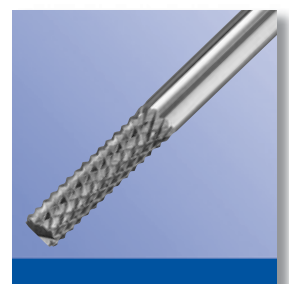
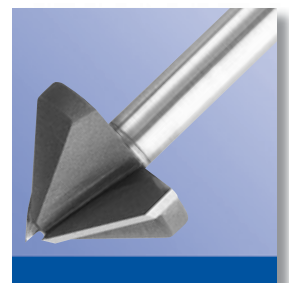
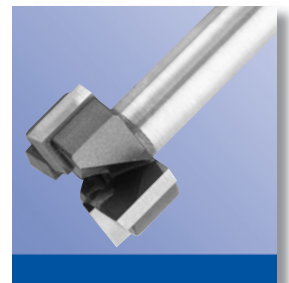
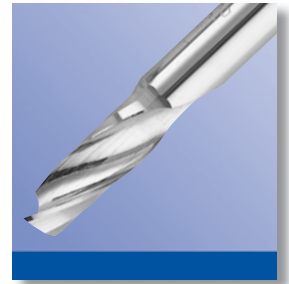
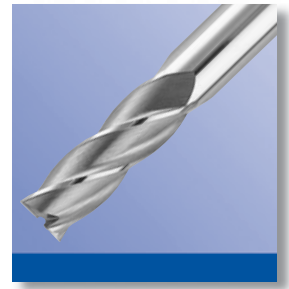


Production Tools



***Solid Carbide
Diamond / PCD***



Plastic/Wood/FoamBoard/Solid Surface

12000 Series/Downcut Single Flute Spiral 'O'



Page 4

13000 Series/Up-cut Single Flute Spiral 'O'



Page 5

Milling Tool with 45° Chamfer



Milling Tool with 3/32 Radius



Page 6

Plastic/Wood/Non-Ferrous Metal

2 Flute Helical Milling Tool Downcut/Up-cut Tool Geometry



Page 7

Straight-cut 2 Flute Mill - Non Helical



31000 Series Special Left Hand Helix Left Hand Cut [counter clockwise rotation]



Page 8

Laminate/Wood Composite/MDO

43000 Series Compression Bit



Page 7

Aluminum/Brass/Copper/Non-Ferrous Metal

22000 Series/Downcut Single Flute Spiral 'O'



Page 9

33000 Series/Up-cut Single Flute Spiral 'O'



Page 10

Milling Tool with 3/64 Radius



Page 9

Milling Tool with 45° Chamfer



Page 10

176000 Series 2 Flute Slotting Cutter



'Panto' Milling Tool for Manual Machine [Brass]



Page 11

Steel/Stainless Steel/Ferrous Metal

102000 Series 3 Flute Center Cut Helical



15000 Series 4 Flute Center Cut Helical



16000 Series 2 Flute Center Cut Helical



Page 12

Shaping/Finishing Tools

Special Radius Milling Tool Various Radii/Cut Diameters



Page 13

Ball Nose/3-D Copying Cutters 117000 Series XXL



185000 Series Std. Length



Page 15

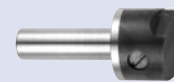
Surfacing Milling Tool Various-Angles/Radii



Page 16

Shaping/Finishing Tools

Natural Diamond Special for Plastic



Page 17

Chamfer/V-Bit Milling Tool for Plastic/Wood



Page 18

Chamfer/V-Bit Milling Tool for Plastic/Nylon/Wood



Page 19

Milling Tool for External Parts Plastic/Foamboard/Hardwood



Page 20

Special Applications

Special Milling Tool for Bending/Folding Plastic



Special Cutter for Bending Aluminum Composite [alucobond]



Page 21

Diamond-tipped 1 Flute Straight-cut Plastic/Composite Materials



Diamond-tipped Fiberglass/Carbon Fiber/ Glass Epoxy



Page 22

Saw Cutters Special for Plastic



Drill Type 400 Solid Carbide



Page 23

Special Slotting/Milling Tool for Plastic



Page 24

Engraving Tools

Engraving Tool (DR • FI • P) for Plastic/Wood/Non-Ferous



Page 26

Engraving Tool (GR • GRP) for All Types of Material



Page 27

Vinyl Blades

Blades for top surface cut out of vinyl [standard/thick/florescent]



Page 28

Accessories

Tapering Drill Sleeve metric/inch-inch/metric conversion

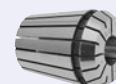


90° Milling Tool for Re-Surfacing CNC Table



Page 31

Collet 'ER' Type



Page 32

Technical Notes, Cutting Formulas, General Information

Page 33

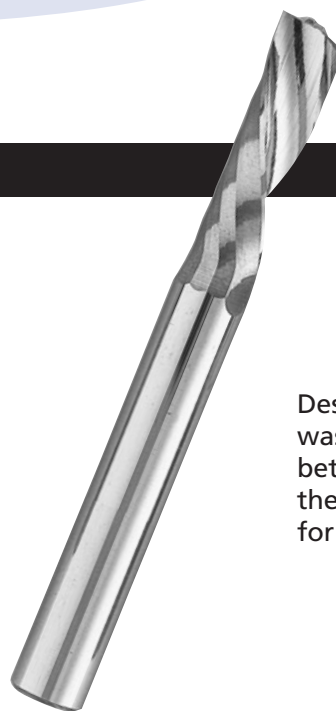
Catalog Index

Page 38

Solid Carbide Single Flute

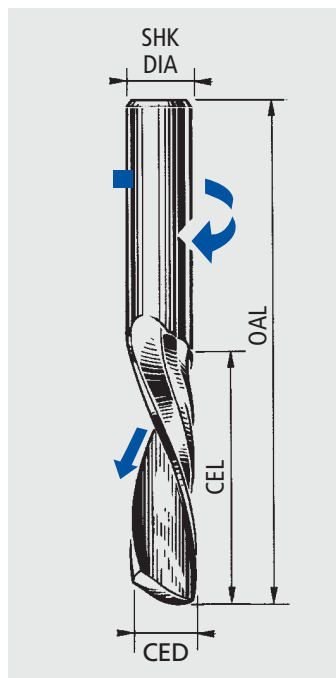
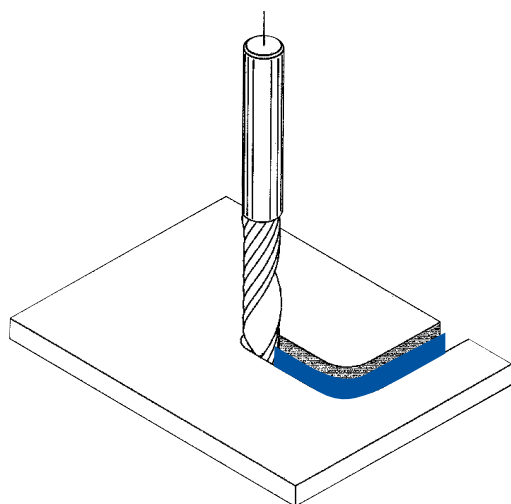
12000 Series Spiral 'O'

TOOL #	CED	CEL	SHK DIA	OAL	
12317	1/8	1/2	1/4	1 1/2	inches (in)
12476	3/16	5/8	1/4	2	
12365	1/4	3/4	1/4	2	
12010	1	4	3	30	metric (mm)
12015	1.5	6	3	30	
12020	2	8	2	30	
12020A	2	8	2	60	
12020B	2	8	3	30	
12025	2.5	8	2.5	30	
12025A	2.5	8	2.5	60	
12030	3	10	3	30	
12030A	3	10	3	60	
12030B	3	10	6	50	
12040	4	12	4	60	
12040A	4	20	4	60	
12040B	4	30	4	70	
12040C	4	12	6	50	
12050	5	16	5	60	
12050A	5	30	5	70	
12050B	5	16	6	50	
12060	6	20	6	60	
12060A	6	30	6	70	
12060B	6	38	6	80	
12080	8	22	8	60	
12080A	8	38	8	80	
12100	10	30	10	75	
12120	12	30	12	75	



Downcut
Left Hand Helix
Right Hand Cut

Designed to throw chip waste) DOWN. Space between the material and the CNC table is required for vacuum/removal.



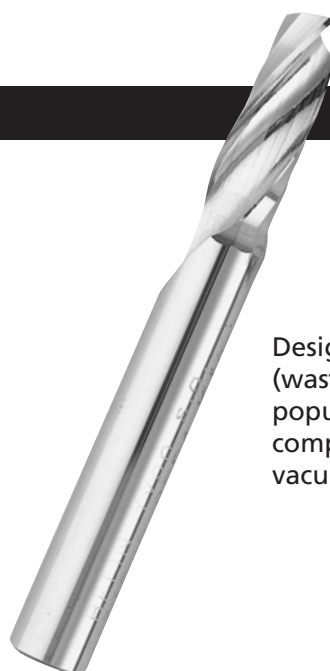
Catalog Abbreviations

IN Inch/Inches	MN Minute
MM Millimeters	Z Number of Flutes / Teeth
M Meters	R Radius
Ø Diameter	RPM Revolutions per Minute
D Diameter	IPM Inches per Minute
R Radius	Ae Max Depth of Cut
CED Cutting Edge Diameter	Ch-CEL Chamfer Cutting Length
CEL Cutting Edge Length	R-CEL Radius Cutting Length
SHK DIA .. Shank Diameter	° Degree / Angle of Cut
SHK L Shank Length	TIP DIA Special Shaping / V-Bits
OAL Overall Length	π 3.14
SFM Cutting Speed – Feet/Mn	Vc Cutting Speed – M/MN
T.I.R. Total Indicated Run-out	

Solid Carbide Single Flute

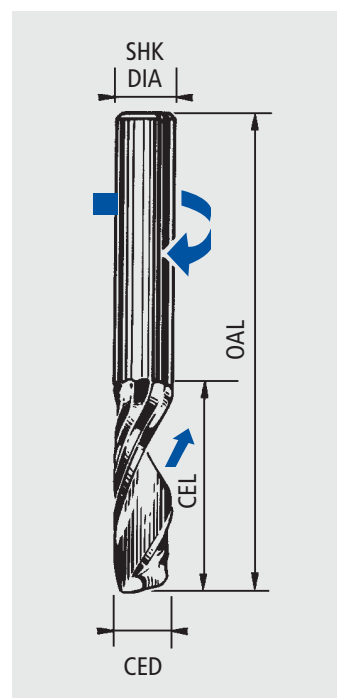
13000 Series Spiral 'O'

TOOL #	CED	CEL	SHK DIA	OAL	
13317	1/8	1/2	1/4	1 1/2	
13317A	1/8	1/2	1/8	2	
13476	3/16	5/8	1/4	2	
13476A	3/16	5/8	3/16	2	
13476B	3/16	1 1/4	1/4	3	
13635	1/4	3/4	1/4	2	
13635A	1/4	1 1/2	1/4	3	
13635B♦	1/4	2 1/4	1/4	3 3/4	
13635C	1/4	1 1/8	1/4	3	
13952	3/8	1 1/8	3/8	3	
13952A♦	3/8	3 3/16	3/8	5	
13127	1/2	1 1/4	1/2	3	
13190	3/4	1 1/4	3/4	4	
13254	1	1 1/2	1	4	
					inches (in)
13010	1	4	3	30	
10315	1.5	6	3	30	
13020	2	8	2	30	
13020A	2	8	2	60	
13020B	2	8	3	30	
13020C	2	8	6	60	
13025	2.5	8	2.5	30	
13025A	2.5	8	2.5	60	
13030	3	10	3	30	
13030A	3	10	3	60	
13030B	3	10	6	50	
13030C	3	20	3	60	
13030D	3	20	6	60	
13030E	3	15	3	40	
13040	4	12	4	60	
13040A	4	20	4	60	
13040B	4	30	4	70	
13040C	4	12	6	50	
13040D	4	20	6	60	
13050	5	16	5	60	
13050A	5	30	5	70	
13050B	5	16	6	50	
13060	6	20	6	60	
13060A	6	30	6	70	
13060B	6	38	6	80	
13080	8	22	8	60	
13080A	8	38	8	80	
13100	10	30	10	75	
13120	12	30	12	75	
					metric (mm)



Upcut
Right Hand Helix
Right Hand Cut

Designed to throw chip (waste) UP. This is the most popular design and is compatible with most CNC vacuum systems.



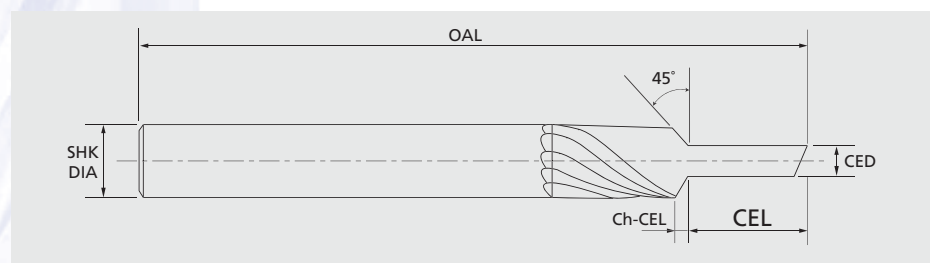
XL CEL FOR ROUTING/MILLING FOAMBOARD MATERIAL ONLY

- ♦ Tool# 13635B – designed to rout/mill 1 1/2" to 2" Foamboard material ONLY
- ♦ Tool# 13952A – designed to rout/mill 2 1/2" to 3" Foamboard material ONLY
 - **Strongly recommended:** RPM's and Feed Rates [IPM] should be reduced by 35 to 50% to avoid tool breakage due to extra long cutting length [CEL].

Solid Carbide Special End Mill

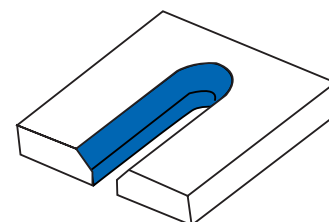
Single Flute + 45° Chamfer

TOOL #	CED	CEL	SHK DIA	OAL	Ch-CEL	
00192	3/16	11/64	3/8	2	3/32	(in)
00193	3/16	1/4	3/8	2	3/32	
99058	4	4.3	8	40	2	(mm)
00191	4	6.3	8	40	2	



Upcut
Right Hand Helix
Right Hand Cut

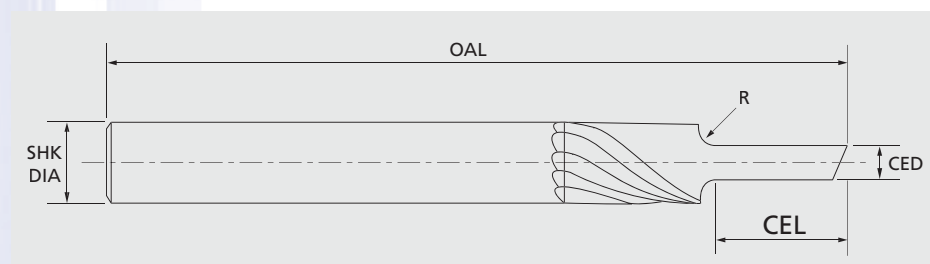
Designed to mill a small chamfer on the edge of the component in a one step process. Eliminates most secondary operations.



Solid Carbide Special End Mill

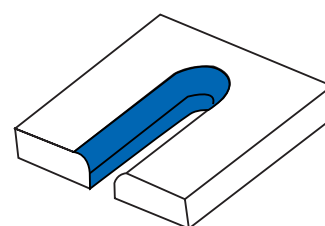
Single Flute + 3/32 Radius

TOOL #	CED	CEL	SHK DIA	OAL	R-CEL	
00196	3/16	11/64	3/8	2	3/32	(in)
00197	3/16	1/4	3/8	2	3/32	
00194	4	4.3	8	40	2	(mm)
00195	4	6.3	8	40	2	



Upcut
Right Hand Helix
Right Hand Cut

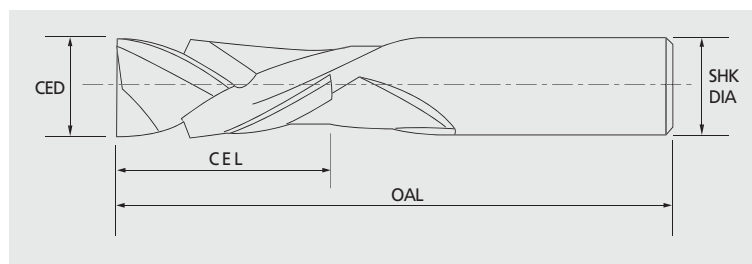
Designed to mill a small radius on the edge of the component in a one step process. Eliminates most secondary operations.



