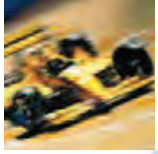
Member IMC Group

Ingersoll Cutting Tools

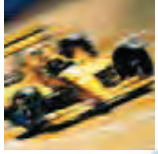
MODULAR CHIP SURFER & SOLID CARBIDE MILLING CUTTERS



MODULAR CHIP SURFER & SOLID CARBIDE MILLING CUTTERS.

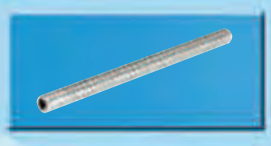
	Diameter	Cutting Depth	Description	Series	Page
	.312 - 1.000	.20 - .88	CHIPSURFER 0° Lead, 45° Helix, Center Cutting for Roughing & Finishing	47C, 47D Rough-fin Solid Carbide End Mill Tip	10
	.312 - .750	.20 - .62	CHIPSURFER 0° Lead, 45° Helix, Center Cutting	47C, 48C Solid Carbide Serrated Roughing Tip	11
	.312 - .500	.20 - .37	CHIPSURFER 0° Lead, 45° Helix, High Precision	46J, 46D Solid Carbide Center Cutting End Mill Tip	12
	.312 - 1.000	.20 - .88	CHIPSURFER 0° Lead, 38° Helix, Center Cutting	47J, 47D, 47C Solid Carbide End Mill Tip, Variable Pitch	13
	.312 - .750	.20 - .62	CHIPSURFER 0° Lead, 45° Helix, High Precision	47J, 47D Solid Carbide Center Cutting End Mill Tip	14
	.250	.20	CHIPSURFER 0° Lead, 45° Helix, Center Cutting	47J End Mill Tip	15
	.312 - 1.000	.20 - .88	CHIPSURFER 0° Lead, 45° Helix, Not Center Cutting	48D, 48J, 49D, 49J Solid Carbide Finishing End Mill Tip	16
	.312 - .750	.20 - .50	CHIPSURFER 0° Lead, 45° Helix, Center Cutting, Polished, Sharp	45D, 45J, 46D, 46J End Mill Tip for Aluminum	17
	.375 - .625	.38 - .60	CHIPSURFER 0° Lead, Center Cutting	45D Drill Mill Tip	18
	.375 - .625	.38 - .60	CHIPSURFER 3° Back Draft, Center Cutting	45V Flat Bottom Plunge Tip	19

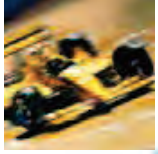
	Diameter	Cutting Depth	Description	Series	Page
	.375 - .750	.02 - .06	CHIPSURFER High Feed Roughing, Center Cutting	45A Solid Carbide Ultra High Feed Tip	20
	.314 - 1.000	.016 - .145	CHIPSURFER High Feed Roughing, Center Cutting	47A, 48A 4 & 6 Flute High Feed Tip	21
	.375 - .625	.19 - .35	CHIPSURFER Back Draft Finishing, Not Center Cutting	48U Solid Carbide Backdraft Toroidal	22
	.312 - .625	.31 - .63	CHIPSURFER Straight Ball Nose	45B Ball Nose Tip	23
	.312 - .625	.31 - .63	CHIPSURFER High Precision Tip for Hardened Steel	45B Ball Nose Tip	23
	.375 - .750	.33 - .66	CHIPSURFER Spherical Ball Nose	45X Spherical Ball Nose Tip	24
	.312 - .750	.20 - .62	CHIPSURFER Helical Ball Nose	45B, 47B High Precision Ball Nose Tip	25
	.250	.20	CHIPSURFER Helical Ball Nose	47B High Precision Ball Nose Tip	26
	.312 - .750	.20 - .50	CHIPSURFER Helical Ball Nose	45B Helical Ball Nose Tip for Aluminum	27
	.315 - .390	.14 - .29	CHIPSURFER 30°, 45°, 60°, 72° Center Cutting	45N, 45M, 45P Chamfer and Spotting Tip	28



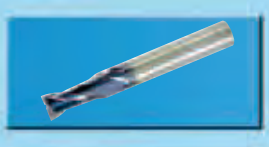
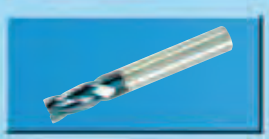
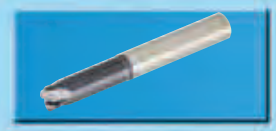
MODULAR CHIP SURFER & SOLID CARBIDE MILLING CUTTERS.

	Diameter	Cutting Depth	Description	Series	Page
	.500 - .787	.20 - .29	CHIP SURFER 45° Helix, Not Center Cutting	47N, 48N Solid Carbide Chamfer and Countersink	29
	.394 - .630	.425 - .560	CHIP SURFER Corner .062", .094", .156", .187" O.D. Radius	45R Solid Carbide Corner Rounding Tip	30
	.625	.13	CHIP SURFER Chamfer .062" x 45°	18T Front/Back Chamfer, V-Form Tip	31
	.500 - 1.000	.09 - .19	CHIP SURFER Corner .015"R, Chamfer .006" x 45°	18T Precision T-Slot Milling Tip	32
	.394 - .630	.252 - .445	CHIP SURFER Solid Carbide Thread Milling Tip	47Y	34
	.129 - .254	.181 - .350	CHIP SURFER 120° Included Point Angle, 10° - 15° Helical Flute, Center Drill	45Z	35
	.375 - .750	.22	CHIP SURFER 90° Lead End Mill	12J1D	36
	.750 - 1.000	.31	EVO-TEC MINI 0° Lead End Mill	1SJ1Y (Chip Surfer Style)	38
	.500 - .750	.250 - .375	CHIP SURFER Pro-ball Tip	1BW7	39
	.312 - 1.250	-	CHIP SURFER Necked Down Straight Shanks	S0_SA, WB_SA	40

