	M10192	M14483
U	—	.3680	.3680	3.307	1.575	1.104	M10200	M14493
—	9,5	.3740	9,5	84	40	28,5	M10201	M14503
3/8	—	.3750	3/8	3.504	1.693	1.125	M10202	M14513
25/64	—	.3906	25/64	3.504	1.693	1.172	M10210	M14523
—	10,0	.3937	10,0	89	43	30,0	M10211	M14533
13/32	—	.4062	13/32	3.504	1.693	1.219	M10212	M14543
—	10,5	.4134	10,5	89	43	31,5	M10220	M14553
27/64	—	.4219	27/64	3.740	1.850	1.266	M10221	M14563
—	11,0	.4331	11,0	95	47	33,0	M10222	M14573
7/16	—	.4375	7/16	3.740	1.850	1.313	M10230	M14583
—	11,5	.4528	11,5	95	47	34,5	M10231	M14593
29/64	—	.4531	29/64	3.740	1.850	1.359	M10232	M14603
15/32	—	.4688	15/32	4.016	2.008	1.406	M10240	M14613
—	12,0	.4724	12,0	102	51	36,0	M10241	M14623
31/64	—	.4844	31/64	4.016	2.008	1.453	M10242	M14633
—	12,5	.4921	12,5	102	51	37,5	M10250	M14643
1/2	—	.5000	1/2	4.016	2.008	1.500	M10251	M14653
—	13,0	.5118	13,0	102	51	39,0	M10252	M14663
33/64	—	.5157	33/64	4.016	2.008	1.547	M10260	M14673
17/32	—	.5312	17/32	4.213	2.126	1.594	M10261	M14683
—	13,5	.5315	13,5	107	54	40,5	M10262	M14693
35/64	—	.5469	35/64	4.213	2.126	1.641	M10270	M14703
—	14,0	.5512	14,0	107	54	42,0	M10271	M14713
9/16	—	.5625	9/16	4.370	2.205	1.688	M10272	M14723
—	14,5	.5709	14,5	111	56	43,5	M10280	M14733
37/64	—	.5781	37/64	4.370	2.205	1.734	M10281	M14743
—	15,0	.5906	15,0	111	56	45,0	M10282	M14753
19/32	—	.5938	19/32	4.528	2.283	1.781	M10290	M14763
—	15,5	.6102	15,5	115	58	46,5	M10291	M14773
5/8	—	.6250	5/8	4.528	2.283	1.875	M10292	M14783
—	16,0	.6299	16,0	115	58	48,0	M10300	M14793
—	16,5	.6496	16,5	119	60	49,5	M10301	M14803
—	17,0	.6693	17,0	119	60	51,0	M10302	M14813
11/16	—	.6875	11/16	4.843	2.441	2.063	M10310	M14823
—	17,5	.6890	17,5	123	62	52,5	M10311	M14833
—	18,0	.7087	18,0	123	62	54,0	M10312	M14843
—	18,5	.7283	18,5	127	64	55,5	M10320	M14853
—	19,0	.7480	19,0	127	64	57,0	M10321	M14863
3/4	—	.7500	3/4	5.157	2.598	2.250	M10322	M14873
—	19,5	.7677	19,5	131	66	58,5	M10330	M14883
—	20,0	.7874	20,5	131	66	60,0	M10331	M14893





Tech Tip:

Recommended for higher speed drilling in low carbon and alloy steels.

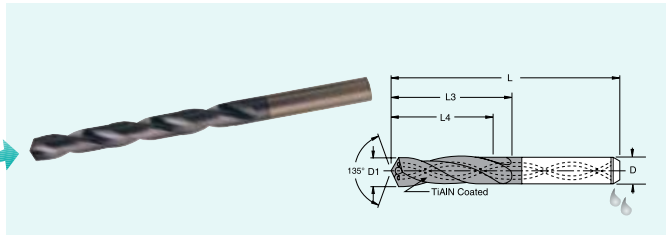
B3S point eliminates the need for spot drilling.

Series 270 drills produce straight, round holes with good finish at heavy feed rates.

Series 258

Features

- 2-flute, right-hand spiral, right-hand cut
- BT4 point — 135° 4-facet, web-thinned point with T-land
- 258 jobbers DIN 338 length
- Two spiral coolant holes
- Parallel shanks
- TiAlN coated standard; uncoated and other coatings available as a modification



Applications

- Use in medium to hard steels and cast irons.
- For applications where through coolant is recommended.
- Series 258 drilling depth up to 5 x diameter.
- TiAlN coating enables drilling at higher speed rates.

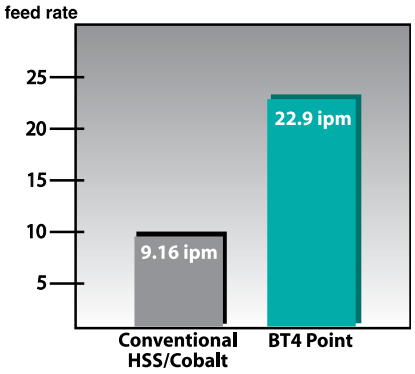


Performance Comparison

BT4 Point versus conventional HSS/Cobalt drill

Material:	4340 (270 BHN)	
Tool Diameter:	3/8"	
Hole Depth:	.950"	
Coolant:	Water Soluble	
	Metal Removal Drill	HSS/Cobalt Drill
Cutting Speed:	225 SFM	90 SFM
	2292 RPM	916 RPM
Feed Rate:	22.9 IPM	9.16 IPM

Metal Removal drilled 238% faster!



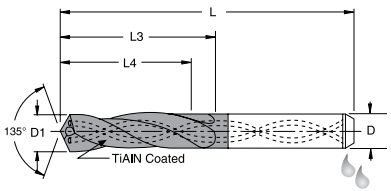
Recommended Feeds and Speeds: Series 258 *(see page 178 for metric recommendations)*

Workpiece Material	BHN	Cutting Speeds (sfm)	Feeds .125" (3 mm)	.250" (6 mm)	.375" (10 mm)	.500" (13 mm)	.625" (16 mm)	.750" (19 mm)
Gray Cast Iron	120-200	350-500	.006-.009	.007-.011	.009-.014	.011-.018	.013-.022	.015-.025
	210-320	300-350	.005-.007	.005-.009	.007-.011	.009-.015	.011-.019	.014-.023
Ductile Irons	140-225	225-300	.005-.008	.005-.009	.007-.011	.008-.014	.010-.017	.013-.021
	225-300	175-225	.004-.007	.004-.008	.006-.010	.007-.012	.009-.015	.012-.020
	310-400	100-175	.003-.006	.004-.006	.055-.008	.006-.010	.008-.014	.011-.018
Malleable Iron	110-200	300-425	.005-.008	.005-.009	.007-.011	.008-.014	.012-.017	.010-.017
	200-255	250-300	.004-.007	.004-.008	.006-.010	.007-.012	.009-.015	.010-.016
	255-320	200-250	.003-.006	.004-.006	.005-.008	.006-.010	.008-.012	.008-.014
Carbon Steel	<150	325-400	.003-.006	.004-.008	.007-.011	.008-.014	.010-.017	.012-.020
	150-180	300-350	.004-.006	.005-.007	.006-.010	.008-.013	.010-.016	.011-.019
	>180	260-325	.004-.006	.005-.007	.005-.009	.007-.011	.008-.014	.010-.017
Alloy Steel	<275	200-250	.003-.006	.004-.008	.007-.011	.008-.014	.010-.017	.012-.020
	275-425	125-200	.004-.006	.005-.007	.006-.010	.008-.013	.010-.016	.011-.019
	45-48RC	80-125	.004-.006	.005-.007	.005-.009	.007-.011	.008-.014	.010-.017
Tool Steel	100-250	100-250	.002-.004	.004-.006	.006-.010	.008-.013	.010-.016	.011-.019

The above recommendations are for hole depths up to 2 drill diameters. On deeper holes, feeds should be reduced 10% to 20%. Higher feed and speed values should be favored for softer material; lower feed and speed values should be used for harder materials. The above recommendations should be considered only as a starting point. Ultimate speeds and feeds will depend upon setup conditions and chip formation.

Series 258 – With Coolant Holes

D1 inch	D1 mm	D1 inch	D	L	L3	L4	TiAlN Coated EDP No.
—	6,0	0.2362	6,0	93	57	30,0	M11846
1/4 (E)	—	0.2500	1/4	4	2-1/2	1.250	M11856
—	6,5	0.2559	6,5	101	63	32,5	M11866
—	6,6	0.2598	6,6	101	63	33,0	M11876
—	6,7	0.2638	6,7	101	63	33,5	M11886
17/64	—	0.2656	17/64	4-1/4	2-3/4	1.328	M11896
—	7,0	0.2756	7,0	109	69	35,0	M11906
9/32	—	0.2813	9/32	4-1/4	2-3/4	1.407	M11916
—	7,5	0.2953	7,5	109	69	37,5	M11926
19/64	—	0.2969	19/64	4-1/2	2	1.485	M11936
5/16	—	0.3125	5/16	4-1/2	2	1.563	M11946
—	8,0	0.3149	8,0	117	75	40,0	M11956
21/64	—	0.3281	21/64	4-1/2	2	1.641	M11966
—	8,5	0.3346	8,5	117	75	42,5	M11976
—	8,7	0.3425	8,7	125	81	43,5	M11986
11/32	—	0.3438	11/32	5	3-1/4	1.719	M11996
—	9,0	0.3543	9,0	125	81	45,0	M12006
23/64	—	0.3594	23/64	5	3-1/4	1.797	M12016
9 (U)	—	0.3680	0.3680	4	3-1/4	1.840	M12026
3/8	—	0.3750	3/8	5-1/4	3-1/2	1.875	M12036
25/64	—	0.3906	25/64	5-1/4	3-1/2	1.953	M12046
—	10,0	0.3937	10,0	133	87	50,0	M12056
13/32	—	0.4063	13/32	5-1/4	3-1/2	2.032	M12066
—	10,5	0.4134	10,5	133	87	62,5	M12076
27/64	—	0.4219	27/64	5-1/2	3-3/4	2.110	M12086
—	10,8	0.4252	10,8	142	94	54,0	M12096
—	11,0	0.4330	11,0	142	94	55,0	M12106
7/16	—	0.4375	7/16	5-1/2	3-3/4	2.188	M12116
—	11,5	0.4527	11,5	142	94	57,5	M12126
15/32	—	0.4688	15/32	6	3-1/2	2.344	M12136
—	12,0	0.4724	12,0	151	101	60,0	M12146
31/64	—	0.4844	31/64	6	3-1/2	2.422	M12156
—	12,5	0.4921	12,5	151	101	62,5	M12166
1/2	—	0.5000	1/2	6	3-1/2	2.500	M12176
—	13,0	0.5118	13,0	151	101	65,0	M12186
33/64	—	0.5156	33/64	5	3	2.578	M12196
—	13,5	0.5315	13,5	160	108	67,5	M12206
35/64	—	0.5469	35/64	6-1/4	4-1/4	2.735	M12216
—	14,0	0.5512	14,0	160	108	70,0	M12226
9/16	—	0.5625	9/16	6-3/4	4-1/2	2.813	M12236
—	14,5	0.5709	14,5	169	114	72,5	M12246
37/64	—	0.5781	37/64	6-3/4	4-1/2	2.891	M12256
—	15,0	0.5905	15,0	169	114	75,0	M12266
—	15,5	0.6102	15,5	178	120	77,5	M12276
5/8	—	0.6250	5/8	7	4-3/4	3.125	M12286





Tolerances

Inch Sizes

D1	tolerance h7
>.1181 to .2362	.0000/-.0005
>.2362 to .3937	.0000/-.0006
>.3937 to .6250	.0000/-.0007

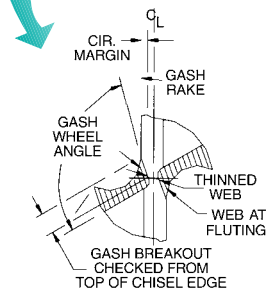
D	tolerance h7
Inch Sizes	
>.1181 to .2362	.0000/-.0005
>.2362 to .3937	.0000/-.0006
>.3937 to .6250	.0000/-.0007

Metric Sizes

D1	tolerance h7
6	0,000/-0,012
>6 to 10	0,000/-0,015
>10 to 15,5	0,000/-0,018

D	tolerance h7
6	0,000/-0,012
>6 to 10	0,000/-0,015
>10 to 15,5	0,000/-0,018

BT4 Drill Point

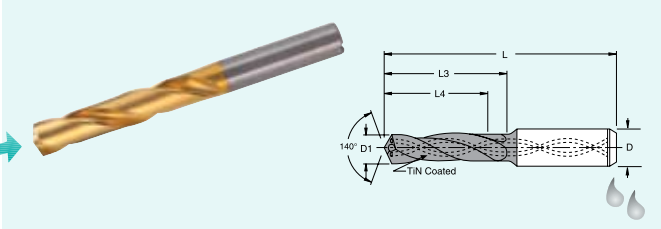


Series D

Features

- 2-flute, right-hand spiral, right-hand cut
- SE point –140° self-centering sculptured edge
- Regular length
- Two spiral coolant holes
- Common shanks
- TiN coated standard; other coatings available as specials

SE Drill Point



Applications

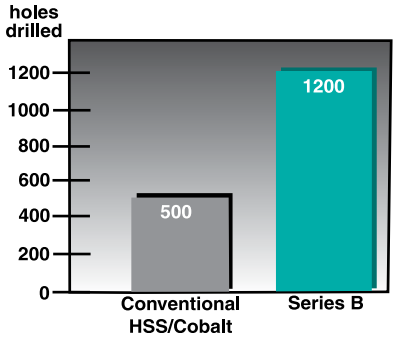
- Use in medium to hard steels and cast irons.
- Use where through coolant is recommended.



Performance Comparison

Series D versus solid carbide P40 + CVD coated drill

Material:	6150 (tensile strength 116,000 psi)	
Tool Diameter:	8,5 mm through holes	
Hole Depth:	30 mm	
Coolant:	Water Soluble	
	Series D Drill	HSS/Cobalt Drill
Cutting Speed:	3000 RPM	3000 RPM
Feed Rate:	33.1 IPM	33.1 IPM
	0.011 IPR	0.011 IPR
Tool Life: (drilled holes)	1200	500



Metal Removal Series D drilled 140% more holes!

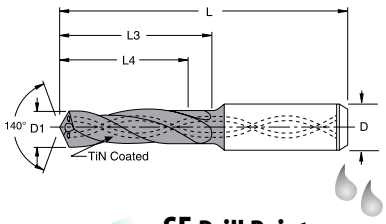
Recommended Speeds and Feeds: Series D *(see page 178 for metric recommendations)*

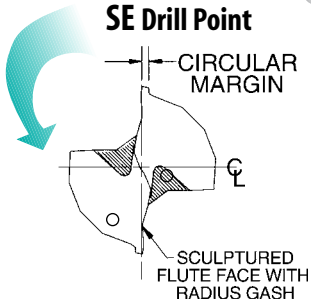
Workpiece Material	BHn	Cutting Speed (sfm)	Feed In Inches Per Revolution For Drill Diameter .125 (3mm)	.250 (6 mm)	.375 (10 mm)	.500 (13 mm)	.625 (16 mm)	.750 (19 mm)
Carbon Steel	<150	395-525	.003-.006	.004-.007	.005-.009	.007-.011	.008-.014	.010-.017
	150-180	325-460	.004-.006	.005-.008	.006-.010	.008-.013	.010-.016	.011-.019
	>180	260-360	.004-.006	.005-.008	.007-.011	.008-.014	.010-.017	.012-.020
Alloy and Cast Steel	<210	230-295	.005-.008	.006-.010	.008-.013	.010-.016	.011-.018	.012-.020
	210-270	230-295	.004-.007	.005-.009	.007-.012	.009-.014	.010-.017	.011-.019
	>270	200-260	.004-.006	.005-.008	.006-.010	.008-.012	.009-.015	.010-.017
High Alloy Steel	<300	165-230	.003-.005	.003-.006	.005-.008	.006-.010	.007-.012	.009-.015
	>300	165-230	.003-.004	.003-.005	.005-.008	.006-.010	.007-.012	.009-.014
Malleable Cast Iron	140-260	260-325	.005-.008	.005-.009	.007-.012	.009-.014	.012-.017	.010-.017
Gray Cast Iron	<180	395-525	.006-.009	.007-.011	.009-.014	.011-.018	.013-.022	.016-.028
	180-220	325-460	.006-.009	.007-.011	.009-.014	.011-.018	.013-.021	.015-.025
	>220	260-360	.005-.007	.005-.009	.007-.011	.009-.015	.011-.019	.014-.023
Nodular Iron	<220	200-260	.005-.008	.005-.009	.007-.011	.008-.014	.010-.017	.013-.021
	>220	130-200	.003-.006	.004-.006	.005-.008	.006-.010	.008-.014	.011-.018
Yellow Brass	—	260-395	.003-.006	.004-.007	.005-.008	.006-.010	.007-.011	.008-.013
Copper Alloys	—	325-820	.006-.009	.006-.010	.007-.012	.008-.014	.009-.016	.010-.017

The above recommendations are for hole depths up to 2 drill diameters. On deeper holes, feeds should be reduced 10% to 20%. Higher feed and speed values should be favored for softer material; lower feed and speed values should be used for harder materials. The above recommendations should be considered only as a starting point. Ultimate speeds and feeds will depend upon setup conditions and chip formation.

Series D – With Coolant Holes

D1 inch	D1 mm	D1 inch	D	L	L3	L4	TiN Coated EDP No.
—	4,0	0.1570	6	74	36	29	M14903
—	4,2	0.1650	6	74	36	29	M14923
—	4,3	0.1690	6	74	36	29	M14933
—	4,5	0.1770	6	74	36	29	M14953
—	4,6	0.1810	6	74	36	29	M14963
—	4,8	0.1890	6	82	44	35	M14983
—	5,0	0.1970	6	82	44	35	M15003
—	5,1	0.2010	6	82	44	35	M15013
—	5,2	0.2050	6	82	44	35	M15023
—	5,6	0.2200	6	82	44	35	M15073
1/4	—	0.2500	1/4	3.23	1.69	1.37	M15133
—	6,4	0.2520	8	91	53	43	M15143
—	6,6	0.2600	8	91	53	43	M15163
—	6,7	0.2640	8	91	53	43	M15173
—	6,9	0.2720	8	91	53	43	M15203
—	7,0	0.2760	8	91	53	43	M15213
9/32	—	0.2813	5/16	3.58	1.97	1.59	M15233
—	7,5	0.2950	8	91	53	43	M15273
—	7,7	0.3030	8	91	53	43	M15293
5/16	—	0.3125	5/16	3.58	1.97	1.59	M15323
—	8,0	0.3150	8	91	53	43	M15333
—	8,1	0.3190	10	103	61	49	M15343
21/64	—	0.3281	3/8	4.05	2.36	1.92	M15373
—	8,5	0.3350	10	103	61	49	M15393
—	8,6	0.3390	10	103	61	49	M15403
—	9,0	0.3540	10	103	61	49	M15453
—	9,1	0.3580	10	103	61	49	M15463
—	9,3	0.3660	10	103	61	49	M15493
—	9,4	0.3700	10	103	61	49	M15503
3/8	—	0.3750	3/8	4.05	2.36	1.92	M15523
—	9,6	0.3780	10	103	61	49	M15533
—	10,2	0.4020	12	118	71	56	M15603
—	10,3	0.4060	12	118	71	56	M15613
13/32	—	0.4063	7/16	4.37	2.60	2.09	M15623
—	10,5	0.4130	12	118	71	56	M15643
—	10,7	0.4210	12	118	71	56	M15653
27/64	—	0.4219	7/16	4.37	2.60	2.09	M15663
—	10,8	0.4250	12	118	71	56	M15673
—	11,1	0.4370	12	118	71	56	M15693
7/16	—	0.4375	7/16	4.37	2.60	2.09	M15703
—	11,5	0.4530	12	118	71	56	M15733
29/64	—	0.4531	1/2	4.64	2.75	2.19	M15743
—	12,2	0.4800	14	124	77	60	M15813
—	12,5	0.4920	14	124	77	60	M15853
1/2	—	0.5000	1/2	4.64	2.75	2.19	M15873
—	12,8	0.5040	14	124	77	60	M15883
—	13,1	0.5160	14	124	77	60	M15913
—	13,3	0.5240	14	124	77	60	M15933
—	13,6	0.5350	14	124	77	60	M15953
—	13,8	0.5430	14	124	77	60	M15973
—	14,0	0.5510	14	124	77	60	M15993
9/16	—	0.5625	9/16	4.88	2.99	2.36	M16013
—	14,5	0.5710	16	133	83	63	M16033
—	14,7	0.5790	16	133	83	63	M16053
5/8	—	0.6250	5/8	5.23	3.23	2.54	M16173
11/16	—	0.6875	11/16	5.63	3.62	2.87	M16223





Drilling Depth

Inch Sizes

.156	= 5.25 x Dia.
.250	= 5.25 x Dia.
.375	= 5 x Dia.
.500	= 4.5 x Dia.
.625	= 4.125 x Dia.
.750	= 3.75 x Dia.

Metric Sizes

4,0	= 7 x Dia.
6,5	= 6.5 x Dia.
9,5	= 4.75 x Dia.
12,0	= 4.5 x Dia.
14,5	= 4.25 x Dia.
17,0	= 4.125 x Dia.
21,0	= 4 x Dia.

Tolerances

Inch Sizes

D1	tolerance m7
>.1181 to .2362	.0002/.0006
>.2362 to .3937	.0002/.0008
>.3937 to .7087	.0003/.0010
>.7087 to .7500	.0003/.0011

D	tolerance h6
.1875	-.0003/.0000
.2500 to .6875	-.0004/.0000
.7500	-.0005/.0000

Metric Sizes

D1	tolerance m7
>3 to 6	0,004/0,016
>6 to 10	0,006/0,021
>10 to 18	0,007/0,025
>18 to 21	0,008/0,029

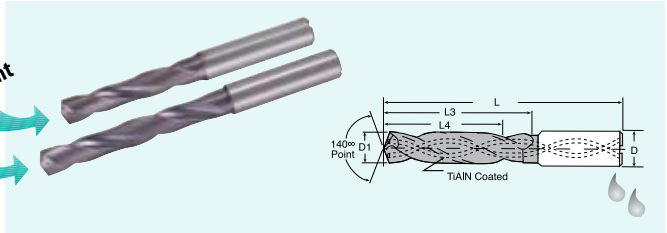
D	tolerance h6
6	-0,008/0,000
8 to 10	-0,009/0,000
12 to 18	-0,011/0,000
20	-0,013/0,000

Series 383, 385

NEW STYLE

Features

- 2-flute, right-hand spiral, right-hand cut
- HQS point – 140° 6-facet "S" gash
- 383 short DIN 6537 length;
  385 long DIN 6537 length
- Two spiral coolant holes
- Common shanks
- TiAlN coated standard; other coatings available as specials



Applications

- Series 383 drills up to 3 x diameter;
- Series 385 drills up to 5 x diameter.
- Ideal for use in harder steels, stainless steels, titanium and titanium alloys, and cast irons.
- Use where internal coolant is recommended; same drill is available without coolant holes – see Series 283, 285, pages 98-103.



Performance Results

Series 383 Tool Diameter: 5,0 mm • Hole Depth: 15 mm • Internal Coolant

Material:	AISI 316	Inconel 718
Cutting Speed:	167 (TiCN)	50 (uncoated)
Feed per Revolution:	0,075 mm	0,075 mm
Tool Life:	1521 holes	148 holes

Recommended Speeds and Feeds: Series 383, 385 *(see page 179 for metric recommendations)*

Material	Hardness	Speed (sfm) TiAlN Coated	Feed (ipr) .125" (3mm)	.250" (6mm)	.375" (10mm)	.500" (13mm)	.625" (16mm)	.750" (19mm)
Alloyed Steel								
4340, 52100	<= 28-32 Rc	220-260	0.0026	0.0043	0.0072	0.0090	0.0099	0.0109
8620, 4104	<= 42 Rc	190-210	0.0020	0.0034	0.0056	0.0070	0.0077	0.0085
Mold Steel								
P-20, h-13, 180	180-320 BHN	250-275	0.0029	0.0048	0.0080	0.0100	0.0110	0.0121
D2, A2, S-5	220-250 BHN	100-110	0.0017	0.0029	0.0048	0.0060	0.0066	0.0073
	50+ Rc	65-85	0.0012	0.0019	0.0032	0.0040	0.0044	0.0048
Iron								
Gray CI 30, G25	150-220 BHN	420-560	0.0058	0.0096	0.0160	0.0200	0.0220	0.0242
Ductile	220-250 BHN	380-490	0.0035	0.0058	0.0096	0.0120	0.0132	0.0145
Nodular	251-320 BHN	300-350	0.0023	0.0038	0.0064	0.0080	0.0088	0.0097
Stainless Steels								
Free 303, 420, 416	< 330 HB <=40 HRc	290-350	0.0023	0.0038	0.0064	0.0080	0.0088	0.0097
Tough 316, 304, 15-5, 13-8, 17-4	330-450 BHN, 36-48 HRc	170-225	0.0017	0.0029	0.0048	0.0060	0.0066	0.0073
Titanium Alloys	110-450 HB							
Ti-6Al 4V, 6A16V	<= 48 HRc	130-150	0.0017	0.0029	0.0048	0.0060	0.0066	0.0073
Nickel Alloys								
718, Inconel, Rene, Nimonic, Waspalloy	140-475 HB <= 48 HRc	65-90	0.0012	0.0019	0.0032	0.0040	0.0044	0.0048

Higher feed and speed values should be favored for softer material; lower feed and speed values should be used for harder materials. These recommendations should be considered only as a starting point. Ultimate speeds and feeds will depend upon setup conditions and chip formation. The above recommendations are for drilling a hole 2 x diameter deep. For other depths, multiply feed rate from above as follows:

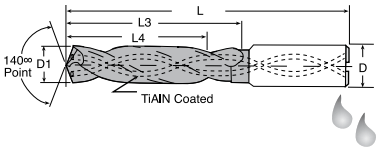
Drilling Depth (N x Diameter):	1	2	3	4	5
Multiplier:	1.2	1.0	0.9	0.75	0.65

Series 383, 385 – With Coolant Holes

NEW STYLE

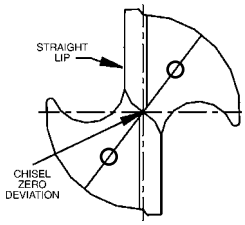
D1 inch	D1 mm	D1 inch	D	L	L3	L4	TiAlN Coated EDP No.
—	3,0	0.1181	6	62	20	14	M12296
—	3,0	0.1181	6	66	26	23	M13686
—	3,1	0.1220	6	62	20	14	M12306
—	3,1	0.1220	6	66	26	23	M13696
1/8	—	0.1250	3/16	2.600	0.910	0.375	M12316
1/8	—	0.1250	3/16	2.910	1.060	0.625	M13706
—	3,2	0.1260	6	62	20	14	M12326
—	3,2	0.1260	6	66	26	23	M13716
—	3,3	0.1299	6	62	20	14	M12336
—	3,3	0.1299	6	66	26	23	M13726
—	3,4	0.1339	6	62	20	14	M12346
—	3,4	0.1339	6	66	26	23	M13736
—	3,5	0.1378	6	62	20	14	M12356
—	3,5	0.1378	6	66	26	23	M13746
—	3,6	0.1417	6	62	20	14	M12366
—	3,6	0.1417	6	66	26	23	M13756
—	3,7	0.1457	6	66	24	14	M12376
—	3,7	0.1457	6	66	36	29	M13766
25	3,8	0.1496	6	66	24	17	M12386
25	3,8	0.1496	6	74	36	29	M13776
—	3,9	0.1535	6	66	24	17	M12396
—	3,9	0.1535	6	74	36	29	M13786
5/32	—	0.1563	3/16	2.600	0.910	0.469	M12406
5/32	—	0.1563	3/16	2.910	1.060	0.781	M13796
—	4,0	0.1575	6	66	24	17	M12416
—	4,0	0.1575	6	74	36	29	M13806
—	4,1	0.1614	6	66	24	17	M12426
—	4,1	0.1614	6	74	36	29	M13816
—	4,2	0.1654	6	66	24	17	M12436
—	4,2	0.1654	6	74	36	29	M13826
18	4,3	0.1693	6	66	24	17	M12446
18	4,3	0.1693	6	74	36	29	M13836
17	4,4	0.1732	6	66	24	17	M12456
17	4,4	0.1732	6	74	36	29	M13846
16	4,5	0.1772	6	66	24	17	M12466
16	4,5	0.1772	6	74	36	29	M13856
—	4,6	0.1811	6	66	24	17	M12476
—	4,6	0.1811	6	74	36	29	M13866
13	4,7	0.1850	6	66	24	17	M12486
13	4,7	0.1850	6	82	44	35	M13876
3/16	—	0.1875	3/16	2.600	1.140	0.563	M12496
3/16	—	0.1875	3/16	2.910	1.380	0.938	M13886
12	4,8	0.1890	6	66	28	20	M12506
12	4,8	0.1890	6	82	44	35	M13896
—	4,9	0.1929	6	66	28	20	M12516
—	4,9	0.1929	6	82	44	35	M13906
—	5,0	0.1969	6	66	28	20	M12526
—	5,0	0.1969	6	82	44	35	M13916
7	5,1	0.2008	6	66	28	20	M12536
7	5,1	0.2008	6	82	44	35	M13926
13/64	—	0.2031	1/4	2.910	1.340	0.656	M12546
13/64	—	0.2031	1/4	3.230	1.690	1.094	M13936
—	5,2	0.2047	6	66	28	20	M12556
—	5,2	0.2047	6	82	44	35	M13946
4	5,3	0.2087	6	66	28	20	M12566
4	5,3	0.2087	6	82	44	35	M13956
—	5,4	0.2126	6	66	28	20	M12576

continued on next page





HQS Drill Point



Tolerances

Inch Sizes

D1	tolerance m7
>.1181 to .2362	.0002/.0006
>.2362 to .3937	.0002/.0008
>.3937 to .7087	.0003/.0010
>.7087 to .7500	.0003/.0011

D	tolerance h6
.1875	-.0003/.0000
.2500 to .6875	-.0004/.0000
.7500	-.0005/.0000

Metric Sizes

D1	tolerance m7
Metric Sizes	
3	0,002/0,012
>3 to 6	0,004/0,016
>6 to 10	0,006/0,021
>10 to 18	0,007/0,025
>18 to 20	0,008/0,029

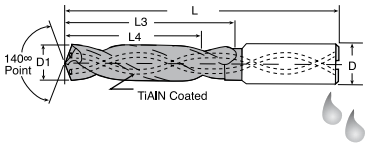
D	tolerance h6
6	-0,008/0,000
8 to 10	-0,009/0,000
12 to 18	-0,011/0,000
20	-0,013/0,000

Series 383, 385 – With Coolant Holes (continued)

NEW STYLE

D1 inch	D1 mm	D1 inch	D	L	L3	L4	TiAlN Coated EDP No.
—	5,4	0.2126	6	82	44	35	M13966
3	—	0.2130	1/4	2.910	1.340	0.656	M12586
3	—	0.2130	1/4	3.230	1.690	1.094	M13976
—	5,5	0.2165	6	66	28	20	M12596
—	5,5	0.2165	6	82	44	35	M13986
7/32	—	0.2188	1/4	2.910	1.340	0.656	M12606
7/32	—	0.2188	1/4	3.230	1.690	1.094	M13996
—	5,6	0.2205	6	66	28	20	M12616
—	5,6	0.2205	6	82	44	35	M14006
—	5,7	0.2244	6	66	28	20	M12626
—	5,7	0.2244	6	82	44	35	M14016
1	5,8	0.2283	6	66	28	20	M12636
1	5,8	0.2283	6	82	44	35	M14026
—	5,9	0.2323	6	66	28	20	M12646
—	5,9	0.2323	6	82	44	35	M14036
A	—	0.2340	1/4	2.910	1.340	0.750	M12656
A	—	0.2340	1/4	3.230	1.690	1.250	M14046
—	6,0	0.2362	6	66	28	20	M12666
—	6,0	0.2362	6	82	44	35	M14056
—	6,1	0.2402	8	79	34	24	M12676
—	6,1	0.2402	8	91	53	43	M14066
—	6,2	0.2441	8	79	34	24	M12686
—	6,2	0.2441	8	91	53	43	M14076
D	—	0.2460	1/4	2.910	1.340	0.750	M12696
D	—	0.2460	1/4	3.230	1.690	1.250	M14086
—	6,3	0.2480	8	79	34	24	M12706
—	6,3	0.2480	8	91	53	43	M14096
1/4 -E	—	0.2500	1/4	2.910	1.340	0.750	M12716
1/4 - E	—	0.2500	1/4	3.230	1.690	1.250	M14106
—	6,4	0.2520	8	79	34	24	M12726
—	6,4	0.2520	8	91	53	43	M14116
—	6,5	0.2559	8	79	34	24	M12736
—	6,5	0.2559	8	91	53	43	M14126
F	—	0.2570	5/16	3.110	1.500	0.797	M12746
F	—	0.2570	5/16	3.580	1.970	1.328	M14136
—	6,6	0.2598	8	79	34	24	M12756
—	6,6	0.2598	8	91	53	43	M14146
—	6,7	0.2638	8	79	34	24	M12766
—	6,7	0.2638	8	91	53	43	M14156
17/64	—	0.2656	5/16	3.110	1.500	0.797	M12776
17/64	—	0.2656	5/16	3.580	1.970	1.328	M14166
—	6,8	0.2677	8	79	34	24	M12786
—	6,8	0.2677	8	91	53	43	M14176
I	6,9	0.2717	8	79	34	24	M12796
I	6,9	0.2717	8	91	53	43	M14186
—	7,0	0.2756	8	79	34	24	M12806
—	7,0	0.2756	8	91	53	43	M14196
—	7,1	0.2795	8	79	41	29	M12816
—	7,1	0.2795	8	91	53	43	M14206
9/32	—	0.2810	5/16	3.110	1.500	0.844	M12826
9/32	—	0.2810	5/16	3.580	1.970	1.328	M14216
—	7,2	0.2835	8	79	41	29	M12836
—	7,2	0.2835	8	91	53	43	M14226
—	7,3	0.2874	8	79	41	29	M12846
—	7,3	0.2874	8	91	53	43	M14236
—	7,4	0.2913	8	79	41	29	M12856
—	7,4	0.2913	8	91	53	43	M14246
M	7,5	0.2953	8	79	41	29	M12866

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Tech Tip:

Ideal for use in harder steels > 30Rc, stainless steels and titanium alloys.