Solid Carbide

Compression Bit 2 Flute Upcut / 2 Flute Downcut

TOOL #	CED	CEL	SHK DIA	OAL	
43635	1/4	7/8	1/4	2 1/2	(in)
43952	3/8	1	3/8	3	
43127	1/2	1 1/8	1/2	3	
43060	6	22	6	65	(mm)
43080	8	25	8	76	
43100	10	30	10	76	



Right Hand Helix
Left Hand Helix
Right Hand Cut

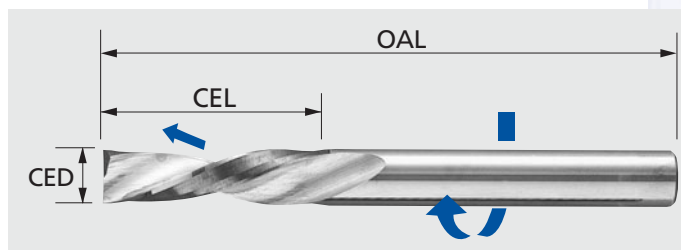
Designed to equalize up/down cutting pressure when milling laminated materials. Excellent edge finish on both sides.

Plastic, Wood, Non-Ferrous Metal

Solid Carbide

Milling Tool 2 Flute Downcut (Metric)

TOOL #	CED	CEL	OAL	
91361A	3	10	30	(mm)
91361B	4	12	40	
91361C	5	16	60	
91361D	6	20	60	

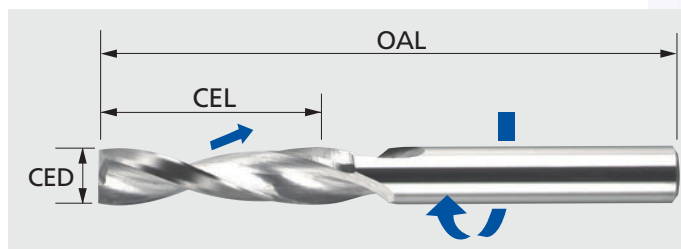


Left Hand Helix
Right Hand Cut

Solid Carbide

Milling Tool 2 Flute Upcut (Metric)

TOOL #	CED	CEL	OAL	
00205	3	10	30	(mm)
00206	4	12	40	
00207	5	16	60	
00208	6	20	60	

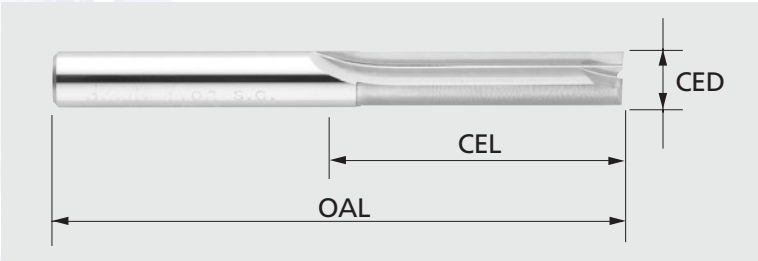


Right Hand Helix
Right Hand Cut

Solid Carbide

Straight-Cut 2 Flute Non-Helical (Metric)

TOOL #	CED	CEL	OAL	
94104	4	20	60	(mm)
94105	6	25	60	
94106	8	35	60	



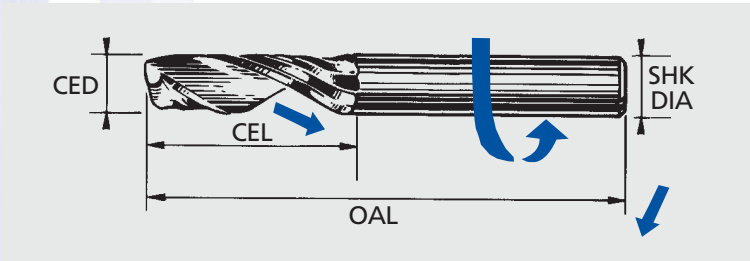
Right Hand Cut

Designed as general purpose tool to rout/mill difficult to cut materials.

Solid Carbide

Milling Tool Single Flute Left Hand Cut* (Metric)

TOOL #	CED	CEL	SHK DIA	OAL	
31030	3	8	3	30	(mm)
31040	4	12	4	60	
31050	5	16	5	60	
31060	6	20	6	60	



Upcut Left Hand Helix Left Hand Cut

*Tool cuts in counter clockwise rotation only.

Catalog Abbreviations

IN	Inch/Inches	MN	Minute
MM	Millimeters	Z	Number of Flutes / Teeth
M	Meters	R	Radius
Ø	Diameter	RPM	Revolutions per Minute
D	Diameter	IPM	Inches per Minute
R	Radius	Ae	Max Depth of Cut
CED	Cutting Edge Diameter	Ch-CEL	Chamfer Cutting Length
CEL	Cutting Edge Length	R-CEL	Radius Cutting Length
SHK DIA ..	Shank Diameter	°	Degree / Angle of Cut
SHK L	Shank Length	TIP DIA	Special Shaping / V-Bits
OAL	Overall Length	π	3.14
SFM	Cutting Speed – Feet/Mn	Vc	Cutting Speed – M/MN
T.I.R.	Total Indicated Run-out		

Solid Carbide

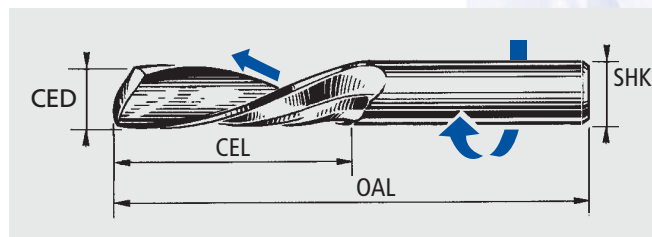
22000 Series Single Flute Spiral 'O'

TOOL #	CED	CEL	SHK DIA	OAL	
22317	1/8	5/16	1/4	1 1/2	inches (in)
22476	3/16	1/2	1/4	2	
22635	1/4	5/8	1/4	2	
22015	1.5	4	3	30	metric (mm)
22020	2	5	3	30	
22025	2.5	6	3	30	
22030	3	8	3	30	
22040	4	12	4	60	
22040A	4	10	6	50	
22050	5	16	5	60	
22050A	5	12	6	50	
22060	6	15	6	50	
22080	8	20	8	60	
22100	10	23	10	60	



Downcut
Left Hand Helix
Right Hand Cut

Designed to throw chip (waste) DOWN. Space between the material and CNC table is required for vacuum/removal.



Solid Carbide Special End Mill

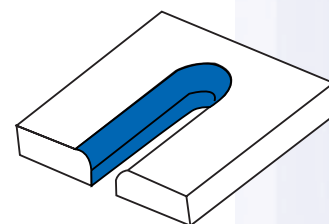
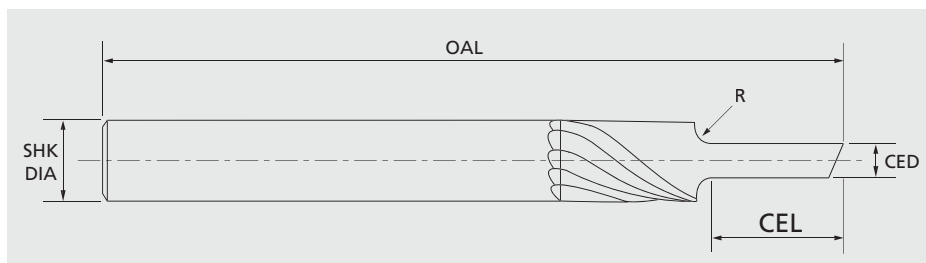
Single Flute + 3/64 Radius

TOOL #	CED	CEL	SHK DIA	OAL	R-CEL	
00203	3/16	3/32	1/4	2	3/64	(in)
00204	3/16	1/8	1/4	2	3/64	
00201	4	2.3	6	40	1	(mm)
00202	4	3.3	6	40	1	



Upcut
Right Hand Helix
Right Hand Cut

Designed to mill a small radius on the edge of the component in a one step process. Eliminates most secondary operations.



Solid Carbide

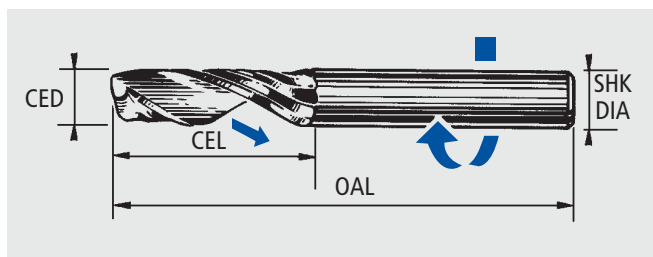
33000 Series Single Flute Spiral 'O'

TOOL #	CED	CEL	SHK DIA	OAL	
33317	1/8	5/16	1/4	1 1/2	inches (in)
33317A	1/8	5/16	1/8	1 1/2	
33476	3/16	1/2	1/4	2	
33476A	3/16	1/2	3/16	2	
33635	1/4	5/8	1/4	2	
33952	3/8	1	3/8	3	
33127	1/2	1 1/8	1/2	3 1/2	
33015	1.5	4	3	30	metric (mm)
33020	2	5	3	30	
33025	2.5	6	3	30	
33030	3	8	3	30	
33040	4	12	4	60	
33040A	4	10	6	50	
33050	5	16	5	60	
33050A	5	12	6	50	
33060	6	15	6	50	
33080	8	20	8	60	
33100	10	23	10	60	



Upcut
Right Hand Helix
Right Hand Cut

Designed to throw chip (waste) UP. This is the most popular design and is compatible with most CNC vacuum systems.



Solid Carbide Special End Mill

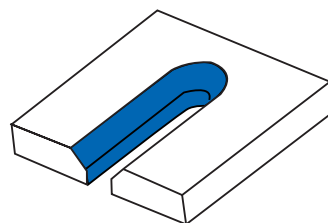
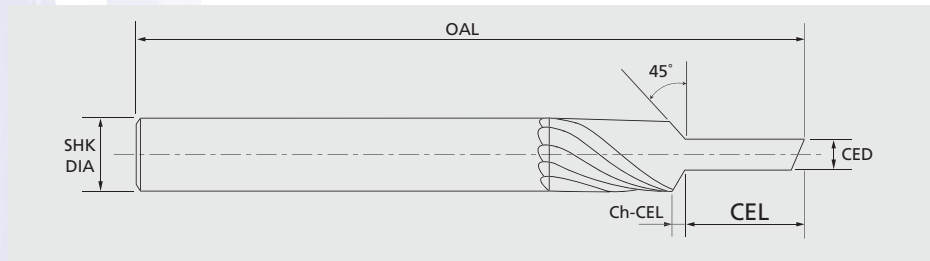
Single Flute + 45° Chamfer

TOOL #	CED	CEL	SHK DIA	OAL	Ch-CEL	
00199	3/16	3/32	1/4	2	3/64	(in)
00200	3/16	1/8	1/4	2	3/64	
99203	4	2.3	6	40	1	(mm)
00198	4	3.3	6	40	1	



Upcut
Right Hand Helix
Right Hand Cut

Designed to mill a small chamfer on the edge of the component in a one step process. Eliminates most secondary operations.



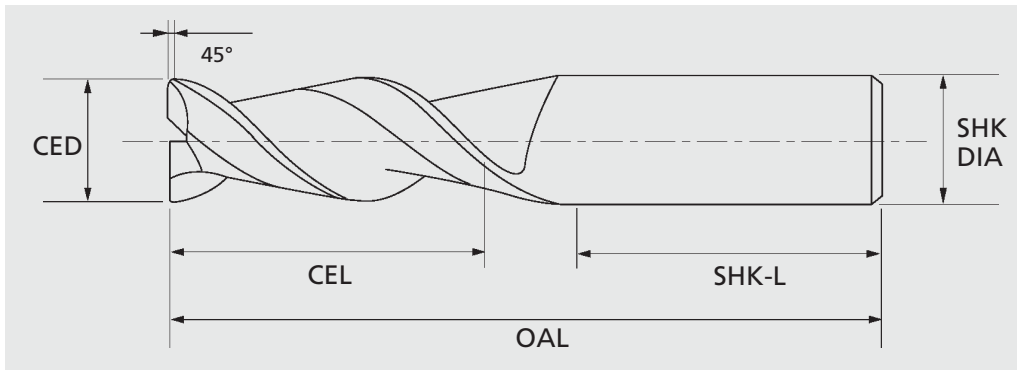
Slotting Cutter

2 Flute Special for Aluminum (Metric)

TOOL #	CED	CEL	SHK DIA	OAL	SHK-L	
176020	2	6	6	50	42	Metric (mm)
176030	3	7	6	50	40	
176040	4	8	6	50	38	
176050	5	10	6	50	35	
176060	6	10	6	50	-	
176080	8	15	8	60	-	
176100	10	18	10	65	-	
176120	12	20	12	70	-	
176140	14	22	14	75	-	



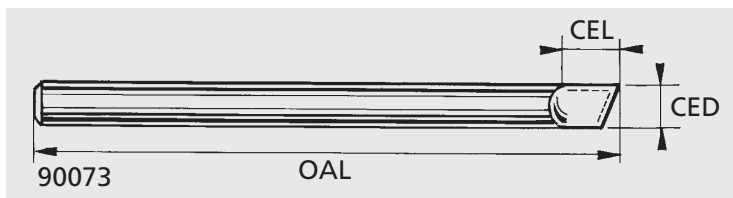
*Upcut
Right Hand Helix
Right Hand Cut*



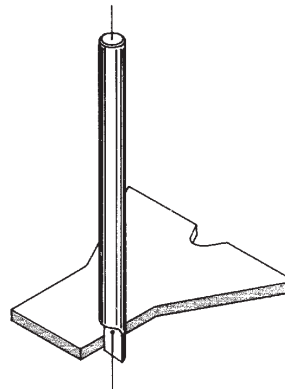
Milling Tool "Panto" Type

Special for Brass Manual Machine (Metric)

TOOL #	CED	CEL	OAL	
90073A	2	4	60	Metric (mm)
90073B	3	5	60	
90073C	4	6	60	
90073D	5	6	60	
90073E	6	10	60	
90073F	8	10	70	



*Single Flute
Staight Cut*



Solid Carbide

3 Flute Center Cut Helical

TOOL #	CED	CEL	SHK DIA	OAL	
102317	1/8	3/8	1/4	1 1/2	(in)
102476	3/16	7/16	1/4	1 7/8	
102635	1/4	5/8	1/4	2 3/8	
102030	3	10	3	40	(mm)
102040	4	11	4	48	
102060	6	16	6	60	

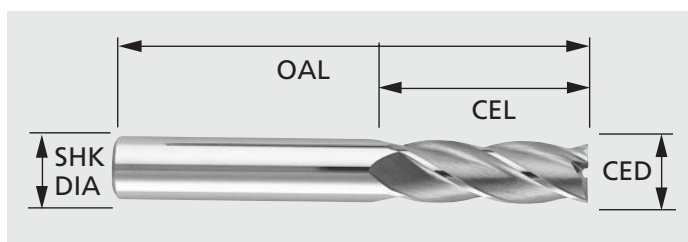


**Upcut
Right Hand Helix
Right Hand Cut**

Recommend use of lubricant/coolant to achieve best results and longer tool life.