	Diameter	Cutting Depth	Description	Series	Page
	.625 - 1.25	-	CHIP•SURFER® Conical Shanks	SO_SK, WB_SK	41
	.312 - .750	-	CHIP•SURFER® Straight Shank, No Neck	SO_CA, SO_SA, SO_HA	42
	.25 - 1.00	-	CHIP•SURFER® Integral ER-Adaptor	ER_SA	43
	.300 - .940	-	CHIP•SURFER® Extension	T_SA	44
	.315 - 1.001	-	CHIP•SURFER® Blanks	4RJ	45
	.315 - .630	-	CHIP•SURFER® Ball Nose Blanks	4RB	46
	.075 - .405	-	CHIP•SURFER® T-Slot Preform Blanks	18T_RSO00	47
	.250 - 1.000	.50 - 2.00	POWER•ROUNDS® Roughing End Mills, 3-flute, 38° Helix, w/Chipsplitters	46C_RM	52
	.125 - 1.000	1.50 - 4.50	POWER•ROUNDS® Precision End Mills, Medium and Long Length, 45° Helix	47J_RD, 48J_RD	53
	.250 - 1.000	.50 - 1.50	POWER•ROUNDS® Precision End Mills for Aluminum, 45° Helix	45J_RD, 46J_RD	54



MODULAR CHIP SURFER & SOLID CARBIDE MILLING CUTTERS.

	Diameter	Cutting Depth	Description	Series	Page
	.125 - .750	.50 - 1.25	POWERoROUNDS™ Precision Center-Cutting End Mills, 2-Flute, 30° Helix	45C_RB	55
	.125 - .750	.38 - 1.50	POWERoROUNDS™ Precision Center-cutting End Mills, 4 Flute, 38° Helix	47J_RC, 47D_RC	56
	.125 - 1.000	.25 - 1.50	POWERoROUNDS™ Precision Center-cutting End Mills, 3 Flute, 38° Helix	46J_RC, 46D_RC	58
	.125 - 1.000	.25 - 2.00	STEDIoROUNDS™ Solid Carbide End Mills for Roughing & Finishing, Variable Pitch	47C_RQ	59
	.250 - 1.000	.35 - 1.50	STEDIoROUNDS™ Solid Carbide End Mills for Aluminum, 3-Flute, Variable Helix	46D_RQ	60
	.250 - 1.000	.50 - 1.50	ROUGHFINoROUNDS™ Solid Carbide End Mills, Combination Roughing/ Finishing	47C_RU	62
	.250 - .750	.50 - 1.87	3N1oROUNDS™ 4 & 5 Flute Hi Feed Roughing End Mill w/ Variable Pitch & Chip Splitters	45D_RP	63
	.062 - .500	.03 - .25	PROoROUNDS™ Bull Nose Solid Carbide End Mills, 2 Flutes	45U	64
	.250 - .500	.12 - .18	FEEDoROUNDS™ Hi Feed Solid Carbide End Mills, 4 Flutes	45A_RA	65
	.125 - .750	.19 - 1.50	PROoROUNDS™ Ball Nose Solid Carbide End Mills, Multi-purpose	45B_RB, 46B_RB, 47B_RB	66

Solid ER style integral collet shanks for Swiss & Live Tooling

- *Solid (spring-free) integral design adds noticeable rigidity*
- *± .0005" axial & radial repeatability with a true simultaneous fit*
- *Dozens of tip styles fit on a single master shank*

See page 43 for details

Hi-PosMicro Indexable

Rough-Fin

Serrated Roughing

0° Lead 45° Helix Center Cutting

Variable Pitch 0° Lead 38° Helix Center Cutting

Polished for Aluminum

Finishing 0° Lead, 45° Helix Non-Center Cutting

High Precision Helical Ball Nose

Flat Bottom Plunger

Drill-Mill

Chamfer & Spotting

Corner Rounding

Precision T-Slot

Thread Mill

Center Drill

CONNECTION CHART	
END MILL SIZE	CONNECTION SIZE
.250/.312	T05
.375	T06
.500	T08
.625	T10
.750	T12
1.00	T15

Extensions

Solid Integral ER Collet Shanks

Reduced Diameter Shanks

Straight Shanks

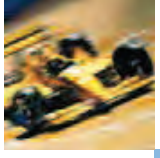
Necked-Down Straight Shanks

CHIPSURFER™

Precision Solid Carbide Modular Tooling

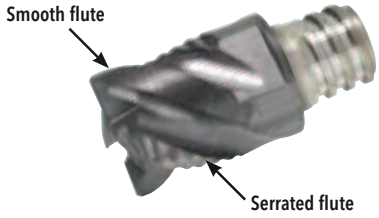
- *Interchangeable carbide tips for extreme versatility:*
  - Change tips right on the machine
  - Various tip styles fit the same shank
- *Precision ground tolerance for accurate finishing:*
  - Each new tip repeats like a master insert
  - No more machine resetting or entering offsets
  - Symmetrically designed for high RPM
  - Advanced grade and geometry for high speed and hardened steel
- *Streamlines high production operations:*
  - Tip changes in seconds
  - Standardize tips to reduce inventory
- *Radical advantages in long reach and short applications:*
  - Tips are more economically replaced when compared to long round tools
  - Short flute length means body core strength
  - Solid ER Shanks add rigidity and streamline tool changes

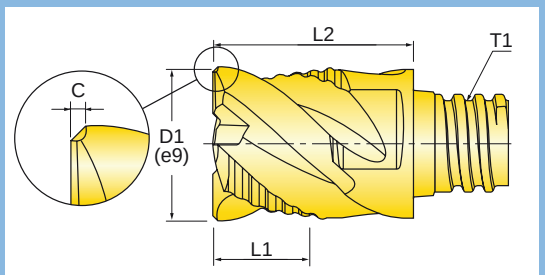
VIRTUAL CHIPSURFER SEMINAR
WWW.INGERSOLL-IMC.COM



CHIPSURFER™ ROUGH-FIN SOLID CARBIDE END MILL TIP - 47C, 47D

0° LEAD, 45° HELIX, CENTER CUTTING FOR ROUGHING & FINISHING





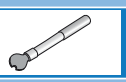
GRADES	P	M	K	N (K)	S (M)	H (P/K)
IN2005	+	+	+		+	

+ Good 0 Bad

Cutter Number	# Effective	D1 Nominal Diameter	L1 Cutting Edge Length	T1 Thread Size	L2 Extension Length	C Corner
47C-3120TQRU01	4	.312	.20	T05	.390	.012 x 45
47C-3727T6RU01	4	.375	.27	T06	.510	.012 x 45
47D-3727T6RU03	4	.375	.27	T06	.495	R .031
47C-5037T8RU01	4	.500	.37	T08	.650	.015 x 45
47D-5037T8RU03	4	.500	.37	T08	.645	R .031
47C-6247TRRU02	4	.625	.47	T10	.800	.024 x 45
47D-6247TRRU06	4	.625	.47	T10	.795	R .062
47C-7562TSRU02	4	.750	.62	T12	1.000	.024 x 45
47D-7562TSRU06	4	.750	.62	T12	.995	R .062
47C-1088TURU02	4	1.000	.88	T15	1.450	.024 x 45

Operating guidelines on page 82.