Coolant feed for faster penetration with a cooler cutting edge.

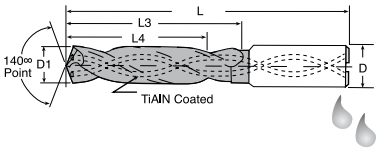
Available without coolant holes – see Series 283 and 285 on page 98.

Series 383, 385 – With Coolant Holes (continued)

NEW STYLE

D1 inch	D1 mm	D1 inch	D	L	L3	L4	TiAlN Coated EDP No.
M	7,5	0.2953	8	91	53	43	M14256
19/64	—	0.2969	5/16	3.110	1.500	0.938	M12876
19/64	—	0.2969	5/16	3.580	1.970	1.484	M14266
—	7,6	0.2992	8	79	41	29	M12886
—	7,6	0.2992	8	91	53	43	M14276
—	7,7	0.3031	8	79	41	29	M12896
—	7,7	0.3031	8	91	53	43	M14286
—	7,8	0.3071	8	79	41	29	M12906
—	7,8	0.3071	8	91	53	43	M14296
—	7,9	0.3110	8	79	41	29	M12916
—	7,9	0.3110	8	91	53	43	M14306
5/16	—	0.3125	5/16	3.110	1.500	0.938	M12926
5/16	—	0.3125	5/16	3.580	1.970	1.563	M14316
—	8,0	0.3150	8	79	41	29	M12936
—	8,0	0.3150	8	91	53	43	M14326
—	8,1	0.3189	10	89	47	35	M12946
—	8,1	0.3189	10	103	61	49	M14336
P	8,2	0.3228	10	89	47	35	M12956
P	8,2	0.3228	10	103	61	49	M14346
—	8,3	0.3268	10	89	47	35	M12966
—	8,3	0.3268	10	103	61	49	M14356
21/64	—	0.3281	3/8	3.500	1.810	0.984	M12976
21/64	—	0.3281	3/8	4.050	2.360	1.641	M14366
—	8,4	0.3307	10	89	47	35	M12986
—	8,4	0.3307	10	103	61	49	M14376
Q	—	0.3320	3/8	3.500	1.810	1.031	M12996
Q	—	0.3320	3/8	4.050	2.360	1.719	M14386
—	8,5	0.3346	10	89	47	35	M13006
—	8,5	0.3346	10	103	61	49	M14396
—	8,6	0.3386	10	89	47	35	M13016
—	8,6	0.3386	10	103	61	49	M14406
—	8,7	0.3425	10	89	47	35	M13026
—	8,7	0.3425	10	103	61	49	M14416
11/32	—	0.3438	3/8	3.500	1.810	1.031	M13036
11/32	—	0.3438	3/8	4.050	2.360	1.719	M14426
—	8,8	0.3465	10	89	47	35	M13046
—	8,8	0.3465	10	103	61	49	M14436
—	8,9	0.3504	10	89	47	35	M13056
—	8,9	0.3504	10	103	61	49	M14446
—	9,0	0.3543	10	89	47	35	M13066
—	9,0	0.3543	10	103	61	49	M14456
T	9,1	0.3583	10	89	47	35	M13076
T	9,1	0.3583	10	103	61	49	M14466
23/64	—	0.3594	3/8	3.500	1.810	1.078	M13086
23/64	—	0.3594	3/8	4.050	2.360	1.797	M14476
—	9,2	0.3622	10	89	47	35	M13096
—	9,2	0.3622	10	103	61	49	M14486
—	9,3	0.3661	10	89	47	35	M13106
—	9,3	0.3661	10	103	61	49	M14496
U	—	0.3680	3/8	3.500	1.810	1.125	M13116
U	—	0.3680	3/8	4.050	2.360	1.875	M14506
—	9,4	0.3701	10	89	47	35	M13126
—	9,4	0.3701	10	103	61	49	M14516
—	9,5	0.3740	10	89	47	35	M13136
—	9,5	0.3740	10	103	61	49	M14526
3/8	—	0.3750	3/8	3.500	1.810	1.125	M13146
3/8	—	0.3750	3/8	1.875	2.360	4.050	M14536

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Tech Tip:

Negative T-land point improves hole roundness and surface finish.

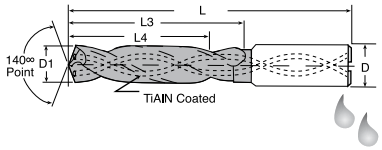
TiAlN coating allows drilling at higher speed rates, reducing manufacturing cycle time.

Series 383, 385 – With Coolant Holes (continued)

NEW STYLE

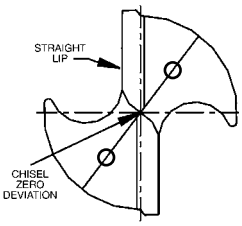
D1 inch	D1 mm	D1 inch	D	L	L3	L4	TiAlN Coated EDP No.
—	9,6	0.3780	10	89	47	35	M13156
—	9,6	0.3780	10	103	61	49	M14546
—	9,7	0.3819	10	89	47	35	M13166
—	9,7	0.3819	10	103	61	49	M14556
W	9,8	0.3858	10	89	47	35	M13176
W	9,8	0.3858	10	103	61	49	M14566
—	9,9	0.3898	10	89	47	35	M13186
—	9,9	0.3898	10	103	61	49	M14576
25/64	—	0.3906	7/16	3.780	2.010	1.172	M13196
25/64	—	0.3906	7/16	4.370	2.600	1.953	M14586
—	10,0	0.3937	10	89	47	35	M13206
—	10,0	0.3937	10	103	61	49	M14596
—	10,1	0.3976	12	102	55	40	M13216
—	10,1	0.3976	12	118	71	56	M14606
—	10,2	0.4016	12	102	55	40	M13226
—	10,2	0.4016	12	118	71	56	M14616
—	10,3	0.4055	12	102	55	40	M13236
—	10,3	0.4055	12	118	71	56	M14626
13/32	—	0.4063	7/16	3.780	2.010	1.219	M13246
13/32	—	0.4063	7/16	4.370	2.600	2.031	M14636
—	10,4	0.4094	12	102	55	40	M13256
—	10,4	0.4094	12	118	71	56	M14646
—	10,5	0.4134	12	102	55	40	M13266
—	10,5	0.4134	12	118	71	56	M14656
—	10,6	0.4173	12	102	55	40	M13276
—	10,6	0.4173	12	118	71	56	M14666
—	10,7	0.4213	12	102	55	40	M13286
—	10,7	0.4213	12	118	71	56	M14676
27/64	—	0.4219	7/16	3.780	2.010	1.266	M13296
27/64	—	0.4219	7/16	4.370	2.600	2.109	M14686
—	10,8	0.4252	12	102	55	40	M13306
—	10,8	0.4252	12	118	71	56	M14696
—	10,9	0.4291	12	102	55	40	M13316
—	10,9	0.4291	12	118	71	56	M14706
—	11,0	0.4331	12	102	55	40	M13326
—	11,0	0.4331	12	118	71	56	M14716
—	11,1	0.4370	12	102	55	40	M13336
—	11,1	0.4370	12	118	71	56	M14726
7/16	—	0.4375	7/16	3.780	2.010	1.313	M13346
7/16	—	0.4375	7/16	4.370	2.600	2.188	M14736
—	11,2	0.4409	12	102	55	40	M13356
—	11,2	0.4409	12	118	71	56	M14746
—	11,3	0.4449	12	102	55	40	M13366
—	11,3	0.4449	12	118	71	56	M14756
—	11,4	0.4488	12	102	55	40	M13376
—	11,4	0.4488	12	118	71	56	M14766
—	11,5	0.4528	12	102	55	40	M13386
—	11,5	0.4528	12	118	71	56	M14776
29/64	—	0.4531	1/2	4.010	2.130	1.359	M13396
29/64	—	0.4531	1/2	4.640	2.750	2.266	M14786
—	11,6	0.4567	12	102	55	40	M13406
—	11,6	0.4567	12	118	71	56	M14796
—	11,7	0.4606	12	102	55	40	M13416
—	11,7	0.4606	12	118	71	56	M14806
—	11,8	0.4646	12	102	55	40	M13426
—	11,8	0.4646	12	118	71	56	M14816
—	11,9	0.4685	12	102	55	40	M13436
—	11,9	0.4685	12	118	71	56	M14826

continued on next page





HQS Drill Point



Tolerances

Inch Sizes

D1	tolerance m7
>.1181 to .2362	.0002/.0006
>.2362 to .3937	.0002/.0008
>.3937 to .7087	.0003/.0010
>.7087 to .7500	.0003/.0011

D	tolerance h6
.1875	-.0003/.0000
.2500 to .6875	-.0004/.0000
.7500	-.0005/.0000

Metric Sizes

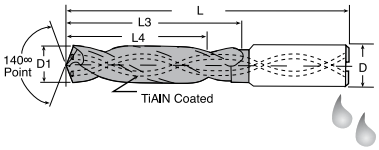
D1	tolerance m7
Metric Sizes	
3	0,002/0,012
>3 to 6	0,004/0,016
>6 to 10	0,006/0,021
>10 to 18	0,007/0,025
>18 to 20	0,008/0,029

D	tolerance h6
6	-0,008/0,000
8 to 10	-0,009/0,000
12 to 18	-0,011/0,000
20	-0,013/0,000

Series 383, 385 – With Coolant Holes (continued)

NEW STYLE

D1 inch	D1 mm	D1 inch	D	L	L3	L4	TiAlN Coated EDP No.
15/32	—	0.4688	1/2	4.010	2.130	1.406	M13446
15/32	—	0.4688	1/2	4.640	2.750	2.344	M14836
—	12,0	0.4724	12	102	55	40	M13456
—	12,0	0.4724	12	118	71	56	M14846
31/64	12,3	0.4843	1/2	4.010	2.13	1.453	M13466
31/64	12,3	0.4843	1/2	4.64	2.75	2.422	M14856
—	12,5	0.4921	14	107	60	43	M13476
—	12,5	0.4921	14	124	77	60	M14866
1/2	—	0.5000	1/2	4.010	2.130	1.500	M13486
1/2	—	0.5000	1/2	4.640	2.750	2.500	M14876
—	13,0	0.5118	14	107	60	43	M13496
—	13,0	0.5118	14	124	77	60	M14886
—	13,5	0.5315	14	107	60	43	M13506
—	13,5	0.5315	14	124	77	60	M14896
—	14,0	0.5512	14	107	60	43	M13516
—	14,0	0.5512	14	124	77	60	M14906
9/16	—	0.5625	9/16	4.210	2.320	1.688	M13526
9/16	—	0.5625	9/16	4.880	2.990	2.813	M14916
—	14,5	0.5709	16	115	65	45	M13536
—	14,5	0.5709	16	133	83	63	M14926
—	15,0	0.5906	16	115	65	45	M13546
—	15,0	0.5906	16	133	83	63	M14936
—	15,5	0.6102	16	115	65	45	M13556
—	15,5	0.6102	16	133	83	63	M14946
5/8	—	0.6250	5/8	4.520	2.520	1.875	M13566
5/8	—	0.6250	5/8	5.230	3.230	3.125	M14956
—	16,0	0.6299	16	115	65	45	M13576
—	16,0	0.6299	16	133	83	63	M14966
—	16,5	0.6496	18	123	73	51	M13586
—	16,5	0.6496	18	143	93	71	M14976
—	17,0	0.6693	18	123	73	51	M13596
—	17,0	0.6693	18	143	93	71	M14986
11/16	—	0.6875	11/16	4.840	2.830	2.063	M13606
11/16	—	0.6875	11/16	5.630	3.620	3.438	M14996
—	17,5	0.6890	18	123	73	51	M13616
—	17,5	0.6890	18	143	93	71	M15006
—	18,0	0.7087	18	123	73	51	M13626
—	18,0	0.7087	18	143	93	71	M15016
—	18,5	0.7283	20	131	79	55	M13636
—	18,5	0.7283	20	153	101	77	M15026
—	19,0	0.7480	20	131	79	55	M13646
—	19,0	0.7480	20	153	101	77	M15036
3/4	—	0.7500	3/4	5.080	2.990	2.250	M13656
3/4	—	0.7500	3/4	5.820	3.740	3.750	M15046
—	19,5	0.7677	20	131	79	55	M13666
—	19,5	0.7677	20	153	101	77	M15056
—	20,0	0.7874	20	131	79	55	M13676
—	20,0	0.7874	20	153	101	77	M15066





Tech Tip:

Ideal for use in harder steels > 30Rc, stainless steels, and titanium alloys.

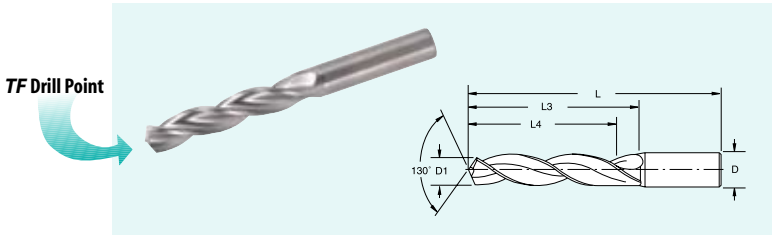
Coolant feed for faster penetration with a cooler cutting edge.

Available without coolant holes – see Series 283 and 285 on page 105.

Series A

Features

- 3-flute, right-hand spiral, right-hand cut
- TF point – 130° self-centering sculptured edge
- Regular DIN 6539 length
- Common shanks
- Lightly honed cutting edges
- No through coolant
- Bright finish standard; coated tools are available as specials



Applications

- Use dry or with external coolant in gray cast iron and ductile iron ferritic.
- Use external coolant when drilling pearlitic, titanium alloys, copper alloys, magnesium alloys, aluminum, and aluminum alloys.

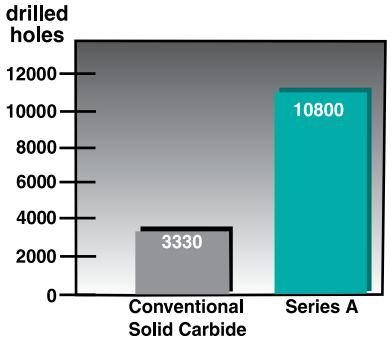


Performance Comparison

Series A versus conventional carbide drill

Material: 60-40-18 ductile cast iron <220 HB
Tool Diameter: 8,5 mm
Hole Depth: 30 mm

	Series A Drill	Conventional Drill
Cutting Speed:	3744 RPM	2447 RPM
Feed Rate:	44.3 IPM	13.3 IPM
	.012 IPR	.006 IPR
Tool Life: (no. of holes)	10,800	3,330



Metal Removal Series A drilled 320% more holes!

Recommended Speeds and Feeds: Series A *(see page 180 for metric recommendations)*

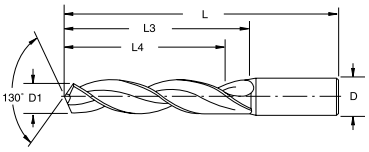
Workpiece Material	BHN	Cutting Speed (sfm)	Feeds (ipr) .125 (3 mm)	.250 (6 mm)	.375 (10 mm)	.500 (13 mm)	.625 (16 mm)	.750 (19 mm)
Gray Cast Iron	<180	400-525	.005-.008	.007-.011	.009-.015	.011-.019	.014-.023	.016-.027
	180-220	325-450	.005-.008	.007-.011	.009-.015	.011-.019	.014-.023	.016-.027
	>220	260-360	.004-.007	.006-.009	.007-.012	.010-.016	.012-.020	.015-.025
Ductile Iron								
Ferritic	—	200-265	.005-.008	.006-.010	.008-.012	.010-.016	.012-.019	.014-.024
Pearlitic	—	130-200	.004-.006	.005-.008	.006-.010	.008-.013	.010-.017	.016-.021
Titanium and Titanium Alloys	—	100-165	.001-.002	.002-.003	.003-.005	.004-.008	.006-.010	.008-.013
Copper Alloys	—	325-820	.007-.011	.009-.015	.011-.018	.013-.021	.014-.023	.015-.026
Magnesium Alloys	—	525-650	.004-.006	.006-.009	.008-.012	.009-.015	.010-.017	.012-.020
Aluminum Alloys								
Wrought	—	325-985	.004-.006	.007-.011	.010-.016	.013-.021	.016-.026	.018-.031
Aluminum < 10% Si	—	325-820	.004-.007	.007-.011	.010-.016	.013-.021	.016-.027	.020-.033
Aluminum >10% Si	—	325-650	.004-.006	.007-.011	.009-.015	.012-.020	.015-.025	.018-.030

The above recommendations are for hole depths up to 2 drill diameters. On deeper holes, feeds should be reduced 10% to 20%. Higher feed and speed values should be favored for softer material; lower feed and speed values should be used for harder materials. The above recommendations should be considered only as a starting point. Ultimate speeds and feeds will depend upon setup conditions and chip formation.

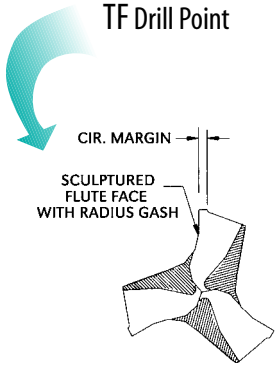
Series A

D1 inch	D1 mm	D1 inch	D	L	L3	L4	Uncoated EDP No.
—	3,0	0.1180	6	66	28	23	M10700
—	3,1	0.1220	6	66	28	23	M10701
1/8	—	0.1250	3/16	2.60	1.06	0.84	M10702
—	3,2	0.1260	6	66	28	23	M10710
30	—	0.1285	3/16	2.60	1.06	0.84	M10711
—	3,3	0.1300	6	66	28	23	M10712
—	3,5	0.1380	6	66	28	23	M10720
9/64	—	0.1406	3/16	2.60	1.06	0.84	M10721
—	3,7	0.1460	6	66	28	23	M10722
—	3,8	0.1500	6	74	36	29	M10730
5/32	—	0.1563	3/16	2.60	1.06	0.84	M10731
—	4,0	0.1570	6	74	36	29	M10732
—	4,1	0.1610	6	74	36	29	M10740
—	4,35	0.1713	6	74	36	29	M10741
11/64	—	0.1719	3/16	2.60	1.06	0.84	M10742
—	4,5	0.1770	6	74	36	29	M10750
—	4,65	0.1830	6	74	36	29	M10751
—	4,7	0.1850	6	74	36	29	M10752
3/16	—	0.1875	3/16	2.91	1.38	1.12	M10760
—	4,8	0.1890	6	82	44	35	M10761
—	5,0	0.1970	6	82	44	35	M10762
—	5,1	0.2010	6	82	44	35	M10770
—	5,2	0.2050	6	82	44	35	M10771
—	5,5	0.2170	6	82	44	35	M10772
7/32	—	0.2188	1/4	3.23	1.69	1.37	M10780
—	5,55	0.2190	6	82	44	35	M10781
—	5,7	0.2240	6	82	44	35	M10782
—	5,8	0.2280	6	82	44	35	M10790
—	6,0	0.2360	6	82	44	35	M10791
—	6,1	0.2400	8	91	53	43	M10792
—	6,3	0.2480	8	91	53	43	M10800
1/4	—	0.2500	1/4	3.23	1.69	1.37	M10801
—	6,4	0.2520	8	91	53	43	M10802
—	6,5	0.2560	8	91	53	43	M10810
—	6,6	0.2600	8	91	53	43	M10811
—	6,7	0.2640	8	91	53	43	M10812
17/64	—	0.2656	5/16	3.58	1.97	1.59	M10820
—	6,8	0.2680	8	91	53	43	M10821
—	7,0	0.2760	8	91	53	43	M10822
—	7,1	0.2800	8	91	53	43	M10830
9/32	—	0.2813	5/16	3.58	1.97	1.59	M10831
—	7,4	0.2910	8	91	53	43	M10832
—	7,5	0.2950	8	91	53	43	M10840
19/64	—	0.2969	5/16	3.58	1.97	1.59	M10841
—	7,6	0.2990	8	91	53	43	M10842
—	7,8	0.3070	8	91	53	43	M10850
5/16	—	0.3125	5/16	3.58	1.97	1.59	M10851
—	8,0	0.3150	8	91	53	43	M10852
—	8,1	0.3190	10	103	61	49	M10860
—	8,3	0.3270	10	103	61	49	M10861
21/64	—	0.3281	3/8	4.05	2.36	1.92	M10862
—	8,4	0.3310	10	103	61	49	M10870
—	8,5	0.3350	10	103	61	49	M10871
—	8,6	0.3390	10	103	61	49	M10872
—	8,7	0.3430	10	103	61	49	M10880
11/32	—	0.3438	3/8	4.05	2.36	1.92	M10881
—	8,8	0.3460	10	103	61	49	M10882
—	9,0	0.3540	10	103	61	49	M10890
—	9,1	0.3580	10	103	61	49	M10891
23/64	—	0.3594	3/8	4.05	2.36	1.92	M10892
—	9,3	0.3660	10	103	61	49	M10900

continued on next page







Tolerances

Inch Sizes

D1	tolerance k6
>.1181 to .2362	.0000/.0004
>.2362 to .3937	.0000/.0004
>.3937 to .7087	.0000/.0005
>.7087 to .7500	.0001/.0006

D	tolerance h6
.1875	-.0003/.0000
.2500 to .6875	-.0004/.0000
.7500	-.0005/.0000

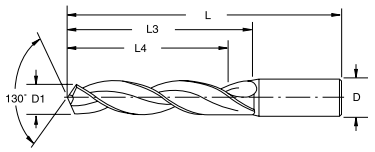
Metric Sizes

D1	tolerance k6
3	0,002/0,012
>3 to 6	0,004/0,016
>6 to 10	0,006/0,021
>10 to 18	0,007/0,025
>18 to 21	0,008/0,029

D	tolerance h6
6	-0,008/0,000
8 to 10	-0,009/0,000
12 to 18	-0,011/0,000
20	-0,013/0,000

Series A (continued)

D1 inch	D1 mm	D1 inch	D	L	L3	L4	Uncoated EDP No.
—	9,5	0.3740	10	103	61	49	M10901
3/8	—	0.3750	3/8	4.05	2.36	1.92	M10902
—	9,7	0.3820	10	103	61	49	M10910
—	9,8	0.3860	10	103	61	49	M10911
25/64	—	0.3906	7/16	4.37	2.60	2.09	M10912
—	10,0	0.3940	10	103	61	49	M10920
—	10,1	0.3980	12	118	71	56	M10921
—	10,2	0.4020	12	118	71	56	M10922
—	10,3	0.4060	12	118	71	56	M10930
13/32	—	0.4063	7/16	4.37	2.60	2.09	M10931
—	10,5	0.4130	12	118	71	56	M10932
—	10,7	0.4210	12	118	71	56	M10940
27/64	—	0.4219	7/16	4.37	2.60	2.09	M10941
—	10,8	0.4250	12	118	71	56	M10942
—	11,0	0.4330	12	118	71	56	M10950
—	11,1	0.4370	12	118	71	56	M10951
7/16	—	0.4375	7/16	4.37	2.6	2.09	M10952
—	11,2	0.4410	12	118	71	56	M10960
—	11,5	0.4530	12	118	71	56	M10961
29/64	—	0.4531	1/2	4.64	2.75	2.19	M10962
—	11,8	0.4650	12	118	71	56	M10970
15/32	—	0.4688	1/2	4.64	2.75	2.19	M10971
—	12,0	0.4720	12	118	71	56	M10972
—	12,1	0.4760	14	124	77	60	M10980
31/64	—	0.4844	1/2	4.64	2.75	2.19	M10981
—	12,5	0.4920	14	124	77	60	M10982
1/2	—	0.5000	1/2	4.64	2.75	2.19	M10990
—	12,7	0.5000	14	124	77	60	M10991
—	12,8	0.5040	14	124	77	60	M10992
—	13,0	0.5120	14	124	77	60	M11000
—	13,1	0.5160	14	124	77	60	M11001
—	13,5	0.5310	14	124	77	60	M11002
—	13,8	0.5430	14	124	77	60	M11010
—	14,0	0.5510	14	124	77	60	M11011
—	14,2	0.5590	16	133	83	63	M11012
9/16	—	0.5625	9/16	4.88	2.99	2.36	M11020
—	14,5	0.5710	16	133	83	63	M11021
—	15,0	0.5910	16	133	83	63	M11022
—	15,1	0.5940	16	133	83	63	M11030
—	15,5	0.6100	16	133	83	63	M11031
—	15,8	0.6220	16	133	83	63	M11032
5/8	—	0.6250	5/8	5.23	3.23	2.54	M11040
—	16,0	0.6300	16	133	83	63	M11041
—	16,5	0.6500	18	143	93	71	M11042
—	16,9	0.6650	18	143	93	71	M11050
—	17,0	0.6690	18	143	93	71	M11051
11/16	—	0.6875	11/16	5.63	3.62	2.87	M11052
—	17,5	0.6890	18	143	93	71	M11060
—	17,7	0.6970	18	143	93	71	M11061
—	18,0	0.7090	18	143	93	71	M11062
—	18,5	0.7280	20	153	101	77	M11070
—	19,0	0.7480	20	153	101	77	M11071
3/4	—	0.7500	3/4	5.82	3.74	2.93	M11072
—	19,5	0.7680	20	153	101	77	M11080
—	20,0	0.7870	20	153	101	77	M11081
—	20,5	0.8070	20	167	112	85	M11082
—	21,0	0.8270	20	167	112	85	M11090
29	—	0.1360	3/16	2.60	1.06	.84	M11910
24	—	0.1520	3/16	2.60	1.06	.84	M11911
LTR "G"	—	0.2610	5/16	3.58	1.97	1.59	M11912
—	6,90	0.2717	8	91	53	43	M11920
LTR"U"	—	0.3680	3/8	4.05	2.36	1.92	M11921
21/32	—	0.6563	11/16	5.63	3.62	2.87	M11922
49/64	—	0.7656	3/4	5.82	3.74	2.93	M11930





Tech Tip:

Controlled cutting edge honing and rounding combined with new chip flute profile ensure smooth chip evacuation.

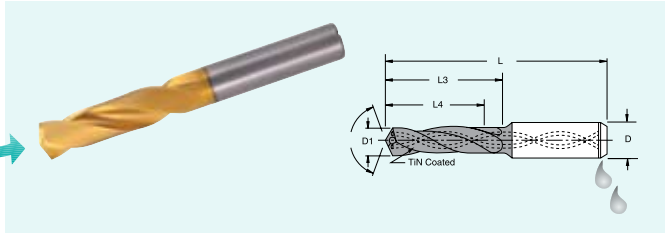
Lower cutting forces are distributed over three edges, resulting in longer tool life.

Series H for Harder Materials

Features

- 2-flute, right-hand spiral, right-hand cut
- SE point – 140° self-centering with sculptured edge
- Regular DIN 6539 length
- Parallel shanks
- Two internal spiral coolant holes
- TiN coated standard; other coatings available as specials

SE Drill Point



Applications

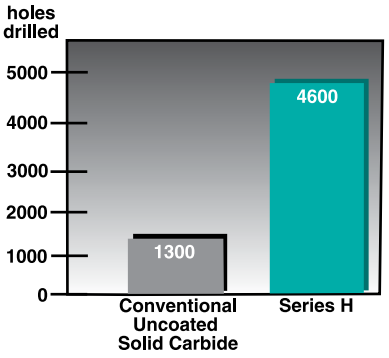
- Use in harder materials, including stainless steels, high-alloy steels, and high-temperature alloys.



Performance Comparison

Series H versus conventional uncoated carbide drill

Material:	tool steel	
Tool Diameter:	5.8 mm	
Hole Depth:	8.9 mm	
Coolant:	Internal	
	Series H Drill	Conventional Drill
Cutting Speed:	2305 RPM	2305 RPM
Feed Rate:	9.1 IPM	9.1 IPM
	.004 IPR	.004 IPR
Tool Life (no. of holes)	4600	1300



Metal Removal Series H drilled over 200% more holes!

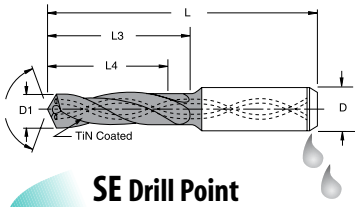
Recommended Speeds and Feeds: Series H *(see page 180 for metric recommendations)*

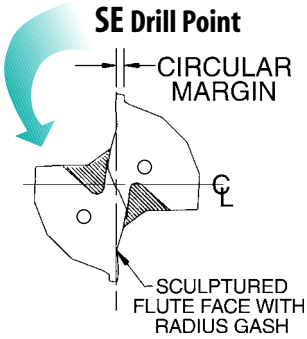
Workpiece Material	BHN	Cutting Speed (sfm)	Feed In Inches Per Revolution For Drill Diameter .1875 (4 mm)	.250 (6 mm)	.375 (10 mm)	.500 (13 mm)	.625 (16 mm)	.750 (19 mm)
Stainless Steel								
Austenitic	—	130-200	.002-.003	.002-.004	.004-.006	.006-.008	.008-.010	.009-.011
Ferritic/Martensitic	<215	160-230	.002-.004	.003-.005	.005-.007	.008-.010	.008-.0122	.010-.013
Ferritic/Martensitic	>215	140-230	.002-.004	.003-.005	.005-.006	.006-.007	.008-.009	.008-.010
High-Temperature Alloys								
Ni-base	—	50-80	.001-.002	.002-.003	.003-.004	.004-.005	.005-.006	.005-.007
Co-base	—	30-60	.001-.002	.002-.003	.003-.004	.004-.005	.005-.006	.005-.007
Fe-base	—	60-90	.001-.002	.002-.003	.003-.005	.004-.006	.005-.008	.006-.009
High-Alloyed Steel								
Alloyed Steel	<285	160-210	.002-.005	.003-.006	.005-.009	.006-.012	.007-.013	.008-.015
High-Alloyed Steel	>285	140-180	.002-.005	.003-.006	.005-.008	.005-.010	.006-.012	.007-.013

These recommendations are for hole depths up to 2 drill diameters. On deeper holes, speeds and feeds should be reduced 10% to 20%. Higher feed and speed values should be favored for softer material; lower feed and speed values should be used for harder materials. These recommendations should be considered only as a starting point. Ultimate speeds and feeds will depend upon setup conditions and chip formation.