4 Flute Center Cut Helical (Metric)

TOOL #	CED	CEL	SHK DIA	OAL	
15010	1	4	3	38	Metric (mm)
15015	1.5	4.5	3	38	
15020	2	7	2	40	
15020A	2	6.3	3	35	
15025	2.5	8	2.5	40	
15025A	2.5	9	3	38	
15030	3	10	3	40	
15040	4	11	4	48	
15050	5	13	5	60	
15060	6	16	6	60	
15070	7	23	7	60	
15080	8	23	8	60	
15090	9	23	9	60	
15100	10	23	10	60	
15120	12	30	12	76	
15140	14	30	14	76	



2 Flute Center Cut Helical (Metric)

TOOL #	CED	CEL	SHK DIA	OAL	
16010	1	4	3	38	Metric (mm)
16015	1.5	4.5	3	38	
16020	2	7	2	40	
16020A	2	6.3	3	35	
16025	2.5	8	2.5	40	
16025A	2.5	9	3	38	
16030	3	10	3	40	
16040	4	11	4	48	
16050	5	13	5	60	
16060	6	16	6	60	
16070	7	23	7	60	
16080	8	23	8	60	
16090	9	23	9	60	
16100	10	23	10	60	
16120	12	30	12	76	
16140	14	30	14	76	

Catalog Abbreviations

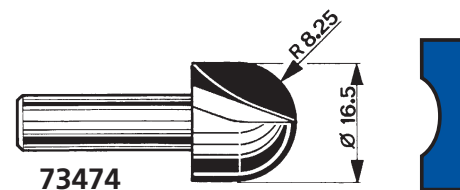
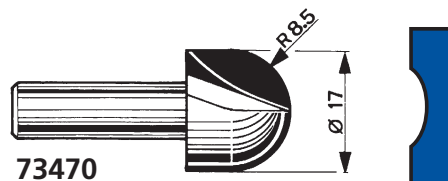
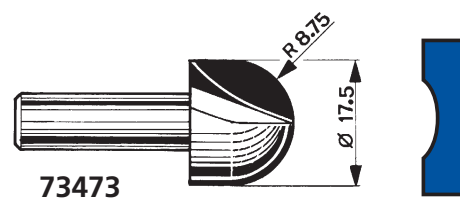
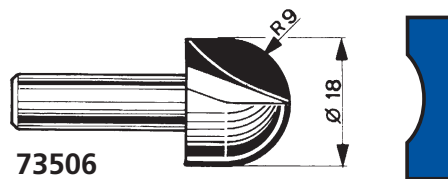
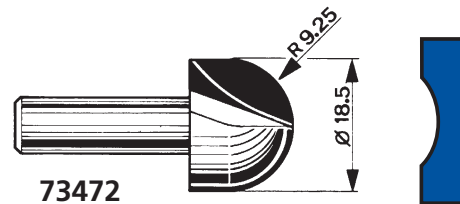
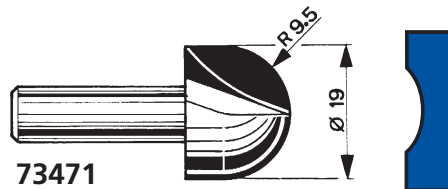
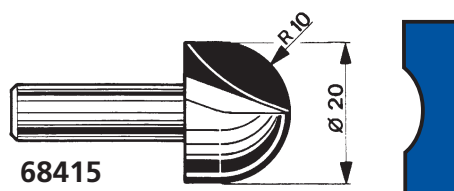
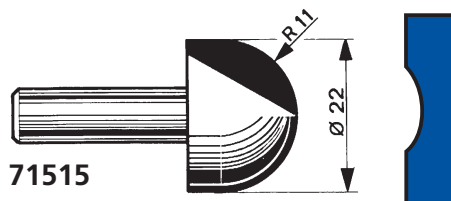
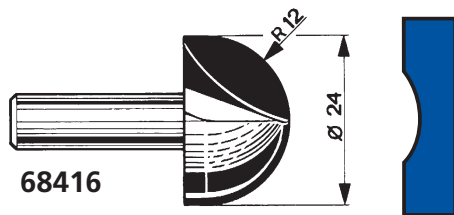
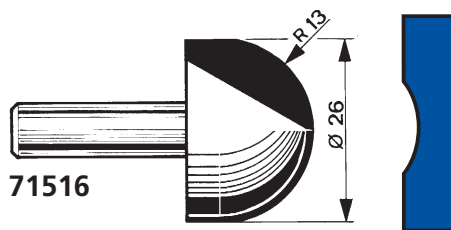
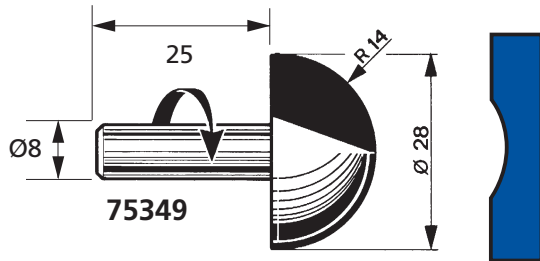
IN Inch/Inches	MN Minute
MM Millimeters	Z Number of Flutes / Teeth
M Meters	R Radius
Ø Diameter	RPM Revolutions per Minute
D Diameter	IPM Inches per Minute
R Radius	Ae Max Depth of Cut
CED Cutting Edge Diameter	Ch-CEL Chamfer Cutting Length
CEL Cutting Edge Length	R-CEL Radius Cutting Length
SHK DIA Shank Diameter	° Degree / Angle of Cut
SHK L Shank Length	TIP DIA Special Shaping / V-Bits
OAL Overall Length	π 3.14
SFM Cutting Speed – Feet/Mn	Vc Cutting Speed – M/MN
T.I.R. Total Indicated Run-out	

Special Radius Milling Tool

2 Flute Spherical (Metric)



Right Hand Cut



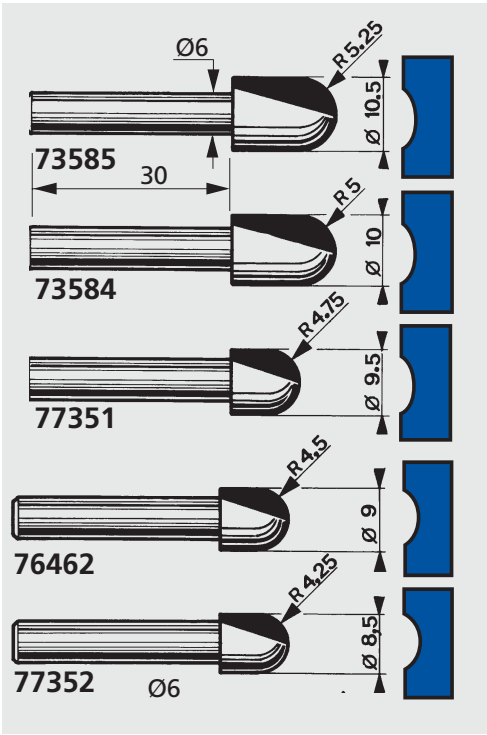
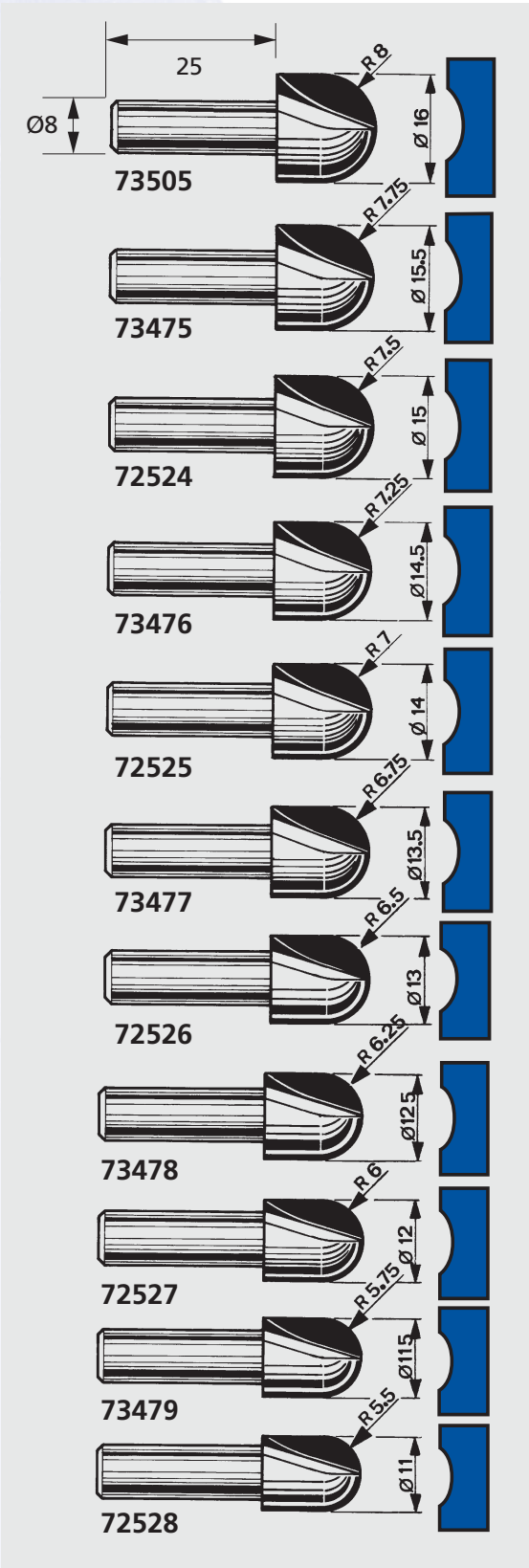
Ø Diameter

Special Radius Milling Tool

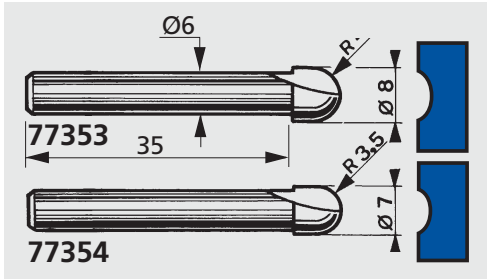
2 Flute Spherical (Metric)



Right Hand Cut



Ø Diameter



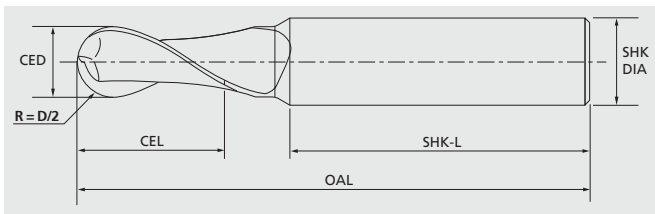
3D Copying Cutter

Ball Nose 2 Flute Center Cut XXL – Long Shank

TOOL #	CED	CEL	SHK DIA	OAL	SHK L	
117317	1/8	5/8	1/4	3 1/4	2 1/2	inches (in)
117476	3/16	7/8	1/4	4	3	
117635	1/4	1 1/4	1/4	5 1/8	–	
117952	3/8	1 5/8	3/8	7	–	
117127	1/2	2	1/2	8	–	
117020	2	10	4	80	66	metric (mm)
117030	3	15	6	90	72	
117040	4	20	6	100	76	
117050	5	20	6	100	78	
117060	6	30	6	130	–	
117080	8	40	8	150	–	
117100	10	50	10	180	–	
117120	12	50	12	200	–	



*Right Hand Helix
Right Hand Cut*



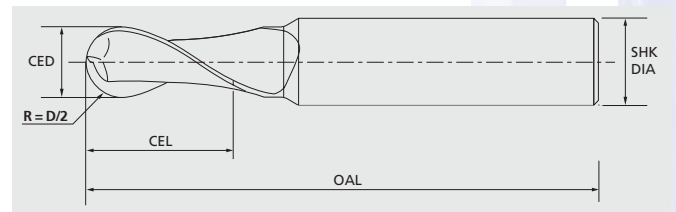
3D Copying Cutter

Ball Nose 2 Flute Center Cut Standard Long

TOOL #	CED	CEL	SHK DIA	OAL	
185317	1/8	3/4	1/8	2 3/8	inches (in)
185476	3/16	1 1/4	3/16	2 3/4	
185635	1/4	1 3/8	1/4	4	
185952	3/8	1 1/2	3/8	4	
185127	1/2	1 3/4	1/2	4 1/2	
185030	3	20	3	60	metric (mm)
185040	4	24	4	60	
185050	5	30	5	70	
185060	6	40	6	100	
185080	8	40	8	100	
185100	10	40	10	100	
185120	12	45	12	100	
185140	14	50	14	120	
185160	16	60	16	140	

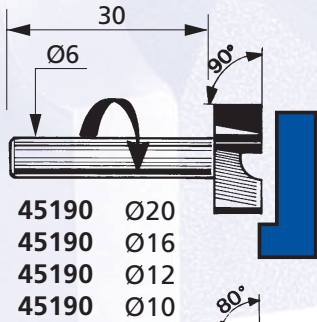


*Right Hand Helix
Right Hand Cut*

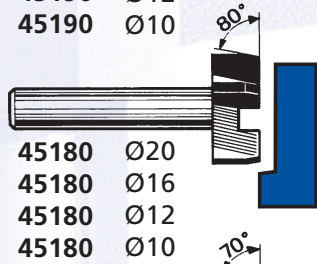


Surfacing Milling Tool

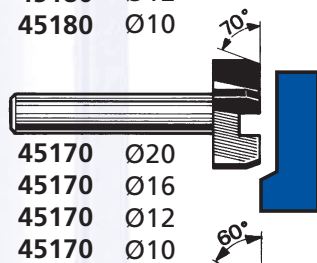
Various Angles/Radii (Metric)



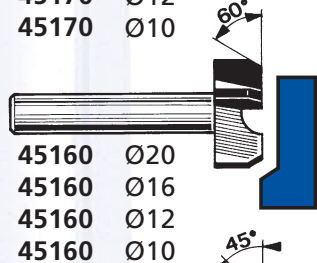
45190 Ø20
45190 Ø16
45190 Ø12
45190 Ø10



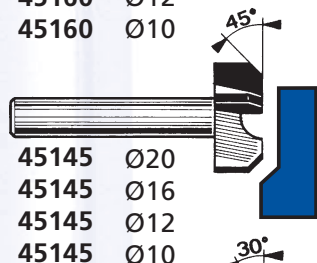
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45180 Ø12
45180 Ø10



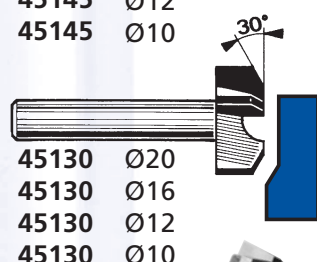
45170 Ø20
45170 Ø16
45170 Ø12
45170 Ø10



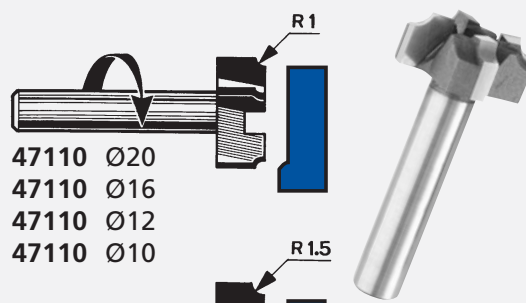
45160 Ø20
45160 Ø16
45160 Ø12
45160 Ø10



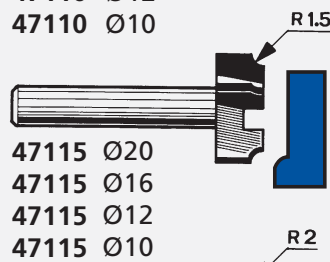
45145 Ø20
45145 Ø16
45145 Ø12
45145 Ø10



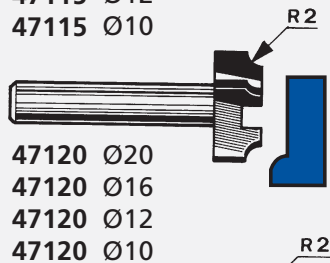
45130 Ø20
45130 Ø16
45130 Ø12
45130 Ø10



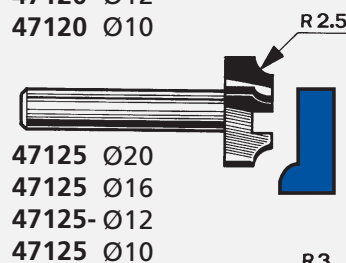
47110 Ø20
47110 Ø16
47110 Ø12
47110 Ø10



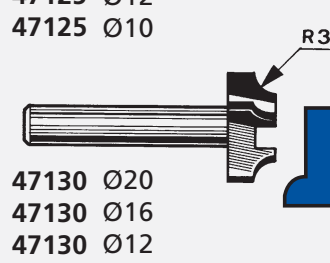
47115 Ø20
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47115 Ø12
47115 Ø10