HARDWARE

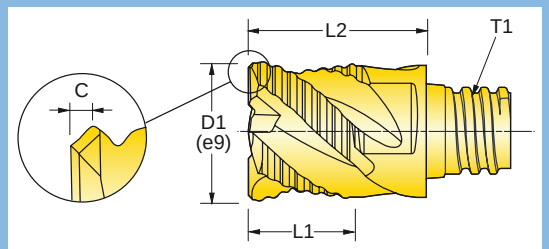


Thread Size	Wrench	Optional Torque Wrench
T05	WS-0043	DT-60-06
T06	WS-0029	DT-90-08
T08	WS-0030	DT-130-10
T10	WS-0044	DT-250-13
T12	WS-0059	DT-250-16
T15	WS-0061	-

When assembling, be sure carbide tip is seated firmly on shank with no gap.
Note: DO NOT apply lubricant to the thread connection. Wrench not included with carbide tip or shank purchase.

CHIPSURFER™ SOLID CARBIDE SERRATED ROUGHING TIP - 47C, 48C

0° LEAD, 45° HELIX, 4 FLUTE CENTER CUTTING, 5 & 6 FLUTE NON-CENTER CUTTING



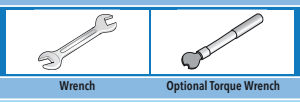
GRADES	P	M	K	N (K)	S (M)	H (P/K)
IN2005	+	+	+		+	

+ Good 0 Bad

Cutter Number	# Effective	D1 Nominal Diameter	L1 Cutting Edge Length	T1 Thread Size	L2 Extension Length	C Corner	Ramp Angle
47C-3120TQRN01	4	.312	.20	T05	.390	.010 x 45	90
47C-3727T6RN01	4	.375	.27	T06	.510	.013 x 45	90
47D-3727T6RN03	4	.375	.27	T06	.495	R .031	90
47C-5037T8RN01	4	.500	.37	T08	.650	.012 x 45	90
47D-5037T8RN03	4	.500	.37	T08	.645	R .031	90
47D-5037T8RN06	4	.500	.37	T08	.645	R .062	90
47C-6247TRRN01	5	.625	.47	T10	.800	.014 x 45	7
48C-7562TSRN01	6	.750	.62	T12	1.000	.016 x 45	3
48D-7562TSRN06	6	.750	.62	T12	.995	R .062	3

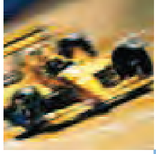
Operating guidelines on page 82.

HARDWARE



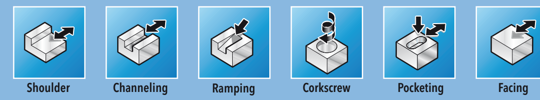
Thread Size	Wrench	Optional Torque Wrench
T05	WS-0043	DT-60-06
T06	WS-0029	DT-90-08
T08	WS-0030	DT-130-10
T10	WS-0044	DT-250-13
T12	WS-0059	DT-250-16

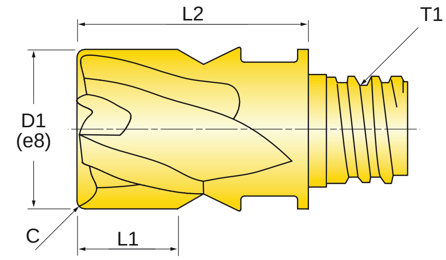
When assembling, be sure carbide tip is seated firmly on shank with no gap.
Note: DO NOT apply lubricant to the thread connection. Wrench not included with carbide tip or shank purchase.



CHIPSURFER™ SOLID CARBIDE END MILL TIP - 46J, 46D

0° LEAD, 45° HELIX, HIGH PRECISION, CENTER CUTTING





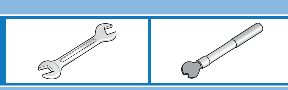
GRADES	P	M	K	N (K)	S (M)	H (P/K)
IN2005	+	+	+		+	0

+ Good 0 Bad

Cutter Number	# Effective	D1 Nominal Diameter	L1 Cutting Edge Length	T1 Thread Size	L2 Extension Length	C Corner
3-Flute End Mill Heads						
46J-3120TQRD04	3	.312	.20	T05	.39	SHARP
46D-3120TQRD03	3	.312	.20	T05	.39	R .031
46J-3727T6RD05	3	.375	.27	T06	.51	SHARP
46D-3727T6RD01	3	.375	.27	T06	.51	R .015
46D-3727T6RD03	3	.375	.27	T06	.51	R .031
46D-3727T6RD06	3	.375	.27	T06	.51	R .062
46J-5037T8RD06	3	.500	.37	T08	.65	SHARP
46D-5037T8RD01	3	.500	.37	T08	.65	R .015
46D-5037T8RD03	3	.500	.37	T08	.65	R .031
46D-5037T8RD06	3	.500	.37	T08	.65	R .062

Operating guidelines on page 82.

HARDWARE

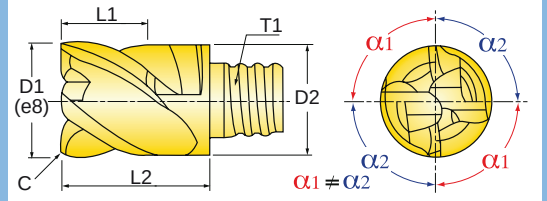


Thread Size	Wrench	Optional Torque Wrench
T05	WS-0043	DT-60-06
T06	WS-0029	DT-90-08
T08	WS-0030	DT-130-10

When assembling, be sure carbide tip is seated firmly on shank with no gap.
Note: DO NOT apply lubricant to the thread connection. Wrench not included with carbide tip or shank purchase.