Series H for Harder Materials

D1 inch	D1 mm	D1 inch	D	L	L3	L4	TiN Coated EDP No.
5/32	—	.1563	3/16	2.48	.91	.69	M11091
3/16	—	.1875	3/16	2.67	1.14	.89	M11092
—	5,0	.1970	6	66	28	20	M11100
—	5,1	.2010	6	66	28	20	M11101
—	5,5	.2170	6	66	28	20	M11102
7/32	—	.2188	1/4	2.87	1.34	1.02	M11110
—	6,0	.2360	6	66	28	20	M11112
—	6,1	.2400	8	79	34	24	M11120
1/4	—	.2500	1/4	2.87	1.34	1.02	M11121
—	6,5	.2560	8	79	34	24	M11122
17/64	—	.2656	5/16	3.11	1.50	1.11	M11130
—	7,0	.2760	8	79	34	24	M11140
9/32	—	.2813	5/16	3.11	1.50	1.11	M11141
—	7,5	.2950	8	79	34	24	M11142
19/64	—	.2969	5/16	3.11	1.50	1.11	M11150
—	7,8	.3070	8	79	34	24	M11151
5/16	—	.3125	5/16	3.11	1.50	1.11	M11152
—	8,0	.3150	8	79	34	24	M11160
21/64	—	.3281	3/8	3.50	1.81	1.37	M11162
—	8,5	.3350	10	89	47	35	M11171
11/32	—	.3438	3/8	3.50	1.81	1.37	M11181
—	9,0	.3540	10	89	47	35	M11182
23/64	—	.3594	3/8	3.50	1.81	1.37	M11190
—	9,5	.3740	10	89	47	35	M11191
3/8	—	.3750	3/8	3.50	1.81	1.37	M11192
—	9,8	.3860	10	89	47	35	M11200
25/64	—	.3906	7/16	3.78	2.01	1.50	M11201
—	10,0	.3940	10	89	47	35	M11202
—	10,2	.4020	12	102	55	40	M11210
13/32	—	.4063	7/16	3.78	2.01	1.50	M11211
—	10,5	.4130	12	102	55	40	M11220
27/64	—	.4219	7/16	3.78	2.01	1.50	M11221
—	11,0	.4330	12	102	55	40	M11222
7/16	—	.4375	7/16	3.78	2.01	1.50	M11230
—	11,5	.4530	12	102	55	40	M11232
29/64	—	.4531	1/2	4.01	2.13	1.56	M11240
15/32	—	.4688	1/2	4.01	2.13	1.56	M11241
—	12,0	.4720	12	102	55	40	M11242
—	12,2	.4800	14	107	60	43	M11250
31/64	—	.4844	1/2	4.01	2.13	1.56	M11251
—	12,5	.4920	14	107	60	43	M11252
1/2	—	.5000	1/2	4.01	2.13	1.56	M11260
—	13,0	.5120	14	107	60	43	M11262
—	13,5	.5310	14	107	60	43	M11270
9/16	—	.5625	9/16	4.21	2.32	1.69	M11281
—	15,0	.5910	16	115	65	45	M11290
5/8	—	.6250	5/8	4.52	2.52	1.83	M11292
—	16,5	.6500	18	123	73	51	M11301
—	17,0	.6690	18	123	73	51	M11302
11/16	—	.6875	11/16	4.84	2.83	2.09	M11310
—	17,5	.6890	18	123	73	51	M11311
3/4	—	.7500	3/4	5.08	2.99	2.19	M11322





Drilling Depth

Inch Sizes

.125	= 7 x Dia.
.250	= 5.5 x Dia.
.375	= 5 x Dia.
.500	= 4.25 x Dia.
.625	= 4 x Dia.
.750	= 3.75 x Dia.

Metric Sizes

4,0	= 7 x Dia.
6,5	= 6.5 x Dia.
9,5	= 5 x Dia.
12,5	= 4.5 x Dia.
16,0	= 4 x Dia.
20,0	= 3.75 x Dia.
25,0	= 4 x Dia.

Tolerances

Inch Sizes

D1	tolerance m7
>.1181 to .2362	.0002/.0006
>.2362 to .3937	.0002/.0008
>.3937 to .7087	.0003/.0010
>.7087 to .7500	.0003/.0011

D	tolerance h6
>.1181 to .2362	-.0003/.0000
>.2362 to .3937	-.0004/.0000
>.3937 to .7087	-.0004/.0000
>.7087 to .7500	-.0005/.0000

Metric Sizes

D1	tolerance m7
>3 to 6	0,004/0,016
>6 to 10	0,006/0,021
>10 to 18	0,007/0,025
>18 to 20	0,008/0,029

D	tolerance h6
>3 to 6	-0,008/0,000
>6 to 10	-0,009/0,000
>10 to 18	-0,011/0,000
>18 to 20	-0,013/0,000

Tech Tip:

New chip flute profile ensures smooth chip evacuation.

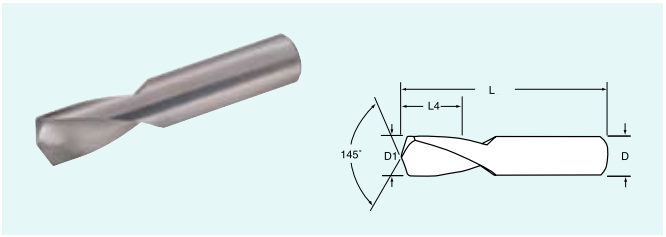
Lower cutting forces help extend tool life.

Series 295 Spotting Drill

NEW STYLE

Features

- 2-flute, right-hand spiral, right-hand cut
- Point: 145°
- Short length
- Common shanks
- Bright or TiAlN coated standard; other coatings available as modifications



Applications

- Use for predrilling spotting holes for high-performance drills in most steels, cast irons, and high-temperature alloys.



Series 295 – Spotting Drill

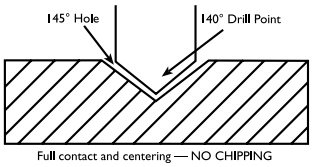
D1 inch	D1 inch	D	L	L3	L4	Uncoated EDP No.	TiAlN Coated EDP No.
1/4	.2500	1/4	2-1/2	—	1/2	M11332	M15076
3/8	.3750	3/8	2-1/2	—	3/4	M11340	M15086
1/2	.5000	1/2	3	—	1	M11341	M15096
3/4	.7500	3/4	4	—	1-1/2	M11342	M15106

Tolerances

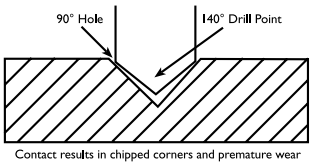
Inch Sizes

D1	tolerance m7
.2500	.0002/.0008
.3750	.0002/.0008
.5000	.0003/.0010
7500	.0003/.0011

D	tolerance h6
.2500-.5000	-.0004/.0000
.7500	-.0005/.0000



The Series 295 spotting drills use a stronger 145° point which assures the best positioning in the hole and increased edge protection for the follow-up drill.



Most conventional spotting drills use a 90° or 120° point, which can cause problems in carbide drilling. The corners of the follow-up drill hit the workpiece materal in the steep-walled starting hole when the drill locates itself, creating premature wear and chipping.

Tech Tip:

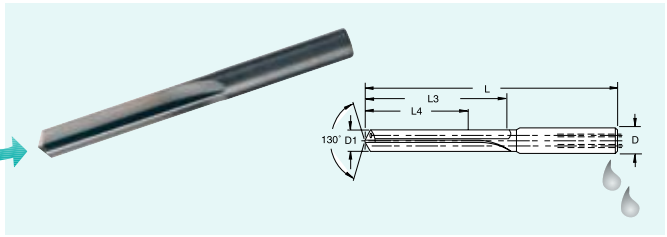
145° point angle makes a wider spotting hole.

Full contact and centering of the following drill eliminates chipping on drill corners.

Series 238 Straight Flutes

Features

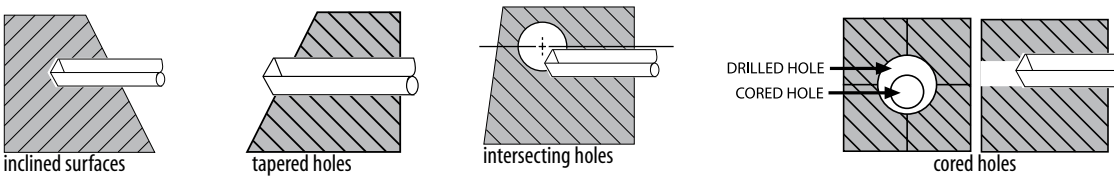
- 2 straight, double-margin flutes
- TX Point –130° 4-facet, web-thinned
- Regular DIN 6539 length
- Common shanks
- Sharp cutting edges
- Bright tools standard; coated tools available as a modification



Applications

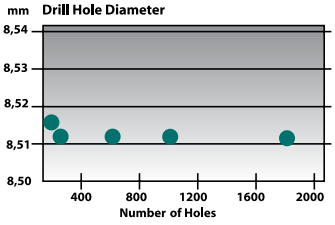
- Use in a wide variety of applications including inclined surfaces, tapered holes, intersecting holes, and cored holes.
- Straight flutes provide better chip evacuation.
- Use in applications where through coolant is required.
- For use in ductile and gray cast irons, free-machining aluminum alloys, and other non-ferrous workpiece materials.

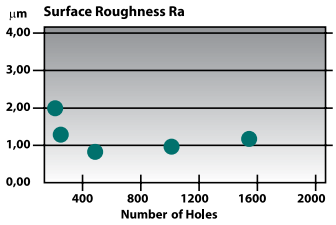




Hole Finish Performance

Material:	AiSi 12
Tool Diameter:	8,5 mm
Hole Depth:	30 mm
Cutting Speed:	160 m/min
Feed Rate:	0,23 mm/min





Metal Removal Series 238 consistently drilled fine quality holes.

Recommended Speeds and Feeds: Series 238 *(see page 181 for metric recommendations)*

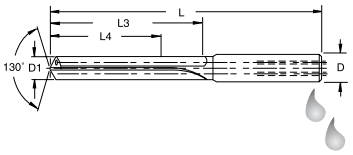
Workpiece Material	BHN	Cutting Speed	Feeds .152 (4 mm)	.236 (6 mm)	.315 (8 mm)	.472 (12 mm)	.630 (16 mm)	.787 (20 mm)	.984 (25 mm)
Malleable Cast Iron									
white	≤ 250	260–293	.003–.005	.005–.007	.006–.008	.007–.009	.008–.011	.0095–.012	.010–.013
black	≤ 250	260–293	.003–.005	.005–.007	.006–.008	.007–.009	.008–.011	.0095–.012	.010–.013
Gray Cast Iron									
GG20	≤ 180	293–390	.004–.006	.006–.008	.007–.009	.008–.010	.0095–.012	.011–.013	.012–.016
GG30	≤ 220	260–325	.004–.006	.006–.008	.007–.009	.008–.010	.0095–.012	.011–.013	.012–.016
GG40	> 220	228–293	.003–.005	.005–.007	.006–.008	.007–.009	.008–.011	.0095–.012	.010–.013
Nodular Cast Iron									
Ferritic	≤ 220	228–293	.003–.005	.005–.007	.006–.008	.007–.009	.008–.011	.0095–.012	.010–.013
Pearlitic	> 220	211–276	.0025–.004	.003–.006	.005–.007	.006–.008	.0075–.0095	.009–.010	.0095–.012
Aluminium Alloys									
Cast Aluminium Alloys ≤ 10% Si	—	325–845	.003–.006	.005–.0075	.007–.009	.0075–.0095	.009–.011	.0095–.0125	.010–.016
Cast Aluminium Alloys ≤ 16% Si	—	293–780	.003 -.006	.005–.0075	.007–.009	.0075–.0095	.009–.011	.0095–.0125	.010–.016

The above recommendations are for hole depths up to 2 drill diameters. On deeper holes, feeds should be reduced 10% to 20%. Higher feed and speed values should be favored for softer material; lower feed and speed values should be used for harder materials. The above recommendations should be considered only as a starting point. Ultimate speeds and feeds will depend upon setup conditions and chip formation.

Series 238 – Straight Flutes

D1 inch	D1 mm	D1 inch	D	L	L3	L4	Uncoated EDP No.
1/8	—	.1250	.1875	2.598	1.083	.843	M11350
—	3,2	.1260	6	66	28	23	M11351
—	3,3	.1299	6	66	28	23	M11352
9/64	—	.1406	.1875	2.598	1.083	.843	M11360
—	3,8	.1496	6	74	36	29	M11361
5/32	—	.1563	.1875	2.598	1.083	.843	M11362
—	4,0	.1575	6	74	36	29	M11370
—	4,2	.1653	6	74	36	29	M11371
11/64	—	.1719	.1875	2.913	1.398	1.126	M11372
—	4,5	.1772	6	74	36	29	M11380
—	4,6	.1811	6	74	36	29	M11381
—	4,65	.1831	6	74	36	29	M11382
3/16	—	.1875	.1875	2.913	1.398	1.126	M11390
—	4,8	.1890	6	82	44	35	M11391
—	4,9	.1929	6	82	44	35	M11392
—	5,0	.1968	6	82	44	35	M11400
—	5,1	.2008	6	82	44	35	M11401
13/64	—	.2031	.2500	3.228	1.713	1.374	M11402
—	5,2	.2047	6	82	44	35	M11410
—	5,5	.2165	6	82	44	35	M11411
—	5,55	.2185	6	82	44	35	M11412
7/32	—	.2188	.2500	3.228	1.713	1.374	M11420
—	5,8	.2283	6	82	44	35	M11421
15/64	—	.2344	.2500	3.228	1.713	1.374	M11422
—	6,0	.2362	6	82	44	35	M11430
—	6,3	.2480	6	91	53	43	M11431
1/4	—	.2500	.2500	3.228	1.713	1.374	M11432
—	6,4	.2520	6	91	53	43	M11440
—	6,5	.2559	6	91	53	43	M11441
—	6,6	.2598	6	91	53	43	M11442
17/64	—	.2656	.3125	3.582	1.988	1.587	M11450
—	6,8	.2677	6	91	53	43	M11451
—	7,0	.2756	6	91	53	43	M11452
9/32	—	.2812	.3125	3.582	1.988	1.587	M11460
—	7,4	.2913	6	91	53	43	M11461
—	7,5	.2953	6	91	53	43	M11462
19/64	—	.2969	.3125	3.582	1.988	1.587	M11470
—	7,8	.3071	6	91	53	43	M11471
5/16	—	.3125	.3125	3.582	1.988	1.587	M11472
—	8,0	.3150	6	91	53	43	M11480
21/64	—	.3281	.3750	4.055	2.382	1.917	M11481
—	8,4	.3307	10	103	61	49	M11482
—	8,5	.3346	10	103	61	49	M11490
11/32	—	.3438	.3750	4.055	2.382	1.917	M11491
—	9,0	.3543	10	103	61	49	M11492
23/64	—	.3594	.3750	4.055	2.382	1.917	M11500
—	9,3	.3661	10	103	61	49	M11501
—	9,5	.3740	10	103	61	49	M11502
3/8	—	.3750	.3750	4.055	2.382	1.917	M11510
—	9,8	.3858	10	103	61	49	M11511
25/64	—	.3906	.4375	4.370	2.618	2.090	M11512
—	10,0	.3937	10	103	61	49	M11520
—	10,2	.4016	12	118	71	56	M11521
13/32	—	.4063	.4375	4.370	2.618	2.090	M11522
—	10,5	.4134	12	118	71	56	M11530
27/64	—	.4219	.4375	4.370	2.618	2.090	M11531
—	11,0	.4331	12	118	71	56	M11532
7/16	—	.4375	.4375	4.370	2.618	2.090	M11540
—	11,2	.4409	12	118	71	56	M11541

continued on next page





Drilling Depth

Inch Sizes

.125	= 7 x Dia.
.250	= 5.5 x Dia.
.375	= 5 x Dia.
.500	= 4.25 x Dia.
.625	= 4 x Dia.
.750	= 3.75 x Dia.

Metric Sizes

4,0	= 7 x Dia.
6,5	= 6.5 x Dia.
9,5	= 5 x Dia.
12,5	= 4.5 x Dia.
16,0	= 4 x Dia.
20,0	= 3.75 x Dia.
25,0	= 4 x Dia.

Tolerances

Inch Sizes

D1	tolerance k6
>.1181 to .2362	.0000/.0004
>.2362 to .3937	.0000/.0004
>.3937 to .7087	.0000/.0005

D	tolerance h6
.1875	-.0003/.0000
.2500 to .6250	-.0004/.0000
.7500	-.0005/.0000

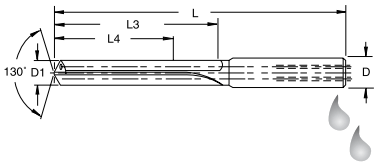
Metric Sizes

D1	tolerance k6
>3 to 6	0,001/0,009
>6 to 10	0,001/0,010
>10 to 18	0,007/0,025
>18 to 25	0,008/0,029

D	tolerance h6
6	-0,008/0,000
8 to 10	-0,009/0,000
12 to 18	-0,011/0,000
20 to 25	-0,013/0,000

Series 238 Straight Flutes (continued)

D1 inch	D1 mm	D1 inch	D	L	L3	L4	Uncoated EDP No.
—	11,5	.4527	12	118	71	56	M11542
29/64	—	.4531	.5000	4.646	2.776	2.189	M11550
—	11,8	.4646	12	118	71	56	M11551
15/32	—	.4688	.5000	4.646	2.776	2.189	M11552
—	12,0	.4724	12	118	71	56	M11560
31/64	—	.4844	.5000	4.646	2.776	2.189	M11561
—	12,5	.4921	14	124	77	60	M11562
1/2	—	.5000	.5000	4.646	2.776	2.189	M11570
—	13,0	.5118	14	124	77	60	M11571
33/64	—	.5156	.5625	4.882	3.012	2.362	M11572
17/32	—	.5313	.5625	4.882	3.012	2.362	M11580
—	13,5	.5315	14	124	77	60	M11581
—	13,8	.5433	14	124	77	60	M11582
35/64	—	.5469	.5625	4.882	3.012	2.362	M11590
—	14,0	.5512	14	124	77	60	M11591
—	14,2	.5590	16	133	83	63	M11592
9/16	—	.5625	.5625	4.882	3.012	2.362	M11600
—	14,5	.5709	16	133	83	63	M11601
37/64	—	.5781	.6250	5.236	3.248	2.539	M11602
—	15,0	.5905	16	133	83	63	M11610
19/32	—	.5938	.6250	5.236	3.248	2.539	M11611
39/64	—	.6094	.6250	5.236	3.248	2.539	M11612
—	15,5	.6102	16	133	83	63	M11620
5/8	—	.6250	.6250	5.236	3.248	2.539	M11621
—	16,0	.6299	16	133	83	63	M11622
—	16,5	.6496	18	143	93	71	M11630
—	17,0	.6693	18	143	93	71	M11631
—	17,5	.6890	18	143	93	71	M11632
—	18,0	.7086	18	143	93	71	M11640
—	19,0	.7480	20	153	101	77	M11641
—	19,5	.7677	20	153	101	77	M11642
—	20,0	.7874	20	153	101	77	M11650
—	21,0	.8267	20	153	101	77	M11651
—	22,0	.8661	20	153	101	77	M11652
—	23,0	.9055	25	184	125	98	M11660
—	24,0	.9449	25	184	125	98	M11661
—	25,0	.9842	25	184	125	98	M11662







Tech Tip:

Straight flutes provide better chip evacuation and minimum drag on hole walls.

Unique TX self-centering point gives better drill penetration.

Double margin design provides extra stability.

Large internal coolant holes reduce heat and aid chip evacuation.

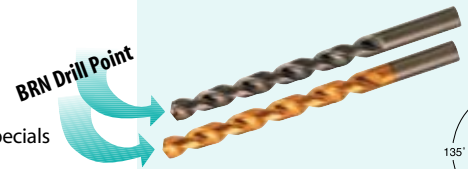
Drill bushings not required.

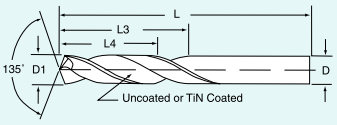
Eliminates need for spot drilling and reaming.

Series 265 for Deep-Hole Drilling

Features

- 2-flute, 38° helix parabolic, right-hand spiral, right-hand cut
- BRN point – 135° radial relieved, web thinned
- Jobber DIN 338 length
- Parallel shanks
- Bright or TiN coated standard; other coatings available as specials





Applications

- Designed for drilling deep holes up to 8 x diameter without pecking; up to 12 x diameter with pecking.
- Use in steels, cast irons, low-silicon aluminum alloys, and miscellaneous non-ferrous materials.

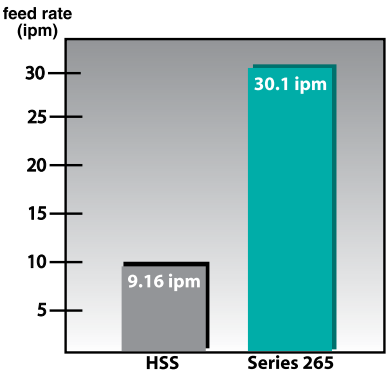


Performance Comparison

Series 265 versus conventional cobalt parabolic drill

Material:	Gray Iron Ferritic	
Tool Diameter:	3/8"	
Hole Depth:	2" (5-1/2 x Dia.)	
Coolant:	Water Soluble	
	Series 265 Drill	Cobalt Parabolic Drill
Cutting Speed:	295 SFM 3005 PRM	90 SFM 916RPM
Feed Rate:	30.1 IPM	9.16 IPM
Cycle Time:	.066	.218

Series 265 drilled 330% faster than the conventional drill.



Recommended Speeds and Feeds: Series 265 *(see page 181 for metric recommendations)*

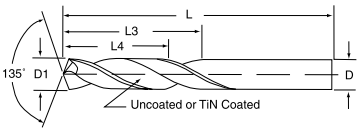
Workpiece Material	Hardness Brinnell / Rc	Cutting Speeds (SFM) Bright	Cutting Speeds (SFM) Coated	Feeds .125" (3 mm)	Feeds .250" (6 mm)	Feeds .375" (10 mm)	Feeds .500" (13 mm)
Aluminum	—	400 - 470	500 - 575	0.006	0.010	0.012	0.014
High Si Aluminum	—	300 - 370	400 - 470	0.004	0.008	0.010	0.012
Copper, Copper Alloys	—	200 - 250	250 -325	0.004	0.006	0.009	0.010
Brass	—	275 - 300	300 - 350	0.004	0.006	0.009	0.010
Bronze	—	145 - 185	185 - 235	0.003	0.005	0.006	0.008
Cast Iron	120 - 220 BHN	200 - 245	250 - 300	0.005	0.008	0.010	0.012
	220 - 320 BHN	150 - 195	200 - 245	0.005	0.008	0.010	0.012
Malleable Iron	110-200 BHN	175 - 240	240 - 270	0.005	0.008	0.010	0.012
	200-255 BHN	145 - 175	195 - 240	0.005	0.008	0.010	0.012
	255-320 BHN	100 - 145	165 - 195	0.005	0.008	0.010	0.012
Ductile or Nodular Iron	110-200 BHN	150 - 215	215 - 250	0.005	0.008	0.010	0.012
	200-255 BHN	120 - 150	170 - 215	0.005	0.008	0.010	0.012
	255-320 BHN	75 - 120	140 - 170	0.005	0.008	0.010	0.012
Carbon Steel	<150	N/A	225 - 300	0.003	0.006	0.009	0.013
	150-180	N/A	175 - 225	0.003	0.005	0.007	0.010
	>180	N/A	150 - 175	0.002	0.004	0.007	0.009
Alloy Steel	<275	N/A	200 - 275	0.003	0.006	0.009	0.013
	275-425	N/A	150 - 200	0.003	0.005	0.007	0.010
	45RC-48RC	N/A	100 - 150	0.002	0.004	0.007	0.009
Tool Steel	100-250	N/A	100 - 150	0.003	0.005	0.007	0.010

The above recommendations are for hole depths up to 4 drill diameters. When hole depths run 5 to 6 diameters, both speeds and feeds should be reduced 10% to 20%. Higher feed and speed values should be favored for softer material; lower feed and speed values should be used for harder materials. These recommendations should be considered only as a starting point. Final recommendations will depend on your individual testing and success.

Series 265 for Deep-Hole Drilling

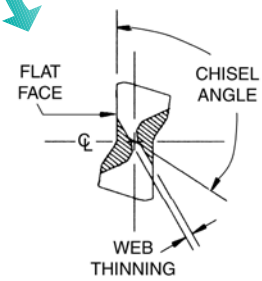
D1 inch	D1 mm	D1 inch	D	L	L3	L4	Uncoated EDP No.	TiN Coated EDP No.
1/8	—	.1250	1/8	2-1/2	1-1/2	1.262	M11670	M16333
30	—	.1285	.1285	2-1/2	1-1/2	1.262	M11671	M16343
29	—	.1360	.136	2-3/4	1-1/2	1.358	M11672	M16353
—	3,5	.1378	3,5	70	39	34,5	M11680	M16363
9/64	—	.1406	9/64	2-3/4	1-1/2	1.358	M11681	M16373
27	—	.1440	.144	2-3/4	1-1/2	1.358	M11682	M16383
26	—	.1470	.147	2-3/4	1-1/2	1.358	M11690	M16393
25	—	.1495	.1495	3	1-3/4	1.493	M11691	M16403
24	—	.1520	.152	3	1-3/4	1.493	M11692	M16413
23	—	.1540	.154	3	1-3/4	1.493	M11700	M16423
5/32	—	.1562	5/32	3	1-3/4	1.493	M11701	M16433
22	—	.1570	.157	3	1-3/4	1.493	M11702	M16443
—	4,0	.1575	4,0	75	43	37,9	M11710	M16453
21	—	.1590	.159	3	1-3/4	1.493	M11711	M16463
20	—	.1610	.161	3	1-3/4	1.493	M11712	M16473
19	—	.1660	.166	3	1-3/4	1.493	M11720	M16483
18	—	.1695	.1695	3-1/4	2	1.666	M11721	M16493
11/64	—	.1719	11/64	3-1/4	2	1.666	M11722	M16503
17	—	.1730	.173	3-1/4	2	1.666	M11730	M16513
—	4,5	.1772	4,5	80	48	42,3	M11731	M16523
15	—	.1800	.18	3-1/4	2	1.666	M11732	M16533
14	—	.1820	.182	3-1/4	2	1.666	M11740	M16543
13	—	.1850	.185	3-1/4	2	1.666	M11741	M16553
3/16	—	.1875	3/16	3-1/2	2-1/4	1.878	M11742	M16563
12	—	.1890	.189	3-1/2	2-1/4	1.878	M11750	M16573
11	—	.1910	.191	3-1/2	2-1/4	1.878	M11751	M16583
10	—	.1935	.1935	3-1/2	2-1/4	1.878	M11752	M16593
9	—	.1960	.196	3-1/2	2-1/4	1.878	M11760	M16603
—	5,0	.1969	5,0	86	54	47,7	M11761	M16613
8	—	.1990	.199	3-1/2	2-1/4	1.878	M11762	M16623
7	—	.2010	.201	3-1/2	2-1/4	1.878	M11770	M16633
13/64	—	.2031	.2031	3-1/2	2-1/4	1.878	M11771	M16643
6	—	.2040	.204	3-1/2	2-1/4	1.878	M11772	M16653
5	—	.2055	.2055	3-1/2	2-1/4	1.878	M11780	M16663
4	—	.2090	.209	3-3/4	2-1/2	2.116	M11781	M16673
3	—	.2130	.213	3-3/4	2-1/2	2.116	M11782	M16683
—	5,5	.2165	5,5	93	61	53,8	M11790	M16693
7/32	—	.2188	7/32	3-3/4	2-1/2	2.116	M11791	M16703
2	—	.2210	.221	3-3/4	2-1/2	2.116	M11792	M16713
1	—	.2280	.228	3-3/4	2-1/2	2.116	M11800	M16723
15/64	—	.2344	15/64	3-3/4	2-1/2	2.116	M11801	M16733
—	6,0	.2362	6,0	93	61	53,8	M11802	M16743
1/4 - E	—	.2500	1/4	4	2-3/4	2.116	M11810	M16753
—	6,5	.2559	6,5	101	69	61,0	M11811	M16763
F	—	.2570	.257	4	2-3/4	2.401	M11812	M16773
17/64	—	.2656	17/64	4-1/4	3	2.401	M11820	M16783
—	7,0	.2756	7,0	109	77	61,0	M11821	M16793
9/32	—	.2812	9/32	4-1/4	3	2.401	M11822	M16803
—	7,5	.2953	7,5	109	77	61,0	M11830	M16813
19/64	—	.2969	19/64	4-1/2	3-1/4	2.401	M11831	M16823
5/16	—	.3125	5/16	4-1/2	3-1/4	2.675	M11832	M16833
—	8,0	.3150	8,0	117	84	67,9	M11840	M16843
21/64	—	.3281	21/64	4-1/2	3-1/4	2.675	M11841	M16853
Q	—	.3320	.332	4-1/2	3-1/4	2.675	M11842	M16863
—	8,5	.3346	8,5	117	84	67,9	M11850	M16873
11/32	—	.3438	11/32	5	3-1/2	2.675	M11851	M16883
—	9,0	.3543	9,0	125	91	67,9	M11852	M16893
23/64	—	.3594	23/64	5	3-1/2	2.675	M11860	M16903

continued on next page





BRN Drill Point



Tolerances

Inch Sizes

D1	tolerance h7
>.1181 to .2362	-.0005/.0000
>.2362 to .3937	-.0006/.0000
>.3937 to .5000	-.0007/.0000

D	tolerance h7
>.1181 to .2362	-.0005/.0000
>.2362 to .3937	-.0006/.0000
>.3937 to .5000	-.0007/.0000

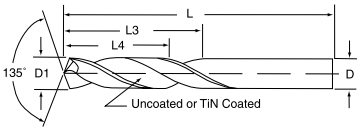
Metric Sizes

D1	tolerance h7
>3 to 6	-0,012/0,000
>6 to 10	-0,015/0,000
>10 to 12	-0,018/0,000

D	tolerance h7
>3 to 6	-0,012/0,000
>6 to 10	-0,015/0,000
>10 to 12	-0,018/0,000

Series 265 for Deep-Hole Drilling (continued)

D1 inch	D1 mm	D1 inch	D	L	L3	L4	Uncoated EDP No.	TiN Coated EDP No.
U	—	.3680	.368	5	3-1/2	2.903	M11861	M16913
3/8	—	.3750	3/8	5-1/4	4	2.903	M11862	M16923
25/64	—	.3906	25/64	5-1/4	4	2.903	M11870	M16933
—	10,0	.3937	10,0	133	99	73,7	M11871	M16943
13/32	—	.4062	13/32	5-1/4	4	2.903	M11872	M16953
27/64	—	.4219	27/64	5-1/2	4-1/4	2.903	M11880	M16963
—	11,0	.4331	11,0	142	106	73,7	M11881	M16973
7/16	—	.4375	7/16	5-1/2	4-1/4	2.903	M11882	M16983
29/64	—	.4531	29/64	5-1/2	4-1/4	2.903	M11890	M16993
15/32	—	.4688	15/32	6	4-1/2	3.131	M11891	M17003
—	12,0	.4724	12,0	151	115	79,5	M11892	M17013
31/64	—	.4844	31/64	6	4-1/2	3.131	M11900	M17023
1/2	—	.5000	1/2	6	4-1/2	3.131	M11901	M17033





Tech Tip:

Designed for effective drilling up to 8 x diameter without pecking.

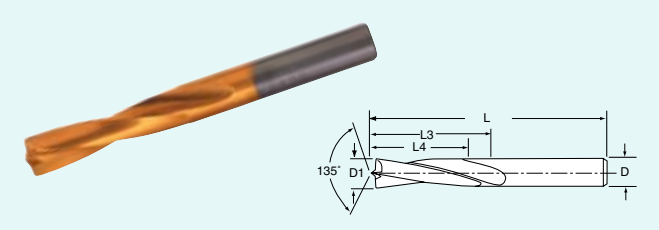
Drills effectively with pecking up to 12 x diameter.

Special parabolic flute design provides rapid chip evacuation.

One Shot™

Features

- 2-flute, right-hand spiral, right-hand cut, coolant holes optional
- 135° self-centering point
- Regular DIN 6537 length
- Parallel shanks



Applications

- Guaranteed to center drill, drill, ream, and chamfer in one operation while achieving high-precision holes in high-volume, high production jobs.
- Specify design selected for the workpiece material.



Tech Tip:
Custom engineered to your specifications to center, drill, ream, and chamfer in one pass.
See Quotation Request on next page to order.

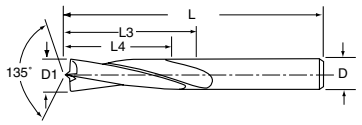
Recommended Speeds and Feeds: One Shot *(see page 182 for metric recommendations)*

Workpiece Material	BHN	Cutting Speeds (sfm)	Feeds .1875"	.250"	.500"	.750"
Carbon Steel	250-525	250-525	.004	.005	.008	.010
Alloy Steel						
Free-Machining	150-375	250-425	.004	.005	.006	.008
	376-425	190-225	.002	.0906	.004	.006
Wrought	150-350	225-400	.004	.0047	.0055	.008
	350-425	190-220	.002	.003	.004	.006
Tool Steel						
HS Annealed	–	225-300	.003	.0045	.0055	.007
Hot & Cold Work Annealed	–	200-300	.004	.005	.006	.008
Iron						
Gray	120-200	300-575	.004	.005	.008	.010
P&C	210-320	125-275	.002	.003	.005	.007
Austenitic	–	175-300	.002	.003	.005	.007
Ductile Irons						
Ferritic	140-225	300-500	.004	.008	.009	.010
(F&P)	225-300	210-300	.003	.004	.007	.009
(M)	310-400	90-150	.002	.003	.005	.007
(A)	140-275	90-125	.0015	.0025	.004	.006
Malleable Iron						
Ferritic	110-245	300-550	.004	.005	.008	.012
Martensitic	200-255	225-300	.002	.003	.005	.006
Tempered	240-320	150-200	.0015	.0025	.005	.005

These recommendations are for hole depths up to 2 drill diameters. On deeper holes, speeds and feeds should be reduced 10% to 20%. Higher feed and speed values should be favored for softer material; lower feed and speed values should be used for harder materials. These recommendations should be considered only as a starting point. Ultimate speeds and feeds will depend upon setup conditions and chip formation.