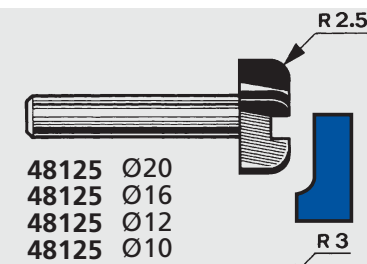
47120 Ø20
47120 Ø16
47120 Ø12
47120 Ø10



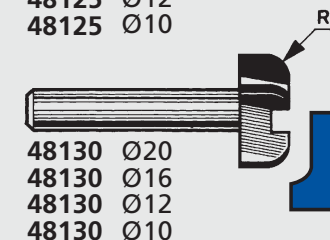
47125 Ø20
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47125 Ø10



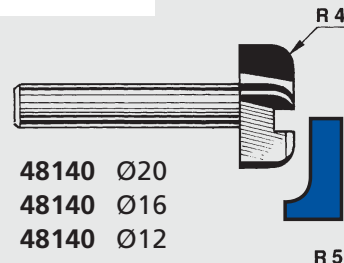
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47130 Ø12
47130 Ø10



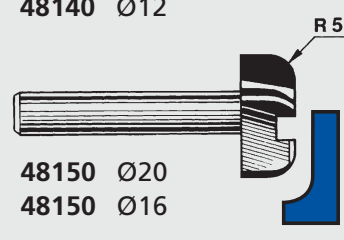
48125 Ø20
48125 Ø16
48125 Ø12
48125 Ø10



48130 Ø20
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48130 Ø12
48130 Ø10

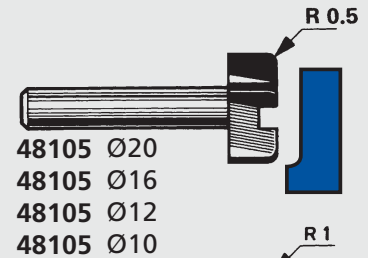


48140 Ø20
48140 Ø16
48140 Ø12

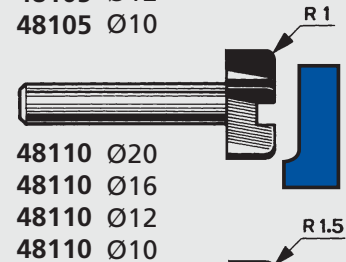


48150 Ø20
48150 Ø16

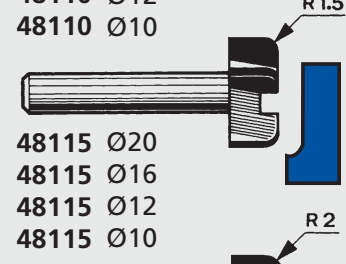
Ø Diameter



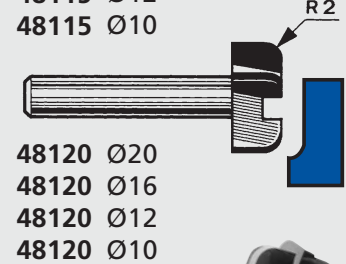
48105 Ø20
48105 Ø16
48105 Ø12
48105 Ø10



48110 Ø20
48110 Ø16
48110 Ø12
48110 Ø10



48115 Ø20
48115 Ø16
48115 Ø12
48115 Ø10



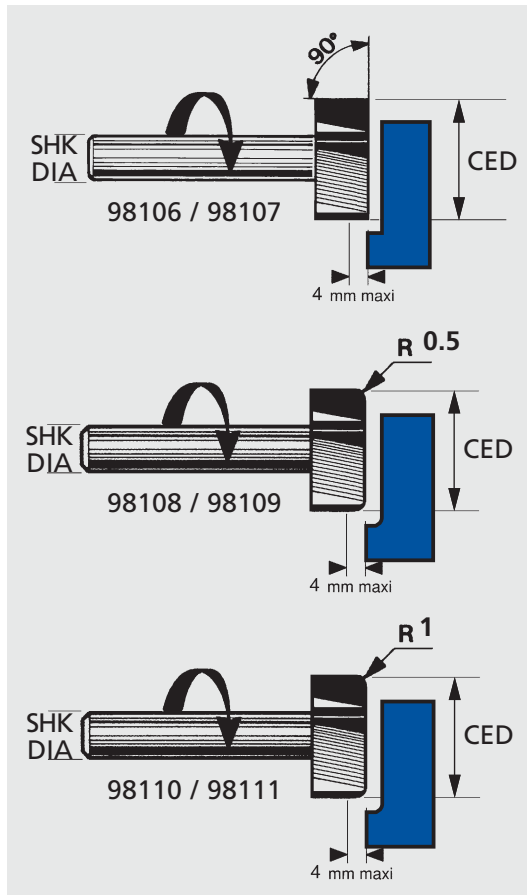
48120 Ø20
48120 Ø16
48120 Ø12
48120 Ø10



Natural Diamond

Single Flute Straight Cut (Metric)

TOOL #	CED	SHK DIA
98106	12	8
98107	20	8
98108	12	8
98109	20	8
98110	12	8
98111	20	8



BRILLIANT
FINISH



NATURAL

Catalog Abbreviations

IN	Inch/Inches	MN	Minute
MM	Millimeters	Z	Number of Flutes / Teeth
M	Meters	R	Radius
Ø	Diameter	RPM	Revolutions per Minute
D	Diameter	IPM	Inches per Minute
R	Radius	Ae	Max Depth of Cut
CED	Cutting Edge Diameter	Ch-CEL	Chamfer Cutting Length
CEL	Cutting Edge Length	R-CEL	Radius Cutting Length
SHK DIA ..	Shank Diameter	°	Degree / Angle of Cut
SHK L	Shank Length	TIP DIA	Special Shaping / V-Bits
OAL	Overall Length	π	3.14
SFM	Cutting Speed – Feet/Mn	Vc	Cutting Speed – M/MN
T.I.R.	Total Indicated Run-out		

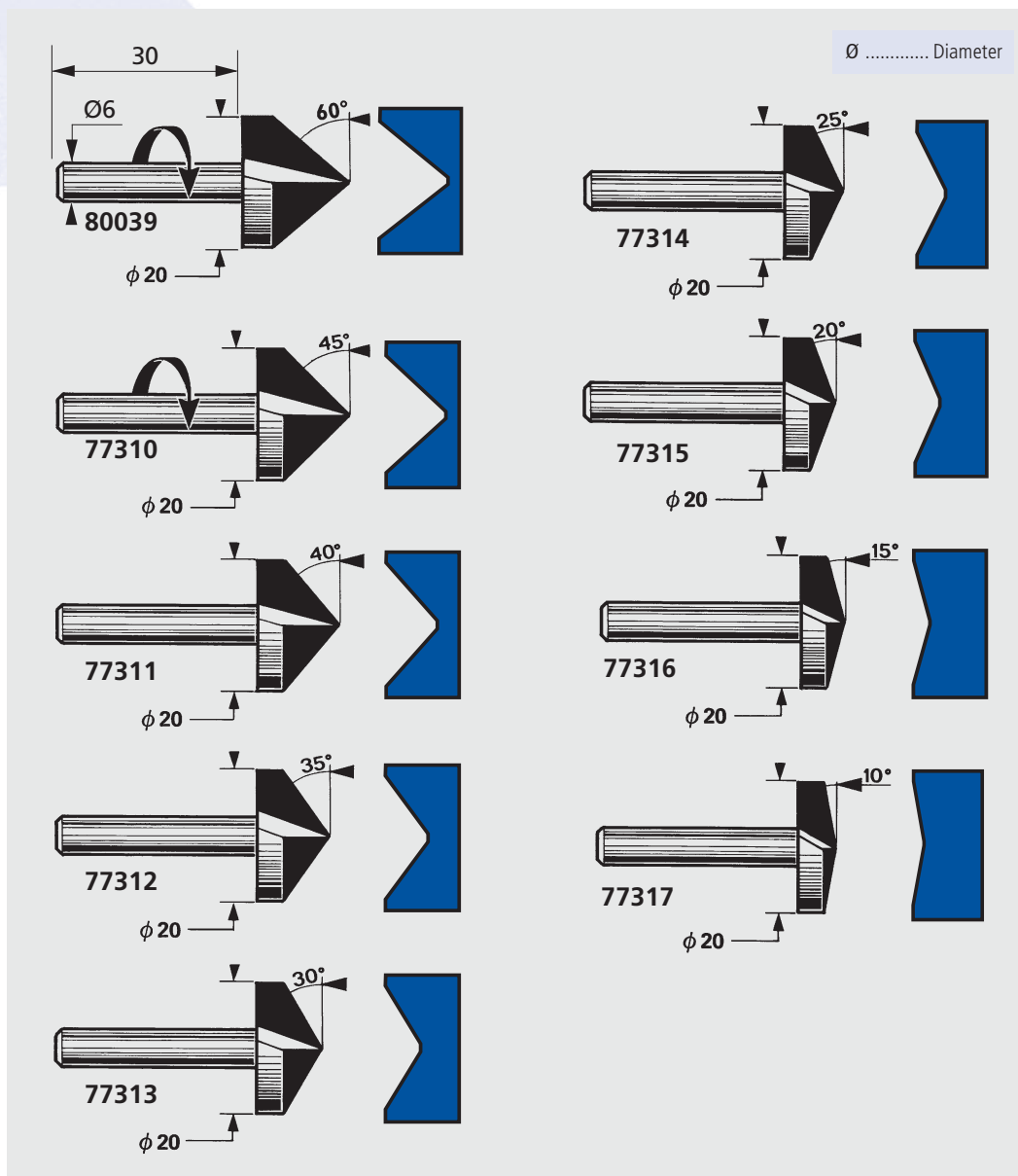
Conical Milling Tool

V-Bit 2 Flute (Metric)

TOOL #	V-Angle	V-Max Dia	Max Depth	SHK DIA	OAL
80039	60°	20	17.3	6	50.3
77310	45°	20	10	6	44
77311	40°	20	8.4	6	42.4
77312	35°	20	7	6	41
77313	30°	20	5.8	6	39.8
77314	25°	20	4.7	6	38.7
77315	20°	20	3.7	6	37.7
77316	15°	20	2.6	6	36.6
77317	10°	20	1.8	6	35.8



Right Hand Cut



Conical Milling Tool

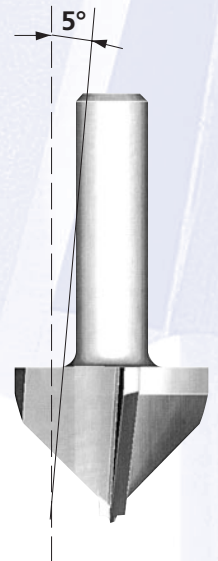
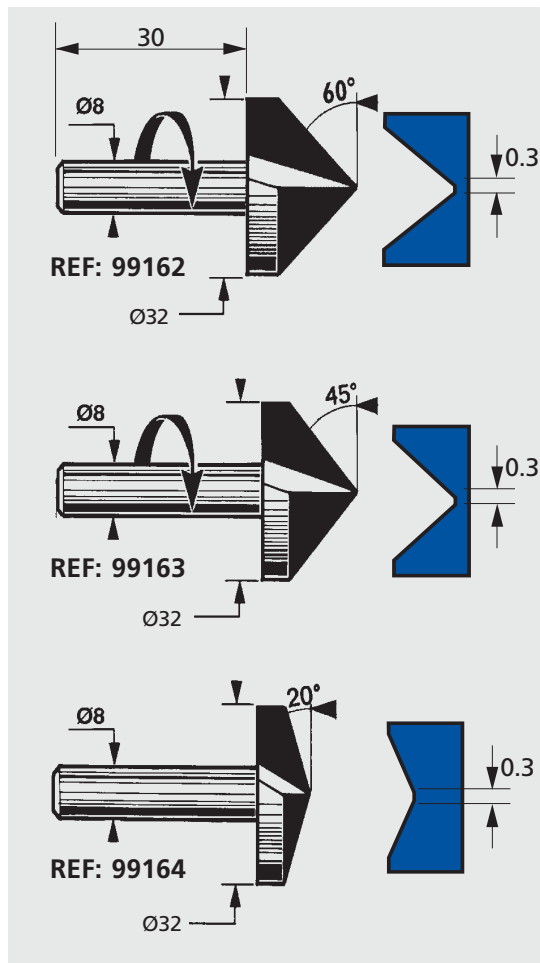
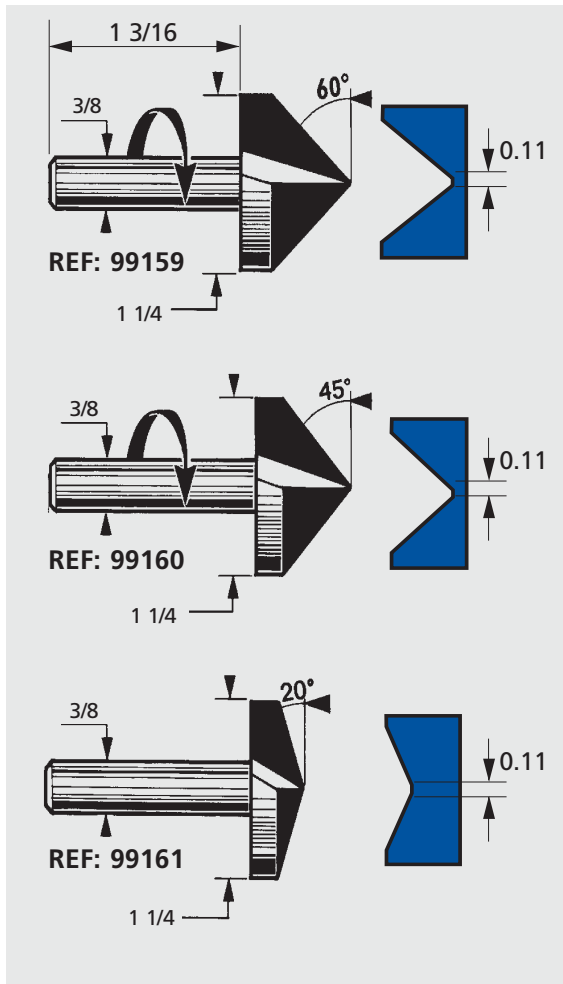
V-Bit 2 Flute

TOOL #	V-Angle	V-Max Dia	Max Depth	SHK DIA	OAL	
99159	60°	1 1/4	1 3/32	3/8	2 7/16	(in)
99160	45°	1 1/4	5/8	3/8	2	
99161	20°	1 1/4	7/32	3/8	1 9/16	
99162	60°	32	28	8	62	(mm)
99163	45°	32	16	8	50	
99164	20°	32	5.8	8	40	