CHIPSURFER™ SOLID CARBIDE END MILL TIP- VARIABLE PITCH - 47J, 47D, 47C

0° LEAD, 38° HELIX, CENTER CUTTING



Shoulder | Channeling | Ramping | Corkscrew | Pocketing | Facing

GRADES	P	M	K	N (K)	S (M)	H (P/K)
IN2005	+	+	+		+	0

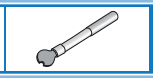
+ Good 0 Bad

λ = 38° | ≤54 HRC

Cutter Number	# Effective	D1 Nominal Diameter	L1 Length of Cut	T1 Thread Size	L2 Extention Length	D2 Neck Diameter	C Corner
47J-3120TQRQ04	4	.312	.200	T5	.390	.300	SC
47D-3120TQRQ01	4	.312	.200	T5	.390	.300	R .015
47C-3120TQRQ01	4	.312	.200	T5	.390	.300	.012 x 45
47J-3727T6RQ05	4	.375	.270	T6	.510	.364	SC
47D-3727T6RQ01	4	.375	.270	T6	.510	.364	R .015
47C-3727T6RQ01	4	.375	.270	T6	.510	.364	.016 x 45
47J-5037T8RQ06	4	.500	.370	T8	.650	.480	SC
47D-5037T8RQ03	4	.500	.370	T8	.650	.480	R .031
47C-5037T8RQ02	4	.500	.370	T8	.650	.480	.020 x 45
47D-6247TRRQ03	4	.625	.470	T10	.810	.600	R .031
47C-6247TRRQ02	4	.625	.470	T10	.810	.600	.024 x 45
47D-7562TSRQ03	4	.750	.620	T12	1.000	.720	R .031
47D-7562TSRQ12	4	.750	.620	T12	1.000	.720	R .125
47C-7562TSRQ02	4	.750	.620	T12	1.000	.720	.024 x 45
47C-1088TURQ02	4	1.000	.880	T15	1.450	.940	.024 x 45
47D-1088TURQ03	4	1.000	.880	T15	1.450	.940	R .031
47D-1088TURQ12	5	1.000	.880	T15	1.450	.940	R .125

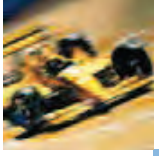
Operating guidelines on page 82.

HARDWARE

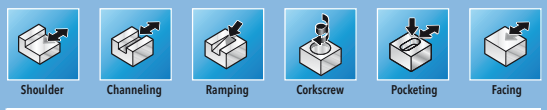
Thread Size	Wrench	Optional Torque Wrench
T05	WS-0043	DT-60-06
T06	WS-0029	DT-90-08
T08	WS-0030	DT-130-10
T10	WS-0044	DT-250-13
T12	WS-0059	DT-250-16
T15	WS-0061	-

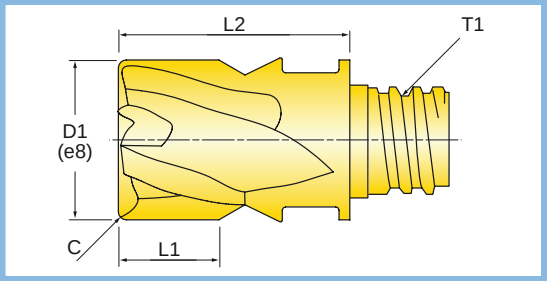
When assembling, be sure carbide tip is seated firmly on shank with no gap.
Note: DO NOT apply lubricant to the thread connection. Wrench not included with carbide tip or shank purchase.



CHIPSURFER™ SOLID CARBIDE END MILL TIP - 47J, 47D

0° LEAD, 45° HELIX, HIGH PRECISION, CENTER CUTTING





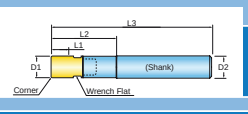
GRADES	P	M	K	N (K)	S (M)	H (P/K)
IN2005	+	+	+		+	0

+ Good 0 Bad

Cutter Number	# Effective	D1 Nominal Diameter	L1 Cutting Edge Length	T1 Thread Size	L2 Extension Length	C Corner
4-Flute End Mill Heads						
47J-3120TQRD04	4	.312	.20	T05	.39	SHARP
47D-3120TQRD01	4	.312	.20	T05	.39	R .015
47D-3120TQRD03	4	.312	.20	T05	.39	R .031
47D-3120TQRD06	4	.312	.20	T05	.39	R .062
47J-3727T6RD05	4	.375	.27	T06	.51	SHARP
47D-3727T6RD01	4	.375	.27	T06	.51	R .015
47D-3727T6RD03	4	.375	.27	T06	.51	R .031
47D-3727T6RD06	4	.375	.27	T06	.51	R .062
47J-5037T8RD06	4	.500	.37	T08	.65	SHARP
47D-5037T8RD01	4	.500	.37	T08	.65	R .015
47D-5037T8RD03	4	.500	.37	T08	.65	R .031
47D-5037T8RD06	4	.500	.37	T08	.65	R .062
47J-6247TRRD08	4	.625	.47	T10	.80	SHARP
47D-6247TRRD03	4	.625	.47	T10	.80	R .031
47D-6247TRRB06	4	.625	.47	T10	.80	R .062
47D-7562TSRD03	4	.750	.62	T12	1.00	R .031
47D-7562TSRB06	4	.750	.62	T12	1.00	R .062

Operating guidelines on page 82.