ONE SHOT™ Drill Quotation Request

Fax to Carbide Special Quotations, Toll-Free 888-434-4001 or 706-860-6021

User:		**Distributor**:	
Contact		Contact	
Company Name		Company name	
Street Address		Distributor Sales Rep	
City/State/Zip			
Telephone No.	Fax No.		
Drill Diameter (D1)	Flute Length (L3)		
Shank Diameter(D)	Overall Length (L)		
Length of Cut (L4)	Drill Depth Required	Hole Size	Hole Tolerance
Material to be Drilled	Hardness	Hole Type ❑ Through ❑ Blind ❑ *Inclined Surface* ❑ *Tapered Hole* ❑ *Intersecting Hole* ❑ *Cored Hole*	

Options

Coating (circle one)

TiN (Titanium Nitride)

TiCN (Titanium Carbon Nitride)

TiAlN (Titanium Aluminum Nitride)

Other _____

_____

Coolant Hole: (circle one)

No _____

Yes, on center line with exit holes _____

Yes, spiral to follow flutes _____

Tang _____

Dimensions for non-industry standard tangs or flutes must be furnished by customer.

Other _____

_____

Notes:

_____

_____

_____

_____

_____

_____

_____

Quantity Required

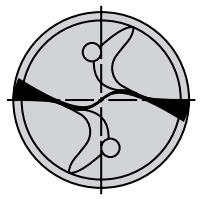
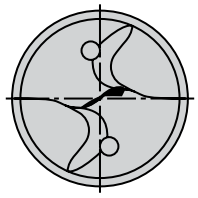
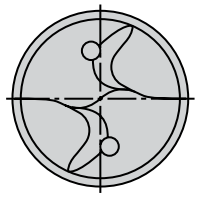
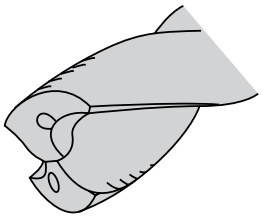
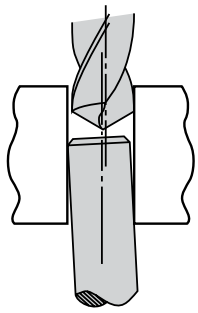
Expected Usage

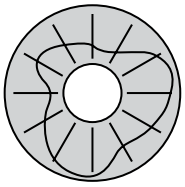
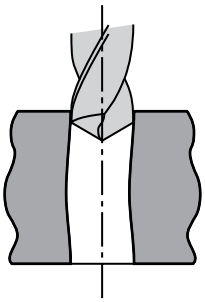
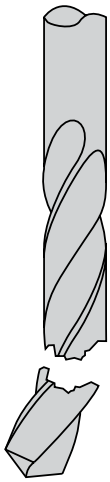
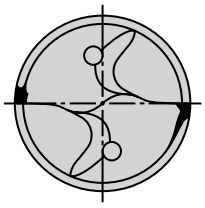
Maintain the improved productivity that Metal Removal's high-performance drills deliver. Demand high quality regrinding and perfect replication of the original point design. Your reconditioned drills are guaranteed to provide consistent performance - even after regrinding!

- ✔ Consistent performance
- ✔ Maximized tool life
- ✔ Guaranteed quality
- ✔ Simple, fast, and competitively priced

Don't take chances with your carbide drill inventory.

Contact your local Metal Removal distributor, or Metal Removal customer service at 888-434-4311 or 706-863-7708 for details.

Problem		Source	Solution
	Heavy wear on the cutting corners	Insufficient coolant	Check cooling lubricant. For internal coolant supply, increase coolant pressure. For external coolant supply, improve arrangement of coolant jet. Cool from both sides.
		Cutting conditions	Reduce cutting speed, increase feed.
	Splintering on the chisel edge	Clamping chuck	Check clamping accuracy. Use hydraulic clamping chuck or high precision chucking system.
		Cutting conditions	Increase feed.
	Splintering on the cutting edges	Clamping chuck	Check clamping accuracy and torque transmission. Use hydraulic clamping chuck or high precision chucking system.
		Cutting conditions	Check cutting values, and possibly, increase cutting speed.
	Splintering on the lands	Workpiece movement	Stabilize workpiece chucking and check stability of machine tool.
		Insufficient coolant	Check cooling lubricant. For internal coolant supply, increase coolant pressure. For external coolant supply, improve arrangement of coolant jet. Cool from both sides.
		Wrong drill	Check drill type, drilling depth, cooling system, and workpiece material.
		Cutting conditions	Check cutting values, and possibly increase feed. When spot-drilling, reduce feed.
	Hole too big	Cutting conditions	Check cutting values, increase cutting speed or reduce feed.
		Clamping chuck	Check clamping accuracy and torque transmission. Use hydraulic clamping chuck or high precision chucking system.
		Wrong drill	Check drill diameter. Please notice, drills are ground in a positive tolerance. Check concentric running.

Problem		Source	Solution
	Hole too small	Insufficient coolant	Check cooling lubricant. For internal coolant supply, increase coolant pressure. For external coolant supply, improve arrangement of coolant jet. Cool from both sides.
		Cutting conditions	Reduce cutting speed, increase feed.
		Wrong drill	Check cutting-edge diameter.
	Hole not cylindrical	Clamping chuck	Check clamping accuracy and torque transmission. Use hydraulic clamping chuck or high precision chucking system.
		Workpiece movement	Stabilize workpiece chucking and check stability of machine tool.
		Wrong drill	Check drill type and drilling depth. Use longer drills.
		Cutting conditions	Increase feed. When spot drilling, reduce feed.
	Drill breakage	Clamping chuck	Check clamping accuracy and torque transmission. Use hydraulic clamping chuck or high-precision chucking system.
		Workpiece movement	Stabilize workpiece chucking and check stability of machine tool.
		Wrong drill	Check drill type, drilling depth, cooling system, and workpiece material.
		Insufficient coolant	Check cooling lubricant. For internal coolant supply, increase coolant pressure. For external coolant supply, improve arrangement of coolant jet. Cool from both sides.
		Cutting conditions	Check cutting values and possibly, reduce feed.
	Splintering on the cutting corners	Clamping chuck	Check torque transmission. Use hydraulic clamping chuck or high-precision chucking system.
		Workpiece movement	Stabilize workpiece chucking and check stability of machine tool.
		Wrong drill	Check drill type, drilling depth, cooling system and workpiece material. Possibly use longer drill.
		Insufficient coolant	Check cooling lubricant. For internal coolant supply, increase coolant pressure. For external coolant supply, improve arrangement of coolant jet. Cool from both sides.
		Cutting conditions	Check cutting values, and possibly reduce feed.

Drill Troubleshooting Guide

Body

The portion of the drill extending from the shank or neck to the outer corners of the cutting lips.

Drill Diameter

The diameter over the margins of the drill measured at the point.

Drilling Depth

The effective axial drilling depth capability of a drill. Drills are not always able to drill to the full dimensional length of the flute.

Flutes

Helical or straight grooves cut or formed in the body of the drill to provide cutting lips, to permit removal of chips, and to allow cutting fluid to reach the cutting lips.

Flute Length

The length from the outer corners of the cutting lips to the extreme back end of the flutes.

Land

The peripheral portion of the body between adjacent flutes.

Land Width

The distance between the leading edge and the heel of the land measured at a right angle to the leading edge.

Margin

The cylindrical portion of the land that is not cut away to provide clearance.

Overall Length

The length from the extreme end of the shank to the outer corners of the cutting lips.

Point

The cutting end of a drill, made up of the ends of the lands and the web. In form it resembles a cone, but departs from a true cone to furnish clearance behind the cutting lips.

Point Angle

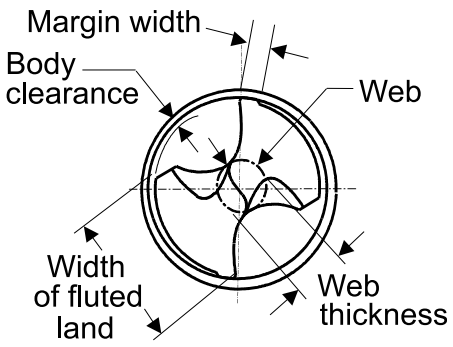
The angle included between the cutting lips projected upon a plane parallel to the drill axis and parallel to the two cutting lips.

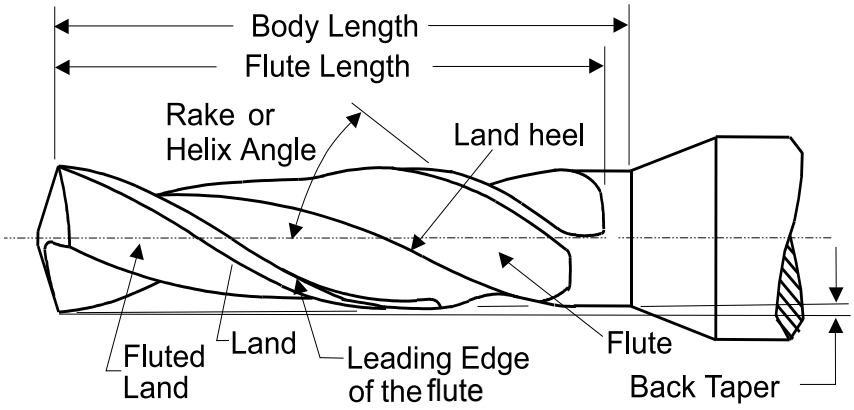
Shank

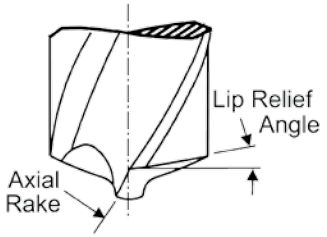
The part of the drill by which it is held and driven.

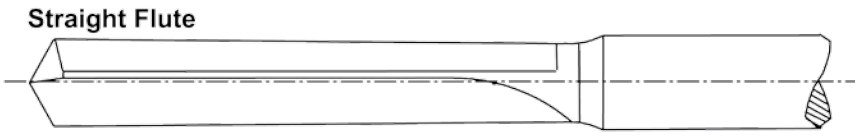
Web

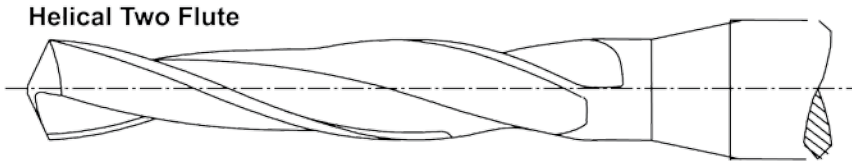
The central portion of the body that joins the lands; the extreme end of the web forms the chisel edge on a two-flute drill.

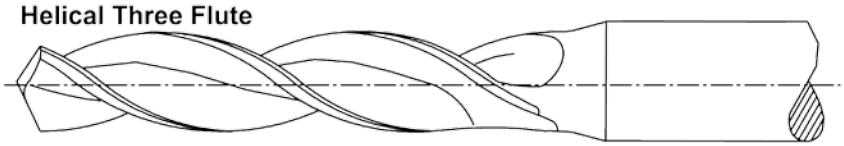


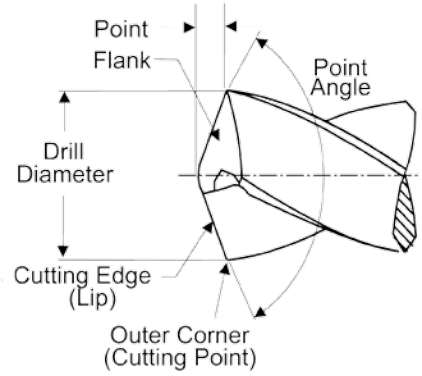












Single-End, General-Purpose, Solid Carbide Reamers

	Series Number	Page Number
Finished Solid Carbide Reamers	CRM	137-139
Finished Steel Shank Reamers	CRMS	140
Semi-Finished Solid Carbide Reamers	CRMSF	141
Long Reach Semi-Finished Solid Carbide Reamers	CRMSFL	142

Countersinks

Combined Drill and Countersink	CSD-2	143
Single-Flute Countersink	CS-1	143
Multi-Flute Countersink	CS-M	144
Multi-Flute Countersink – Metric Sizes	CS-MM	144

Boring Tools

Solid Carbide Minature Boring Tools	CB-M	145
Carbide Head, Steel Shank Boring Tools	CB-S	145

Chamfer Tools

2-Flute Chamfer Tool, Double End	CPCH-2D	146
2-Flute Chamfer Tool, Single End	CPCH-2	146
4-Flute Chamfer Tool, Double End	CPCH-4D	146
4-Flute Chamfer Tool, Single End	CPCH-4	146

Routers

2-Flute Solid Carbide Router, Straight Flutes	CRTS-2	147
2-Flute Solid Carbide Router, Spiral Flutes	CRTL-2	147
3-Flute Solid Carbide Router, Straight Flutes	CRTS-3	147
3-Flute Solid Carbide Router, Spiral Flutes	CRTL-3	147
Fiberglass Router, No End Cut	CRTF-NE	148
Fiberglass Router, Bur End Cut	CRTF-BE	148
Fiberglass Router, End Mill End Cut	CRTF-CC	148
Fiberglass Router, Drill Point End Cut	CRTF-DP	148

Solid Carbide Reamers

Series Number	Page Number
 CRM-ST	137-139
CRM-RS	137-139
 CRMS-ST	140
CRMS-RS	140
 CRMSF-ST	141
CRMSF-RS	141
 CRMSFL-ST	142
CRMSFL-RS	142

Solid Carbide Countersinks

 CSD-2	143
CS-1	143
 CS-M	144
CS-MM	144
	

Solid Carbide Boring Tools

 CB-M	145
CB-S	145

Chamfer Tools

Series Number	Page Number
 CPCH-2D	146
CPCH-2	146
 CPCH-4D	146
CPCH-4	146

Solid Carbide Routers

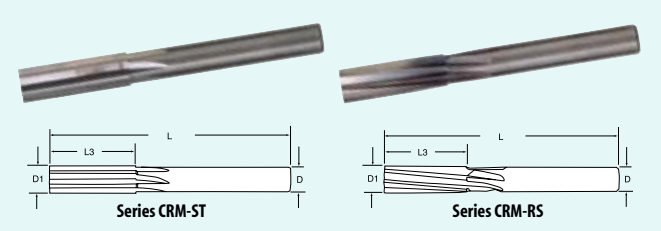
 CRTS-2	147
CRTL-2	147
 CRTS-3	147
CRTL-3	147
 CRTF-NE	148
 CRTF-BE	148
 CFTF-CC	148
 CRTF-DP	148

Series CRM-ST, CRM-RS Finishing Solid Carbide Reamers

Features

- Series CRM-ST with straight flutes;
  Series CRM-RS with right-hand spiral flutes
- Solid carbide construction
- 4 flutes in sizes up to .2540 "(D); 6 flutes in sizes .2570" and up

Old List 208-10 and 208-30



Applications

- Use in general-purpose reaming applications.
- Spiral fluted reamers provide improved chip evacuation and freer cutting action for enhanced productivity and better workpiece finishes.



Series CRM Finished Solid Carbide Reamer Offering

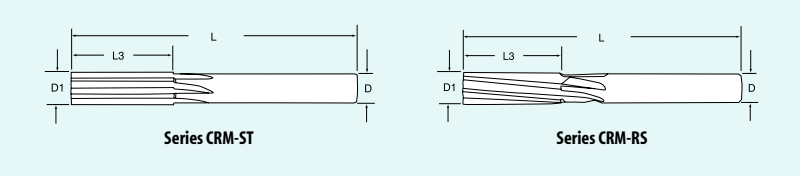
D1 inch	D1 inch	D	L	L3	No. of Flutes	**CRM-ST** Straight Flutes EDP No.	**CRM-RS** RHS Flutes EDP No.
58	0.0420	0.0410	1-1/2	3/8	4	M40735	
57	0.0430	0.0410	1-1/2	3/8	4	M40000	M40084
56	0.0465	0.0410	1-1/2	3/8	4	M40734	
3/64	0.0469	0.0410	1-1/2	3/8	4	M40001	
55	0.0520	0.0410	1-1/2	3/8	4	M40002	M40086
54	0.0550	0.0520	1-1/2	3/8	4	M40003	M40087
53	0.0595	0.0520	1-1/2	3/8	4	M40004	M40088
1/16	0.0625	0.0520	1-1/2	3/8	4	M40005	
52	0.0635	0.0520	1-1/2	3/8	4	M40006	M40090
51	0.0670	0.0625	1-3/4	1/2	4	M40729	
50	0.0700	0.0625	1-3/4	1/2	4	M40728	
49	0.0730	0.0625	1-3/4	1/2	4	M40727	
48	0.0760	0.0625	1-3/4	1/2	4	M40007	M40091
5/64	0.0781	0.0625	1-3/4	1/2	4	M40008	
47	0.0785	0.0625	1-3/4	1/2	4	M40009	M40093
46	0.0810	0.0781	2	1/2	4	M40724	
45	0.0820	0.0781	2	1/2	4	M40723	
44	0.0860	0.0781	2	1/2	4	M40722	
43	0.0890	0.0781	2	1/2	4	M40721	
42	0.0935	0.0781	2	1/2	4	M40010	M40094
3/32	0.0938	0.0781	2	1/2	4	M40011	
41	0.0960	0.0938	2-1/4	5/8	4	M40012	M40096
40	0.0980	0.0938	2-1/4	5/8	4	M40013	M40097
39	0.0995	0.0938	2-1/4	5/8	4	M40717	
38	0.1015	0.0938	2-1/4	5/8	4	M40716	
7/64	0.1094	0.0938	2-1/4	5/8	4	M40014	
35	0.1100	0.0938	2-1/4	5/8	4	M40015	M40099
33	0.1130	0.0938	2-1/4	5/8	4	M40712	
31	0.1200	0.1094	2-1/4	5/8	4	M40711	
0.1230	0.1230	0.1094	2-1/4	5/8	4	M40016	
0.1240	0.1240	0.1094	2-1/4	5/8	4	M40017	
1/8	0.1250	0.1094	2-1/4	5/8	4	M40018	M40102
0.1260	0.1260	0.1094	2-1/4	5/8	4	M40019	
30	0.1285	0.1094	2-1/4	5/8	4	M40020	M40104
29	0.1360	0.1250	2-1/2	3/4	4	M40709	
28	0.1405	0.1250	2-1/2	3/4	4	M40708	

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Diameter Tolerances

All Sizes
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Series CRM-ST, CRM-RS Finishing Solid Carbide Reamers



Series CRM-ST | Series CRM-RS

Series CRM Finished Solid Carbide Reamer Offering (continued)

D1 inch	D1 inch	D inch	L inch	L3 inch	No. of Flutes	**CRM-ST** Straight Flutes EDP No.	**CRM-RS** RHS Flutes EDP No.
9/64	0.1406	0.1250	2-1/2	3/4	4	M40021	
27	0.1440	0.1250	2-1/2	3/4	4	M40707	
26	0.1470	0.1250	2-1/2	3/4	4	M40022	M40106
25	0.1495	0.1250	2-1/2	3/4	4	M40705	
23	0.1540	0.1250	2-1/2	3/4	4	M40704	
5/32	0.1563	0.1406	2-1/2	3/4	4	M40023	
22	0.1570	0.1406	2-1/2	3/4	4	M40024	M40108
21	0.1590	0.1406	2-1/2	3/4	4	M40025	M40109
20	0.1610	0.1406	2-1/2	3/4	4	M40702	
19	0.1660	0.1406	2-1/2	3/4	4	M40701	
18	0.1695	0.1562	2-3/4	7/8	4	M40026	M40110
11/64	0.1719	0.1562	2-3/4	7/8	4	M40027	
15	0.1800	0.1562	2-3/4	7/8	4	M40700	
13	0.1850	0.1562	2-3/4	7/8	4	M40699	
0.1855	0.1855	0.1719	2-3/4	7/8	4	M40028	
0.1865	0.1865	0.1719	2-3/4	7/8	4	M40029	
3/16	0.1875	0.1719	2-3/4	7/8	4	M40030	M40114
0.1885	0.1885	0.1719	2-3/4	7/8	4	M40031	
12	0.1890	0.1719	2-3/4	7/8	4	M40032	M40116
11	0.1910	0.1875	3	1	4	M40033	M40117
10	0.1935	0.1875	3	1	4	M40034	M40118
9	0.1960	0.1875	3	1	4	M40035	M40119
8	0.1990	0.1875	3	1	4	M40036	M40120
7	0.2010	0.1875	3	1	4	M40037	M40121
13/64	0.2031	0.1875	3	1	4	M40038	
6	0.2040	0.1875	3	1	4	M40039	M40123
5	0.2055	0.1875	3	1	4	M40040	M40124
4	0.2090	0.1875	3	1	4	M40041	M40125
3	0.2130	0.1875	3	1	4	M40042	M40126
7/32	0.2188	0.1875	3	1	4	M40043	
2	0.2210	0.1875	3	1	4	M40044	M40128
1	0.2280	0.2188	3	1	4	M40045	M40129
A	0.2340	0.2188	3	1	4	M40046	M40130
15/64	0.2344	0.2188	3	1	4	M40047	
B	0.2380	0.2188	3	1	4	M40684	
D	0.2460	0.2188	3	1	4	M40049	M40133
.2480	0.2480	0.2188	3	1	4	M40050	
.2490	0.2490	0.2188	3	1	4	M40051	
1/4	0.2500	0.2188	3	1	4	M40048	M40132
.2510	0.2510	0.2188	3	1	4	M40052	
F	0.2570	0.2500	3-1/4	1-1/8	6	M40053	M40137
17/64	0.2656	0.2500	3-1/4	1-1/8	6	M40054	
9/32	0.2813	0.2500	3-1/4	1-1/8	6	M40055	
L	0.2900	0.2812	3-1/4	1-1/8	6	M40056	M40140
M	0.2950	0.2812	3-1/4	1-1/8	6	M40057	M40141
19/64	0.2969	0.2812	3-1/4	1-1/8	6	M40058	
0.3105	0.3105	0.2812	3-1/4	1-1/8	6	M40059	
0.3115	0.3115	0.2812	3-1/4	1-1/8	6	M40060	



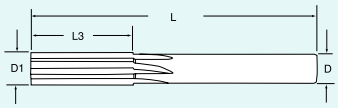
Diameter Tolerances

All Sizes

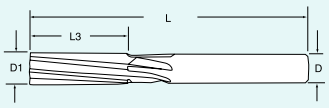
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Series CRM-ST, CRM-RS Finishing Solid Carbide Reamers



Series CRM-ST



Series CRM-RS

Series CRM Finished Solid Carbide Reamer Offering (continued)

D1 inch	D1 inch	D inch	L inch	L3 inch	No. of Flutes	CRM-ST Straight Flutes EDP No.	CRM-RS RHS Flutes EDP No.
5/16	0.3125	0.2812	3-1/4	1-1/8	6	M40061	M40145
0.3135	0.3135	0.2812	3-1/4	1-1/8	6	M40062	
O	0.3160	0.3125	3-1/2	1-1/4	6	M40063	M40147
P	0.3230	0.3125	3-1/2	1-1/4	6	M40064	M40148
21/64	0.3281	0.3125	3-1/2	1-1/4	6	M40065	
R	0.3390	0.3125	3-1/2	1-1/4	6	M40066	M40150
11/32	0.3438	0.3125	3-1/2	1-1/4	6	M40067	
S	0.3480	0.3125	3-1/2	1-1/4	6	M40068	M40152
23/64	0.3594	0.3125	3-1/2	1-1/4	6	M40069	
U	0.3680	0.3594	3-1/2	1-1/4	6	M40070	M40154
0.3730	0.3730	0.3594	3-1/2	1-1/4	6	M40071	
0.3740	0.3740	0.3594	3-1/2	1-1/4	6	M40072	
3/8	0.3750	0.3594	3-1/2	1-1/4	6	M40073	M40157
0.3760	0.3760	0.3594	3-1/2	1-1/4	6	M40074	
V	0.3770	0.3594	3-1/2	1-1/4	6	M40075	M40159
13/32	0.4063	0.3800	3-1/2	1-1/4	6	M40076	—
7/16	0.4375	0.4100	3-3/4	1-3/8	6	M40077	M40161
1/2	0.5000	0.4688	4	1-1/2	6	M40079	M40163



Diameter Tolerances

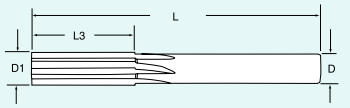
All Sizes

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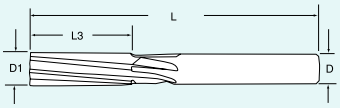
Series CRMS-ST, CRMS-RS Steel Shank Reamers

Features

- Series CRMS-ST with straight flutes;
  Series CRMS-RS with right hand spiral flutes
- Steel shank construction



Series CRMS-ST



Series CRMS-RS

Applications

- Use in general-purpose reaming applications requiring longer reach.
- Spiral fluted reamers provide improved chip evacuation and freer cutting action for enhanced productivity and better workpiece finishes.



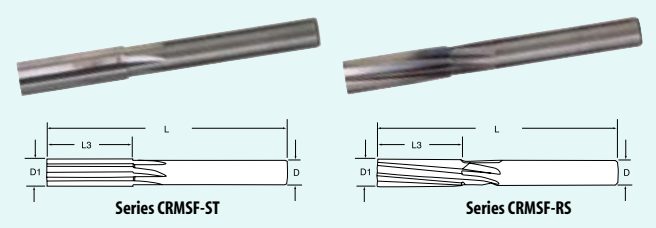
Series CRMS-ST and CRMS-RS Steel Shank Offering

D1 inch	D1 inch	D inch	L inch	L3 inch	No. of Flutes	**CRMS-ST** Straight Flutes EDP No.	**CRMS-RS** RHS Flutes EDP No.
1/8	0.1250	0.1094	3-1/2	7/8	4	M40168	M42503
5/32	0.1563	0.1250	3-1/2	7/8	4	M40169	M42504
3/16	0.1875	0.1406	4	1	4	M40170	M42631
7/32	0.2188	0.1562	4	1	4	M40171	M42505
1/4	0.2500	0.1719	4-1/2	1-1/8	4	M40172	M42506
9/32	0.2813	0.1875	5	1-1/4	6	M40173	M42507
5/16	0.3125	0.2188	6	1-1/4	6	M40174	M42508
11/32	0.3438	0.2500	6	1-3/8	6	M40175	M42509
3/8	0.3750	0.2812	6	1-3/8	6	M40176	M42510
13/32	0.4063	0.3125	6	1-1/2	6	M40177	M42511
7/16	0.4375	0.3438	7	1-1/2	6	M42500	M42512
15/32	0.4688	0.3750	7	1-5/8	6	M42501	M42513
1/2	0.5000	0.4375	8	1-3/4	6	M42502	M42514

Series CRMSF-ST, CRMSF-RS Semi-Finishing Reamers

Features

- Same as CRM chucking reamers in a semi-finished configuration for sizing at your facility. These reamers are supplied with flutes ground, shanks finish ground, and the reamer diameter ground oversize for finishing to diameters within the range shown.
- Series CRMSF-ST with straight flutes; Series CRMSF-RS with right-hand spiral flutes
- Solid carbide construction through .1455" size; .1456" and larger have steel shanks



- Sizes up to and including .2540" furnished with male centers on both ends; larger tools have female centers
- Reamer diameters .2540" and smaller have 4 flutes; diameters .2541" and larger have 6 flutes

Old List 208-10SF and 208-30SF

Applications

- Make your own special size reamer. A low cost and fast way to serve the special hole size you need.
- Use in general-purpose reaming applications.



Series CRMSF-ST and CRMSF-RS Semi-Finished Offering

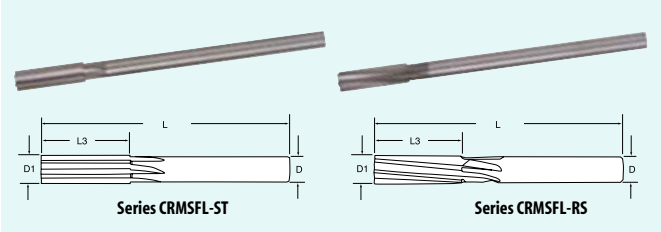
D1 Size Range inch	D inch	L inch	L3 inch	No. of Flutes	**CRMSF-ST** Straight Flutes EDP No.	**CRMSF-RS** RHS Flutes EDP No.
.0420-.0535	0.0410	1-1/2	3/8	4	M42573	M42589
.0536-.0650	0.0520	1-1/2	3/8	4	M42574	M42590
.0651-.0790	0.0625	1-3/4	1/2	4	M42575	M42591
.0791-.0950	0.0781	2	1/2	4	M42576	M42592
.0951-.1145	0.0938	2-1/4	5/8	4	M42577	M42593
.1146-.1290	0.1094	2-1/4	5/8	4	M42578	M42594
.1291-.1455	0.1250	2-1/2	3/4	4	M42579	M42595
.1456-.1590	0.1406	2-1/2	3/4	4	M42580	M42596
.1591-.1750	0.1562	2-3/4	7/8	4	M42581	M42597
.1751-.1900	0.1719	2-3/4	7/8	4	M42582	M42598
.1901-.2240	0.1875	3	1	4	M42583	M42599
.2241-.2540	0.2188	3	1	4	M42584	M42600
.2541-.2850	0.2500	3-1/4	1-1/8	6	M42585	M42601
.2851-.3150	0.2812	3-1/4	1-1/8	6	M42586	M42602
.3151-.3630	0.3125	3-1/2	1-1/4	6	M42587	M42603
.3631-.3860	0.3594	3-1/2	1-1/4	6	M42588	M42604

Series CRMSFL Long Reach Semi-Finished Reamers

Features

- Same as CRM chucking reamers, but with longer steel shanks, in a semi-finished configuration for sizing at your facility. These reamers are supplied with flutes ground, shanks finish ground, and the reamer diameter ground oversize for finishing to diameters within the range shown.
- Series CRMSFL-ST with straight flutes; Series CRMSFL-RS with right-hand spiral flutes
- 4-flutes in sizes .2250" and smaller; 6 flutes in sizes .2251" and up

Old List 204-10SF and 204-30SF



Applications

- Make your own special size reamer. A low cost and fast way to serve the special hole size you need.
- Use in general purpose reaming applications in harder materials.
- Longer shanks are useful in applications where additional reach is necessary.



Series CRMSFL Long Reach Offering

D1 Size Range inch	D inch	L inch	L3 inch	No. of Flutes	**CRMSFL-ST** Straight Flutes EDP No.	**CRMSFL-RS** RHS Flutes EDP No.
.1150-.1300	0.1094	3-1/2	7/8	4	M42605	M42618
.1301-.1450	0.1250	3-1/2	7/8	4	M42606	M42619
.1451-.1600	0.1406	4	1	4	M42607	M42620
.1601-.1750	0.1562	4	1	4	M42608	M42621
.1751-.1950	0.1719	4-1/2	1-1/8	4	M42609	M42622
.1951-.2250	0.1875	5	1-1/4	4	M42610	M42623
.2251-.2550	0.2188	6	1-1/4	6	M42611	M42624
.2551-.2859	0.2500	6	1-3/8	6	M42612	M42625
.2851-.3200	0.2812	6	1-3/8	6	M42613	M42626
.3201-.3500	0.3125	6	1-1/2	6	M42614	M42627
.3501-.3850	0.3438	7	1-1/2	6	M42615	M42628
.3851-.4450	0.3750	7	1-5/8	6	M42616	M42629
.4451-.5100	0.4375	8	1-3/4	6	M42617	M42630

Tech Tip:

To order semi-finished chucking reamers, select the part number corresponding to the specific size range and fluting style you require.

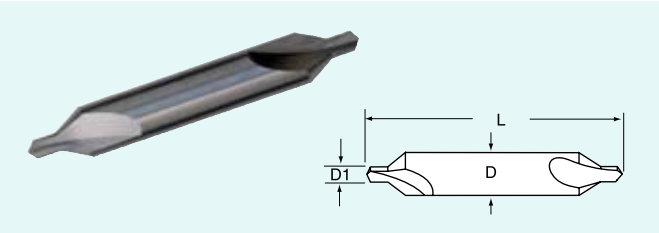
To finish the semi-finished reamer, cylindrically grind the head to the required diameter, grind the secondary clearance and primary clearance on diameter, then grind the lead chamfer.

Series CSD-2 Combined Drill and Countersink

Features

- 90° drill point, 80° included countersink angle
- Solid carbide construction
- Double end
- 2 straight flutes

Old List 250-00



Applications

- For centering hole location with 82° countersink chamfer.