Right Hand Cut

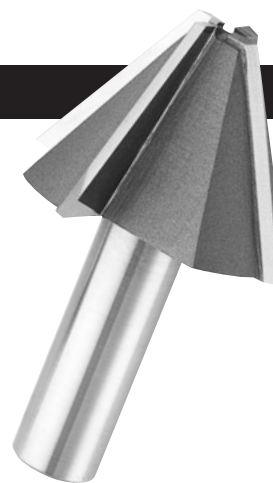
Ø Diameter



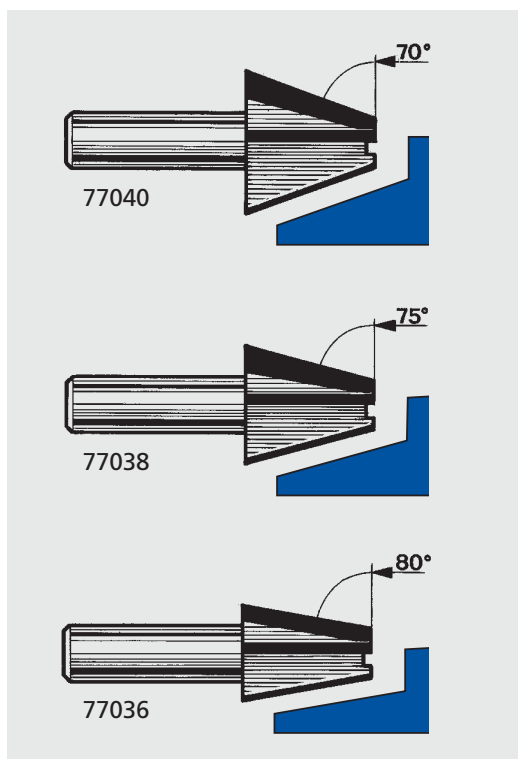
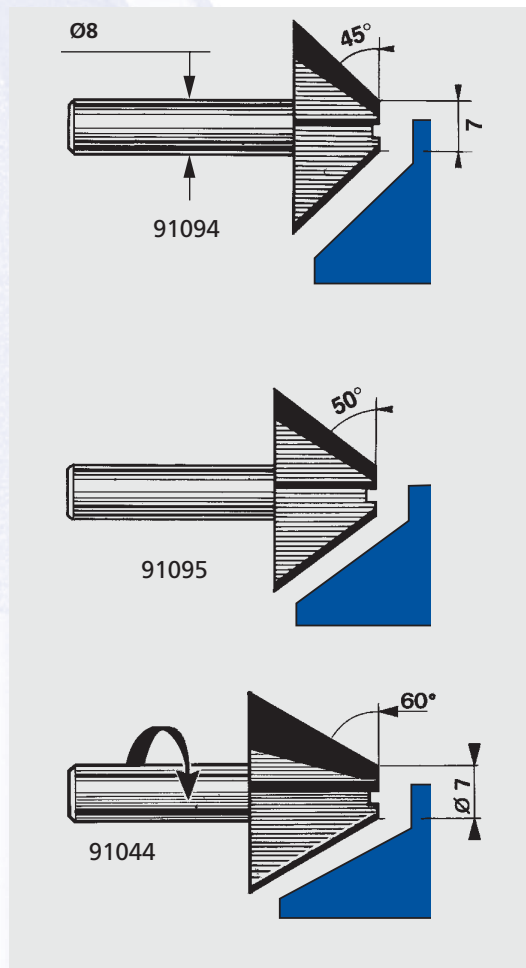
Milling Tool for External Parts

4 Flute (Metric)

TOOL #	Angle	TIP	Max CEL	SHK DIA	OAL
91094	45°	7	12	8	37
91095	50°	7	14	8	39
77044	60°	7	18	8	43
77040	70°	7	18	8	43
77038	75°	7	18	8	43
77036	80°	7	18	8	43



Right Hand Cut



Ø Diameter

Catalog Abbreviations

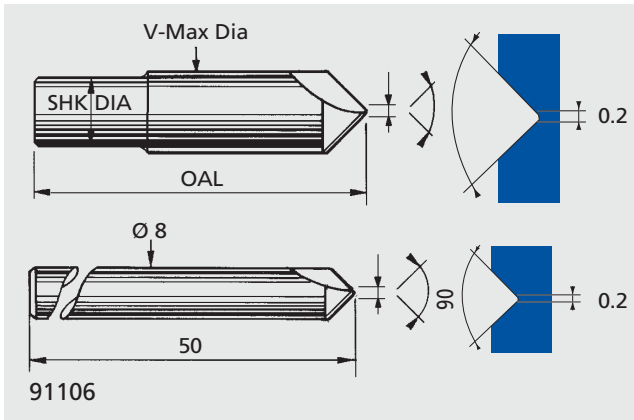
IN Inch/Inches	MN Minute
MM Millimeters	Z Number of Flutes / Teeth
M Meters	R Radius
Ø Diameter	RPM Revolutions per Minute
D Diameter	IPM Inches per Minute
R Radius	Ae Max Depth of Cut
CED Cutting Edge Diameter	Ch-CEL Chamfer Cutting Length
CEL Cutting Edge Length	R-CEL Radius Cutting Length
SHK DIA .. Shank Diameter	° Degree / Angle of Cut
SHK L Shank Length	TIP DIA Special Shaping / V-Bits
OAL Overall Length	π 3.14
SFM Cutting Speed – Feet/Mn	Vc Cutting Speed – M/MN
T.I.R. Total Indicated Run-out	

Special Milling Tool for Folding

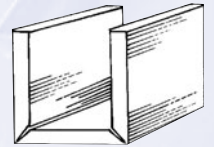
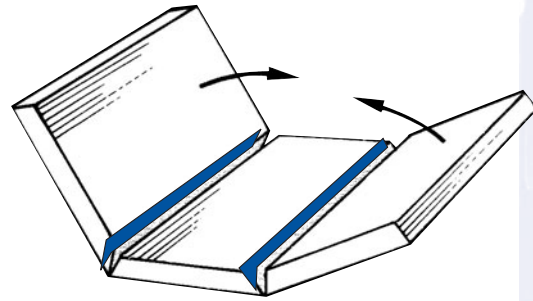
2 Flute 90° (Metric)

TOOL #	V-Angle	V-Max Dia	SHK DIA	TIP DIA	OAL
96188	90	16	8	0.2	50
00209	90	16	8	0.2	50
00210	90	16	8	0.2	50
91106	90	8	8	0.2	50

Right Hand Cut



Ø Diameter

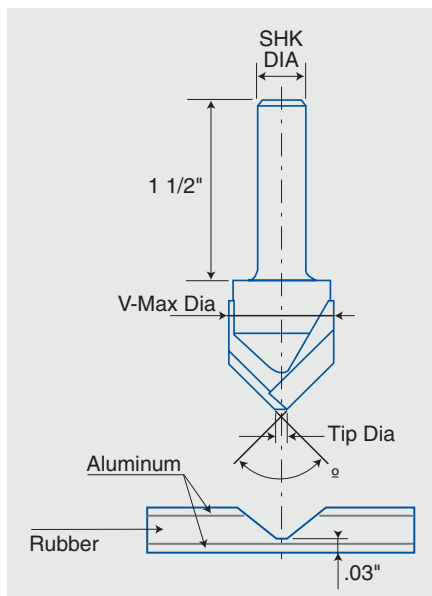


Special Cutter for Aluminum Composite

2 Flute V-Bit for Bending 90° - 135°

TOOL #	V-Angle	V-Max Dia	SHK DIA	TIP DIA	OAL	
99167	90°	3/4	3/8	1/8	2 3/8	(in)
99168	135°	3/4	3/8	5/64	2 3/8	
99165	90°	20	8	3	60	(mm)
99166	135°	20	8	2	60	

Right Hand Cut



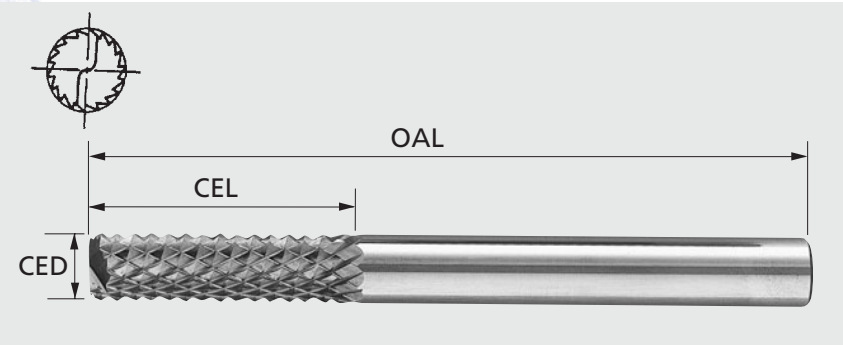
Diamond-Tipped End Mill

Straight Cut

TOOL #	CED	CEL	SHK DIA	OAL	inches (in)
118317	1/8	1/2	1/8	1 1/2	
118476	3/16	11/16	3/16	2	
118635	1/4	7/8	1/4	2 1/2	
					metric (mm)
118030	3	12	3	38	
118040	4	16	4	50	
118060	6	19	6	63	
118060A	6	25	6	75	
118080	8	25	8	63	
118100	10	25	10	75	



Right Hand Cut



Plastic, Composite Materials

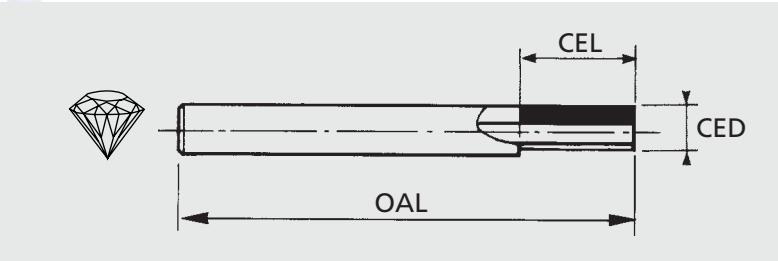
Diamond End Mill PCD

Single FLute Straight Cut (Metric)

TOOL #	CED	CEL	OAL	(mm)
94077	4	8	50	
94078	6	12	60	



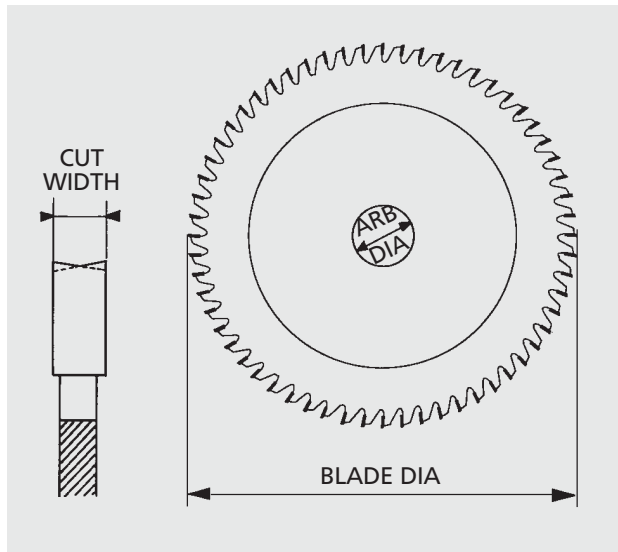
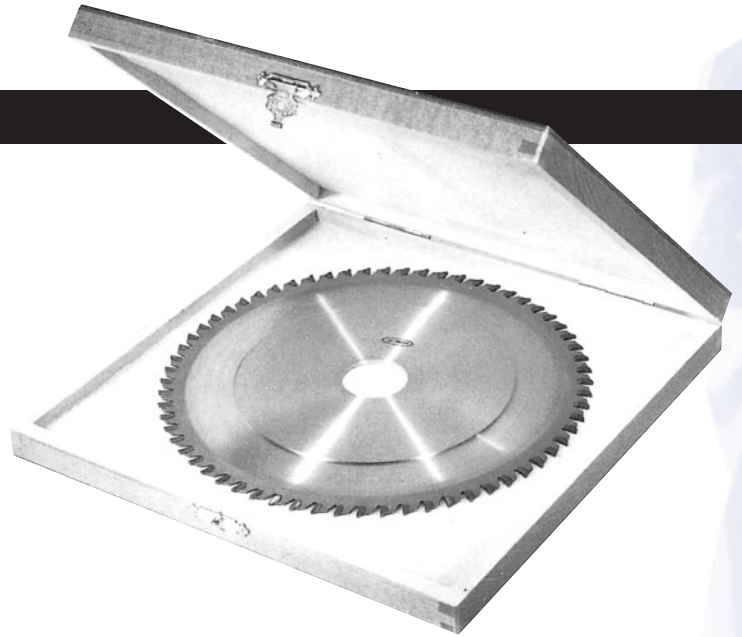
Right Hand Cut



Solid Carbide Saw Cutter

64 Teeth (Metric)

TOOL #	CUT WIDTH	ARBOR DIA	BLADE DIA
20030	1.6	30	200



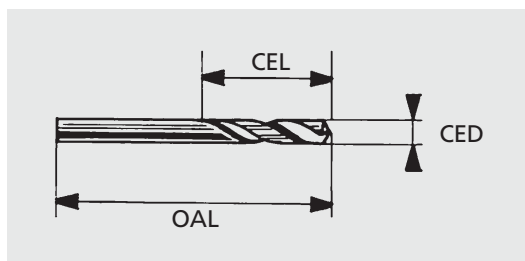
Solid Carbide Drills – 400 Series

Standard Dimensions Listed (Metric)

CED	CEL	OAL	CED	CEL	OAL
1	6	26	3.8 to 4.2	22	55
1.1	7	28	4.3 to 4.7	24	58
1.2 to 1.3	8	30	4.8 to 5.3	26	62
1.4 to 1.5	9	32	5.4 to 6.0	28	66
1.6 to 1.7	10	34	6.1 to 6.7	31	70
1.8 to 1.9	11	36	6.8 to 7.5	34	74
2.0 to 2.1	12	38	7.6 to 8.5	37	79
2.2 to 2.3	13	40	8.6 to 9.5	40	84
2.4 to 2.6	14	43	9.6 to 10.5	43	89
2.7 to 3.0	16	46	10.6 to 11.8	47	95
3.1 to 3.3	18	49	11.9 to 13.2	51	102
3.4 to 3.7	20	52	13.3 to 14.0	54	107

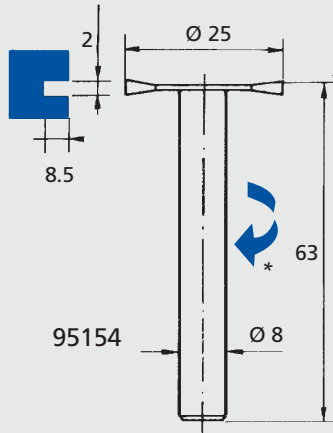
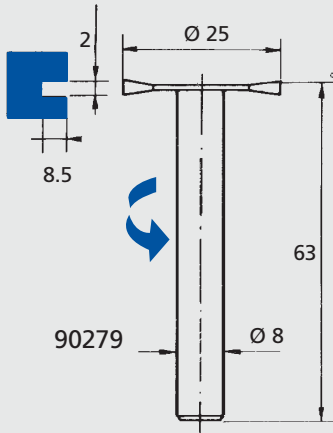
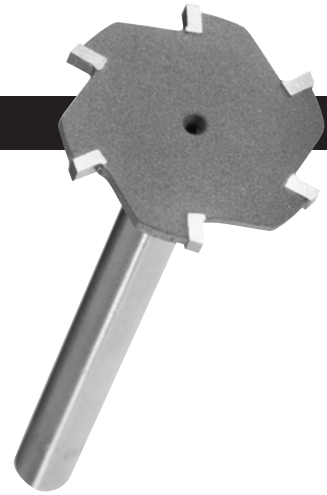