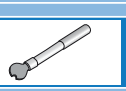
CHIPSURFER PAKS



ORDER THIS PAK NUMBER	End Mill Tip	Straight Shank	D1 End Mill Diameter	R End Mill Corner	D2 Shank Adaption	L1 Length of Cut	L2 Projection Length	L3 Assm Length	Wrench
S037T06KA-06-11	47D-3727T6RD03	S037T06SA-06 (Steel)	.375	.031	.375 Cyl	.27	1.00	3.50	WS-0029
S050T08KA-06-11	47D-5037T8RD03	S050T08SA-06 (Steel)	.500	.031	.500 Cyl	.37	1.18	4.15	WS-0030

HARDWARE

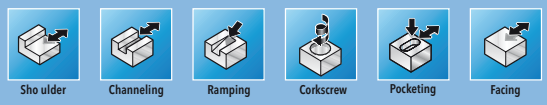

Wrench

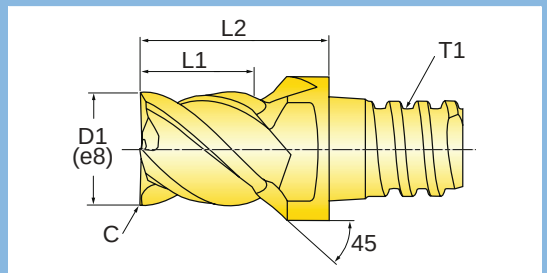

Optional Torque Wrench

Thread Size	Wrench	Optional Torque Wrench
T05	WS-0043	DT-60-06
T06	WS-0029	DT-90-08
T08	WS-0030	DT-130-10
T10	WS-0044	DT-250-13
T12	WS-0059	DT-250-16

When assembling, be sure carbide tip is seated firmly on shank with no gap.
Note: DO NOT apply lubricant to the thread connection. Wrench not included with carbide tip or shank purchase.

0° LEAD, 45° HELIX, CENTER CUTTING





GRADES	P	M	K	N (K)	S (M)	H (P/K)
IN2005	+	+	+		+	0

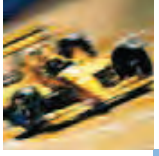
+ Good 0 Bad

Cutter Number	# Effective	D1 Nominal Diameter	L1 Length of Cut	T1 Thread Size	L2 Extension Length	C Corner
47J-2520TQRD04	4	0.250	0.20	T5	0.39	Sharp

Operating guidelines on page 82.

HARDWARE		
Thread Size	Wrench	Optional Torque Wrench
T05	WS-0043	DT-60-06

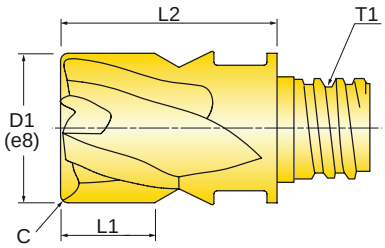
When assembling, be sure carbide tip is seated firmly on shank with no gap.
Note: DO NOT apply lubricant to the thread connection. Wrench not included with carbide tip or shank purchase.



CHIPSURFER™ SOLID CARBIDE FINISHING END MILL TIP - 48D, 48J, 49D, 49J

0° LEAD, 45° HELIX, NOT CENTER CUTTING

Shoulder | Ramping | Corkscrew | Facing



GRADES	P	M	K	N (K)	S (M)	H (P/K)
IN2005	+	+	+		+	+

+ Good 0 Bad

λ =45° | ≤63 HRC

Cutter Number	# Effective	D1 Nominal Diameter	L1 Cutting Edge Length	T1 Thread Size	L2 Extension Length	C Corner	Ramp Angle
48J-3120TQRD04	6	.312	.20	T05	.39	SHARP	3
48D-3120TQRD03	6	.312	.20	T05	.39	R .031	3
48J-3727T6RD05	6	.375	.27	T06	.50	SHARP	5
48D-3727T6RD01	6	.375	.27	T06	.50	R .015	5
48D-3727T6RD03	6	.375	.27	T06	.50	R .031	5
48D-3727T6RD06	6	.375	.27	T06	.50	R .062	5
48J-5037T8RD06	6	.500	.37	T08	.65	SHARP	5
48D-5037T8RD01	6	.500	.37	T08	.65	R .015	5
48D-5037T8RD03	6	.500	.37	T08	.65	R .031	5
48D-5037T8RD06	6	.500	.37	T08	.65	R .062	5
49J-6247TRRD08	8	.625	.47	T10	.80	SHARP	5
49D-6247TRRD03	8	.625	.47	T10	.80	R .031	5
49D-6247TRRD06	8	.625	.47	T10	.80	R .062	5
49D-7562TSRD03	10	.750	.62	T12	1.00	R .031	3
49D-7562TSRD06	10	.750	.62	T12	1.00	R .062	3
49D-7562TSRD12	8	.750	.62	T12	1.00	R .125	-
49D-1088TURD12	10	1.000	.88	T15	1.45	R .125	-

Operating guidelines on page 82.

HARDWARE


Wrench

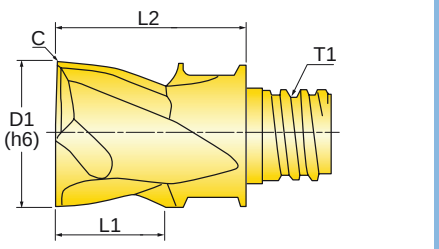

Optional Torque Wrench

Thread Size	Wrench	Optional Torque Wrench
T05	WS-0043	DT-60-06
T06	WS-0029	DT-90-08
T08	WS-0030	DT-130-10
T10	WS-0044	DT-250-13
T12	WS-0059	DT-250-16
T15	WS-0061	-

When assembling, be sure carbide tip is seated firmly on shank with no gap.
Note: DO NOT apply lubricant to the thread connection. Wrench not included with carbide tip or shank purchase.