Series CSD-2 Combined Drill and Countersink Offering

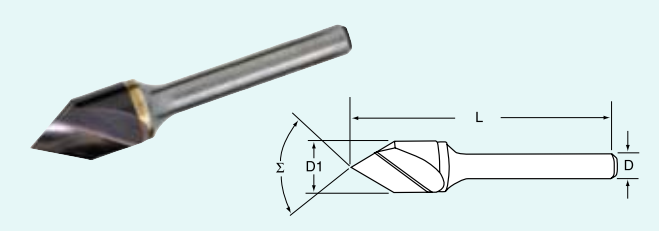
Size	D inch	D1 inch	L inch	EDP Number
1	1/8	3/64	1-1/2	M40599
2	3/16	5/64	1-7/8	M40600
3	1/4	7/64	2	M40601
4	5/16	1/8	2 1/8	M40602
5	7/16	3/16	2 3/4	M40603
6	1/2	7/32	3	M40604

Series CS-1 Single Flute Countersink

Features

- Solid carbide construction
- Available with 60°, 82°, or 90° included angle
- 1/8" and 1/4" double end; 3/8" and larger single end
- One spiral flute

Old List 110-50, 110-60, 110-70



Applications

- Produces finishes comparable to ground surface.
- No chatter or tearing.
- Use in mild steels; not suitable for hardened steel.



Series CS-1 Single-Flute Countersink Offering

D1 inch	D inch	L inch	Σ 60° EDP No.	Σ 82° EDP No.	Σ 90° EDP No.
1/8*	1/8	1-1/2	M40605	M40606	M40607
1/4*	1/4	2	M40608	M40609	M40610
3/8	1/4	2-9/16	M40611	M40612	M40613
1/2	1/4	2-5/8	M40614	M40615	M40616
5/8	1/4	2-3/4	M40617	M40618	M40619
5/8	3/8	3	M40620	M40621	M40622
3/4	3/8	3	M40623	M40624	M40625
1	1/2	3-1/4	M40626	M40627	M40628

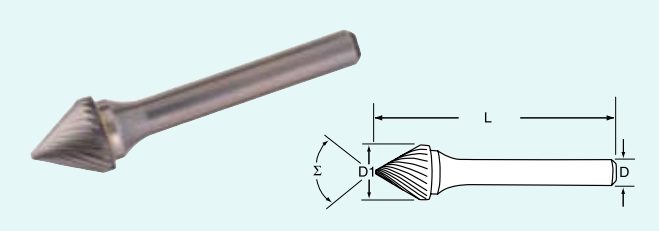
**Double end countersinks; all others single end.*

Series CS-M Multi-Flute Countersink

Features

- Solid carbide construction
- Same as SJ, SK, and ST carbide burs
- Available with 60°, 82°, or 90° included angle
- 1/8", 3/16" and 1/4" double end; 3/8" and larger single end
- Multi flutes

Old List 111-50, 111-60, 111-70



Applications

- Use where tolerance and finish are important and where down time must be reduced.
- Use in difficult-to-machine materials, high production applications.



Series CS-M Offering

D1 inch	D inch	L inch	Σ 60° EDP No.	Σ 82° EDP No.	Σ 90° EDP No.
1/8*	1/8	1-1/2	M40629		M40630
3/16*	3/16	2	M40631		M40632
1/4*	1/4	2	M40633	M40634	M40635
3/8	1/4	2-3/16	M40636	M40637	M40638
1/2	1/4	2-9/32	M40639	M40640	M40641
5/8	1/4	2-7/16	M40642	M40643	M40644
3/4	1/4	2-17/32	M40645	M40646	M40647
1	1/4	2-23/32	M40648	M40649	M40650

**Double end countersinks; all others single end.*

Tech Tip:

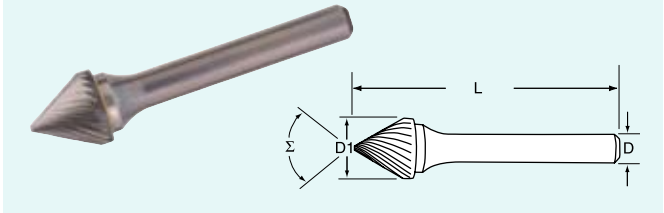
Multi-flute countersinks are also known as Style SJ, SK, and ST burs.

Series CS-MM Multi-Flute Countersink - Metric

Features

- Metric sizes
- Solid carbide construction
- Same as SJ, SK, and ST carbide burs
- Available with 60° or 90° included angle
- 1/8", 3/16" and 1/4" double end; 3/8" and larger single end
- Multi flutes

Old List 111-50, 111-60, 111-70



Applications

- Use where tolerance and finish are important and where down-time must be reduced.
- Use in difficult-to-machine materials, high production applications.



Series CS-MM Offering

D1 mm	D mm	L mm	Σ 60° EDP No.	Σ 90° EDP No.
3,2*	3	38,1	M40651	
6,4*	6	50,8	M40652	M40653
9,5	6	55,6	M40654	M40655
12,7	6	57,9	M40656	M40657
15,9	6	61,9	M40658	M40659
19,1	6	64,3	M40660	M40661
25,4	6	60,3		M40662

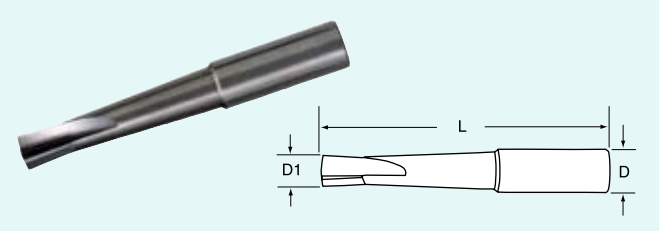
** Double end countersinks; all others single end*

Series CB-M Solid Carbide Miniature Boring Tool

Features

- Solid carbide construction with close tolerances
- Ultra-fine finish on flute and cutting edge produces low RMS finishes
- Single end

Old List 220-00



Applications

- For close jig boring in difficult-to-machine alloys.
- Use in difficult-to-machine materials, high production applications.
- Creates accurate and precise holes.



Series CB-M Offering

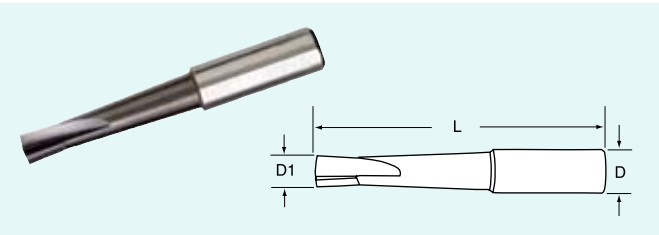
D1 Min. inch	D inch	Max. Depth inch	L inch	EDP No.
0.060	1/8	3/16	1-1/2	M40663
0.070	1/8	1/4	1-1/2	M40664
0.080	1/8	3/8	1-1/2	M40665
0.090	1/8	1/2	1-1/2	M40666
0.120	1/8	5/8	1-1/2	M40667
0.150	3/16	3/4	2	M40668
0.180	3/16	1	2	M40669
0.210	1/4	1-1/4	2	M40670
0.240	1/4	1-1/4	2	M40671
0.270	5/16	1-1/4	2-1/4	M40672
0.300	5/16	1-1/4	2-1/4	M40673
0.330	3/8	1-1/2	2-1/2	M40674
0.360	3/8	1-1/2	2-1/2	M40675

Series CB-S Carbide Head, Steel Shank Boring Tool

Features

- Solid carbide head with close tolerances brazed to a steel shank
- Steel shank 3/8" dia. x 1" length
- Ultra fine finish on flute and cutting edge produces low RMS finishes
- Single end

Old List 221-00



Applications

- For close jig boring in difficult-to-machine alloys.
- Create accurate and precise holes.
- Use in difficult-to-machine materials, high production applications.



Series CB-S Offering

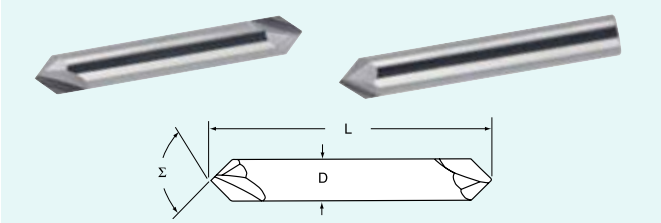
D1 Min. inch	D inch	Max Depth inch	L inch	EDP No.
0.090	3/8	3/4	1-3/4	M40676
0.120	3/8	7/8	1-7/8	M40677
0.150	3/8	1-1/4	2-1/4	M40678
0.180	3/8	1-1/4	2-1/4	M40679
0.210	3/8	1-3/8	2-3/8	M40680
0.240	3/8	1-3/8	2-3/8	M40681
0.270	3/8	1-1/2	2-1/2	M40682
0.300	3/8	1-1/2	2-1/2	M40683

Series CPCH-2D, CPCH-2 Chamfer Tools

NEW STYLE

Features

- Solid carbide construction
- 2-flute
- Series CPCH-2D has double end; CPCH-2 has single end
- Series CPCH-2D features 90° included angle;
  Series CPCH-2 is available with 60°, 82°, 90°, or 120° included angle



Applications

- Use to chamfer edges of harder, difficult-to-machine workpiece materials.



Series CPCH-2D Offering

D inch	L inch	Σ	EDP No.
1/8	1-1/2	90°	M30101
3/16	2	90°	M30121
1/4	2-1/2	90°	M30142
3/8	2-1/2	90°	M30161
1/2	3	90°	M30182
3/4	4	90°	M30212

Series CPCH-2 Offering

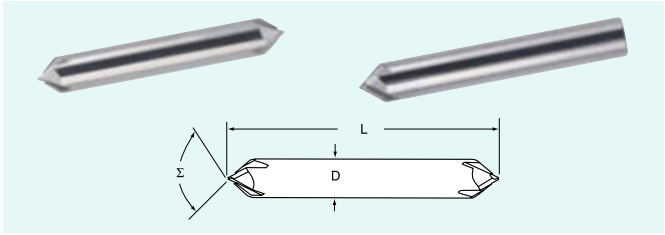
D inch	L inch	Σ 60° EDP No.	Σ 82° EDP No.	Σ 90° EDP No.	Σ 120° EDP No.
1/8	1-1/2		M30120	M30112	
3/16	2			M30122	
1/4	2-1/2	M30150	M30151	M30152	
3/8	2-1/2	M30172	M30180	M30181	
1/2	3	M30190	M30191	M30210	M30211
3/4	4			M30222	

Series CPCH-4D, CPCH-4 Chamfer Tools

NEW STYLE

Features

- Solid carbide construction
- 4-flute
- Series CPCH-4D has double end; CPCH-4 has single end
- Series CPCH-4D features 90° included angle;
  Series CPCH-4 is available with 60°, 82°, 90°, or 120° included angle



Applications

- Use to chamfer edges of harder, difficult-to-machine workpiece materials.



Series CPCH-4D Offering

D inch	L inch	Σ	EDP No.
1/4	2-1/2	90°	M33012
3/8	2-1/2	90°	M33030
1/2	3	90°	M33041
3/4	4	90°	M33060

Series CPCH-4 Offering

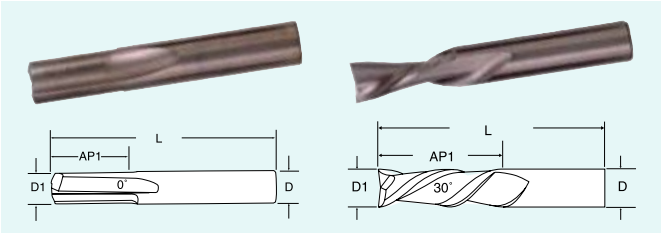
D inch	L inch	Σ 60° EDP No.	Σ 82° EDP No.	Σ 90° EDP No.	Σ 120° EDP No.
1/4	2-1/2	M33020	M33021	M33022	
3/8	2-1/2	M33031	M33032	M33040	
1/2	3	M33042	M33050	M33051	M33052
3/4	4			M33061	

Series CRTS-2, CRTL-2 Routers

Features

- Solid carbide construction
- 2-flute
- Plunge-style end cut
- High rake angles and added clearance geometry to increase shearing ability
- Series CRTS-2 features straight flutes, right-hand cut; Series CRTL-2 features 30° left-hand helix, right-hand cut flutes

Old List Numbers180-12, 180-62



Applications

- Use straight-fluted routers in materials such as plexiglass and plastic and where the workpiece is fairly rigid.
- Use spiral fluted routers in flexible materials that are subject to flutter when using a straight fluted tool, such as soft plastics, rubber, and copper.

NON-FERROUS MATERIAL

Series CRTS-2 Offering

D1 inch	D inch	AP1 inch	L inch	EDP No.
1/8	1/8	1/2	1-1/2	M32102
3/16	3/16	5/8	2	M32110
1/4	1/4	3/4	2-1/2	M32111
5/16	5/16	13/16	2-1/2	M32112
3/8	3/8	7/8	2-1/2	M32120
7/16	7/16	1	2-1/2	M32121
1/2	1/2	1	3	M32122

Series CRTL-2 Offering

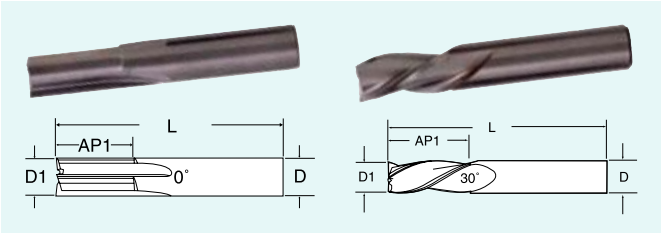
D1 inch	D inch	AP1 inch	L inch	EDP No.
1/8	1/8	1/2	1-1/2	M31840
3/16	3/16	5/8	2	M31841
1/4	1/4	3/4	2-1/2	M31842
5/16	5/16	13/16	2-1/2	M31851
3/8	3/8	7/8	2-1/2	M31852
7/16	7/16	1	2-1/2	M31860
1/2	1/2	1	3	M31861

Series CRTS-3, CRTL-3 Routers

Features

- Solid carbide construction
- 3-flute
- Plunge-style end cut
- Series CRTS-3 features straight flutes, right-hand cut; Series CRTL-3 features 30° left-hand helix, right-hand cut flutes

Old List Number 180-13, 180-63



Applications

- Three-flute routers offer more strength than two-flute routers.
- Use straight-fluted routers in harder materials and where a fine finish is critical. Excellent for routing slots. Use in hard woods and hard rubber.
- Downcut action of the spiral flute router is best suited for fine finish applications and in free hand routing
- where smooth, chatterless operation is necessary.

NON-FERROUS MATERIAL

Series CRTS-3 Offering

D1 inch	D inch	AP1 inch	L inch	EDP No.
1/8	1/8	1/2	1-1/2	M32851
3/16	3/16	5/8	2	M32852
1/4	1/4	3/4	2-1/2	M32860
5/16	5/16	13/16	2-1/2	M32861
3/8	3/8	7/8	2-1/2	M32862
7/16	7/16	1	2-1/2	M32870
1/2	1/2	1	3	M32871

Series CRTL-3 Offering

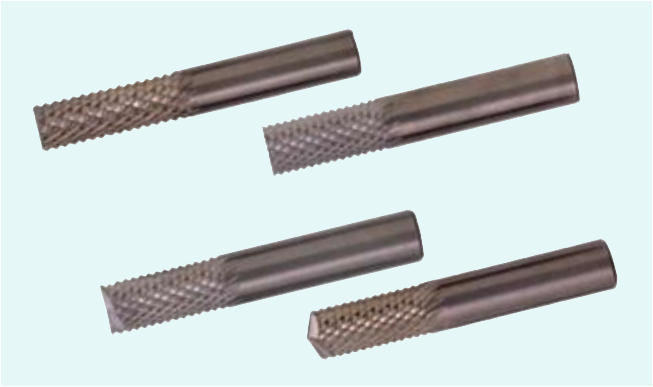
D1 inch	D inch	AP1 inch	L inch	EDP No.
1/8	1/8	1/2	1-1/2	M32800
3/16	3/16	5/8	2	M32801
1/4	1/4	3/4	2-1/2	M32802
5/16	5/16	13/16	2-1/2	M32810
3/8	3/8	7/8	2-1/2	M32811
7/16	7/16	1	2-1/2	M32812
1/2	1/2	1	3	M32820

Series CRTF Fiberglass Routers

Features

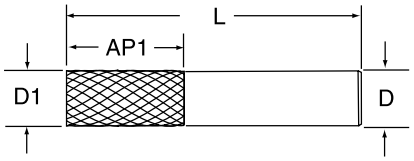
- Solid carbide construction
- Multiple flute, 30° left-hand spiral, right-hand cut with diamond cut flutes
- Straight shank
- Four end cut styles
  - Series CRTF-NE – no end cut
  - Series CRTF-BE – bur end cut
  - Series CRTF-CC – end mill end cut
  - Series CRTF-DP – drill point end cut

Old List Number 190-10, 190-20, 190-30, 190-40



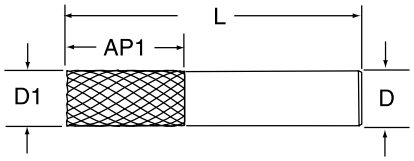
Applications

- For use in phenolic-epoxy parts, polyester glass reinforced products, graphite composite laminates and certain grades of Kevlar material.



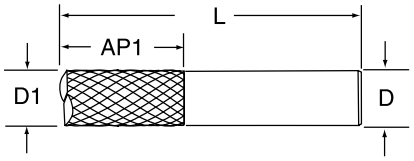
Series CRTF-NE No End Cut Offering

D1 inch	D inch	AP1 inch	L inch	EDP No.
1/16	1/8	3/16	1-1/2	M34872
1/8	1/8	1/2	1-1/2	M34880
3/16	3/16	5/8	2	M34881
1/4	1/4	3/4	2	M34882
1/4	1/4	1	3	M34890
5/16	5/16	1	2-1/2	M34891
3/8	3/8	1	2-1/2	M34892
1/2	1/2	1	3	M34900



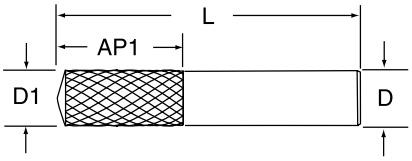
Series CRTF-BE Bur End Cut Offering

D1 inch	D inch	AP1 inch	L inch	EDP No.
1/16	1/8	3/16	1-1/2	M34820
1/8	1/8	1/2	1-1/2	M34821
3/16	3/16	5/8	2	M34822
3/16	1/4	5/8	2	M34830
1/4	1/4	3/4	2	M34831
1/4	1/4	3/4	2-1/2	M34832
5/16	5/16	1	2-1/2	M34840
3/8	3/8	1	2-1/2	M34841
1/2	1/2	1	3	M34842



Series CRTF-CC End Mill End Cut Offering

D1 inch	D inch	AP1 inch	L inch	EDP No.
1/16	1/8	3/16	1-1/2	M34792
1/8	1/8	1/2	1-1/2	M34800
3/16	3/16	5/8	2	M34801
1/4	1/4	3/4	2	M34802
5/16	5/16	1	2-1/2	M34810
3/8	3/8	1	2-1/2	M34811
1/2	1/2	1	3	M34812



Series CRTF-DP Drill Point End Cut Offering

D1 inch	D inch	AP1 inch	L inch	EDP No.
1/16	1/8	3/16	1-1/2	M34850
1/8	1/8	1/2	1-1/2	M34851
3/16	3/16	5/8	2	M34852
1/4	1/4	3/4	2	M34860
1/4	1/4	1	3	M34861
5/16	5/16	1	2-1/2	M34862
3/8	3/8	1	2-1/2	M34870
1/2	1/2	1	3	M34871





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METAL REMOVAL

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- complete selection of shapes and cut styles for every metal-removing application
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- wide array of sizes and shank lengths
- USCTI codes easily identified



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Burs

	Series Number	Page Number
Cylindrical with no end cut	SA	153-154
Cylindrical with end cut	SB	155
Cylindrical Ball Nose	SC	156
Round	SD	157
Egg Shaped	SE	158
Round Nose Tree	SF	159
Pointed Nose Tree	SG	160
Flame Shaped	SH	161
Included Angle	SL	162
Pointed Cone	SM	163
Inverted Taper	SN	164
Internal Threaded Shank	IGT	165
Internal Threaded Shank with End Cut	IGT-EC	165
Internal Grinding Tool	ITS	166
Bur Sets		166

For styles SJ, SK, and ST burs, see page 155, Series CS-M and CS-MM multi-flute countersinks.

Bur Technical Data

Bur Cut Styles	152
Bur Shank Styles	152
Bur Cutting Speeds	154

Burs



SA
Cylindrical with no end cut 153-154



SB
Cylindrical with end cut 155



SC
Cylindrical Ball Nose 156



SD
Round 157



SE
Egg 158



SF
Round Nose Tree 159



SG
Pointed Nose Tree 160



SH
Flame 161

Burs



SL
Included Angle 162



SM
Pointed Cone 163



SN
Inverted Taper 164



IGT
Internal Threaded Shank 165



IGT-EC
with End Cut 165



ITS
Internal Grinding Tool 166



Bur Sets 166

Bur Cut Styles 152
Bur Shank Styles 152
Bur Cutting Speeds 154

Standard Cut Styles

Standard Cut (Right-Hand Spiral)

Metal Removal's ***Standard (right-hand spiral) Cut*** produces a smooth finish for general-purpose use on steel, cast iron, and other ferrous and non-ferrous materials. Most Metal Removal carbide burs are available in the right-hand spiral design.



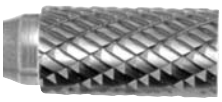


Master Cut (Double Cut)

Metal Removal's exclusive ***Master Cut***, with its chisel-type cutting edge, is a machine ground tool built to exacting tolerances of concentricity, size, and shape. This accuracy, when combined with precision grinders, results in smooth-running, fast metal removal and fine finishes. The right- and left-hand helical flutes combine to produce a chisel-type cutting tooth. This results in faster penetration and stock removal with minimal bounce or chatter.

The Master Cut design also produces an easy-to-handle granular-type chip in most metals, as opposed to the conventional sliver-type chips.

Throughout its life, the Master Cut gives faster stock removal and less operator fatigue, and maintains a good finish on the widest possible variety of workpiece materials.





Aluminum Cut

Metal Removal's ***Aluminum Cut*** burs are outstanding on soft or nonferrous type materials. Use the aluminum cut design on aluminum, magnesium, brass, lead, and most plastics.





Special Cut Styles

Coarse Cut

Coarse Cut burs are favored for applications in softer materials such as brass, lead, annealed low-carbon steels, and some aluminum alloys. The combination of fewer flutes with greater depths provides chip clearance necessary for these matrials. Available as specials.





Fine Cut RHS

Metal Removal's ***Fine Cut Right-Hand Spiral*** is used in applications where stock removal is light and workpiece finish is critical. A greater number of flutes reduces chip load and provides excellent control in deburring small intricate areas. Metal Removal now supplies many popular 1/8" and smaller diameter burs with fine cut configuration. Available as specials.





Shank Styles

A Shank



1/8" and 3 mm solid carbide shank

B Shank



1/8" and 3 mm hardened steel shank

C Shank



1/4" and 3 mm hardened steel shank

D Shank



1/8" and 3 mm solid carbide shank

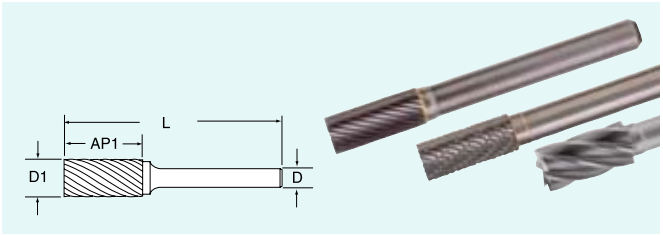
Series SA, SA-M Cylindrical

Features

- Cylindrical shape
- No end cut
- SA inch sizes; SA-M metric sizes
- Shank types A, B, C; see page 152 for shank style definitions

Old List Numbers 010-20, 011-20, 041-20, 020-20, 015-20





Series SA Offering

USCTI Number	D1 inch	D inch	AP1 inch	L inch	Shank Style	Standard Cut EDP No.	Master Cut EDP No.	Aluminum Cut EDP No.
SA-41	1/16	1/8	1/4	1-1/2	A	M40200	M41200	
SA-42	3/32	1/8	7/16	1-1/2	A	M40201	M41201	
SA-43	1/8	1/8	9/16	1-1/2	A	M40202	M41202	
SA-43L2	1/8	1/8	9/16	2	A	M40203	M41203	
SA-43L3	1/8	1/8	9/16	3	A	M40204	M41204	
SA-11	1/8	1/4	1/2	2	C	M40205	M41205	
SA-52	5/32	1/8	1/2	1-1/2	A	M40206	M41206	
SA-53	3/16	1/8	1/2	1-1/2	A	M40207	M41207	
SA-14	3/16	1/4	5/8	2	C	M40208	M41208	
SA-51	1/4	1/8	3/16	1-7/16	B	M40209	M41209	
SA-51-2	1/4	1/8	1/2	1-3/4	B	M40210	M41210	
SA-1	1/4	1/4	5/8	2	C	M40211	M41211	
SA-1L6	1/4	1/4	5/8	6-5/8	C	M40212	M41212	
SA-2	5/16	1/4	3/4	2-1/2	C	M40213	M41213	
SA-3	3/8	1/4	3/4	2-1/2	C	M40214	M41214	
SA-3L6	3/8	1/4	3/4	6-3/4	C	M40215	M41215	
SA-4	7/16	1/4	1	2-3/4	C	M40216	M41216	
SA-5	1/2	1/4	1	2-3/4	C	M40217	M41217	
SA-5L6	1/2	1/4	1	7	C	M40218	M41218	
SA-6	5/8	1/4	1	2-3/4	C	M40219	M41219	
SA-7	3/4	1/4	1	2-3/4	C	M40220	M41220	
SA-9	1	1/4	1	2-3/4	C	M40221	M41221	

Series SA-M Offering

USCTI Number	D1 mm	D mm	AP1 mm	L mm	Shank Style	Standard Cut EDP No.	Master Cut EDP No.	Aluminum Cut EDP No.
SA-41M	1,6	3,0	4,8	38,1	A	M40222	M41222	
SA-42M	2,4	3,0	11,1	38,1	A	M40223	M41223	
SA-43M	3,0	3,0	14,3	31,8	A	M40224	M41224	
SA-11M	3,1	6,0	12,7	50,8	C	M40225	M41225	
SA-52M	4,0	3,0	12,7	38,1	A	M40226	M41226	
SA-53M	4,8	3,0	12,7	38,1	A	M40227	M41227	
SA-14M	4,8	6,0	15,9	50,8	C	M40228	M41228	
SA-1M	6,0	6,0	15,9	50,8	C	M40229	M41229	M40551
SA-51M	6,4	3,0	4,8	36,5	B	M40230	M41230	
SA-51M-2	6,4	3,0	12,7	44,5	B	M40231	M41231	
SA-2M	7,9	6,0	19,1	63,5	C	M40232	M41232	
SA-3M	9,5	6,0	19,1	63,5	C	M40233	M41233	M40552
SA-3M-2	9,5	8,0	19,1	69,9	C	M40234	M41234	
SA-4M	11,1	6,0	25,4	69,9	C	M40235	M41235	
SA-4M-2	11,1	8,0	25,4	76,2	C	M40236	M41236	
SA-5M	12,7	6,0	25,4	69,9	C	M40237	M41237	M40553

continued on next page

Series SA-M Offering (continued from previous page)

USCTI Number	D1 mm	D mm	AP1 mm	L mm	Shank Style	Standard Cut EDP No.	Master Cut EDP No.	Aluminum Cut EDP No.
SA-5M-2	12,7	8,0	25,4	76,2	C	M40238	M41238	M40554
SA-6M	15,9	6,0	25,4	69,9	C	M40239	M41239	M40555
SA-6M-2	15,9	8,0	25,4	76,2	C	M40240	M41240	M40556
SA-16M	19,1	6,0	19,1	69,9	C	M40241	M41241	
SA-16M-2	19,1	8,0	25,4	76,2	C	M40244	M41244	
SA-7M	19,1	6,0	25,4	69,9	C	M40242	M41242	M40557
SA-7M-2	19,1	8,0	25,4	76,2	C	M40243	M41243	M40558
SA-9M	25,4	6,0	25,4	69,9	C	M40245	M41245	
SA-9M-2	25,4	8,0	25,4	76,2	C	M40246	M41246	

Bur Technical Data

Technical Support Telephone: 888-434-8665 Fax: 888-434-3299

Bur Cutting Speeds

Bur Diameter	Recommended Cutting Speed (RPM)	Maximum Cutting Speed (RPM)
1/16	60,000 - 90,000	100,000
1/8	40,000 - 70,000	90,000
3/16	35,000 - 60,000	80,000
1/4	30,000 - 50,000	70,000
5/16	20,000 - 40,000	68,000
3/8	20,000 - 40,000	66,000
7/16	15,000 - 40,000	58,000
1/2	15,000 - 40,000	50,000
5/8	12,000 - 25,000	40,000
3/4	10,000 - 20,000	33,000
1	7,500 - 20,000	25,000
1-1/8	7,000 - 13,000	20,000
1-1/2	5,000 - 10,000	17,000
1-3/4	4,500 - 9,000	14,000
2	4,000 - 8,000	12,500

Shank Styles

A Shank



1/8" and 3 mm solid carbide shank

B Shank



1/8" and 3 mm hardened steel shank

C Shank



1/4" and 3 mm hardened steel shank

D Shank



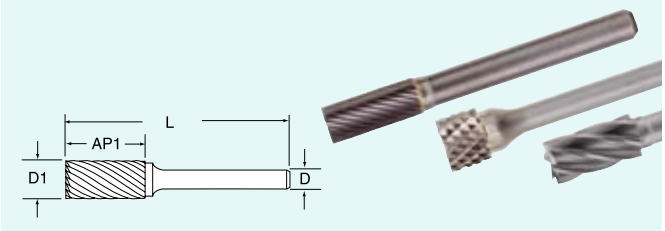
1/8" and 3 mm solid carbide shank

Series SB, SB-M Cylindrical with End Cut

Features

- Cylindrical shape
- With end cut
- SB inch sizes; SB-M metric sizes
- Shank types A, B, C; see page 152 for shank style definitions

Old List Numbers 010-21, 041-21, 015-21, 101-00



Series SB Offering

USCTI Number	D1 inch	D inch	AP1 inch	L inch	Shank Style	Standard Cut EDP No.	Master Cut EDP No.	Aluminum Cut EDP No.
SB-41	1/16	1/8	1/4	1-1/2	A	M40247		
SB-42	3/32	1/8	7/16	1-1/2	A	M40248		
SB-43	1/8	1/8	9/16	1-1/2	A	M40249		
SB-11	1/8	1/4	1/2	2	C	M40250	M41250	
SB-14	3/16	1/4	5/8	2	C	M40251	M41251	
SB-51	1/4	1/8	3/16	1-7/16	A	M40252	M41252	
SB-51-2	1/4	1/8	1/2	1-3/4	A	M40253	M41253	
SB-1	1/4	1/4	5/8	2	C	M40254	M41254	M40527
SB-2	5/16	1/4	3/4	2-1/2	C	M40255	M41255	
SB-3	3/8	1/4	3/4	2-1/2	C	M40256	M41256	M40528
SB-4	7/16	1/4	1	2-3/4	C		M41257	
SB-5	1/2	1/4	1	2-3/4	C	M40258	M41258	M40529
SB-6	5/8	1/4	1	2-3/4	C		M41259	M40530
SB-7	3/4	1/4	1	2-3/4	C		M41260	M40531

Series SB-M Offering

USCTI Number	D1 mm	D mm	AP1 mm	L mm	Shank Style	Standard Cut EDP No.	Master Cut EDP No.
SB-41M	1,6	3,0	6,4	38,1	A	M40261	M41261
SB-42M	2,4	3,0	11,1	38,1	A	M40262	M41262
SB-43M	3,0	3,0	14,3	38,1	A	M40263	M41263
SB-11M	3,1	6,0	12,7	50,8	C	M40264	M41264
SB-52M	4,0	3,0	12,7	38,1	A	M40265	M41265
SB-53M	4,8	3,0	12,7	38,1	A	M40266	M41266
SB-14M	4,8	6,0	15,9	50,8	C	M40267	M41267
SB-1M	6,0	6,0	15,9	50,8	C	M40268	M41268
SB-51M	6,4	3,0	4,8	36,5	B	M40269	M41269
SB-51M-2	6,4	3,0	12,7	44,5	B	M40270	M41270
SB-2M	7,9	6,0	19,1	63,5	C	M40271	M41271
SB-3M	9,5	6,0	19,1	63,5	C	M40272	M41272
SB-4M	11,1	6,0	25,4	69,9	C	M40273	M41273
SB-5M	12,7	6,0	25,4	69,9	C	M40274	M41274
SB-5M-2	12,7	8,0	25,4	76,2	C	M40275	M41275
SB-6M	15,9	6,0	25,4	69,9	C	M40276	M41276
SB-6M-2	15,9	8,0	25,4	76,2	C	M40277	M41277
SB-16M	19,1	6,0	19,1	69,9	C	M40279	M41279
SB-16M-2	19,1	8,0	25,4	76,2	C	M40281	M41281
SB-7M	19,1	6,0	25,4	69,9	C	M40278	M41278
SB-7M-2	19,1	8,0	25,4	76,2	C	M40280	M41280
SB-9M	25,4	6,0	25,4	69,9	C	M40282	M41282
SB-9M-2	25,4	8,0	25,4	76,2	C	M40283	M41283