**Up Cut
Right Hand Helix
Right Hand Cut**

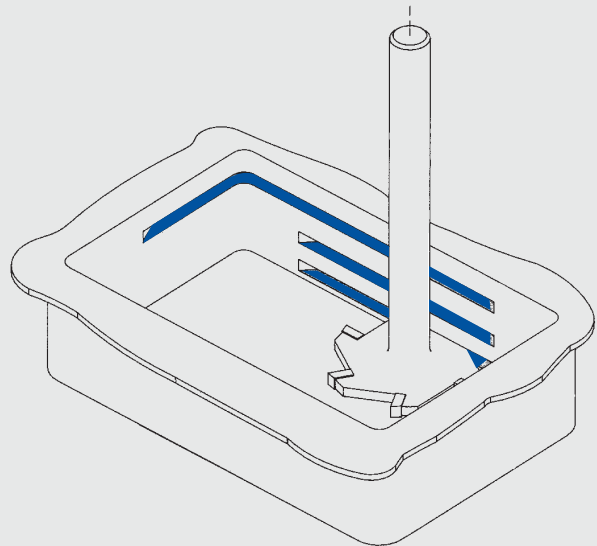
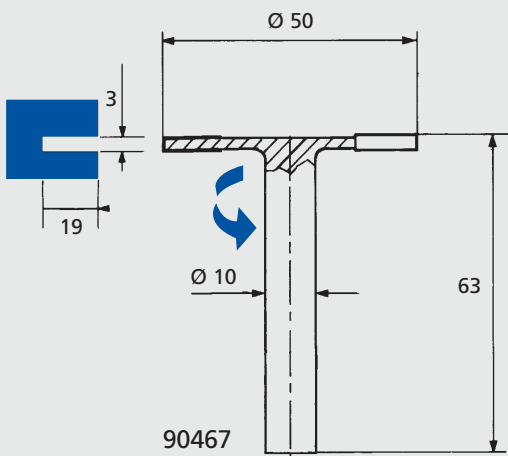
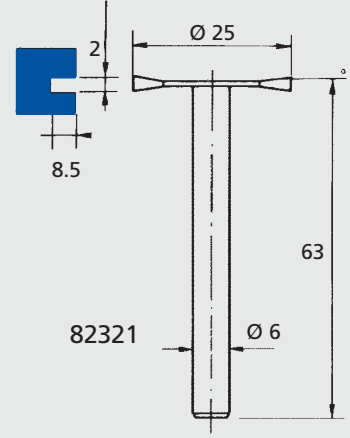
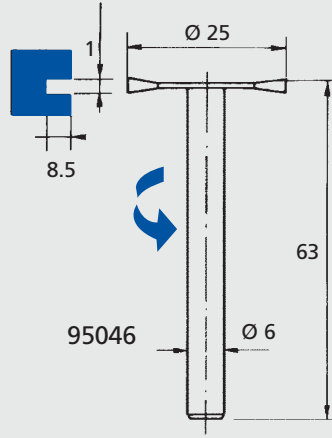
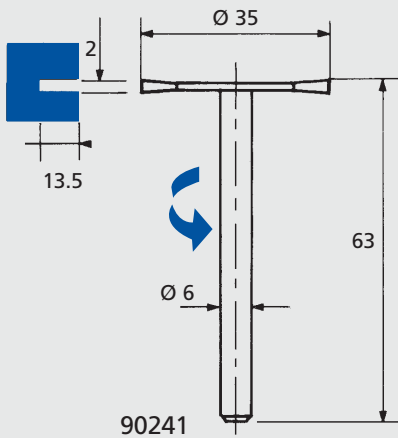


Special Slotting Tool

6 Flute (Metric)



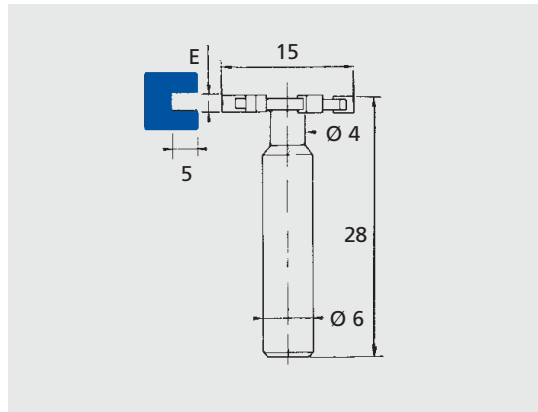
Ø Diameter



Special Slotting Tool

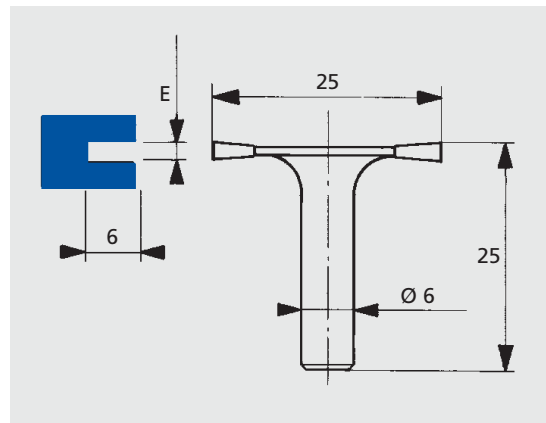
6 Flute (Metric)

TOOL #	E	Ø
18112	1.2	15
18114	1.4	15
18116	1.6	15
18118	1.8	15
18120	2.0	15



Ø Diameter

TOOL #	E	Ø
18010	1.0	25
18011	1.1	25
18012	1.2	25
18013	1.3	25
18014	1.4	25
18015	1.5	25
18016	1.6	25
18018	1.8	25
18020	2.0	25



Catalog Abbreviations

IN Inch/Inches	MN Minute
MM Millimeters	Z Number of Flutes / Teeth
M Meters	R Radius
Ø Diameter	RPM Revolutions per Minute
D Diameter	IPM Inches per Minute
R Radius	Ae Max Depth of Cut
CED Cutting Edge Diameter	Ch-CEL Chamfer Cutting Length
CEL Cutting Edge Length	R-CEL Radius Cutting Length
SHK DIA .. Shank Diameter	° Degree / Angle of Cut
SHK L Shank Length	TIP DIA Special Shaping / V-Bits
OAL Overall Length	π 3.14
SFM Cutting Speed – Feet/Mn	Vc Cutting Speed – M/MN
T.I.R. Total Indicated Run-out	

Engraving Tool (DR • FI • P)

(Metric)



Right Hand Cut

DR

Diagram showing eight different DR engraving tools with their dimensions and tool numbers:

- 77355: $\varnothing 6$ mm, 40, R3, $\varnothing 6$
- 77356: $\varnothing 6$ mm, R2.5, $\varnothing 5$
- 77357: $\varnothing 6$ mm, R2, 4
- 77358: $\varnothing 6$ mm, R1.5, 3
- 96085: $\varnothing 6$ mm, R1.25, 2.5
- 78085: $\varnothing 6$ mm, R1, 2
- 96185: $\varnothing 6$ mm, R0.75, 1.5
- 96186: $\varnothing 6$ mm, R0.5, 1

P

Diagram showing a P engraving tool with its dimensions:

- $\varnothing 6$
- 40
- D

TOOL #	D
19020	2
19025	2.5
19030	3
19035	3
19040	4
19045	4.5
19050	5
19055	5.5
19060	6
19080	8

$\varnothing$ Diameter

FI

Diagram showing eight different FI engraving tools with their dimensions and tool numbers:

Tool #	Top View Dimensions	Bottom View Dimensions
79354	0.875, 5, 0.7	79354
79599	0.853, 10, 0.5	79599
79245	1.353, 10, 1	79245
91006	10, 0.5	91006
93071	0.8	93071
93070	1	93070
93069	1.5	93069
93068	2	93068

Additional dimensions for FI tools:

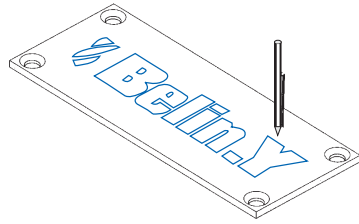
- $\varnothing 3$
- 30

Diagram showing a single FI engraving tool with its dimensions:

- $\varnothing 2$
- 30

Engraving Tool (GR)

Ultra Micrograin Carbide

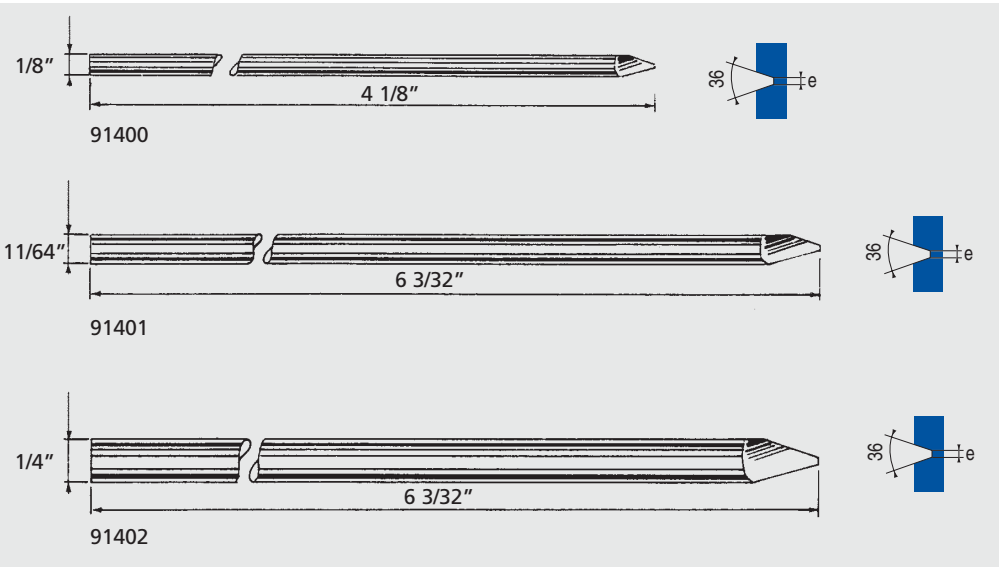


Right Hand Cut

Inches		Metric	
 00187		 94163	
 00186		 94162	
 00185		 94161	
 00184		 92176	
 00183		 92175	
 00182		 91101	
 00181		 91100	
 00180		 91099	
 00179		 91098	
 00178		 91097	
 00177		 91096	

Gravograph Machine – GR

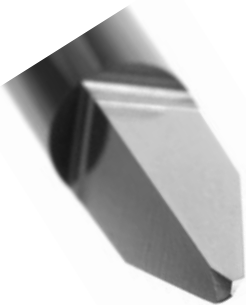
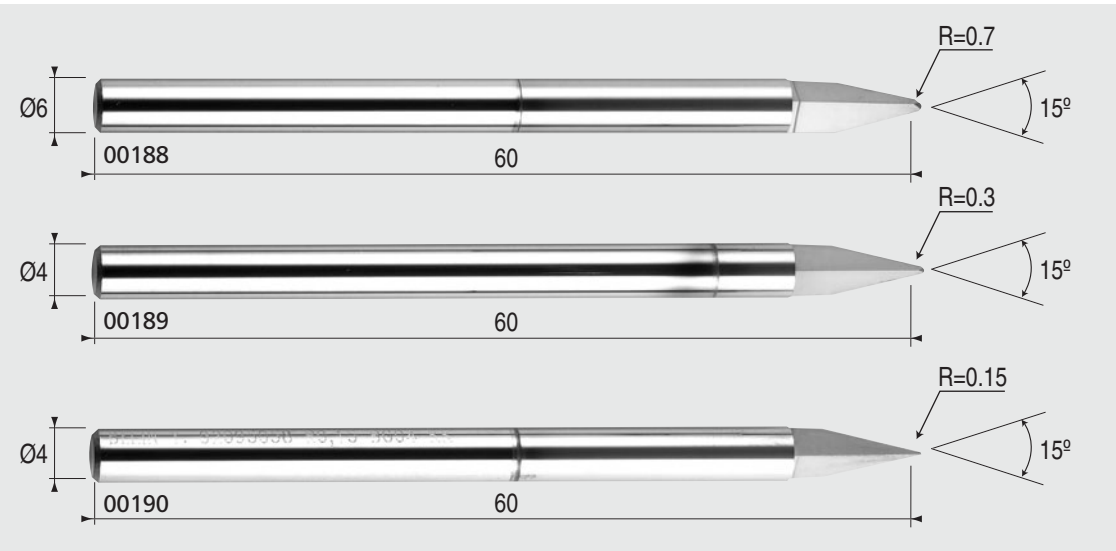
Engraving Tool (GR • GRP)



Tip 'e' available for 91400 series in following tips:

Inch	Metric
.013	0.32
.019	0.50
.030	0.75
.039	1.00
.049	1.25
.078	2.00

Pyramidal Engraving Cutter* / Xtialn Coated – GRP (Metric)



Ø Diameter

* Special cutter for form manufacturing or engraving of hard materials (steel, inox, treated steel)

Vinyl Blades for Top Surface Cut Out of Standard, Thick and Fluorescent Materials



Belin Performance blades made of ultra micrograin carbide provide the highest quality cutting performance and longer blade life. Check and reduce pressure setting on your plotter machine to avoid cutting through the material.

Graphix: 2 - 3 - 4 - Sprint Super-Sprint - Advantage

★ REF: 84272 ♦ REF: 94147

Graphix: ENVISION 375 - 750

★ REF: 00176

Graphix: GSX

★ REF: 94177

KONGSBERG

★ REF: 92171 ♦ REF: 92172

Roland: CAMMI - PNC 1100 - 1500 - 1900 - 450

★ REF: 91115 ♦ REF: 92054

Aristo: AG 50 • AG 130

★ REF: 91112 ♦ REF: 94148

Wild: TA 30 - 41/40 - 410 - 500 Zund : P700 - P1200 plus - P2000

★ REF: 95126

Wild: TA 30 - 41/40 - 410... Zund: P700 - P1200 plus - P2000

★ REF: 91113 ♦ REF: 94149

Wild: TA 30 - 41/40 - 410... -500 Zund: P700 - P1200 plus - P2000

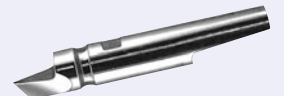
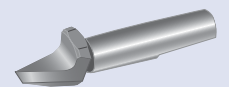
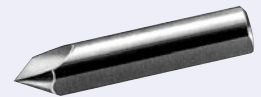
★ REF: 91114 ♦ REF: 94150

SUMMA GRAPHICS: D 610

★ REF: 94170 ♦ REF: 94171

SUMMA GRAPHICS: 69... - T600 HOUSTON

★ REF: 91116



★ Standard Usage ♦ Blade for thick or fluorescent materials

Vinyl Blades for Top Surface Cut Out of Standard, Thick and Fluorescent Materials

Belin Performance blades made of ultra micrograin carbide provide the highest quality cutting performance and longer blade life. Check and reduce pressure setting on your plotter machine to avoid cutting through the material.