CHIPSURFER™ END MILL TIP FOR ALUMINUM - 45D, 45J, 46D, 46J

0° LEAD, 45° HELIX, CENTER CUTTING, SHARP



GRADES	P	M	K	N (K)	S (M)	H (P/K)
IN05S				+		

+ Good 0 Bad

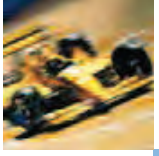
Cutter Number	# Effective	D1 Nominal Diameter	L1 Cutting Edge Length	T1 Thread Size	L2 Extension Length	C Corner
46D-3120TQRD02-P	3	.312	.20	T05	.39	R .020
45J-3727T6RD05-P	2	.375	.27	T06	.50	SHARP
45D-3727T6RD02-P	2	.375	.27	T06	.50	R .020
46D-3727T6RD03-P	3	.375	.27	T06	.50	R .031
46D-3727T6RD06-P	3	.375	.27	T06	.50	R .062
45J-5037T8RD06-P	2	.500	.37	T08	.65	SHARP
46D-5037T8RD02-P	2	.500	.37	T08	.65	R .020
46D-5037T8RD03-P	3	.500	.37	T08	.65	R .031
46D-5037T8RD06-P	3	.500	.37	T08	.65	R .062
46D-5037T8RD09-P	3	.500	.37	T08	.65	R .094
46D-5037T8RD12-P	3	.500	.37	T08	.65	R .125
46J-6239TRRD08-P	3	.625	.39	T10	.80	SHARP
46D-6239TRRD03-P	3	.625	.39	T10	.80	R .031
46D-6239TRRD06-P	3	.625	.39	T10	.80	R .062
46D-6239TRRD09-P	3	.625	.39	T10	.80	R .094
46D-6239TRRD12-P	3	.625	.39	T10	.80	R .125
46D-7550TSRD02-P	3	.750	.50	T12	1.00	R .020
46D-7550TSRD06-P	3	.750	.50	T12	1.00	R .062
46D-7550TSRD09-P	3	.750	.50	T12	1.00	R .094
46D-7550TSRD12-P	3	.750	.50	T12	1.00	R .125

Operating guidelines on page 82.

HARDWARE

Thread Size	Wrench	Optional Torque Wrench
T05	WS-0043	DT-60-06
T06	WS-0029	DT-90-08
T08	WS-0030	DT-130-10
T10	WS-0044	DT-250-13
T12	WS-0059	DT-250-16

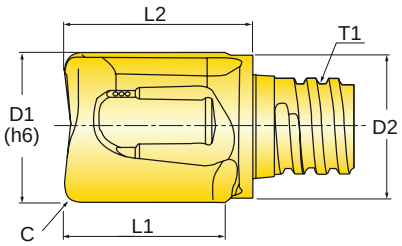
When assembling, be sure carbide tip is seated firmly on shank with no gap.
Note: DO NOT apply lubricant to the thread connection. Wrench not included with carbide tip or shank purchase.



CHIPSURFER™ DRILL MILL TIP - 45D

0° LEAD, CENTER CUTTING

Shoulder | Channeling | Ramping | Pocketing | Drill | Std. Bottom



GRADES	P	M	K	N (K)	S (M)	H (P/K)
IN2005	+	+	+		+	0

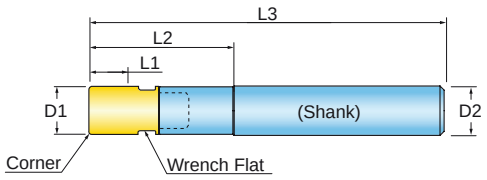
+ Good 0 Bad

λ = 10° | ≤54 HRC

Cutter Number	# Effective	D1 Nominal Diameter	D2 Flange Diameter	T1 Thread Size	L1* Edge Length	L2 Extension Length	C Corner
45D-3738T6RA01	2	.375	.35	T06	.38	.48	R .015
45D-5045T8RA01	2	.500	.48	T08	.45	.60	R .015
45D-6263TRRA01	2	.625	.60	T10	.60	.75	R .015

*Drill depth not to exceed 2/3 edge length.
Operating guidelines on page 82.

CHIPSURFER PAKS



ORDER THIS PAK NUMBER	(QTY) End Mill Tip	Straight Shank	D1 End Mill Dia.	End Mill Corner	D2 Shank Adaption	L1 Length of Cut	L2 Projection Length	L3 Assem. Length	Wrench
S037T06KA-06-D1	(2) 45D-3738T6RA01	S037T06SA-06 (Steel)	.375	.015	.375 Cylindrical	.38	.98	3.48	WS-0029
S050T08KA-06-D1	(2) 45D-5045T8RA01	S050T08SA-06 (Steel)	.500	.015	.500 Cylindrical	.45	1.13	4.10	WS-0030

HARDWARE


Wrench


Optional Torque Wrench

Thread Size	Wrench	Optional Torque Wrench
T06	WS-0029	DT-90-05
T08	WS-0030	DT-130-07
T10	WS-0044	DT-250-08

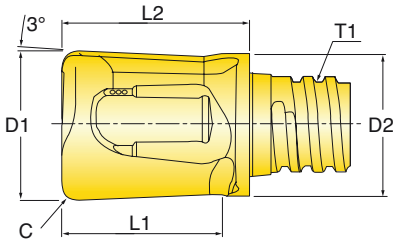
When assembling, be sure carbide tip is seated firmly on shank with no gap.
Note: DO NOT apply lubricant to the thread connection. Wrench not included with carbide tip or shank purchase.

CHASEline

CHIPSURFER™ FLAT BOTTOM PLUNGE TIP - 45V

3° BACK DRAFT, CENTER CUTTING

Drill | Flat Bottom | Plunge



GRADES	P	M	K	N (K)	S (M)	H (P/K)
IN2005	+	+	+		+	0

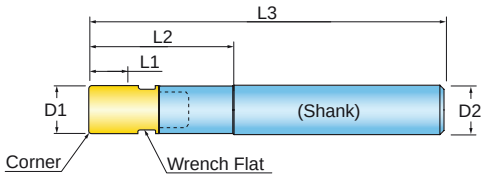
+ Good 0 Bad

λ = 10° | ≤54 HRC

Cutter Number	# Effective	D1 Nominal Diameter	D2 Flange Diameter	T1 Thread Size	* L1 Edge Length	L2 Extension Length	C Corner
45V-3738T6RA03	2	.375	.35	T06	.38	.48	R .031
45V-5045T8RA03	2	.500	.48	T08	.45	.60	R .031
45V-6260TRRA03	2	.625	.60	T10	.60	.75	R .031

*If used for spot facing, drilling or boring, drill depth not to exceed 2/3 edge length.
Operating guidelines on page 82.