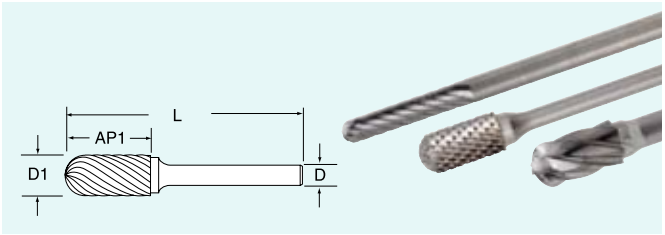
Series SC, SC-M Cylindrical Ball Nose

Features

- Cylindrical shape
- Ball nose with end cut
- SC inch sizes; SC-M metric sizes
- Shank types A, B, C; see page 152 for shank style definitions

Old List Numbers 010-21, 041-21, 015-21, 101-00





Series SC Offering

USCTI Number	D1 inch	D inch	AP1 inch	L inch	Shank Style	Standard Cut EDP No.	Master Cut EDP No.	Aluminum Cut EDP No.
SC-41	3/32	1/8	7/16	1-1/2	A	M40284	M41284	
SC-42	1/8	1/8	9/16	1-1/2	A	M40285	M41285	
SC-42L2	1/8	1/8	9/16	2	A	M40286	M41286	
SC-42L3	1/8	1/8	9/16	3	A	M40287	M41287	
SC-11	1/8	1/4	1/2	2	A	M40288	M41288	
SC-52	5/32	1/8	1/2	1-1/2	A	M40289	M41289	
SC-53	3/16	1/8	1/2	1-1/2	A	M40290	M41290	
SC14	3/16	1/4	5/8	2	A	M40291	M41291	
SC-51	1/4	1/8	1/2	1-3/4	B	M40292	M41292	
SC-1	1/4	1/4	5/8	2	A	M40293	M41293	M40532
SC-1L6	1/4	1/4	5/8	6-5/8	C	M40294	M41294	
SC-2	5/16	1/4	3/4	2-1/2	A	M40295	M41295	
SC-3	3/8	1/4	3/4	2-1/2	A	M40296	M41296	M40533
SC-3L6	3/8	1/4	3/4	6-3/4	C	M40297	M41297	
SC-4	7/16	1/4	1	2-3/4	A	M40298	M41298	
SC-5	1/2	1/4	1	2-3/4	A	M40299	M41299	M40534
SC-5L6	1/2	1/4	1	7	C	M40300	M41300	
SC-6	5/8	1/4	1	2-3/4	A	M40301	M41301	M40535
SC-7	3/4	1/4	1	2-3/4	C	M40302	M41302	M40536

Series SC-M Offering

USCTI Number	D1 mm	D mm	AP1 mm	L mm	Shank Style	Standard Cut EDP No.	Master Cut EDP No.	Aluminum Cut EDP No.
SC-41M	2,4	3,0	11,1	38,1	A	M40303	M41303	
SC-42M	3,0	3,0	14,3	38,1	A	M40304	M41304	
SC-11M	3,1	6,0	12,7	50,8	C	M40305	M41305	
SC-52M	4,0	3,0	12,7	38,1	A	M40306	M41306	
SC-53M	4,8	3,0	12,7	38,1	A	M40307	M41307	
SC-14M	4,8	6,0	15,9	50,8	C	M40308	M41308	
SC-1M	6,0	6,0	15,9	50,8	C	M40309	M41309	M40559
SC-51M	6,4	3,0	12,7	44,5	B	M40310	M41310	
SC-2M	7,9	6,0	19,1	63,5	C	M40311	M41311	
SC-3M	9,5	6,0	19,1	63,5	C	M40312	M41312	M40560
SC-3M-2	9,5	8,0	19,1	69,9	C	M40313	M41313	
SC-4M	11,1	6,0	25,4	69,9	C	M40314	M41314	
SC-4M-2	11,1	8,0	25,4	76,2	C	M40315	M41315	
SC-5M	12,7	6,0	25,4	69,9	C	M40316	M41316	M40561
SC-5M-2	12,7	8,0	25,4	76,2	C	M40317	M41317	M40562
SC-6M	15,9	6,0	25,4	69,9	C	M40318	M41318	M40563
SC-6M-2	15,9	8,0	25,4	76,2	C	M40319	M41319	M40564
SC-7M	19,1	6,0	25,4	69,9	C	M40320	M41320	M40565
SC-7M-2	19,1	8,0	25,4	76,2	C	M40321	M41321	M40566

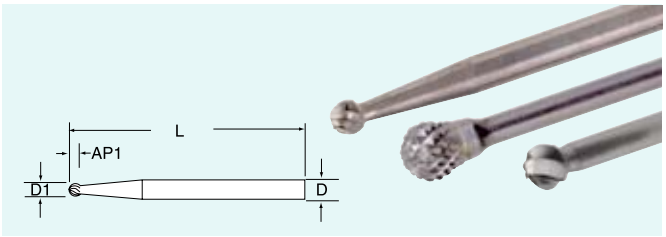
Series SD, SD-M Ball

Features

- Ball shape
- SD inch sizes; SD-M metric sizes
- Shank types A, B, C; see page 152 for shank style definitions

Old List Numbers 010-21, 041-21, 015-21, 101-00





Series SD Offering

USCTI Number	D1 inch	D inch	AP1 inch	L inch	Shank Style	Standard Cut EDP No.	Master Cut EDP No.	Aluminum Cut EDP No.
SD-40	1/16	1/8	1/16	1-1/2	A	M40322		
SD-41	3/32	1/8	3/32	1-1/2	A	M40323	M41323	
SD-42	1/8	1/8	1/8	1-1/2	A		M41324	
SD-42L2	1/8	1/8	1/8	2	A	M40325	M41325	
SD-42L3	1/8	1/8	1/8	3	A	M40326	M41326	
SD-11	1/8	1/4	1/8	2	C	M40327	M41327	
SD-53	3/16	1/8	3/16	1-1/2	A	M40328	M41328	
SD-14	3/16	1/4	3/16	2	C	M40329	M41329	
SD-51	1/4	1/8	1/4	1-3/4	B	M40330	M41330	
SD-1	1/4	1/4	1/4	2	C	M40331	M41331	M40537
SD-1L6	1/4	1/4	1/4	6-1/4	C	M40332	M41332	
SD-2	5/16	1/4	5/16	2-1/32	C	M40333	M41333	
SD-3	3/8	1/4	3/8	2-5/64	C	M40334	M41334	M40538
SD-3L6	3/8	1/4	3/8	6-3/8	C	M40335	M41335	
SD-4	7/16	1/4	7/16	2-9/64	C	M40336	M41336	
SD-5	1/2	1/4	1/2	2-13/64	C	M40337	M41337	M40539
SD-5L6	1/2	1/4	1/2	6-1/2	C	M40338	M41338	
SD-6	5/8	1/4	5/8	2-5/16	C	M40339	M41339	M40540
SD-7	3/4	1/4	3/4	2-7/16	C	M40340	M41340	
SD-9	1	1/4	1	2-11/16	C	M40341	M41341	

Series SD-M Offering

USCTI Number	D1 mm	D mm	AP1 mm	L mm	Shank Style	Standard Cut EDP No.	Master Cut EDP No.	Aluminum Cut EDP No.
SD-40M	1,6	3,0	1,6	38,1	A	M40342		
SD-41M	2,4	3,0	2,4	38,1	A	M40343	M41343	
SD-42M	3,0	3,0	3,0	38,1	A	M40344	M41344	
SD-53M	4,8	3,0	4,8	38,1	A		M41345	
SD-14M	4,8	6,0	4,8	50,8	C	M40346	M41346	
SD-1M	6,0	6,0	6,0	50,8	C	M40347	M41347	M40567
SD-51M	6,4	3,0	6,4	38,1	B	M40348	M41348	
SD-2M	7,9	6,0	7,9	51,6	C	M40349	M41349	
SD-3M	9,5	6,0	9,5	52,8	C	M40350	M41350	M40568
SD-4M	11,1	6,0	11,1	54,4	C	M40351	M41351	
SD-5M	12,7	6,0	12,7	56,0	C	M40352	M41352	M40569
SD-5M-2	12,7	8,0	12,7	62,3	C	M40353	M41353	M40570
SD-6M	15,9	6,0	15,9	58,7	C	M40354	M41354	M40571
SD-6M-2	15,9	8,0	15,9	65,1	C	M40355	M41355	M40572
SD-7M	19,1	6,0	19,1	61,9	C	M40356	M41356	
SD-7M-2	19,1	8,0	19,1	68,3	C	M40357	M41357	
SD-9M	25,4	6,0	25,4	68,3	C	M40358	M41358	
SD-9M-2	25,4	8,0	25,4	74,7	C	M40359	M41359	

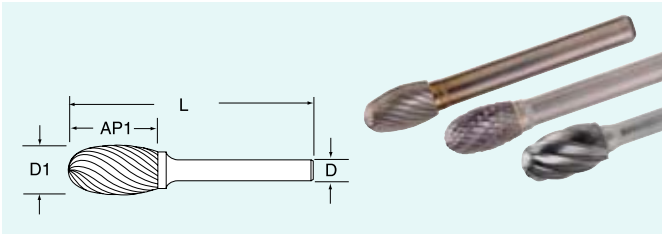
Series SE, SE-M Egg

Features

- Egg shape
- SE inch sizes; SE-M metric sizes
- Shank types A, B, C; see page 152 for shank style definitions

Old List Numbers 010-21, 041-21, 015-21, 101-00





Series SE Offering

USCTI Number	D1 inch	D inch	AP1 inch	L inch	Shank Style	Standard Cut EDP No.	Master Cut EDP No.	Aluminum Cut EDP No.
SE-41	1/8	1/8	7/32	1-1/2	A	M40360	M41360	
SE-53	3/16	1/8	9/32	1-1/2	A	M40361	M41361	
SE-51	1/4	1/8	3/8	1-5/8	B	M40362	M41362	
SE-1	1/4	1/4	3/8	2	C	M40363	M41363	
SE-3	3/8	1/4	5/8	2-3/8	C	M40364	M41364	M40541
SE-5	1/2	1/4	7/8	2-5/8	C	M40365	M41365	M40542
SE-6	5/8	1/4	1	2-3/4	C	M40366	M41366	M40543
SE-7	3/4	1/4	1	2-3/4	C	M40367	M41367	

Series SE-M Offering

USCTI Number	D1 mm	D mm	AP1 mm	L mm	Shank Style	Standard Cut EDP No.	Master Cut EDP No.	Aluminum Cut EDP No.
SE-41M	3,0	3,0	5,6	38,1	A	M40368	M41368	
SE-53M	4,8	3,0	7,1	38,1	A	M40369	M41369	
SE-1M	6,0	6,0	9,5	50,8	C	M40372	M41372	
SE-51M	6,4	3,0	9,5	41,3	B	M40370	M41370	
SE-3M	9,5	6,0	15,9	60,3	C	M40371	M41371	M40573
SE-5M	12,7	6,0	22,2	66,7	C	M40373	M41373	M40574
SE-5M-2	12,7	8,0	25,4	76,2	C	M40374	M41374	
SE-6M	15,9	6,0	25,4	69,9	C	M40375	M41375	M40575
SE-6M-2	15,9	8,0	15,9	76,2	C	M40376	M41376	
SE-7M	19,1	6,0	25,4	69,9	C	M40377	M41377	
SE-7M-2	19,1	8,0	25,4	76,2	C	M40378	M41378	

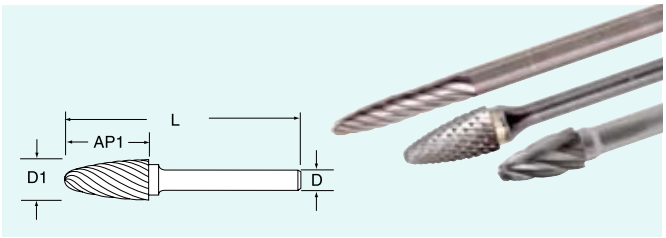
Series SF, SF-M Round Nose Tree

Features

- Round Nose Tree shape
- SF inch sizes; SF-M metric sizes
- Shank types A, B, C; see page 152 for shank style definitions

Old List Numbers 010-21, 041-21, 015-21, 101-00





Series SF Offering

USCTI Number	D1 inch	D inch	AP1 inch	L inch	Shank Style	Standard Cut EDP No.	Master Cut EDP No.	Aluminum Cut EDP No.
SF-41	1/8	1/8	1/4	1-1/2	A	M40379	M41379	
SF-42	1/8	1/8	1/2	1-1/2	A	M40380	M41380	
SF-53	3/16	1/8	1/2	1-1/2	A	M40381	M41381	
SF-51	1/4	1/8	1/2	1-3/4	B	M40382	M41382	
SF-1	1/4	1/4	5/8	2	C	M40383	M41383	M40544
SF-1L6	1/4	1/4	5/8	6	C	M40384	M41384	
SF-3	3/8	1/4	3/4	2-1/2	C	M40385	M41385	M40545
SF-3L6	3/8	1/4	3/4	6-3/4	C	M40386	M41386	
SF-4	7/16	1/4	1	2-3/4	C	M40387	M41387	
SF-13	1/2	1/4	3/4	2-1/2	C	M40388	M41388	
SF-5	1/2	1/4	1	2-3/4	C	M40389	M41389	M40546
SF-5L6	1/2	1/4	1	7	C	M40390	M41390	
SF-6	5/8	1/4	1	2-3/4	C	M40391	M41391	M40547
SF-7	3/4	1/4	1	2-3/4	C	M40392	M41392	
SF-14	3/4	1/4	1-1/4	3	C	M40394	M41394	
SF-15	3/4	1/4	1-1/2	3-1/4	C	M40393	M41393	

Series SF-M Offering

USCTI Number	D1 mm	D mm	AP1 mm	L mm	Shank Style	Standard Cut EDP No.	Master Cut EDP No.	Aluminum Cut EDP No.
SF-41M	3,0	3,0	3,4	38,1	A	M40395	M41395	
SF-42M	3,0	3,0	12,7	38,1	A	M40396	M41396	
SF-53M	4,8	3,0	12,7	38,1	B	M40397	M41397	
SF-1M	6,0	6,0	15,9	50,8	C	M40398	M41398	M40576
SF-51M	6,4	3,0	12,7	44,5	A	M40399	M41399	
SF-3M	9,5	6,0	19,1	63,5	C	M40400	M41400	M40577
SF-4M	11,1	6,0	25,4	69,9	C	M40401	M41401	
SF-13M	12,7	6,0	19,1	63,5	C	M40402	M41402	
SF-13M-2	12,7	8,0	19,1	69,9	C	M40404	M41404	
SF-5M	12,7	6,0	25,4	69,9	C	M40403	M41403	M40578
SF-5M-2	12,7	8,0	25,4	76,2	C	M40405	M41405	M40579
SF-6M	15,9	6,0	25,4	69,9	C	M40406	M41406	
SF-6M-2	15,9	8,0	25,4	76,2	C	M40407	M41407	M40580
SF-7M	19,1	6,0	25,4	69,9	C	M40408	M41408	
SF-7M-2	19,1	8,0	25,4	76,2	C	M40410	M41410	
SF-14M	19,1	6,0	31,8	76,2	C	M40409	M41409	
SF-14M-2	19,1	8,0	31,8	82,6	C	M40411	M41411	M40581
SF-15M	19,1	6,0	38,1	82,6	C	M40412	M41412	
SF-15M-2	19,1	8,0	38,1	88,9	C	M40413	M41413	

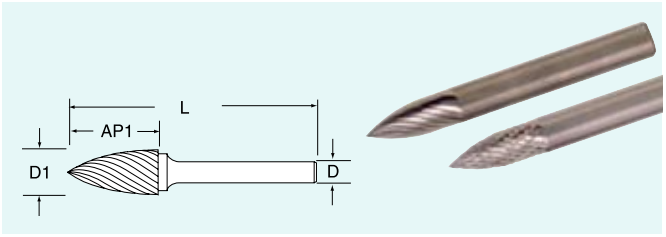
Series SG, SG-M Pointed Tree

Features

- Pointed Tree shape
- SG inch sizes; SG-M metric sizes
- Shank types A, B, C; see page 152 for shank style definitions

Old List Numbers 010-21, 041-21, 015-21, 101-00





Series SG Offering

USCTI Number	D1 inch	D inch	AP1 inch	L inch	Shank Style	Standard Cut EDP No.	Master Cut EDP No.
SG-41	1/8	1/8	1/4	1-1/2	A	M40414	M41414
SG-42	1/8	1/8	5/16	1-1/2	A	M40415	M41415
SG-43	1/8	1/8	3/8	1-1/2	A	M40416	M41416
SG-44	1/8	1/8	1/2	1-1/2	A	M40417	M41417
SG-53	3/16	1/8	1/2	1-1/2	A	M40418	M41418
SG-51	1/4	1/8	1/2	1-3/4	B	M40419	M41419
SG-1	1/4	1/4	5/8	2	C	M40420	M41420
SG-2	5/16	1/4	3/4	2-1/2	C	M40421	M41421
SG-3	3/8	1/4	3/4	2-1/2	C	M40422	M41422
SG-13	1/2	1/4	3/4	2-1/2	C	M40423	M41423
SG-5	1/2	1/4	1	2-3/4	C	M40424	M41424
SG-6	5/8	1/4	1	2-3/4	C	M40425	M41425
SG-7	3/4	1/4	1	2-3/4	C	M40426	M41426

Series SG-M Offering

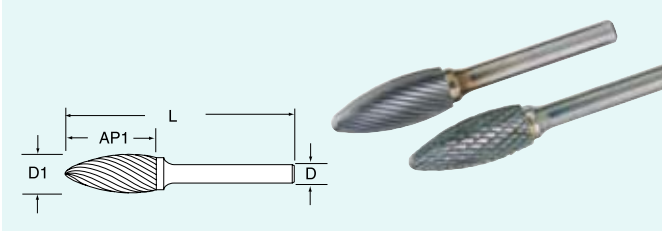
USCTI Number	D1 mm	D mm	AP1 mm	L mm	Shank Style	Standard Cut EDP No.	Master Cut EDP No.
SG-41M	3,0	3,0	6,4	38,1	A	M40427	M41427
SG-41M-2	3,0	3,0	6,4	38,1	A	M40428	M41428
SG-42M	3,0	3,0	5,9	38,1	A	M40429	M41429
SG-43M	3,0	3,0	9,5	38,1	A	M40430	M41430
SG-44M	3,0	3,0	12,7	38,1	A	M40431	M41431
SG-53M	4,8	3,0	12,7	38,1	A	M40432	M41432
SG-1M	6,0	6,0	15,9	50,8	C	M40433	M41433
SG-51M	6,4	3,0	12,7	69,9	B	M40434	M41434
SG-2M	7,9	6,0	19,1	63,5	C	M40435	M41435
SG-3M	9,5	6,0	19,1	63,5	C	M40436	M41436
SG-3M-2	9,5	8,0	19,1	69,9	C	M40437	M41437
SG-13M	12,7	6,0	19,1	63,5	C	M40438	M41438
SG-13M-2	12,7	8,0	19,1	69,9	C	M40441	M41441
SG-5M	12,7	6,0	25,4	69,9	C	M40439	M41439
SG-5M-2	12,7	8,0	25,4	76,2	C	M40442	M41442
SG-6M	15,9	6,0	25,4	69,9	C	M40440	M41440
SG-6M-2	15,9	8,0	25,4	76,2	C	M40443	M41443
SG-7M	19,1	6,0	25,4	76,2	C	M40444	M41444
SG-7M-2	19,1	8,0	25,4	76,2	C	M40445	M41445

Series SH, SH-M Flame

Features

- Flame shape
- SH inch sizes; SH-M metric sizes
- Shank types A, C; see page 152 for shank style definitions

Old List Numbers 010-20, 020-20, 051-20



Series SH Offering

USCTI Number	D1 inch	D inch	AP1 inch	L inch	Shank Style	Standard Cut EDP No.	Master Cut EDP No.
SH-41	1/8	1/8	1/4	1-1/2	A	M40446	M41446
SH-53	3/16	1/8	3/8	1-1/2	A	M40447	M41447
SH-2	5/16	1/4	3/4	2-1/2	C	M40448	M41448
SH-5	1/2	1/4	1-1/4	3	C	M40449	M41449
SH-6	5/8	1/4	1-7/16	3-3/16	C	M40450	M41450
SH-7	3/4	1/4	1-5/8	3-3/8	C	M40451	M41451

Series SH-M Offering

USCTI Number	D1 mm	D mm	AP1 mm	L mm	Shank Style	Standard Cut EDP No.	Master Cut EDP No.
SH-41M	3,0	3,0	6,4	38,1	A	M40452	M41452
SH-53M	4,8	3,0	9,5	38,1	A	M40453	M41453
SH-2M	7,9	6,0	19,1	63,5	C	M40454	M41454
SH-5M	12,7	6,0	31,8	76,2	C	M40455	M41455
SH-5M-2	12,7	8,0	31,8	82,6	C	M40456	M41456
SH-6M	15,9	6,0	36,5	81,0	C	M40457	M41457
SH-6M-2	15,9	8,0	36,5	87,3	C	M40458	M41458
SH-7M	19,1	6,0	41,3	85,7	C	M40459	M41459
SH-7M-2	19,1	8,0	41,3	92,1	C	M40460	M41460

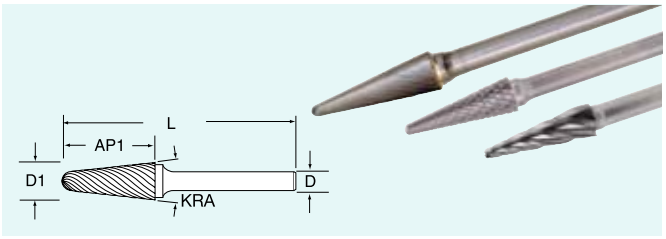
Series SL, SL-M Included Angle

Features

- Included angle shape
- SL inch sizes; SL-M metric sizes
- Shank types A, C; see page 152 for shank style definitions

Old List Numbers 010-21, 041-21, 015-21, 101-00





Series SL Offering

USCTI Number	D1 inch	D inch	AP1 inch	L inch	Shank Style	KRA	Standard Cut EDP No.	Master Cut EDP No.	Aluminum Cut EDP No.
SL-41	1/8	1/8	3/8	1-1/2	A	8°	M40461	M41461	
SL-42	1/8	1/8	1/2	1-1/2	A	8°	M40462	M41462	
SL-53	3/16	1/8	1/2	1-1/2	A	14°	M40463	M41463	
SL-1	1/4	1/4	5/8	2	C	14°	M40464	M41464	
SL-1L6	1/4	1/4	5/8	6-5/8	C	14°	M40465	M41465	
SL-2	5/16	1/4	7/8	2-3/4	C	14°	M40466	M41466	
SL-3	3/8	1/4	1-1/16	2 15/16	C	14°	M40467	M41467	M40548
SL-3L6	3/8	1/4	1-1/16	7-3/16	C	14°	M40468	M41468	
SL-4	1/2	1/4	1-1/8	3	C	14°	M40469	M41469	M40549
SL-4L6	1/2	1/4	1-1/8	7-1/4	C	14°	M40470	M41470	
SL-6	5/8	1/4	1-5/16	3-3/16	C	14°	M40471	M41471	M40550
SL-7	3/4	1/4	1-1/2	3-3/8	C	14°	M40472	M41472	

Series SL-M Offering

USCTI Number	D1 mm	D mm	AP1 mm	L mm	Shank Style	KRA	Standard Cut EDP No.	Master Cut EDP No.	Aluminum Cut EDP No.
SL-41M	3,0	3,0	9,5	38,1	A	8°	M40473	M41473	
SL-42M	3,0	3,0	12,7	38,1	A	8°	M40474	M41474	
SL-53M	4,8	3,0	12,7	38,1	A	14°	M40475	M41475	
SL-1M	6,0	6,0	15,9	50,8	C	14°	M40476	M41476	
SL-2M	7,9	6,0	22,2	69,9	C	14°	M40477	M41477	
SL-3M	9,5	6,0	27,0	74,6	C	14°	M40478	M41478	M40582
SL-4M	12,7	6,0	31,8	76,2	C	14°	M40479	M41479	M40584
SL-4M-2	12,7	8,0	31,8	82,6	C	14°	M40480	M41480	
SL-6M	15,9	6,0	33,3	81,0	C	14°	M40481	M41481	M40585
SL-6M-2	15,9	8,0	33,3	87,4	C	14°	M40482	M41482	M40586
SL-7M	19,1	6,0	38,1	85,7	C	14°	M40483	M41483	
SL-7M-2	19,1	8,0	38,1	92,1	C	14°	M40484	M41484	M40587

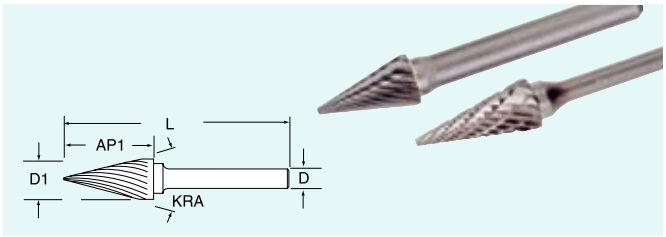
Series SM, SM-M Pointed Cone

Features

- Pointed cone shape
- SM inch sizes; SM-M metric sizes
- Shank types A, B, C; see page 152 for shank style definitions

Old List Numbers 010-20, 020-20, 045-20, 010-20, 015-20





Series SM Offering

USCTI Number	D1 inch	D inch	AP1 inch	L inch	Shank Style	KRA	Standard Cut EDP No.	Master Cut EDP No.
SM-41	1/8	1/8	3/8	1-1/2	A	12°	M40485	M41485
SM-42	1/8	1/8	7/16	1-1/2	A	14°	M40486	M41486
SM-43	1/8	1/8	5/8	1-1/2	A	7°	M40487	M41487
SM-53	3/16	1/8	1/2	1-1/2	A	16°	M40488	M41488
SM-51	1/4	1/8	1/2	1-7/8	B	22°	M40489	M41489
SM-1	1/4	1/4	1/2	2	C	22°	M40490	M41490
SM-2	1/4	1/4	3/4	2	C	14°	M40491	M41491
SM-3	1/4	1/4	1	2	C	10°	M40492	M41492
SM-4	3/8	1/4	5/8	2-1/2	C	28°	M40493	M41493
SM-5	1/2	1/4	7/8	2-3/4	C	28°	M40494	M41494
SM-6	5/8	1/4	1	2-7/8	C	31°	M40495	M41495

Series SM-M Offering

USCTI Number	D1 mm	D mm	AP1 mm	L mm	Shank Style	KRA	Standard Cut EDP No.	Master Cut EDP No.
SM-41M	3,0	3,0	9,5	38,1	A	12°	M40496	M41496
SM-42M	3,0	3,0	11,1	38,1	A	14°	M40497	M41497
SM-43M	3,0	3,0	15,9	38,1	A	7°	M40498	M41498
SM-53M	4,8	3,0	12,7	38,1	A	16°	M40499	M41499
SM-1M	6,0	6,0	12,7	50,8	C	22°	M40500	M41500
SM-2M	6,0	6,0	19,1	50,8	C	14°	M40501	M41501
SM-3M	6,0	6,0	25,4	50,8	C	10°	M40502	M41502
SM-51M	6,4	3,0	12,7	47,6	B	22°	M40503	M41503
SM-4M	9,5	6,0	15,9	63,5	C	28°	M40504	M41504
SM-5M	12,7	6,0	22,2	69,9	C	28°	M40505	M41505
SM-5M-2	12,7	8,0	22,2	76,2	C	28°	M40506	M41506
SM-6M	15,9	6,0	25,4	73,0	C	31°	M40507	M41507
SM-6M-2	15,9	8,0	25,4	79,6	C	31°	M40508	M41508

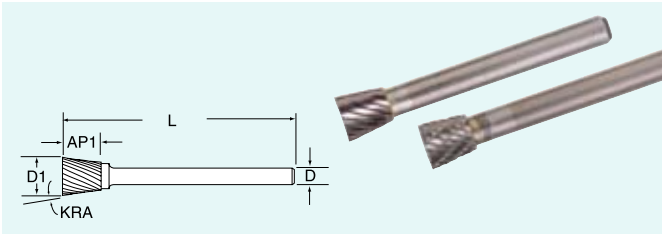
Series SN, SN-M Inverted Taper

Features

- Inverted taper shape
- SN inch sizes; SN-M metric sizes
- Shank types A, C; see page 152 for shank style definitions

Old List Numbers 010-21, 041-21, 015-21, 101-00





Series SN Offering

USCTI Number	D1 inch	D inch	AP1 inch	L inch	Shank Style	KRA	Standard Cut EDP No.	Master Cut EDP No.
SN-41	3/32	1/8	3/16	1-1/2	A	10°	M40509	
SN-42	1/8	1/8	3/16	1-1/2	A	10°	M40510	M41510
SN-53	3/16	1/8	1/4	1-1/2	A	10°	M40511	M41511
SN-51	1/4	1/8	1/4	1-1/2	A	10°	M40512	M41512
SN-1	1/4	1/4	5/16	2	C	10°	M40513	M41513
SN-3	1/2	1/4	1/2	2-1/4	C	16°		M41514
SN-4	1/2	1/4	1/2	2-1/4	C	28°	M40515	

Series SN-M Offering

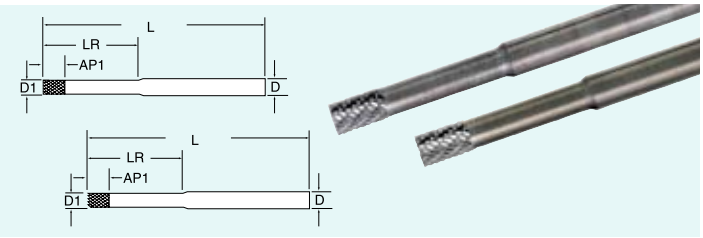
USCTI Number	D1 mm	D mm	AP1 mm	L mm	Shank Style	KRA	Standard Cut EDP No.	Master Cut EDP No.
SN-42M	3,0	3,0	4,8	38,1	A	10°	M40516	M41516
SN-53M	4,8	3,0	6,4	38,1	A	10°	M40517	M41517
SN-51M	6,4	3,0	6,4	38,1	A	10°	M40518	M41518
SN-1M	6,0	6,0	7,9	5,8	C	10°	M40519	M41519
SN-2M	9,5	6,0	9,5	57,2	C	13°	M40520	M41520
SN-4M	12,7	6,0	12,7	57,2	C	28°	M40521	
SN-3M	12,7	6,0	12,7	57,2	C	16°	M40522	M41522
SN-6M	15,9	6,0	19,1	63,5	C	18°	M40523	M41523
SN-6M-2	15,9	8,0	19,1	69,9	C	18°	M40524	M41524
SN-7M	19,1	6,0	15,9	60,3	C	30°	M40525	M41525
SN-7M-2	19,1	8,0	15,9	66,7	C	30°	M40526	M41526

Series IGT Internal Grinding Tool

Features

- Fine master-cut style
- Cylindrical shape
- Series IGT has no end cut;
  Series IGT-EC has end cut
- Solid carbide constructiion

Old List Number 115-10, 115-11





Series IGT Offering

D1 inch	D inch	AP1 inch	Reach Length	L inch	Master Cut EDP No.
1/16	1/8	1/8	1/2	1-1/2	M42006
5/64	1/8	5/32	1/2	1-1/2	M42007
3/32	1/8	5/32	1/2	1-1/2	M42008
7/64	1/8	3/16	1/2	1-1/2	M42009
1/8	1/8	3/16	1/2	1-1/2	M42010
9/64	3/16	7/32	5/8	2	M42019
5/32	3/16	7/32	5/8	2	M42020
11/64	3/16	1/4	5/8	2	M42021
3/16	3/16	1/4	5/8	2	M42022
13/64	1/4	9/32	3/4	2	M42011
7/32	1/4	9/32	3/4	2	M42012
15/64	1/4	5/16	3/4	2	M42013
1/4	1/4	5/16	3/4	2	M42014
9/32	1/4	11/32		2-1/2	M42015
5/16	1/4	11/32		2-1/2	M42016
11/32	1/4	3/8		2-1/2	M42017
3/8	1/4	3/8		2-1/2	M42018

Series IGT-EC Offering

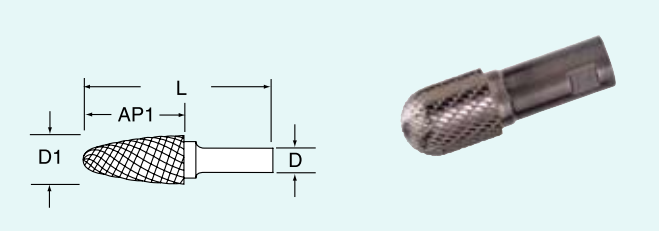
D1 inch	D inch	AP1 inch	Reach Length	L inch	Master Cut EDP No.
1/16	1/8	1/8	1/2	1-1/2	M42023
5/64	1/8	5/32	1/2	1-1/2	M42024
3/32	1/8	5/32	1/2	1-1/2	M42025
7/64	1/8	3/16	1/2	1-1/2	M42026
1/8	1/8	3/16	1/2	1-1/2	M42027
9/64	3/16	7/32	5/8	2	M42036
5/32	3/16	7/32	5/8	2	M42037
11/64	3/16	1/4	5/8	2	M42038
3/16	3/16	1/4	5/8	2	M42039
13/64	1/4	9/32	3/4	2	M42028
7/32	1/4	9/32	3/4	2	M42029
15/64	1/4	5/16	3/4	2	M42030
1/4	1/4	5/16	3/4	2	M42031
9/32	1/4	11/32		2-1/2	M42032
5/16	1/4	11/32		2-1/2	M42033
11/32	1/4	3/8		2-1/2	M42034
3/8	1/4	3/8		2-1/2	M42035

Series ITS Internal Threading Shank

Features

- Internal threaded shank
- Solid carbide construction

Old List Number 115-10



Applications

- For rigorous foundry casting cleaning applications:
  - smoothing out casting risers and fins, repairing welds, removing core sand

Design enables the bur to operate closer to the grinder bearings, reducing the overhang and providing:

- minimal bur runout
- less chatter
- improved finish
- reduced whipping action
- increased stock removal rates
- longer bearing life
- smoother operation
- secure operator control
- bur usage in tight corners

- Enables usage of shank extensions.
- No need for costly collets.
- No bending or breaking.