GRAPHITYP: CSR 466 - 700 - TURBO

★ REF: 91272 ♦ REF: 93196



GRAPHITYP: CSR 466 - 700 - TURBO

★ REF: 93278



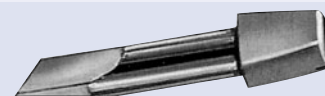
GRAPHTEC:

★ REF: 93342



MECANUMERIC

★ REF: 94046



SEI: 750 - 1400 CSR: 1000 - 1200 - 2400

★ REF: 94012 ♦ REF: 94151



SEI

★ REF: 94155 ♦ REF: 94156



CSR ECOM 2

★ REF: 93343



MUTHO

★ REF: 96065



MUTHO

★ REF: 94152 ♦ REF: 95003



MIMAKI

★ REF: 94153 ♦ REF: 94154



CREAGRAPH

★ REF: 94165 ♦ REF: 94166



IOLINE

★ REF: 94159 ♦ REF: 94160



WIDMATIC

★ REF: 98293

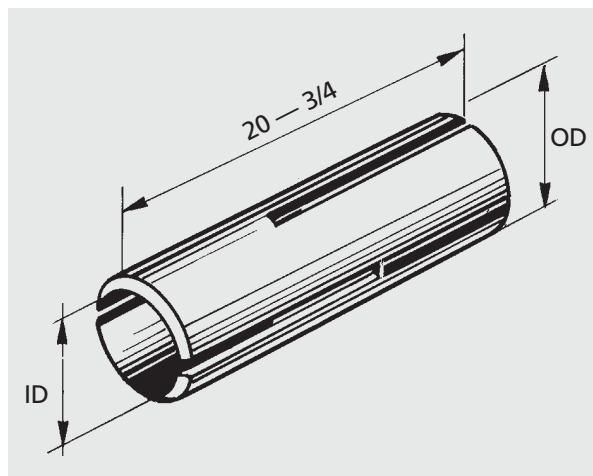


★ *Standard Usage* ♦ *Blade for thick or fluorescent materials*

Tapering Drill Sleeve

Reducer Sleeves for Converting Metric & Inch Dimensions

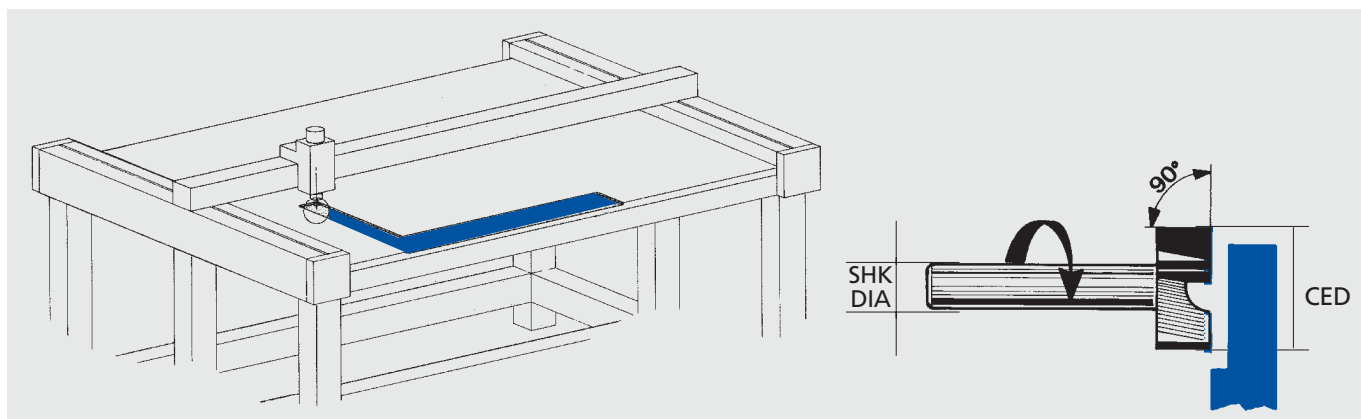
TOOL #	OD	ID	OAL	
86060H	1/4	2 mm	3/4	Inch [in] to Metric [mm]
86060I	1/4	2.5 mm	3/4	
86060J	1/4	3 mm	3/4	
86060K	1/4	4 mm	3/4	
86060A	4	2	20	Metric [mm] to Metric [mm]
86060B	4	2.5	20	
86060C	4	3	20	
86060D	6	2	20	
86060E	6	2.5	20	
86060F	6	3	20	
86060G	6	4	20	
86060L	6	3.17 / 1/8"	20	Metric [mm] to Inch [in]



Special Milling Tool

Re-Surface / Level Table 4 Solid Carbide Cutters

TOOL #	CED	CEL	SHK DIA	OAL	DEG	
45190A	3/4	1/4	1/4	1 1/2	90°	(in)
45190 - 20	20	6	6	38	90°	(mm)
45190 - 30	30	6	8	38	90°	



ER 16 (Standard)

Metric to Inch

Clamping range of collet for tool holding/grip

COLLET #	Diameter (mm)	Decimal (in)	Fractional (in)
09816020	2.0 ... 1.0	.07870394	1/16
09816025	2.5 ... 1.5	.09840591	3/32
09816030	3.0 ... 2.0	.11810787	
09816317	3.5 ... 2.5	.13780984	1/8
09816040	4.0 ... 3.0	.15751181	5/32
09816050	5.0 ... 4.0	.19691575	3/16
09816060	6.0 ... 5.0	.23621969	7/32
09816635	6.5 ... 5.5	.25592165	1/4
09816070	7.0 ... 6.0	.27562362	
09816080	8.0 ... 7.0	.31502756	5/16
09816100	10.0 ... 9.0	.39373543	3/8

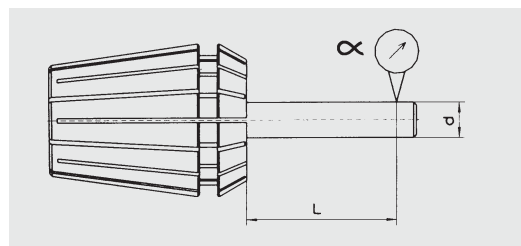


ER 25 (Standard)

Metric to Inch

Clamping range of collet for tool holding/grip

COLLET #	Diameter (mm)	Decimal (in)	Fractional (in)
09825020	2.0 ... 1.0	.07870394	1/16
09825025	2.5 ... 1.5	.09840591	3/32
09825030	3.0 ... 2.0	.11810787	
09825317	3.5 ... 2.5	.13780984	1/8
09825040	4.0 ... 3.0	.15751181	5/32
09825050	5.0 ... 4.0	.19691575	3/16
09825060	6.0 ... 5.0	.23621969	7/32
09825635	6.5 ... 5.5	.25592165	1/4
09825070	7.0 ... 6.0	.27562362	
09825080	8.0 ... 7.0	.31502756	5/16
09825100	10.0 ... 9.0	.39373543	3/8
09825127	13.0 ... 12.0	.51184724	1/2

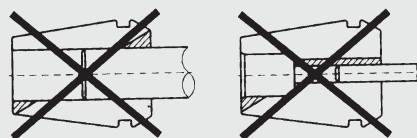
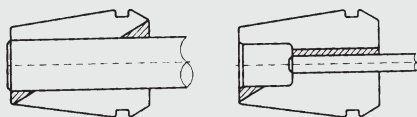


Metric

Shaft Diameter	Shaft Length	T.I.R.*
2-3	10	.01
4-5-6	16	.01
7-8-10	25	.01
12-18	40	.01

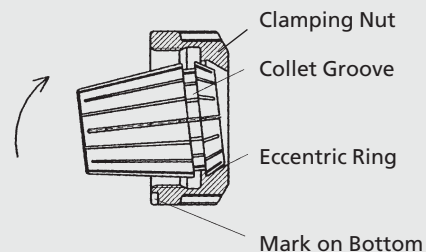
*Total Indicated Run-out

Select Collet that is slightly larger than tool.
Never clamp oversize tool shanks in Collet.

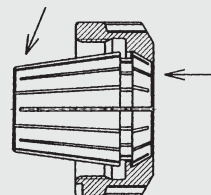


Insert tool the full length of the Collet.
Never insert tool less than 2/3 of the Collet.

Assembling Collet



Removing Collet



Never place Collet into spindle/toolholder
without first assembling into the Clamping Nut.

m = meter = 39.37 inches
mm = millimeter = .039 inches
mn = minute

BELIN PRECISION TOOLS

METRIC FORMULAS

Recommended cutting & feed rates for specific materials

- Select [Vc] for specific material to rout/mill – **calculate** RPM and Feed Rates using Belin formula
- Plunge at 40-60% [hard materials 20-30%] of the calculated feed rate / avoid tool hitting table in plunge
- Best results are achieved with stable material /proper hold down / no vibration
- Machine rigidity / software / setup / minimal runout [side pressure] - gives best results and longer tool life
- Follow Max. Depth of Cut [Ae] - and - Lubrication/Coolant recommendations for best results
- The quality, efficiency and performance of Belin tools depend on numerous interdependent factors

	Units
Vc	m/mn
Tool Diameter	mm
R	mm
Tool Radius	mm
Ad	mm
Feed Rate per minute	RPM
N	mm
Rotation per minute	RPM
Z	mm
Number of teeth / flutes	RPM
Ae	mm
Maximum depth of cut	mm

Material	Vc	Metric - Ad (Feed rate per minute) Cutting Edge Diameters in mm			Ae	Lubricant	Recommended		
		Ø < 3mm	3mm < Ø < 8mm	Ø > 8mm					
Aluminum Pure	200<Vc<400	0.01xDxZxN R	0.02xDxZxN D	0.025xDxZxN D	Ae	Petrol or RGV Swarf soft, sticky	176 22000 33000 99203	176	176
Aluminum Alloy	200<Vc<400	0.01xDxZxN R	0.02xDxZxN D	0.025xDxZxN D	Ae	Cutting oil emulsion Drier swarf	176 22000 33000 99203	102 176 15000 16000	102 176 15000 16000
Brass	150<Vc<300	0.01xDxZxN R	0.02xDxZxN D	0.025xDxZxN D	Ae	Cutting oil emulsion	176 22000 33000 99203	102 176 15000 16000	102 176 15000 16000
Bronze- Zinc	100<Vc<150	0.01xDxZxN R	0.02xDxZxN D	0.025xDxZxN D	Ae	Cutting oil emulsion	176 22000 33000 99203	102 176 15000 16000	102 176 15000 16000
Material	Vc	Ø < 4mm	4mm < Ø < 8mm	Ø > 8mm					
Plastics - Bakelite	50<Vc<100	0.03xDxZxN 1.5xR	0.04xDxZxN 1.5xD	0.045xDxZxN 1.5xD	Ae	Air	12000 13000 91361 94106 99058	13000 91361 94106	13000 91361 94106
Plastics - PVC	100< Vc <200	0.03xDxZxN 1.5xR	0.04xDxZxN 1.5xD	0.045xDxZxN 1.5xD	Ae	Air	12000 13000 91361 94106 99058	13000 91361 94106	13000 91361 94106
Plastics - Acetate Plexiglas - Nylon	300< Vc <500	0.03xDxZxN 1.5xR	0.04xDxZxN 1.5xD	0.045xDxZxN 1.5xD	Ae	Vaporized water	12000 13000 91361 94106 99058	13000 91361 94106	13000 91361 94106
Material	Vc	Ø < 3mm	3mm < Ø < 8mm	Ø > 8mm					
Wood	300< Vc <400	0.01xDxZxN 1.5xR	0.02xDxZxN 1.5xD	0.025xDxZxN 1.5xD	Ae	Air	12000 13000 91361 94106 99058	13000 91361 94106	13000 91361 94106
Material	Vc	Ø < 3mm	3mm < Ø < 8mm	Ø > 8mm					
Stainless Steel	90	0.0033xDxZxN R	0.0045xDxZxN R	0.0045xDxZxN R	Ae	Cutting oil emulsion	102 16000	102 15000	102 16000

$$\text{Formulas: } N = \frac{1000 \times Vc}{\Pi \times D} \quad Vc = \frac{\Pi \times D \times N}{1000}$$

For other tool profiles refer to bottom of catalog page for cutting information.

BELIN PRECISION TOOLS

INCH FORMULAS

Recommended cutting & feed rates for specific materials

- Select [SFM] for specific material to rout/mill – **calculate** RPM and Feed Rates using Belin formula
- Plunge at 40-60% [hard materials 20-30%] of the calculated feed rate / avoid tool hitting table in plunge
- Best results are achieved with stable material /proper hold down / no vibration
- Machine rigidity / software / setup / minimal runout [side pressure] - gives best results and longer tool life
- Follow Max. Depth of Cut [Ae] - and - Lubrication/Coolant recommendations for best results
- The quality, efficiency and performance of Belin tools depend on numerous interdependent factors

	Units
SFM	Cutting Speed
D	Tool Diameter
R	Tool Radius
IPM	Inches per minute / Feed Rate
RPM	Revolutions per minute
Z	Number- Flutes/Teeth
Ae	Maximum depth of cut
	Inches

IPM (Feed rate per minute) by Cutting Edge Diameters - inches				Ae- Max depth of cut each pass	Lubricant/Coolant	Recommended		
Materials	SFM	Up to 1/8"	3/16" to 3/8"	3/8" to 1"				
Aluminum Pure	> 1000	.0004xDxZxRPM x25.4 R	.0008xDxZxRPM x25.4 D	.001xDxZxRPM x25.4 D	Ae	Petrol or RGV Swarf soft, sticky	176000 22000 33000	176000 00199 00203
Aluminum Alloy	> 1000	.0004xDxZxRPM x25.4 R	.0008xDxZxRPM x25.4 D	.001xDxZxRPM x25.4 D	Ae	Cutting oil emulsion Drier swarf	99203	102000 176000 16000
Brass	490 < > 1000	.0004xDxZxRPM x25.4 R	.0008xDxZxRPM x25.4 D	.001xDxZxRPM x25.4 D	Ae	Cutting oil emulsion	102000 22000 33000	102000 176000 16000
Bronze- Zinc	330 < > 500	.0004xDxZxRPM x25.4 R	.0008xDxZxRPM x25.4 D	.001xDxZxRPM x25.4 D	Ae	Cutting oil emulsion	99203	
Materials	SFM	Up to 1/8"	3/16" to 3/8"	3/8" to 1"				
Plastics - Bakelite	160 < > 330	.0012xDxZxRPM x25.4 1.5xR	.0016xDxZxRPM x25.4 1.5xD	.0018xDxZxRPM x25.4 1.5xD	Ae	Air	12000 13000 91361	13000 91361 91361
Plastics - PVC	330 < > 700	.0012xDxZxRPM x25.4 1.5xR	.0016xDxZxRPM x25.4 1.5xD	.0018xDxZxRPM x25.4 1.5xD	Ae	Air	94106 99058	94106 00192
Plastics - Acetate Plexiglas - Nylon	980 < > 1600	.0012xDxZxRPM x25.4 1.5xR	.0016xDxZxRPM x25.4 1.5xD	.0018xDxZxRPM x25.4 1.5xD	Ae	Air Vaporised water		43000
Materials	SFM	Up to 1/8"	3/16" to 3/8"	3/8" to 1"				
Wood	980 < > 1300	.0004xDxZxRPM x25.4 1.5xR	.0008xDxZxRPM x25.4 1.5xD	.001xDxZxRPM x25.4 1.5xD	Ae	Air		
Materials	SFM	Up to 1/8"	3/16" to 3/8"	3/8" to 1"				
Stainless steel	300	.00013xDxZxRPMx25.4 R	.00018xDxZxRPM x25.4 R	.00018xDxZxRPMx25.4 R	Ae	Cutting oil emulsion	102000 16000	102000 15000 16000

Formulas: $RPM = \frac{SFM}{0.2618 \times D}$ $SFM = 0.262 \times D \times RPM$

For other tool profiles refer to bottom of catalog page for cutting information.

Follow the CNC machine manufacturer guidelines for setup — alignment — calibration and maintenance schedules. Regular attention to these guidelines will keep your CNC machine in top operating condition. Belin Precision Tools work best in well-maintained CNC machines giving excellent cutting performance and longer tool life.

CNC Rigidity – Setup – machine stability is when material hold down is achieved with no movement and minimal vibration. Also, consider that software programs need to be verified and the spindle(s) aligned and calibrated, creating the optimum working conditions to minimize runout side pressures giving the best cut/edge quality and longer tool life.

Collets – inspect often, especially if you change tools hourly — daily — weekly. Clean and inspect collets at every tool changeover. Replace collets at the first sign of wear. Worn or dirty collets will contribute to shorter tool life and tool breakage.

Plunging the material – harder the material to be routed/milled, the softer you should plunge. Reducing the plunge helps to avoid damaging the tool as it “hits” the material. Consider slower plunge when using small diameter tools, extra long cutting length tools and flatter tipped tools.

Examples:

Plastic/Wood – 40-60% of the calculated feed rate [IPM]

Aluminum/Non-Ferrous – 35-50% of the calculated feed rate [IPM]

Steel/Ferrous Metal – 20-30% of the calculated feed rate [IPM]

Depth of Cut – ‘Ae’ – important to follow the recommended ‘Ae’ listed on the Belin Cutting Formula Chart. Smaller cutting edge diameters and harder material being routed/milled require the depth of cut ‘Ae’ be reduced. Exceeding the recommended ‘Ae’ can contribute to less than optimal edge quality, shorter tool life and tool breakage.