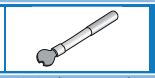
CHIPSURFER PAKS



ORDER THIS PAK NUMBER	(QTY) End Mill Tip	Straight Shank	D1 End Mill Dia.	End Mill Corner	D2 Shank Adaption	L1 Length of Cut	L2 Projection Length	L3 Assem. Length	Wrench
S037T06KA-06-P1	(2) 45V-3738T6RA03	S037T06SA-06 (Steel)	.375	.030	.375 Cylindrical	.38	.98	3.48	WS-0029
S050T08KA-06-P1	(2) 45V-5045T8RA03	S050T08SA-06 (Steel)	.500	.030	.500 Cylindrical	.45	1.13	4.10	WS-0030

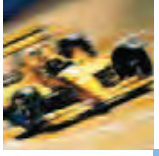
HARDWARE


Wrench


Optional Torque Wrench

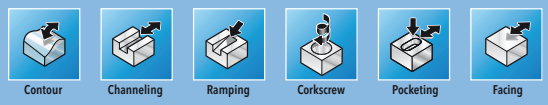
Thread Size	Wrench	Optional Torque Wrench
T06	WS-0029	DT-90-05
T08	WS-0030	DT-130-07
T10	WS-0044	DT-250-08

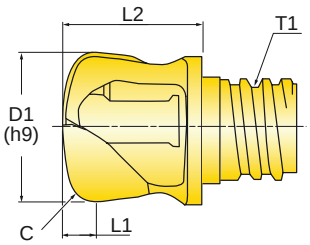
When assembling, be sure carbide tip is seated firmly on shank with no gap.
Note: DO NOT apply lubricant to the thread connection. Wrench not included with carbide tip or shank purchase.



CHIPSURFER™ SOLID CARBIDE ULTRA HIGH FEED TIP - 45A

HIGH FEED ROUGHING, CENTER CUTTING





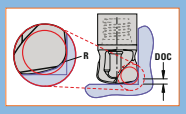
GRADES	P	M	K	N (K)	S (M)	H (P/K)
IN2005	+	+	+		+	+

+ Good 0 Bad

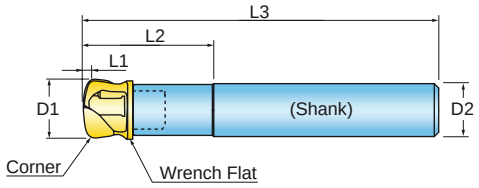
Cutter Number	# Effective	D1 Nominal Diameter	L1 Depth of Cut	T1 Thread Size	L2 Extension Length	C Corner
45A-3703T6RA06	2	.375	.02	T06	.47	0.080
45A10001T6RA20	2	.394 (10mm)	.02	T06	.49	0.080
45A12001T8RA25	2	.472 (12mm)	.04	T08	.44	0.100
45A-5004T8RA08	2	.500	.04	T08	.59	0.100
45A16001TRRA30	2	.629 (16mm)	.04	T10	.80	0.120
45A-7506TSRA12	2	.750	.06	T12	.70	0.120

Operating guidelines on page 86.

NOTE: Program as for a square bottom end mill with noted corner radius. This method will ensure and minimize remaining stock for secondary passes.



CHIPSURFER PAKS



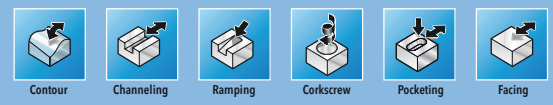
ORDER THIS PAK NUMBER	(QTY) End Mill Tip	Straight Shank	D1 End Mill Dia.	D2 Shank Adaption	L1 Depth of Cut	L2 Projection Length	L3 Assem. Length	Wrench
S037T06KA-06-F2	(2) 45A-3703T6RA06	S037T06SA-06 (stl)	.375	.375 Cyl	.02	.98	3.48	WS-0029
S037T06KA-20-F2	(2) 45A-3703T6RA06	S037T06CA-20 (carb)	.375	.375 Cyl	.02	2.43	5.23	WS-0029
S050T08KA-06-F1	(2) 45A12001T8RA25	S050T08SA-061(stl)	.472 (12mm)	.500 Cyl	.04	1.07	3.94	WS-0030
S050T08KA-25-F1	(2) 45A12001T8RA25	S050T08CA-251(carb)	.472 (12mm)	.500 Cyl	.04	2.90	5.94	WS-0030
S050T08KA-06-F2	(2) 45A-5004T8RA08	S050T08SA-06 (stl)	.500	.500 Cyl	.04	1.33	4.30	WS-0030
S050T08KA-25-F2	(2) 45A-5004T8RA08	S050T08CA-25 (carb)	.500	.500 Cyl	.04	3.25	6.30	WS-0030

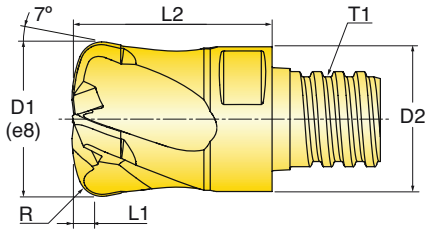
HARDWARE

Thread Size	Wrench	Optional Torque Wrench
T06	WS-0029	DT-90-05
T08	WS-0030	DT-130-07
T10	WS-0044	DT-250-08
T12	WS-0059	DT-250-16

CHIPSURFER™ 4 & 6 FLUTE HIGH FEED TIP - 47A, 48A

HIGH FEED ROUGHING, CENTER CUTTING





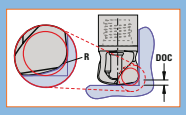
GRADES	P	M	K	N (K)	S (M)	H (P/K)
IN2006	+	+	+		+	+

+ Good 0 Bad

Cutter Number	# Effective	D1 Nominal Diameter	D2 Flange Diameter	R Radius	T1 Thread Size	L1 Depth of Cut	L2 Extension Length
47A08001TQRA16	4	.314 (8 mm)	0.295	0.065	T05	0.016	0.393
47A10001T6RA20	4	.393 (10 mm)	0.374	0.080	T06	0.019	0.511
47A-5004T8RA09	4	0.500	0.480	0.100	T08	0.023	0.649
47A16001TRRA32	4	.630 (16 mm)	0.608	0.125	T10	0.031	0.807
47A20001TSRA40	4	.787 (20 mm)	0.726	0.160	T12	0.039	1.000
48A-1004TURA20	6	1.000	0.940	0.145	T15	0.047	1.450

Operating guidelines on page 84.