Series ITS Offering

	D1 inch	D inch	AP1 inch	L inch	Internal Shank Threads Per Inch	Master Cut EDP No.	Aluminum Cut EDP No.
Ball Nose							
	3/4	9/16	1	2-1/4	24	M42000	
	1-1/8	7/8	2	3-3/8	11	M42001	
Round Nose Tree							
	3/4	9/16	1-1/2	2-3/4	24	M42002	M42004
	1-1/8	7/8	2	3-3/8	11	M42003	M42005

Bur Sets

Features

- Available in A, B, C shank styles; see page 152 for shank style definitions
- Assortment of bur styles for multiple applications
- Most popular inch and metric sizes



Bur Sets

Head Dia.	Shank Dia.	No. of Pieces	Shank Style	Cut Style	Includes	EDP No.
1/8	1/8	9	A	Master	SA-42, SA-43, SC-41. SC-42, SD-42, SE-41, SF-42, SG-42, SM-43	M40588
3 mm	3mm	9	A	Master	SA-42M, SA-43M, SC-41M. SC-42M, SD-42M, SE-41M, SF-42M, SG-42M, SM-43M	M40589
3 mm	3mm	9	B	Master	SA-42M, SA-43M, SC-41M. SC-42M, SD-42M, SE-41M, SF-42M, SG-42M, SM-43M	M40590
1/4	1/8	9	B	Master	SA-51, SB-51, SC-51. SD-51, SE-51, SF-51, SG-51, SM-51, SN-51	M40591
1/4	3mm	9	B	Master	SA-51M, SB-51M, SC-51M. SD-51M, SE-51M, SF-51M, SG-51M, SM-51M, SN-51M	M40592
1/4	1/4	8	C	Master	SA-1, SC-1, SD-1, SE-1, SF-1, SG-1, SL-1, SM-2	M40593
6mm	6mm	8	C	Master	SA-1M, SC-1M, SD-1M, SE-1M, SF-1M, SG-1M, SL-1M, SM-2M	M40595
3/8	6mm	8	C	Standard	SA-3M, SC-3M, SD-3M, SE-3M, SF-3M, SG-3M, SL-3M, SM-4M	M40596
3/8	6mm	8	C	Master	SA-3M, SC-3M, SD-3M, SE-3M, SF-3M, SG-3M, SL-3M, SM-4M	M40597
1/2	1/4	8	C	Master	SA-5, SC-5, SD-5, SE-5, SF-5, SG-5, SL-4, SM-5	M40594
1/2	6mm	8	C	Master	SA-5M, SC-5M, SD-5M, SE-5M, SF-5M, SG-5M, SL-4M, SG-5M	M40598

Group	Group Description	Hardness	
	**Low-Carbon Steel** *AISI: 1008, 1010, 1018, 1020, 1026, 10L18, 10L45, 10L50, 1108, 1117, 11L44, 1200 Series, 12L14*	**< 220 HB**	
	Free-Machining Steels *AISI: 1109, 1111, 1112, 1113, 1114, 1115, 1116, 1132, 1137, 1138, 1140, 1141, 1144, 1145, 1151*	**< 275 HB**	**≤ 28 HRc**
	Medium and High Plain Carbon, Alloy and Tool Steels *Medium and High Carbon Steels: AISI: 1035, 1040, 1045, 1055, 1080, 1090, 1095, 1525, 1541, 1548, 1551, 1561, 1572* *Alloy Steels: AISI: 1300 series, 2000 series, 3000 series, 4012, 4023, 4140, 4150, 4320, 4422, 5120, E51100, E52100, 6118, 6150, 7000 series, 8620, 8622, 86540, 8822, E-9310, 94B15, Rycut 40, Cr-Mo alloy, Super-Kut steels* *Tool Steels: high speed classes M and T; hot and cold work SAE classes A, D, H, O and S; wrought high carbon/low alloy W1, W2, L2, P1, P6, P20*	**≤ 330 HRc**	**≤ 35 HRc**
	Medium and High Plain Carbon, Alloy and Alloy Steels *Alloy Steels: AISI: 1335, 4140, 4330, 5046, 5140, 52100, 8625, 8640, 300-M, EDT-180, Hy Tuff steel and stress-proof steel* *Tool Steels: SAE class M and T, hot and cold work SAE classes A, D, H, O and S; wrought high carbon/low alloy W1, W2, L2, P1, P6, P20*	**340-450 HB**	**36-48 HRc**
	Ferritic, Martensitic, and PH Stainless Steels *400 and 500 series AISI: 410, 416, 416F, 416Se, 420Fm, 4389F, Se, 440, 440C, 502, 504 and precipitation hardening (PH) 17-4PH, PH 13-8 Mo, 15-5 PH*	**< 330 HB**	**≤ 40 HRc**
	**Austenitic Stainless Steels** *200 and 300 series, Duplex* *AISI: 210, 209, 302, 303, 304, 304L, 310, 316, 316L, 321, 329, 347, 384* *ASTM: XM-1, SM-5, XM-7, XM-21, CF-8M*	**135-275 HB**	**≤ 28 HRc**
	**Ductile (Nodular) and Malleable Cast Irons** *nodular/ductile, ferritic/pearlitic, pearlitic/martensitic* *ASTM A536, 60-40-18, 65-45-12, 80-55-06, 100-70-03* *SAE: J434, D4018, D4512, D5506, D7003*	**120-320 HB**	
	Gray Cast Irons *ASTM: A48, class 20, 25, 30, 35, 40, 45, 50, 55, 60* *SAE: J431: grade G1800, G3000, G3500, G4000*	**120-320 HB**	
	**Free-Machining and Low-Silicon Aluminum Alloys** *AA: 2024-T4, 2014-T6, 2011-T3, 3003-H18, A2, Alcoa 510, Duralumin aluminum, 6061-T4, 6061-T6, 7075-T4, 7075-T-6*	**Hypoeutectic <12.2% Si**	
	High-Silicon Aluminum Alloys AA: A380, A390, A38 *AA: A380, A390, A380-1, A390-1, A380-2, Duralcan*	**Hypereutectic >12.2% Si**	
	Miscellaneous Non-ferrous Workpiece Materials *Nonferrous machining alloys, copper, brass, zinc*	**—**	
	**Iron-Base Heat-Resistant Alloys** *Wrought: A-286, Discaloy, Incoloy 801, N-155, 16-25-6, 19-9 DL* *Cast: ASTM A297, A351, A608, A567*	**135-320 HB**	**≤ 34 HRc**
	Cobalt-Base Heat-Resistant Alloys *Wrought: AiResist 213, Haynes 25 (L605), Haynes 188, J-1570, Stellite* *Cast: Ai Resist 13, Haynes 21, MAR-M509, NASA Co-W-Re, WI-52*	**150-425 HB**	**≤ 45 HRc**
	Nickel-Base Heat-Resistant Alloys *Astroloy, Hastelloy, B/C/C0276/X, Inconel 601/ 617/ 625/ 700/ 706/718, IN 102, Incoloy 901, MAR-M200, Nimonic, Rene 41, Udimet, Waspaloy, Monel*	**140-475 HB**	**≤ 48 HRc**
	Titanium and Titanium Alloys *pure: Ti98.8, Ti99.9* *alloyed: Ti5Al2.5Sn, Ti-5Al-4V, Ti6Al2Sn-4Zr-2Mo, Ti3Al-8V-6Cr-4Mo-4Zr, Ti10V-2Fe-3Al, Ti-13V-11Cr-3Al*	**110-450 HB**	**≤ 48 HRc**
	**Hardened Materials** *steels, stainless steels, and irons*	**48-65 HRc**	

Decimal Equivalent Chart

FRACTIONAL • LETTER • WIRE GAGE • METRIC

Drill Size	Decimal	Drill Size	Decimal	Drill Size	Decimal	Drill Size	Decimal	Drill Size	Decimal
0,3mm	.0118	1,75mm	.0689	4,1mm	.1614	L	.2900	33/64	.5156
0,32mm	.0126	50	.0700	4,2mm	.1654	7,4mm	.2913	13,2mm	.5197
80	.0135	1,8mm	.0709	19	.1660	M	.2950	17/32	.5312
0,35mm	.0138	1,85mm	.0728	4,3mm	.1693	7,5mm	.2953	13,5mm	.5315
79	.0145	49	.0730	18	.1695	19/64	.2969	13,8mm	.5433
0,38mm	.0150	1,9mm	.0748	11/64	.1719	7,6mm	.2992	35/64	.5469
1/64	.0156	48	.0760	17	.1730	N	.3020	14,0mm	.5512
0,4mm	.0157	1,95mm	.0768	4,4mm	.1732	7,7mm	.3031	14,25mm	.5610
78	.0160	5/64	.0781	16	.1770	7,8mm	.3071	9/16	.5625
0,42mm	.0165	47	.0785	4,5mm	.1772	7,9mm	.3110	14,5mm	.5709
0,45mm	.0177	2,0mm	.0787	15	.1800	5/16	.3125	37/64	.5781
77	.0180	2,05mm	.0807	4,6mm	.1811	8,0mm	.3150	14,75mm	.5807
0,48mm	.0189	46	.0810	14	.1820	O	.3160	15,0mm	.5906
0,5mm	.0197	45	.0820	4,7mm,13	.1850	8,1mm	.3189	19/32	.5938
76	.0200	2,1mm	.0827	3/16	.1875	8,2mm	.3228	15,25mm	.6004
75	.0210	2,15mm	.0846	4,8mm,12	.1890	P	.3230	39/64	.6094
0,55mm	.0217	44	.0860	11	.1910	8,3mm	.3268	15,5mm	.6102
74	.0225	2,2mm	.0866	4,9mm	.1929	21/64	.3281	15,75mm	.6201
0,6mm	.0236	2,25mm	.0886	10	.1935	8,4mm	.3307	5/8	.6250
73	.0240	43	.0890	9	.1960	Q	.3320	16,0mm	.6299
0,62mm	.0244	2,3mm	.0906	5,0mm	.1969	8,5mm	.3346	16,25mm	.6398
72	.0250	2,35mm	.0925	8	.1990	8,6mm	.3386	41/64	.6406
0,65mm	.0256	42	.0935	5,1mm	.2008	R	.3390	16,5mm	.6496
71	.0260	3/32	.0938	7	.2010	8,7mm	.3425	21/32	.6562
0,7mm	.0276	2,4mm	.0945	13/64	.2031	11/32	.3438	16,75mm	.6594
70	.0280	41	.0960	6	.2040	8,8mm	.3465	17,0mm	.6693
69	.0292	2,45mm	.0965	5,2mm	.2047	S	.3480	43/64	.6719
0,75mm	.0295	40	.0980	5	.2055	8,9mm	.3504	17,25mm	.6791
68	.0310	2,5mm	.0984	5,3mm	.2087	9,0mm	.3543	11/16	.6875
1/32	.0312	39	.0995	4	.2090	T	.3580	17,5mm	.6890
0,8mm	.0315	38	.1015	5,4mm	.2126	9,1mm	.3583	45/64	.7031
67	.0320	2,6mm	.1024	3	.2130	23/64	.3594	18,0mm	.7087
66	.0330	37	.1040	5,5mm	.2165	9,2mm	.3622	23/32	.7188
0,85mm	.0335	2,7mm	.1063	7/32	.2188	9,3mm	.3661	18,5mm	.7283
65	.0350	36	.1065	5,6mm	.2205	U	.3680	47/64	.7344
0,9mm	.0354	7/64	.1094	2	.2210	9,4mm	.3701	19,0mm	.7480
64	.0360	35	.1100	5,7mm	.2244	9,5mm	.3740	3/4	.7500
63	.0370	2,8mm	.1102	1	.2280	3/8	.3750	49/64	.7656
0,95mm	.0374	34	.1110	5,8mm	.2283	V	.3770	19,5mm	.7677
62	.0380	33	.1130	5,9mm	.2323	9,6mm	.3780	25/32	.7812
61	.0390	2,9mm	.1142	A	.2340	9,7mm	.3819	20,0mm	.7874
1,0mm	.0394	32	.1160	15/64	.2344	9,8mm	.3858	51/64	.7969
60	.0400	3,0mm	.1181	6,0mm	.2362	W	.3860	20,5mm	.8071
59	.0410	31	.1200	B	.2380	9,9mm	.3898	13/16	.8125
1,05mm	.0413	3,1mm	.1220	6,1mm	.2402	25/64	.3906	21,0mm	.8268
58	.0420	1/8	.1250	C	.2420	10,0mm	.3937	53/64	.8281
57	.0430	3,2mm	.1260	6,2mm	.2441	X	.3970	27/32	.8438
1,1mm	.0433	30	.1285	D	.2460	10,2mm	.4016	21,5mm	.8465
1,15mm	.0453	3,3mm	.1299	6,3mm	.2480	Y	.4040	55/64	.8594
56	.0465	3,4mm	.1339	1/4, E	.2500	13/32	.4062	22,0mm	.8661
3/64	.0469	29	.1360	6,4mm	.2520	Z	.4130	7/8	.8750
1,2mm	.0472	3,5mm	.1378	6,5mm	.2559	10,5mm	.4134	22,5mm	.8858
1,25mm	.0492	28	.1405	F	.2570	27/64	.4219	57/64	.8906
1,3mm	.0512	9/64	.1406	6,6mm	.2598	10,8mm	.4252	23,0mm	.9055
55	.0520	3,6mm	.1417	G	.2610	11,0mm	.4331	29/32	.9062
1,35mm	.0531	27	.1440	6,7mm	.2638	7/16	.4375	59/64	.9219
54	.0550	3,7mm	.1457	17/64	.2656	11,2mm	.4409	23,5mm	.9252
1,4mm	.0551	26	.1470	H	.2660	11,5mm	.4528	15/16	.9375
1,45mm	.0571	25	.1495	6,8mm	.2677	29/64	.4531	24,0mm	.9449
1,5mm	.0591	3,8mm	.1496	6,9mm	.2717	11,8mm	.4646	61/64	.9531
53	.0595	24	.1520	I	.2720	15/32	.4688	24,5mm	.9646
1,55mm	.0610	3,9mm	.1535	7,0mm	.2756	12,0mm	.4724	31/32	.9688
1/16	.0625	23	.1540	J	.2770	12,2mm	.4803	25,0mm	.9843
1,6mm	.0630	5/32	.1562	7,1mm	.2795	31/64	.4844	63/64	.9844
52	.0635	22	.1570	K	.2810	12,5mm	.4921	1"	1.0000
1,65mm	.0650	4,0mm	.1575	9/32	.2812	1/2	.5000		
1,7mm	.0669	21	.1590	7,2mm	.2835	12,8mm	.5039		
51	.0670	20	.1610	7,3mm	.2874	13,0mm	.5118		

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270	Drills	104-106
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295	Drills	122
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383, 385	Drills	111-116
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CG-2	End Mills	15-17
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CG-2MD	End Mills	18
CG-2MDB	End Mills	23
CG-2R	End Mills	19
CG-3	End Mills	25
CG-3B	End Mills	27
CG-3M	End Mills	26
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CG-4	End Mills	28-30
CG-4B	End Mills	34-35
CG-4M	End Mills	32
CG-4MB	End Mills	36
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CGDS-4	End Mills	41
CGDS-4B	End Mills	42
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SH	Burs	161
SL	Burs	162
SM	Burs	163
SN	Burs	164

Suggested Feeds for General-Purpose Carbide End Mills (see page 12 for inch recommendations)

The following recommendations are for profiling operations; reduce speeds 20% for slotting operations



Material	Hardness Brinell	Hardness HRc	Preferred Coating	Alternate Coating	Speed Range	mm per Minute Uncoated	TiN Coated	TiCN Coated	TiAlN Coated
Low and Plain Carbon, Alloy and Tool Steels	< 220 HB	<19	TiCN	TiN	Low	82	91	98	—
					High	110	131	152	—
Plain Carbon, Alloy and Tool Steels	225-286	20-30	TiCN	TiAlN or TiN	Low	55	61	67	76
					High	82	98	116	131
Plain Carbon, Alloy and Tool Steels	294-371	31-40	TiCN	TiAlN or TiN	Low	46	52	55	64
					High	61	73	85	98
Ferritic, Martensitic 400, 500, and PH Stainless Steels	135-330	<35	TiAlN	TiCN or TiN	Low	49	55	58	67
					High	82	98	116	131
Austenitic Stainless Steels 200 and 300 Series	135-275	<28	TiAlN	TiCN or TiN	Low	55	61	67	76
					High	84	101	119	134
Ductile and Malleable Cast Irons	120-320	<35	TiAlN	TiCN or TiN	Low	49	55	58	67
					High	82	98	116	131
Cast Iron (Gray)	120-220	<18	TiAlN	TiCN or TiN	Low	96	107	116	134
					High	137	165	192	219
Cast Iron (Gray)	220-320	19-34	TiAlN	TiCN or TiN	Low	69	76	82	98
					High	96	116	134	152
Low-Silicon Aluminum and Other Non-Ferrous Alloys	50-150	—	TiCN	TiN	Low	219	241	262	—
					High	274	329	384	—
High-Silicon Aluminum	—	—	TiCN	TiN	Low	165	180	198	—
					High	219	262	308	—
Cobalt-Based High-Temperature Alloys	150-425	<45	TiAlN	TiCN	Low	9	—	12	12
					High	14	—	18	21
Nickel-Based High-Temperature Alloys	140-300	<32	TiAlN	TiCN or TiN	Low	14	15	15	18
					High	27	34	40	43
Nickel Based High-Temperature Alloys	300-475	32-50	TiAlN	TiCN	Low	12	—	15	18
					High	21	—	30	34
Titanium, Pure	—	—	NONE	NONE	Low	55	—	—	—
					High	82	—	—	—
Titanium, Alloyed	300-440	32-43	TiAlN	TiCN	Low	27	—	34	40
					High	41	—	58	67

The higher values for surface speed should be used for radial depths of cut less than 25% of the diameter. Lower values for surface speed should be used for radial depths of cut greater than 25% of the diameter. The above recommendations are for axial lengths of cut not to exceed 1 times the cutter diameter for profiling and .5 times the diameter for slotting. The above speeds are a recommended starting point only. Ultimate speeds will depend upon setup conditions. Higher or lower parameters may be required to achieve optimum conditions.

Suggested Feeds for General-Purpose Carbide End Mills (see page 13 for inch recommendations)

The following recommendations are for profiling operations; reduce chip load per tooth 20% for slotting operations



Material	Hardness Brinell	Hardness HRc	Chip Load Per Tooth (mm) 1,6	3,2	4,8	6,4	7,9	9,5	12,7	15,9	19,1	25,4
Low and Plain Carbon, Alloy and Tool Steels	< 220 HB	<19	0,010	0,015	0,025	0,038	0,051	0,064	0,076	0,089	0,102	0,114
Plain Carbon, Alloy and Tool Steels	225-286	20-30	0,010	0,015	0,025	0,038	0,051	0,064	0,076	0,089	0,102	0,114
Plain Carbon, Alloy and Tool Steels	294-371	31-40	0,008	0,010	0,018	0,028	0,036	0,046	0,053	0,064	0,071	0,081
Ferritic, Martensitic 400, 500, and PH Stainless Steels	135-330	<35	0,005	0,010	0,015	0,025	0,038	0,051	0,064	0,076	0,089	0,102
Austenitic Stainless Steels 200 and 300 Series	135-275	<28	0,010	0,015	0,020	0,038	0,051	0,064	0,076	0,089	0,102	0,114
Ductile and Malleable Cast Irons	120-320	<35	0,020	0,030	0,051	0,076	0,102	0,127	0,152	0,178	0,203	0,229
Cast Iron (Gray)	120-220	<18	0,013	0,018	0,030	0,046	0,061	0,076	0,091	0,107	0,122	0,140
Cast Iron (Gray)	220-320	19-34	0,008	0,010	0,018	0,028	0,036	0,046	0,053	0,064	0,071	0,081
Low-Silicon Aluminum and Other Non-Ferrous Alloys	50-150	—	0,005	0,010	0,015	0,023	0,030	0,038	0,046	0,053	0,061	0,069
High-Silicon Aluminum	—	—	0,005	0,010	0,015	0,023	0,030	0,038	0,046	0,053	0,061	0,069
Cobalt-Based High-Temperature Alloys	150-425	<45	0,005	0,010	0,015	0,023	0,030	0,038	0,046	0,053	0,061	0,069
Nickel-Based High-Temperature Alloys	140-300	<32	0,005	0,010	0,015	0,023	0,030	0,038	0,046	0,053	0,061	0,069
Nickel-Based High-Temperature Alloys	300-475	32-50	0,005	0,010	0,015	0,023	0,030	0,038	0,046	0,053	0,061	0,069
Titanium, Pure	—	—	0,015	0,025	0,041	0,061	0,081	0,102	0,122	,0142	0,163	0,183
Titanium, Alloyed	300-440	32-43	0,015	0,025	0,041	0,061	0,081	0,102	0,122	0,142	0,163	0,183

The above recommendations are for axial lengths of cut not to exceed 1 times the cutter diameter for profiling and .5 times the diameter for slotting. The above feeds are a recommended starting point only. Ultimate speeds and feeds will depend upon setup conditions. Higher or lower parameters may be required to achieve optimum conditions.

Cutting Speeds and Feed Rates *(see page 59 for inch recommendations)*

Workpiece Material	Cutting Speed	Feed Rates																				
		6			8			10			12			16			19			25		
	(m/min)	RPM	Fz	Vf	RPM	Fz	Vf	RPM	Fz	Vf	RPM	Fz	Vf	RPM	Fz	Vf	RPM	Fz	Vf	R PM	Fz	Vf
Gray	137	7269	0.0432	1256.2	5452	0.056	1221.3	4362	0.071	1238.7	3635	0.086	1250.3	2726	0.091	992.3	2296	0.099	909.1	1745	0.099	690.9
Cast Iron	168	8914	0.0432	1540.4	6686	0.056	1497.6	5349	0.071	1519.0	4457	0.086	1533.3	3343	0.091	1216.8	2815	0.099	1114.8	2139	0.099	84702
Tool Steels	152	8065	0.0406	1809.8	6049	0.051	1234.0	4839	0.056	1084.0	4033	0.076	1225.9	3025	0.081	979.9	2547	0.089	906.7	1936	0.099	847.2
(A2,D2,S7)	183	9710	0.0406	1577.0	7283	0.051	1485.7	5826	0.056	1305.1	4855	0.076	1476.0	3641	0.081	1179.8	3066	0.089	1091.6	2330	0.102	950.8
Die Steels	107	5678	0.0406	922.0	4258	0.051	868.7	3407	0.064	872.1	2839	0.079	897.1	2129	0.089	758.0	1793	0.094	674.1	1363	0.102	556.0
(P20, H13)	137	7269	0.0406	1180.6	5452	0.051	1112.2	4362	0.064	1116.6	3635	0.079	1148.6	2726	0.089	970.5	2296	0.094	863.2	1745	0.102	711.8
Soft Steels >36Rc	152	8065	0.0406	1309.8	6049	0.054	1306.6	4839	0.066	1277.6	4033	0.079	1274.3	3025	0.086	1040.4	2547	0.091	927.1	1936	0.091	704.6
(1018-1060)	183	9710	0.0406	1577.0	7283	0.053	1543.9	5826	0.066	1538.1	4855	0.079	1534.2	3641	0.086	1252.6	3066	0.091	1116.2	2330	0.091	848.3
Easy-to-cut	91	4829	0.0406	784.2	3621	0.053	767.7	2897	0.066	764.9	2414	0.079	762.9	1811	0.086	622.9	1525	0.091	555.0	1159	0.091	421.8
Stainless Steels	116	6155	0.0406	999.6	4616	0.053	978.7	3693	0.066	975.0	3078	0.079	972.5	2308	0.086	794.0	1944	0.091	707.5	1477	0.091	537.7
(303 etc.)																						
Moderately difficult	79	4192	0.0356	596.9	3144	0.048	603.6	2515	0.061	613.7	2096	0.074	620.4	1572	0.079	496.7	1324	0.086	455.4	1006	0.086	346.1
Stainless Steels	88	4669	0.0356	664.9	3502	0.048	672.4	2802	0.061	683.6	2335	0.074	691.1	1751	0.079	553.3	1475	0.086	507.2	1121	0.086	385.5
(304,Invar, Kovar)																						
Difficult																						
Stainless Steels	45	2388	0.0305	291.3	1791	0.041	293.7	1433	0.051	292.3	1194	0.061	291.3	895	0.066	236.4	754	0.071	214.1	573	0.071	162.8
(316L, 304L,	64	3396	0.0305	414.3	2547	0.041	417.7	2038	0.051	415.7	1698	0.061	414.3	1273	0.066	336.2	1072	0.071	304.6	815	0.071	231.5
13-8 PH etc.)																						
Alloy Steels	76	4033	0.0406	654.9	3025	0.051	617.0	2420	0.064	619.4	2016	0.079	637.2	1512	0.089	538.4	1273	0.094	478.8	968	0.102	394.9
(4140-4340)	137	7269	0.0406	1180.6	5452	0.051	1112.2	4362	0.064	1116.6	3635	0.079	1148.6	2726	0.089	970.5	2296	0.094	863.2	1745	0.102	711.8
High-Temp Alloys	23	1220	0.0254	124.0	915	0.031	113.5	732	0.041	120.1	610	0.046	112.3	458	0.051	93.4	385	0.061	94.0	293	0.061	71.5
(718 Inconel,	27	1433	0.0254	145.6	1074	0.031	132.2	860	0.041	141.0	716	0.046	131.8	537	0.051	109.6	452	0.061	110.4	344	0.061	83.9
A286, Haynes)																						
Titanium Alloys	37	1963	0.0356	279.6	1472	0.048	282.7	1178	0.061	287.4	982	0.074	290.6	736	0.079	232.6	620	0.086	213.3	471	0.086	162.1
(6Al-4V, 6-2222)	49	2600	0.0356	370.2	1950	0.048	374.4	1560	0.061	18.6	1300	0.074	984.8	975	0.079	308.1	621	0.086	282.4	624	0.086	214.7

Recommendations are for slotting conditions with depth of cut equal to the diameter of the end mill. For profiling operations, increase the feed by 20%. The feeds and speeds shown on this table are based on providing a combination of high metal removal rates with a long tool life and avoiding tool breakage. The low rates are more appropriate for 40 taper machines and weak fixturing. The high rates are more suitable for 50-taper machines and rigid setups. With long length run X% slower speed.

Recommended Chip Loads for Maestro End Mills *(see page 59 for inch recommendations)*

Workpiece Material	Cutting Speed (m/min)	Chip Load Per Tooth (mm/tooth)									Profiling		Slotting
		3,2	4,8	6,4	7,9	9,5	12,7	15,9	19,1	25,4	Axial Depth	Radial Depth	
Gray Cast Iron	137-168	0,020	0,025	0,038	0,051	0,058	0,066	0,074	0,084	0,091	1 x Dia.	.5 x Dia.	1 x Dia.
Tool Steels (A2,D2,S7)	152-183	0,020	0,025	0,041	0,051	0,056	0,076	0,081	0,089	0,102	1 x Dia.	.5 x Dia.	1 x Dia.
Die Steels (P20, H13)	107-137	0,015	0,020	0,036	0,046	0,051	0,071	0,076	0,084	0,097	2 x Dia.	.5 x Dia.	1 x Dia.
Soft Steels (1018-1060) >36Rc	152-183	0,020	0,025	0,041	0,051	0,056	0,076	0,081	0,089	0,102	1 x Dia.	.5 x Dia.	1 x Dia.
Easy-to-cut Stainless Steels (303 etc.)	91-116	0,018	0,028	0,038	0,046	0,053	0,061	0,069	0,076	0,084	1 x Dia.	.5 x Dia.	1 x Dia.
Moderately difficult Stainless Steels (304,Invar, Kovar)	79-88	0,013	0,023	0,033	0,041	0,046	0,056	0,064	0,071	0,079	1 x Dia.	.5 x Dia.	1 x Dia.
Difficult Stainless Steels (316L, 304L, 13-8 PH etc.)	49-64	0,010	0,018	0,028	0,036	0,041	0,051	0,058	0,066	0,074	1 x Dia.	.5 x Dia.	1 x Dia.
Alloy Steels (4140-4340)	76-98	0,015	0,025	0,041	0,051	0,064	0,079	0,089	0,094	0,102	1 x Dia.	.5 x Dia.	1 x Dia.
High-Temp Alloys (718 Inconel, A286, Haynes)	23-27	0,010	0,018	0,023	0,030	0,036	0,041	0,046	0,051	0,056	1 x Dia.	.2 x Dia.	.3 x Dia.
Titanium Alloys (6Al-4V, 6-2222)	37-49	0,018	0,025	0,033	0,041	0,051	0,058	0,066	0,074	0,084	1 x Dia.	.3 x Dia.	.5 x Dia.

Suggested Speeds for Series CS End Mills *(see page 63 for inch recommendations)*

M/Min for MASTERmill™ Series CS-3, CS-3B, CS-5, CSF-6, CH-2

Material	Hardness Brinell	Hardness HRc	Preferred Coating	Alternate Coating	Speed Range	Cutting Speed (m/min) Uncoated	TiCN Coated	TiAlN Coated
Low and Plain Carbon, Alloy & Tool Steels	< 220	<19	TiCN	TiN or TiAlN	Low	82	99	131
					High	110	152	175
Plain Carbon, Alloy & Tool Steels	225-286	20-30	TiAlN	TiN or TiCN	Low	55	66	107
					High	82	114	131
Plain Carbon, Alloy & Tool Steels	294-371	31-40	TiAlN	TiN or TiCN	Low	46	55	64
					High	61	85	98
Ferritic, Martensitic 400, 500, & PH Stainless Steels	135-330	<35	TiAlN	TiCN	Low	49	58	69
					High	82	114	131
Austenitic Stainless Steels 200 and 300 Series	135-275	<28	TiAlN	TiCN	Low	55	66	76
					High	96	134	152
Cobalt-Based High Temperature Alloys	150-425	<45	TiAlN	TiCN	Low	9	11	14
					High	14	20	23
Nickel-Based High Temperature Alloys	140-300	<32	TiAlN	TiCN	Low	14	17	20
					High	27	38	44
Nickel-Based High Temperature Alloys	300-475	32-50	TiAlN	TiCN	Low	12	15	17
					High	21	30	34
Titanium - Pure	—	—	NONE	NONE	Low	55	—	—
					High	82	—	—
Titanium - Alloyed	300-440	32-43	TiAlN	TiCN	Low	27	34	38
					High	41	58	66

Suggested Feeds for Series CS End Mills *(see page 63 for inch recommendations)*

M/Min for MASTERmill™ Series CS-3, CS-3B, CS-5, CSF-6, CH-2

Material	Hardness Brinell	Hardness HRc	Chip Load per Tooth (mm/tooth) 1,6	3,2	4,8	6,4	7,9	9,5	12,7	15,9	19,1	25,4
Low and Plain Carbon, Alloy & Tool Steels	< 220	<19	0,010	0,015	0,025	0,038	0,051	0,064	0,076	0,089	0,102	0,114
Plain Carbon, Alloy & Tool Steels	225-286	20-30	0,010	0,015	0,025	0,038	0,051	0,064	0,076	0,089	0,071	0,114
Plain Carbon, Alloy & Tool Steels	294-371	31-40	0,008	0,010	0,018	0,028	0,036	0,046	0,053	0,064	0,102	0,081
Ferritic, Martensitic 400, 500, & PH Stainless Steels	135-330	<35	0,010	0,015	0,020	0,038	0,051	0,064	0,076	0,089	0,089	0,114
Austenitic Stainless Steels 200 and 300 Series	135-275	<28	0,005	0,010	0,015	0,025	0,038	0,051	0,064	0,076	0,061	0,102
Cobalt-Based High Temperature Alloys	150-425	<45	0,005	0,010	0,015	0,023	0,030	0,038	0,046	0,053	0,061	0,069
Nickel-Based High Temperature Alloys	140-300	<32	0,005	0,010	0,015	0,023	0,030	0,038	0,046	0,053	0,061	0,069
Nickel-Based High Temperature Alloys	300-475	32-50	0,005	0,010	0,015	0,023	0,030	0,038	0,046	0,053	0,061	0,069
Titanium Pure	—	—	0,005	0,010	0,015	0,023	0,030	0,038	0,046	0,053	0,061	0,069
Titanium-alloyed	300-440	32-43	0,005	0,010	0,015	0,023	0,030	0,038	0,046	0,053	0,061	0,069

Suggested Speeds for Series CA End Mills *(see page 68 for inch recommendations)*

M/Min for End Mills Series CA-2, CA-2M, CA-2B, CA-3, CA-3M

Reduce Speeds and CLPT 20 % for Slotting Operations

						Cutting Speed (m/min)		
Material	Preferred Coating	Alternate Coating	Hardness Brinell	HRc	Speed Range	Uncoated	TiN Coated	TiCN Coated
Low-Silicon Aluminum & Other Non-Ferrous Alloys	TiCN	TiN	50-150	—	Low	244	268	293
					High	1219	1463	1707
High-Silicon Aluminum	TiCN	TiN	—	—	Low	183	201	219
					High	610	732	853

The higher values for surface speed should be used for radial depths of cut less than 25% of the diameter. Lower values for surface speed should be used for radial depths of cut greater than 25% of the diameter. The above recommendations are for axial lengths of cut not to exceed 1 times the cutter diameter for profiling and .5 times the cutter diameter for slotting.