Examples:

1/8" CED - rout/mill aluminum – ‘Ae’ R- radius = 1/16" ‘Ae’ per pass/cut

1/4" CED - rout/mill steel/ferrous metal – ‘Ae’ R- radius = 1/8" ‘Ae’ per pass/cut

3/16" CED - rout/mill aluminum – ‘Ae’ D- diameter = 3/16" ‘Ae’ per pass/cut

1/8" CED - rout/mill plastic/wood – ‘Ae’ 1.5 x R- radius = 3/16" ‘Ae’ per pass/cut

1/4" CED - rout/mill plastic/wood – ‘Ae’ 1.5 x D- diameter = 3/8" ‘Ae’ per pass/cut

Lubricant - Coolant – follow recommendation on the Belin Cutting Formula Chart for safe CNC production. Routing – Milling without recommended lubricant-coolant will contribute to shorter tool life, less than optimum edge quality and tool breakage.

Problems to consider when lubricant – coolant is not used:

- ❖ Contributes to weld back when routing – milling most plastic materials
- ❖ Excessive heat builds up of when routing – milling non-ferrous and ferrous metal creating an unsafe working environment and potential fire hazard.

SFM listed by material type on the Belin Cutting Formula Chart.
 Calculate RPM by multiplying .262* x CED = .0000 (listed below) –
 that result is then divided into SFM which = RPM
 *[Pi (3.14) divided by 12 = .262 rounded]

$$\text{RPM} = \frac{\text{SFM}}{.262 \times \text{CED}}$$

1/16 - .063 x .262 = .0165	9/16 - .563 x .262 = .1475
1/8 - .125 x .262 = .0328	5/8 - .625 x .262 = .1638
3/16 - .188 x .262 = .0493	11/16 - .688 x .262 = .1803
1/4 - .250 x .262 = .0655	3/4 - .750 x .262 = .1965
5/16 - .313 x .262 = .0820	13/16 - .813 x .262 = .2130
3/8 - .375 x .262 = .0983	7/8 - .875 x .262 = .2293
7/16 - .438 x .262 = .1148	15/16 - .938 x .262 = .2458
1/2 - .500 x .262 = .1310	1/1 - 1.000 x .262 = .2620

DECIMAL / METRIC CONVERTER

Inch	mm	Inch	mm
1/64	.015	33/64	.515
1/32	.031	17/32	.531
3/64	.046	35/64	.546
1/16	.062	9/16	.562
5/64	.078	37/64	.578
3/32	.093	19/32	.593
7/64	.109	39/64	.609
1/8	.125	5/8	.625
9/64	.140	41/64	.640
5/32	.156	21/32	.656
11/64	.171	43/64	.671
3/16	.187	11/16	.687
13/64	.203	45/64	.703
7/32	.218	23/32	.718
15/64	.234	47/64	.734
1/4	.250	3/4	.750
17/64	.265	49/64	.765
9/32	.281	25/32	.781
19/64	.296	51/64	.796
5/16	.312	13/16	.812
21/64	.328	53/64	.828
11/32	.343	27/32	.843
23/64	.359	55/64	.859
3/8	.375	7/8	.875
25/64	.390	57/64	.890
13/32	.406	29/32	.906
27/64	.421	59/64	.921
7/16	.437	15/16	.937
29/64	.453	61/64	.953
15/32	.468	31/32	.968
31/64	.484	63/64	.984
1/2	.500	1/1	1.000

Examples of RPM calculated for:

ALUMINUM - SFM 1000

Material to be routed - milled - Aluminum – SFM 1000

Formula .262 x CED [Cutting Edge Diameter] .262 x 1/4" [.250] = .0655

SFM – 1000 divided by .0655 = 15,267 RPM

PLASTIC/WOOD - SFM - select by material type – SFM range 160 to 1600

Material to be routed - milled - example Plexiglas - 1200 SFM

Material to be routed - milled - example PVC - 600 SFM

Material to be routed - milled - example Hardwood - 980 SFM

Formula .262 x CED [Cutting Edge Diameter] .262 x 3/16" [.188] = .0493

SFM – 1200 divided by .0493 = 24,340 RPM for Plexiglas

SFM – 600 divided by .0493 = 12,170 RPM for PVC

SFM – 980 divided by .0493 = 19,880 RPM for Hardwood

STEEL/FERROUS METAL - SFM 300

Material to be routed - milled - Stainless Steel – SFM 300

Formula .262 x CED [Cutting Edge Diameter] .262 x 3/16" [.188] = .0493

SFM – 300 divided by .0493 = 6085 RPM

Example 1:

Material to be routed - milled – Aluminum – SFM is 1000
 Belin Tool # 33635 - 1/4" CED
 $.262 \times .250 = .0655$
 SFM 1000 divided by $.0655 = 15,267$ RPM
 Belin Cutting Formula for Aluminum - 1/4 " CED
 $.0008 \times .250 \times 1 \times 15,267 \times 25.4 = 77"$ - IPM Feed Rate
 Ae – max depth of cut D – 1/4" each pass
 Lubricant/Coolant – recommended for best results and longer tool life

Example 2:

Material to be routed - milled – Stainless Steel – SFM is 300
 Belin Tool # 102476 - 3/16" CED
 $.262 \times .188 = .0493$
 SFM 300 divided by $.0493 = 6,085$ RPM
 Belin Cutting Formula for Stainless Steel - 3/16 " CED
 $.00018 \times .188 \times 3 \times 6,085 \times 25.4 = 15/16"$ - IPM Feed Rate
 Ae – max depth of cut R – 3/32" each pass
 Lubricant/Coolant – recommended for best results and longer tool life

Example 3:

Material to be routed - milled - Foam board - SFM 980 to 1600
 Belin Tool # 13952A - 3/8" CED - Special XXL CEL 3 3/16"
 SFM 1600 divided by $.0983 = 16,275$ RPM
 Belin Cutting Formula - **** Reduce RPM & IPM by 30-50% ****
 $.0018 \times .375 \times 1 \times 16,275 \times 25.4 = 279"$ - IPM Feed Rate
**** REDUCE RPM & IPM ****
 Reduced by 30% - RPM = 11,393 - IPM = 195 inches per minute
 Reduced by 40% - RPM = 9,765 - IPM = 167 inches per minute
 Reduced by 50% - RPM = 8,138 - IPM = 140 inches per minute
 #13952A- 3/8" designed for Routing/Milling 2"- 3" Foam Board Material **ONLY**.
 #13635B- 1/4" designed for Routing/Milling 1 1/2" - 2" Foam Board Material **ONLY**.
 Belin strongly recommends reducing RPM and Feed Rate [IPM] by 30-50% to avoid tool breakage due to extra long cutting length [XXL CEL].
 Ae - max depth of cut - 3"- #13952A FOAM ONLY - 2" - #13635B FOAM ONLY
 Lubricant/Coolant recommended for best results and longer tool life

Example 4:

Material to be routed - milled – Plastic -Acetate – SFM is 980 to 1600
 Belin Tool # 13476 – 3/16" CED
 $.262 \times .188 = .0493$
 SFM 1400 divided by $.0493 = 28,397$ RPM
 Belin Cutting Formula for Plastic – Acetate – SFM 1400
 $.0016 \times .188 \times 1 \times 28,397 \times 25.4 = 217"$ - IPM Feed Rate
 Ae – max depth of cut 1.5 x D – 9/32" each pass
 Lubricant/Coolant – recommended for best results and longer tool life

*When using different RPM than Cutting Formula *

When the router spindle RPM is higher or lower, or you prefer a specific RPM, this will adjust feed rates [IPM]. Belin recommends not exceeding the cutting formula RPM and feed rate [IPM] calculation more than 20%. Best results are when feed rate [IPM] and RPM are in balance allowing the tool and CNC machine to work together giving the best results.

*Refer to Example 4:

- ❖ CNC - Spindle RPM = 34,076 RPM
- ❖ $.0016 \times .188 \times 1 \times 34,076 \times 25.4 = 260"$ – IPM Feed Rate
- ❖ CNC - Spindle RPM = 18,000 RPM
- ❖ $.0016 \times .188 \times 1 \times 18,000 \times 25.4 = 137 - 138"$ – IPM Feed Rate
- ❖ CNC - Spindle RPM = 15,500 RPM
- ❖ $.0016 \times .188 \times 1 \times 15,500 \times 25.4 = 118"$ – IPM Feed Rate
- ❖ CNC - Spindle RPM = 12,000 RPM
- ❖ $.0016 \times .188 \times 1 \times 12,000 \times 25.4 = 91 - 92"$ – IPM Feed Rate

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00176	29	12040	4	13120	5	16120	12	31060	8	45190 - 30	31
00177	27	12040A	4	13127	5	16140	12	33015	10	45190A - 20	31
00178	27	12040B	4	13317	5	18010	25	33020	10	45190 - 20	31
00179	27	12040C	4	13317A	5	18011	25	33025	10	45190 Ø16	16
00180	27	12050	4	13476	5	18012	25	33030	10	45190 Ø12	16
00181	27	12050A	4	13476A	5	18013	25	33040	10	45190 Ø10	16
00182	27	12050B	4	13476B	5	18014	25	33040A	10	47110 Ø20	16
00183	27	12060	4	13635	5	18015	25	33050	10	47110 Ø16	16
00184	27	12060A	4	13635A	5	18016	25	33050A	10	47110 Ø12	16
00185	27	12060B	4	13635B	5	18018	25	33060	10	47110 Ø10	16
00186	27	12080	4	13635C	5	18020	25	33080	10	47115 Ø20	16
00187	27	12080A	4	13952	5	18112	25	33100	10	47115 Ø16	16
00188	28	12100	4	13952A	5	18114	25	33317	10	47115 Ø12	16
00189	28	12120	4	13190	5	18116	25	33317A	10	47115 Ø10	16
00190	28	12317	4	13254	5	18118	25	33476	10	47120 Ø20	16
00191	6	12476	4	15010X	12	18120	25	33476A	10	47120 Ø16	16
00192	6	12635	4	15015	12	19020	26	33635	10	47120 Ø12	16
00193	6	13010	5	15020	12	19025	26	33952	10	47120 Ø10	16
00194	6	13015	5	15020 A	12	19030	26	33127	10	47125 Ø20	16
00195	6	13020	5	15025	12	19035	26	43060	7	47125 Ø16	16
00196	6	13020A	5	15025 A	12	19040	26	43080	7	47125 Ø12	16
00197	6	13020B	5	15030	12	19045	26	43100	7	47125 Ø10	16
00198	10	13020C	5	15040	12	19050	26	43127	7	47130 Ø20	16
00199	10	13025	5	15050	12	19055	26	43635	7	47130 Ø16	16
00200	10	13025A	5	15060	12	19060	26	43952	7	47130 Ø12	16
00201	9	13030	5	15070	12	19080	26	45130 Ø20	16	47130 Ø10	16
00202	9	13030A	5	15080	12	20030	23	45130 Ø16	16	48105 Ø20	16
00203	9	13030B	5	15090	12	DRILL TYPE 400	23	45130 Ø12	16	48105 Ø16	16
00204	9	13030C	5	15100	12	22015	9	45130 Ø10	16	48105 Ø12	16
00205	7	13030D	5	15120	12	22020	9	45145 Ø20	16	48105 Ø10	16
00206	7	13030E	5	15140	12	22025	9	45145 Ø16	16	48110 Ø20	16
00207	7	13040	5	16010	12	22030	9	45145 Ø12	16	48110 Ø16	16
00208	7	13040A	5	16015	12	22040	9	45145 Ø10	16	48110 Ø12	16
00209	21	13040B	5	16020	12	22040A	9	45160 Ø20	16	48110 Ø10	16
00210	21	13040C	5	16020 A	12	22050	9	45160 Ø16	16	48115 Ø20	16
12010	4	13040D	5	16025	12	22050A	9	45160 Ø12	16	48115 Ø16	16
12015	4	13050	5	16025 A	12	22060	9	45160 Ø10	16	48115 Ø12	16
12020	4	13050A	5	16030	12	22080	9	45170 Ø20	16	48115 Ø10	16
12020A	4	13050B	5	16040	12	22100	9	45170 Ø16	16	48120 Ø20	16
12020B	4	13060	5	16050	12	22317	9	45170 Ø12	16	48120 Ø16	16
12025	4	13060A	5	16060	12	22476	9	45170 Ø10	16	48120 Ø12	16
12025A	4	13060B	5	16070	12	22635	9	45180 Ø20	16	48120 Ø10	16
12030	4	13080	5	16080	12	31030	8	45180 Ø16	16	48125 Ø20	16
12030A	4	13080A	5	16090	12	31040	8	45180 Ø12	16	48125 Ø16	16
12030B	4	13100	5	16100	12	31050	8	45180 Ø10	16	48125 Ø12	16

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48125 Ø10	16	77316	18	91096	27	94150	29	102030	12	185476	15
48130 Ø20	16	77317	18	91097	27	94151	30	102040	12	185635	15
48130 Ø16	16	77351	14	91098	27	94152	30	102060	12	185952	15
48130 Ø12	16	77352	14	91099	27	94153	30	102317	12	09816020	32
48130 Ø10	16	77353	14	91100	27	94154	30	102476	12	09816025	32
48140 Ø20	16	77354	14	91101	27	94155	30	102635	12	09816030	32
48140 Ø16	16	77355	26	91106	21	94156	30	117020	15	09816040	32
48140 Ø12	16	77356	26	91112	29	94159	30	117030	15	09816050	32
48150 Ø20	16	77357	26	91113	29	94160	30	117040	15	09816060	32
48150 Ø16	16	77358	26	91114	29	94161	27	117050	15	09816070	32
68415	13	78085	26	91115	29	94162	27	117060	15	09816080	32
68416	13	79245	26	91116	29	94163	27	117080	15	09816100	32
71515	13	79354	26	91272	30	94165	30	117100	15	09816317	32
71516	13	79599	26	91361A	7	94166	30	117120	15	09816635	32
73474	13	80039	18	91361B	7	94170	29	117317	15	09825020	32
72524	13	80206	26	91361C	7	94171	29	117476	15	09825025	32
72525	13	82321	25	91361D	7	94177	29	117635	15	09825030	32
72526	13	83470	26	91400	28	95003	30	117952	15	09825040	32
72527	13	84272	29	91401	28	95046	24	117127	15	09825050	32
72528	13	86060A	31	91402	28	95126	29	118030	22	09825060	32
73505	13	86060B	31	92054	29	95154	24	118040	22	09825070	32
73470	13	86060C	31	92171	29	96065	30	118060	22	09825080	32
73471	13	86060D	31	92172	29	96085	26	118060A	22	09825100	32
73472	13	86060E	42	92175	27	96185	26	118080	22	09825127	32
73473	13	86060F	42	92176	27	96186	26	118100	22	09825317	32
73475	14	86060G	31	93068	26	96188	21	176020	11	09825635	32
73476	14	86060H	31	93069	26	98106	17	176030	11		
73477	14	86060I	31	93070	26	98107	17	176040	11		
73478	14	86060J	31	93071	26	98108	17	176050	11		
73479	14	86060K	31	93072	26	98109	17	176060	11		
73506	13	86060L	31	93196	30	98110	17	176080	11		
73584	14	90073	11	93278	30	98111	17	176100	11		
73585	14	90073 A	11	93342	30	98293	30	176120	11		
75349	13	90073 B	11	93343	30	99058	6	176140	11		
76462	14	90073 C	11	94012	30	99159	19	185030	15		
77036	20	90073 D	11	94046	30	99160	19	185040	15		
77038	20	90073 E	11	94077	22	99161	19	185050	15		
77040	20	90073 F	11	94078	22	99162	19	185060	15		
77044	20	90241	24	94083	26	99163	19	185080	15		
77310	18	90279	24	94104	8	99164	19	185100	15		
77311	18	90467	24	94105	8	99165	21	185120	15		
77312	18	91006	26	94106	8	99166	21	185127	15		
77313	18	91014	26	94147	29	99167	21	185140	15		
77314	18	91094	20	94148	29	99168	21	185160	15		
77315	18	91095	20	94149	29	99203	10	185317	15		