Suggested Feeds for Series CA End Mills *(see page 68 for inch recommendations)*

Chip Load per Tooth for End Mills Series CA-2, CA-2M, CA-2B, CA-3, CA-3M

			Feed per tooth (mm/tooth)									
Material	Hardness Brinell	HRc	1,6	3,2	4,8	6,4	7,9	9,5	12,7	15,9	19,1	25,4
Low-Silicon Aluminum & Other Non-Ferrous Alloys	50-150	—	0,018	0,028	0,046	0,064	0,086	0,102	0,122	0,152	0,183	0,244
High-Silicon Aluminum	—	—	0,015	0,025	0,041	0,058	0,079	0,094	0,112	0,142	0,17	0,226

Note: The above speeds and feeds are recommended starting points only and depend upon setup conditions; higher or lower parameters may be required to achieve optimum conditions.

MASTERmill™ Series CRS Recommended Speed and Chip Load *(see page 76 for inch recommendations)*

Material	Hardness Brinell	Hardness HRc	Coatings Preferred Coating	Coatings Alternate Coating	Speed Range TIN Low High	Speed Range TICN Low High	Speed Range TiAlN Low High	Chip Load Per Tooth 6,35 - 12,7	Chip Load Per Tooth 12,7 - 25,4
Low and Plain Carbon, Alloy & Tool Steels	< 220 HB	<19	TiCN	TiN/TiAlN	82-110	99-152	131-175	0,038 - 0,076	0,076 - 0,114
Plain Carbon, Alloy, & Tool Steels	225-286	20-30	TiAlN	TiN/TiCN	55-82	66-114	107-131	0,038 - 0,076	0,076 - 0,114
Plain Carbon, Alloy, & Tool Steels	294-371	31-40	TiAlN	TiN/TiCN	46-61	55-85	64-98	0,028 - 0,053	0,053 - 0,081
Austenitic Stainless Steels 200 and 300 Series135-275	135-275	<28	TiAlN	TiN/TiCN	55-96	66-134	76-152	0,025 - 0,064	0,064 - 0,102
Ferritic, Martensitic 400, 500, & PH Stainless Steels	135-330	<35	TiAlN	TiN/TiCN	49-82	58-114	69-131	0,038 - 0,076	0,076 - 0,114
Titanium Alloys	300-440	32-43	TiAlN	TiN/TiCN	27-41	34-58	38-66	0,023 - 0,046	0,046 - 0,069
Nickel-Based High-Temperature Alloys	140-300	<32	TiAlN	TiN/TiCN	14-27	17-38	20-44	0,023 - 0,046	0,046 - 0,069
Nickel-Based High-Temperature Alloys	300-475	32-50	TiAlN	TiN/TiCN	12-21	15-30	17-34	0,023 - 0,046	0,046 - 0,069
Cobalt-Based High-Temperature Alloys	150-425	<45	TiAlN	TiN/TiCN	9-14	11-20	14-23	0,023 - 0,046	0,046 - 0,069

MASTERmill™ Series CRA Recommended Speed and Chip Load *(see page 76 for inch recommendations)*

Material	Coating	Hardness Brinell	Hardness HRc	Speed (M/Min)	Speed Range 1,6	Feed Per Tooth (mm/tooth) 3,2 - 6,4	Feed Per Tooth (mm/tooth) 6,4 - 12,7	Feed Per Tooth (mm/tooth) 12,7 - 25,4
Low-Silicon Alumunum & Other Non-Ferrous Alloys	TiCN	50-150	–	244-no limit	0,014	0,022 - 0,051	0,051 - 0,097	0,097 - 0.196
High-Silicon Aluminum	TiCN	–	–	183-853	0,012	0,012 - 0,047	0,047 - 0,089	0,089 - 0.180

The above speeds and feeds are a recommended starting point only. Ultimate speeds and feeds will depend upon setup conditions, and chip formation. See application notes on page 20.

Technical Data - GP Drill Speeds & Feeds *(see page 84 for inch recommendations)*



Material Group	Drill Series	Recommended Speed* (m/min)	Feed (mm/rev) Drill Diameter 1,6	3,2	6,4	12,7	19,1	25,4
Low-Carbon Steel Annealed	235	26-46	0.013	0.025	0.051	0.102	0.127	0.152
	240		0.038	0.076	0.127	0.229	0.254	0.305
Medium Carbon Steel 275-425 BHN	235	20-37	0.013	0.025	0.051	0.076	0.102	0.102
	240		0.025	0.051	0.102	0.203	0.229	0.254
Hardened Steel 48-52 Rc "C"	235	9-27	0.013	0.025	0.051	0.076	0.102	0.102
	240		0.025	0.076	0.076	0.127	0.152	0.178
Stainless Steel Soft 135-275 BHN	235	15-46	0.013	0.013	0.051	0.102	0.127	0.152
	240		0.025	0.076	0.152	0.152	0.203	0.254
Stainless Steel Hard 275-425 BHN	235	9-27	0.013	0.013	0.025	0.038	0.051	0.064
	240		0.025	0.051	0.076	0.102	0.152	0.178
Cast Iron (Soft)120-220 BHN	225	30-91	0.025	0.051	0.102	0.127	0.178	0.229
	235		0.051	0.102	0.203	0.254	0.305	0.356
Cast Iron (Hard) 220-320 BHN	235	18-61	0.038	0.025	0.051	0.076	0.102	0.127
	240		0.051	0.076	0.102	0.178	0.203	0.254
Ductile Iron	235	21-76	0.025	0.051	0.076	0.127	0.152	0.178
	240		0.051	0.102	0.152	0.203	0.229	0.381
Malleable Iron	235	24-76	0.025	0.051	0.076	0.127	0.152	0.178
	240		0.051	0.127	0.152	0.305	0.356	0.381
Aluminum/Aluminum Alloys	225	46-122	0.025	0.051	0.076	0.127	—	—
	240		0.051	0.102	0.178	0.330	—	—
Brass/Bronze	225	30-91	0.013	0.025	0.051	0.102	—	—
	235		0.038	0.076	0.102	0.254	—	—
Copper/Copper Alloys	225	46-122	0.025	0.076	0.127	0.152	—	—
	240		0.076	0.127	0.305	0.356	—	—
Magnesium/Magnesium Alloys	225	61-198	0.038	0.076	0.127	0.203	—	—
	240		0.076	0.178	0.305	0.381	—	—
Plastics–Glass Filled	225	46-91	0.025	0.051	0.076	0.127	—	—
	240		0.051	0.102	0.152	0.305	—	—
Plastics	225	76-183	0.038	0.076	0.102	0.152	—	—
	240		0.076	0.127	0.305	0.406	—	—
High-Temp Alloys–Nickel Base	235	9-27	0.013	0.013	0.025	0.038	0.051	0.064
	240		0.025	0.076	0.102	0.127	0.152	0.178
Monel-High Nickel Steels	235	9-27	0.013	0.013	0.025	0.038	0.051	0.064
	240		0.025	0.051	0.076	0.102	0.127	0.152
Titanium (soft)	235	18-61	0.013	0.051	0.102	0.127	0.152	0.178
	240		0.025	0.076	0.152	0.152	0.203	0.254
Titanium (hard)	235	14-61	0.013	0.025	0.051	0.102	0.102	0.127
	240		0.051	0.102	0.178	0.229	0.254	0.305
Refractory Alloys	235	15-61	0.013	0.013	0.051	0.102	0.127	0.127
	240		0.025	0.076	0.152	0.254	0.305	0.305

*TiN -and TiCN-coated end mills may be operated at 50% higher speeds.
TiAlN-coated end mills can be operated at 100% higher speeds.

Speeds and feeds for high-performance drills can be found on page 98-129

Recommended Speeds and Feeds: Series 283, 285 *(see page 98 for inch recommendations)*

Material	Hardness	Cutting Speed (m/min) TiAlN Coated	Feed (mm/rev) 3,0	6,0	10,0	13,0	16,0	19,0
Alloyed Steel								
4340, 52100	<= 28-32 Rc	58-69	0,066	0,109	0,183	0,229	0,251	0,277
8620, 4104	<= 42 Rc	43-44	0,051	0,086	0,142	0,178	0,196	0,216
Mold Steel								
P-20, h-13, 180	180-320 BHN	58-69	0,074	0,122	0,203	0,254	0,279	0,307
D2, A2, S-5	220-250 BHN	26-32	0,043	0,074	0,122	0,152	0,168	0,185
	50+ Rc	15-18	0,03	0,048	0,081	0,102	0,112	0,122
Iron								
Gray CI 30, G25	150-220 BHN	58-137	0,147	0,244	0,406	0,508	0,559	0,615
Ductile	220-250 BHN	46-91	0,089	0,147	0,244	0,305	0,335	0,368
Nodular	251-320 BHN	50-76	0,058	0,097	0,163	0,203	0,224	0,246
Stainless Steels								
Free 303, 420, 416	< 330 HB <=40 HRc	61-79	0,058	0,097	0,163	0,203	0,224	0,246
Tough 316, 304, 15-5,13-8, 17-4	330-450 BHN, 36-48 HRc	49-59	0,043	0,074	0,122	0,152	0,168	0,185
Titanium Alloys	110-450 HB							
Ti-6Al 4V, 6A16V	<= 48 HRc	27-35	0,043	0,074	0,122	0,152	0,168	0,185
Nickel Alloys								
718, Inconel, Rene, Nimonic, Waspalloy	140-475 HB <= 48 HRc	17-24	0,03	0,048	0,081	0,102	0,112	0,122

Higher feed and speed values should be favored for softer material; lower feed and speed values should be used for harder materials. These recommendations should be considered only as a starting point. Ultimate speeds and feeds will depend upon setup conditions and chip formation. The above recommendations are for drilling a hole 2 x diameter deep. For other depths, multiply feed rate from above as follows:

Drilling Depth (N x Diameter):	1	2	3	4	5
Multiplier:	1.2	1.0	0.9	0.75	0.65

Recommended Speeds and Feeds: Series 270 *(see page 104 for inch recommendations)*

Workpiece Material	BHN	Cutting Speeds (m/min)	Feeds (mm/rev) 3,0	6,0	10,0	13,0	16,0	19,0
Alloy Steel, including	<230	61-99	0.051	0.102	0.152	0.203	0.229	0.254
low-carbon and	230-300	61-79	0.051	0.102	0.152	0.203	0.229	0.254
medium-carbon	300-426	40-79	0.051	0.076	0.127	0.152	0.178	0.229

These recommendations are for hole depths up to 2 drill diameters. On deeper holes, speeds and feeds should be reduced 10% to 20%. Higher feed and speed values should be favored for softer material; lower feed and speed values should be used for harder materials. These recommendations should be considered only as a starting point. Ultimate speeds and feeds will depend upon setup conditions and chip formation.

Recommended Feeds and Speeds: Series 257, 258 *(see page 107 for inch recommendations)*

Workpiece Material	BHN	Cutting Speeds (m/min)	Feeds (mm/rev) 3,0	6,0	10,0	13,0	16,0	19,0
Gray Cast Iron	120-200	107-152	0,152-0,229	0,178-0,279	0,229-0,356	0,279-0,457	0,330-0,559	0,381-0,635
	210-320	91-107	0,127-0,178	0,127-0,229	0,178-0,279	0,229-0,381	0,279-0,483	0,356-0,584
Ductile Irons	140-225	69-91	0,127-0,203	0,127-0,229	0,178-0,279	0,203-0,356	0,254-0,432	0,33-0,533
	225-300	53-69	0,102-0,178	0,102-0,203	0,152-0,254	0,178-0,305	0,229-0,381	0,305-0,508
	310-400	30-53	0,076-0,152	0,102-0,152	0,140-0,203	0,152-0,254	0,203-0,356	0,279-0,457
Malleable Iron	110-200	91-130	0,127-0,203	0,127-0,229	0,178-0,279	0,203-0,356	0,305-0,432	0,254-0,432
	200-255	76-91	0,102-0,178	0,102-0,203	0,152-0,254	0,178-0,305	0,229-0,381	0,254-0,406
	255-320	61-76	0,076-0,152	0,102-0,152	0,127-0,203	0,152-0,254	0,203-0,305	0,203-0,356
Carbon Steel	<150	99-122	0,076-0,152	0,102-0,203	0,178-0,279	0,203-0,356	0,254-0,432	0,305-0,508
	150-180	91-107	0,102-0,152	0,127-0,178	0,152-0,254	0,178-0,33	0,254-0,406	0,279-0,483
	>180	79-99	0,102-0,152	0,127-0,178	0,127-0,229	0,203-0,279	0,203-0,356	0,254-0,432
Alloy Steel	<275	61-76	0,076-0,152	0,102-0,203	0,178-0,279	0,203-0,356	0,254-0,432	0,305-0,508
	275-425	38-61	0,102-0,152	0,127-0,178	0,152-0,254	0,203-0,33	0,254-0,406	0,279-0,483
	45-48RC	24-38	0,102-0,152	0,127-0,178	0,127-0,229	0,178-0,279	0,203-0,356	0,254-0,432
Tool Steel	100-250	30-76	0,051-0,102	0,102-0,152	0,152-0,254	0,203-0,330	0,254-0,406	0,279-0,483

The above recommendations are for hole depths up to 2 drill diameters. On deeper holes, feeds should be reduced 10% to 20%. Higher feed and speed values should be favored for softer material; lower feed and speed values should be used for harder materials. The above recommendations should be considered only as a starting point. Ultimate speeds and feeds will depend upon setup conditions and chip formation.

Recommended Speeds and Feeds: Series D *(see page 109 for inch recommendations)*

Workpiece Material	BHn	Cutting Speed (m/min)	Feed in mm Per Revolution For Drill Diameter 3,0	6,0	10,0	13,0	16,0	19,0
Carbon	<150	120-160	0,076-0,152	0,102-0,178	0,127-0,229	0,178-0,279	0,203-0,356	0,254-0,432
Steel	150-180	99-140	0,102-0,152	0,127-0,203	0,152-0,254	0,203-0,330	0,254-0,406	0,279-0,483
	>180	79-110	0,102-0,152	0,127-0,203	0,178-0,279	0,203-0,356	0,254-0,432	0,305-0,508
Alloy and	<210	70-90	0,127-0,203	0,152-0,254	0,203-0,330	0,254-0,406	0,279-0,457	0,305-0,508
Cast Steel	210-270	70-90	0,102-0,178	0,127-0,229	0,178-0,305	0,229-0,356	0,254-0,432	0,279-0,483
	>270	61-79	0,102-0,152	0,127-0,203	0,152-0,254	0,203-0,305	0,229-0,381	0,254-0,432
High Alloy	<300	50-70	0,076-0,127	0,076-0,152	0,127-0,203	0,152-0,254	0,178-0,305	0,229-0,381
Steel	>300	50-70	0,076-0,102	0,076-0,127	0,127-0,203	0,152-0,254	0,178-0,305	0,229-0,356
Malleable								
Cast Iron	140-260	79-99	0,127-0,203	0,127-0,229	0,178-0,305	0,229-0,356	0,305-0,432	0,254-0,432
Gray	<180	120-160	0,152-0,229	0,178-0,279	0,229-0,356	0,279-0,457	0,330-0,559	0,406-0,711
Cast Iron	180-220	99-140	0,152-0,229	0,178-0,279	0,229-0,356	0,279-0,457	0,330-0,533	0,381-0,635
	>220	79-110	0,127-0,178	0,127-0,229	0,178-0,279	0,229-0,381	0,279-0,483	0,356-0,584
Nodular Iron	<220	61-79	0,127-0,203	0,127-0,229	0,178-0,279	0,203-0,356	0,254-0,432	0,330-0,533
	>220	40-61	0,076-0,152	0,102-0,152	0,127-0,203	0,152-0,254	0,203-0,356	0,279-0,457
Yellow Brass	—	79-120	0,076-0,152	0,102-0,178	0,127-0,203	0,152-0,254	0,178-0,279	0,203-0,330
Copper Alloys	—	99-250	0,152-0,229	0,152-0,254	0,178-0,305	0,203-0,356	0,229-0,406	0,254-0,432

The above recommendations are for hole depths up to 2 drill diameters. On deeper holes, feeds should be reduced 10% to 20%. Higher feed and speed values should be favored for softer material; lower feed and speed values should be used for harder materials. The above recommendations should be considered only as a starting point. Ultimate speeds and feeds will depend upon setup conditions and chip formation.

Recommended Speeds and Feeds: Series 383, 385 *(see page 111 for inch recommendations)*

Material	Hardness	Speed (m/min) TiAlN Coated	Feed (mmpr) 3,0	6,0	10,0	13,0	16,0	19,0
Alloyed Steel								
4340, 52100	<= 28-32 Rc	67-79	0,066	0,109	0,183	0,229	0,251	0,277
8620, 4104	<= 42 Rc	58-64	0,051	0,086	0,142	0,178	0,196	0,216
Mold Steel								
P-20, h-13, 180	180-320 BHN	76-84	0,074	0,122	0,203	0,254	0,279	0,307
D2, A2, S-5	220-250 BHN	30-34	0,043	0,074	0,122	0,152	0,168	0,185
	50+ Rc	20-26	0,030	0,048	0,081	0,102	0,112	0,122
Iron								
Gray CI 30, G25	150-220 BHN	128-171	0,147	0,244	0,406	0,508	0,559	0,615
Ductile	220-250 BHN	116-149	0,089	0,147	0,244	0,305	0,335	0,368
Nodular	251-320 BHN	91-107	0,058	0,097	0,163	0,203	0,224	0,246
Stainless Steels								
Free 303, 420, 416	< 330 HB <=40 HRc	88-107	0,058	0,097	0,163	0,203	0,224	0,246
Tough 316, 304, 15-5, 13-8, 17-4	330-450 BHN, 36-48 HRc	52-69	0,043	0,074	0,122	0,152	0,168	0,185
Titanium Alloys	110-450 HB							
Ti-6Al 4V, 6A16V	<= 48 HRc	40-46	0,043	0,074	0,122	0,152	0,168	0,185
Nickel Alloys								
718, Inconel, Rene, Nimonic, Waspalloy	140-475 HB <= 48 HRc	20-27	0,030	0,048	0,081	0,102	0,112	0,122

Higher feed and speed values should be favored for softer material; lower feed and speed values should be used for harder materials. These recommendations should be considered only as a starting point. Ultimate speeds and feeds will depend upon setup conditions and chip formation. The above recommendations are for drilling a hole 2 x diameter deep. For other depths, multiply feed rate from above as follows:

Drilling Depth (N x Diameter):	1	2	3	4	5
Multiplier:	1.2	1.0	0.9	0.75	0.65

Recommended Speeds and Feeds: Series A *(see page 117 for inch recommendations)*

Workpiece Material	BHN	Cutting Speed (m/min)	Feeds (mmpr) 3,0	6,0	10,0	13,0	16,0	19,0
Gray Cast Iron	<180	122-160	0,127-0,203	0,178-0,279	0,229-0,381	0,279-0,483	0,356-0,584	0,406-0,686
	180-220	99-137	0,127-0,203	0,178-0,279	0,229-0,381	0,279-0,483	0,356-0,584	0,406-0,686
	>220	79-110	0,102-0,178	0,152-0,229	0,178-0,305	0,254-0,406	0,305-0,508	0,381-0,635
Ductile Iron								
Ferritic	—	200-265	0,127-0,203	0,152-0,254	0,203-0,305	0,254-0,406	0,305-0,483	0,356-0,610
Pearlitic	—	130-200	0,102-0,152	0,127-0,203	0,152-0,254	0,203-0,330	0,254-0,432	0,320-0,533
Titanium and Titanium Alloys	—	30-50	0,025-0,051	0,051-0,076	0,076-0,127	0,102-0,203	0,152-0,254	0,203-0,330
Copper Alloys	—	99-250	0,178-0,279	0,229-0,381	0,279-0,457	0,330-0,533	0,356-0,584	0,381-0,660
Magnesium Alloys	—	160-198	0,102-0,152	0,152-0,229	0,203-0,305	0,229-0,381	0,254-0,432	0,305-0,508
Aluminum Alloys								
Wrought	—	99-300	0,102-0,152	0,178-0,279	0,254-0,406	0,330-0,533	0,406-0,660	0,457-0,787
Aluminum < 10% Si	—	99-250	0,102-0,178	0,178-0,279	0,254-0,406	0,330-0,533	0,406-0,686	0,508-0,838
Aluminum >10% Si	—	99-198	0,102-0,152	0,178-0,279	0,229-0,381	0,305-0,508	0,381-0,635	0,457-0,762

The above recommendations are for hole depths up to 2 drill diameters. On deeper holes, feeds should be reduced 10% to 20%. Higher feed and speed values should be favored for softer material; lower feed and speed values should be used for harder materials. The above recommendations should be considered only as a starting point. Ultimate speeds and feeds will depend upon setup conditions and chip formation.

Recommended Speeds and Feeds: Series H *(see page 120 for inch recommendations)*

Workpiece Material	BHN	Cutting Speed (m/min)	Feed In mm Per Revolution For Drill Diameter 4,0	6,0	10,0	13,0	16,0	19,0
Stainless Steel								
Austenitic	—	40-61	0,051-0,076	0,051-0,102	0,102-0,152	0,152-0,203	0,203-0,254	0,229-0,279
Ferritic/Martensitic	<215	49-70	0,051-0,102	0,076-0,127	0,127-0,178	0,203-0,254	0,203-0,310	0,254-0,330
Ferritic/Martensitic	>215	43-70	0,051-0,102	0,076-0,127	0,127-0,152	0,152-0,178	0,203-0,229	0,203-0,254
High-Temperature Alloys								
Ni-base	—	15-24	0,025-0,051	0,051-0,076	0,076-0,102	0,102-0,127	0,127-0,152	0,127-0,178
Co-base	—	9-18	0,025-0,051	0,051-0,076	0,076-0,102	0,102-0,127	0,127-0,152	0,127-0,178
Fe-base	—	18-27	0,025-0,051	0,051-0,076	0,076-0,127	0,102-0,152	0,127-0,203	0,152-0,229
High-Alloyed Steel								
Alloyed Steel	<285	49-64	0,051-0,127	0,076-0,152	0,127-0,229	0,152-0,305	0,178-0,330	0,203-0,381
High-Alloyed Steel	>285	43-55	0,051-0,127	0,076-0,152	0,127-0,203	0,127-0,254	0,152-0,305	0,178-0,330

These recommendations are for hole depths up to 2 drill diameters. On deeper holes, speeds and feeds should be reduced 10% to 20%. Higher feed and speed values should be favored for softer material; lower feed and speed values should be used for harder materials. These recommendations should be considered only as a starting point. Ultimate speeds and feeds will depend upon setup conditions and chip formation.

Recommended Speeds and Feeds: Series 238 *(see page 123 for inch recommendations)*

Workpiece Material	BHN	Cutting Speeds (m/min)	Feeds 4,0	6,0	8,0	12,0	16,0	20,0	25,0
Malleable Cast Iron									
white	≤ 250	79-89	0,076-0,127	0,127-0,178	0,152-0,203	0,178-0,229	0,203-0,279	0,241-0,305	0,254-0,33
black	≤ 250	79-89	0,076-0,127	0,127-0,178	0,152-0,203	0,178-0,229	0,203-0,279	0,241-0,305	0,254-0,33
Gray Cast Iron									
GG20	≤ 180	89-119	0,102-0,152	0,152-0,203	0,178-0,229	0,203-0,254	0,241-0,305	0,279-0,33	0,305-0,406
GG30	≤ 220	79-99	0,102-0,152	0,152-0,203	0,178-0,229	0,203-0,254	0,241-0,305	0,279-0,33	0,305-0,406
GG40	> 220	69-89	0,076-0,127	0,127-0,178	0,152-0,203	0,178-0,229	0,203-0,279	0,241-0,305	0,254-0,33
Nodular Cast Iron									
Ferritic	≤ 220	69-89	0,076-0,127	0,127-0,178	0,152-0,203	0,178-0,229	0,203-0,279	0,241-0,305	0,254-0,33
Pearlitic	> 220	64-84	0,064-0,102	0,076-0,152	0,127-0,178	0,142-0,203	1,905-0,241	0,229-0,254	0,241-0,305
Aluminium Alloys									
Cast Aluminium Alloys									
≤ 10% Si	—	99-258	0,076-0,152	0,127-0,191	0,178-0,229	0,191-0,241	0,229-0,279	0,241-0,318	0,254-0,406
Cast Aluminium Alloys									
≤ 16% Si	—	89-238	0,076-0,152	0,127-0,191	0,178-0,229	0,191-0,241	0,229-0,279	0,241-0,318	0,254-0,406

The above recommendations are for hole depths up to 2 drill diameters. On deeper holes, feeds should be reduced 10% to 20%. Higher feed and speed values should be favored for softer material; lower feed and speed values should be used for harder materials. The above recommendations should be considered only as a starting point. Ultimate speeds and feeds will depend upon setup conditions and chip formation.

Recommended Speeds and Feeds: Series 265 *(see page 126 for inch recommendations)*

Workpiece Material	Hardness Brinnell / Rc	Cutting Speeds (m/min) Bright	Coated	Feeds mm/rev 3,0	6,0	10,0	13,0
Aluminum	—	122-143	152-175	0,152	0,254	0,305	0,356
High Si Aluminum	—	91-113	122-143	0,102	0,203	0,254	0,305
Copper, Copper Alloys	—	61-76	76-99	0,102	0,152	0,229	0,254
Brass	—	84-91	91-107	0,102	0,152	0,229	0,254
Bronze	—	44-56	56-72	0,076	0,127	0,152	0,203
Cast Iron	120 - 220 BHN	61-75	76-91	0,127	0,203	0,254	0,305
	220 - 320 BHN	46-59	61-75	0,127	0,203	0,254	0,305
Malleable Iron	110-200 BHN	53-73	73-82	0,127	0,203	0,254	0,305
	200-255 BHN	44-53	59-73	0,127	0,203	0,254	0,305
	255-320 BHN	30-44	50-59	0,127	0,203	0,254	0,305
Ductile or Nodular Iron	110-200 BHN	46-66	66-76	0,127	0,203	0,254	0,305
	200-255 BHN	37-46	52-66	0,127	0,203	0,254	0,305
	255-320 BHN	23-37	43-52	0,127	0,203	0,254	0,305
Carbon Steel	<150	N/A	69-91	0,076	0,152	0,229	0,330
	150-180	N/A	53-69	0,076	0,127	0,178	0,254
	>180	N/A	46-53	0,051	0,102	0,178	0,229
Alloy Steel	<275	N/A	61-84	0,076	0,152	0,229	0,330
	275-425	N/A	46-61	0,076	0,127	0,178	0,254
	45RC-48RC	N/A	30-46	0,051	0,102	0,178	0,229
Tool Steel	100-250	N/A	30-46	0,076	0,127	0,178	0,254

The above recommendations are for hole depths up to 4 drill diameters. When hole depths run 5 to 6 diameters, both speeds and feeds should be reduced 10% to 20%. Higher feed and speed values should be favored for softer material; lower feed and speed values should be used for harder materials. These recommendations should be considered only as a starting point. Final recommendations will depend on your individual testing and success.

Recommended Speeds and Feeds: One Shot *(see page 129 for inch recommendations)*

Workpiece Material	BHN	CuttingSpeeds (m/min)	Feeds 4,8	6,4	12,7	19,1
Carbon Steel	250-525	76-160	0,102	0,127	0,203	0,254
Alloy Steel						
Free-Machining	150-375	76-130	0,102	0,127	0,152	0,203
	376-425	58-69	0,051	0,023	0,102	0,152
Wrought	150-350	69-122	0,102	0,119	0,14	0,203
	350-425	58-67	0,051	0,076	0,102	0,152
Tool Steel						
HS Annealed	–	69-91	0,076	0,114	0,14	0,178
Hot & Cold Work Annealed	–	61-91	0,102	0,127	0,152	0,203
Iron						
Gray	120-200	91-175	0,102	0,127	0,203	0,254
P&C	210-320	38-84	0,051	0,076	0,127	0,178
Austenitic	–	53-91	0,051	0,076	0,127	0,178
Ductile Irons						
Ferritic	140-225	91-152	0,102	0,203	0,229	0,254
(F&P)	225-300	64-91	0,076	0,102	0,178	0,229
(M)	310-400	27-46	0,051	0,076	0,127	0,178
(A)	140-275	27-38	0,038	0,064	0,102	0,152
Malleable Iron						
Ferritic	110-245	91-168	0,102	0,127	0,203	0,305
Martensitic	200-255	69-91	0,051	0,076	0,127	0,152
Tempered	240-320	46-61	0,038	0,064	0,127	0,127

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M10012	270	105
M10016	285	99
M10020	270	105
M10021	270	105
M10022	270	105
M10026	285	99
M10030	270	105
M10031	270	105
M10032	270	105
M10036	285	99
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Metalcutting Safety

(read this before using Metal Removal products)

Modern metalcutting operations involve high energy, high spindle or cutter speeds, and high temperatures and cutting forces. Hot, flying chips may be projected from the workpiece during metalcutting. Although advanced cutting tool materials are designed and manufactured to withstand the high cutting forces and temperatures that normally occur in these operations, they are susceptible to fragmenting in service, particularly if they are subjected to over-stress, severe impact or otherwise abused. Therefore, precautions should be taken to adequately protect workers, observers and equipment against hot, flying chips, fragmented cutting tools, broken workpieces or other similar projectiles. Machines should be fully guarded and personal protective equipment should be used at all times.

When grinding advanced cutting tool materials, a suitable means for collection and disposal of dust, mist or sludge should be provided. Overexposure to dust or mist containing metallic particles can be hazardous to health particularly if exposure continues over an extended period of time and may cause eye, skin and mucous membrane irritation and temporary or permanent respiratory disease. Certain existing pulmonary and skin conditions may be aggravated by exposure to dust or mist. Adequate ventilation, respiratory protection and eye protection should be provided when grinding and workers should avoid breathing of and prolonged skin contact with dust or mist. General Industry Safety and Health Regulations, Part 1910. U.S. Department of Labor, published in Title 29 of the Code of Federal Regulations should be consulted. Obtain from Metal Removal and read the applicable Material Safety Data Sheet before grinding.

Cutting tools are only one part of the worker-machine-tool system. Many variables exist in machining operations, including the metal removal rate; the workpiece size, shape, strength and rigidity; the chucking and fixturing; the load carrying capability of centers; the cutter and spindle speed and torque limitations; the holder and boring bar overhang; the available power; and the condition of the tooling and the machine. A safe metalcutting operation must take all of these variables, and others, into consideration.

Metal Removal has no control over the end use of its products or the environment into which those products are placed. Metal Removal urges that its customers adhere to the recommended standards of use of their metalcutting machines and tools, and that they follow procedures that ensure safe metalcutting operations. The information included throughout this catalog under the heading “Technical Data” and other recommendations on machining practices referred to herein are only advisory in nature and do not constitute representations or warranties and are not necessarily appropriate for any particular work environment or application.

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