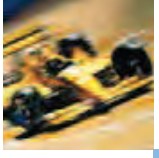
NOTE: Program as for a square bottom end mill with noted corner radius. This method will ensure and minimize remaining stock for secondary passes.



HARDWARE

Thread Size	Wrench	Optional Torque Wrench
T05	WS-0043	DT-60-06
T06	WS-0029	DT-90-08
T08	WS-0030	DT-130-10
T10	WS-0044	DT-250-13
T12	WS-0059	DT-250-16
T15	WS-0061	-

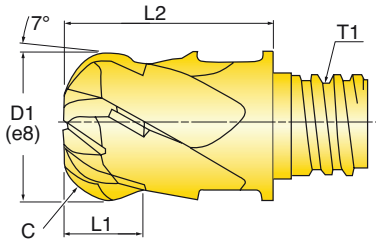
When assembling, be sure carbide tip is seated firmly on shank with no gap.
Note: DO NOT apply lubricant to the thread connection. Wrench not included with carbide tip or shank purchase.



CHIPSURFER™ SOLID CARBIDE BACKDRAFT TOROIDAL TIP - 48U

BACK DRAFT FINISHING, NOT CENTER CUTTING

Contour | Ramping | Corkscrew



GRADES	P	M	K	N (K)	S (M)	H (P/K)
IN2005	+	+	+		+	0

+ Good 0 Bad

λ = 30° | ≤44 HRC

Cutter Number	# Effective	D1 Nominal Diameter	L1 Cutting Edge Length	T1 Thread Size	L2 Extension Length	C Corner	Ramp Angle
48U-3719T6RB03	6	.375	.19	T06	.50	R .031	9°
48U-3719T6RB06	6	.375	.19	T06	.50	R .062	9°
48U-5027T8RB03	6	.500	.27	T08	.65	R .031	9°
48U-5027T8RB06	6	.500	.27	T08	.65	R .062	9°
48U-5027T8RB12	6	.500	.27	T08	.65	R .125	9°
48U-6235TRRB20	6	.625	.35	T10	.80	R .200	9°

Operating guidelines on page 82.

HARDWARE

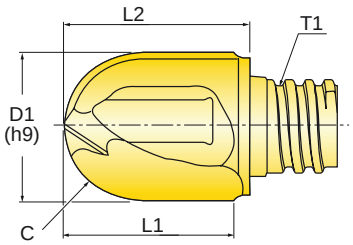
Thread Size	Wrench	Optional Torque Wrench
T06	WS-0029	DT-90-08
T08	WS-0030	DT-130-10
T10	WS-0044	DT-250-13

When assembling, be sure carbide tip is seated firmly on shank with no gap.
Note: DO NOT apply lubricant to the thread connection. Wrench not included with carbide tip or shank purchase.

CHASEline

STRAIGHT BALL NOSE

Contour | Channeling | Ramping | Corkscrew | Pocketing | Plunge



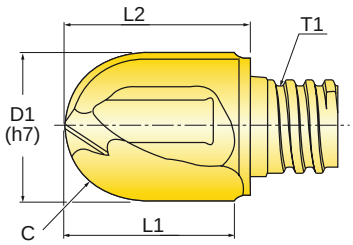
GRADES	P	M	K	$N_{(K)}$	$S_{(M)}$	$H_{(P/K)}$
IN2005	+	+	+		+	+

+ Good 0 Bad

λ = 0° | ≤54 HRC

Cutter Number	# Effective	D1 Nominal Diameter	L1 Cutting Edge Length	T1 Thread Size	L2 Extension Length	C Corner
45B-3131TQRA04	2	.312	.31	T05	.39	R .156
45B-3738T6RA04	2	.375	.38	T06	.48	R .187
45B-5050T8RA06	2	.500	.50	T08	.64	R .250
45B-6263TRRA07	2	.625	.63	T10	.75	R .312

Operating guidelines on page 82.



HIGH PRECISION TIP FOR HARDENED STEEL

GRADES	P	M	K	$N_{(K)}$	$S_{(M)}$	$H_{(P/K)}$
IN2006	+		+			+

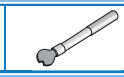
+ Good 0 Bad

λ = 0° | ≤63 HRC

Cutter Number	# Effective	D1 Nominal Diameter	L1 Cutting Edge Length	T1 Thread Size	L2 Extension Length	C Corner
45B-3131TQRW04	2	.312	.31	T05	.39	R .156
45B-3738T6RW04	2	.375	.38	T06	.48	R .187
45B-5050T8RW06	2	.500	.50	T08	.64	R .250
45B-6263TRRW07	2	.625	.63	T10	.75	R .312

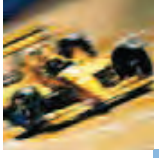
Operating guidelines on page 82.

HARDWARE



Thread Size	Wrench	Optional Torque Wrench
T05	WS-0043	DT-60-04
T06	WS-0029	DT-90-05
T08	WS-0030	DT-130-07
T10	WS-0044	DT-250-08

When assembling, be sure carbide tip is seated firmly on shank with no gap.
Note: DO NOT apply lubricant to the thread connection. Wrench not included with carbide tip or shank purchase.



CHIPSURFER™ SPHERICAL BALL NOSE TIP - 45X

STRAIGHT BALL NOSE


Contour

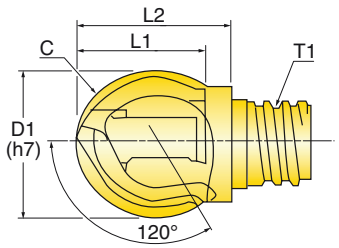

Channeling


Ramping


Corkscrew


Pocketing


Plunge



GRADES	P	M	K	N (K)	S (M)	H (P/K)
IN2005	+	+	+		+	+

+ Good 0 Bad

Cutter Number	# Effective	D1 Nominal Diameter	T1 Thread Size	L1 Cutting Length	L2 Extension Length	C Corner
45X-3727TQRA03	2	.375	T05	.33	.38	R .187
45X-5037T6RA04	2	.500	T06	.40	.48	R .250
45X-6248T8RA06	2	.625	T08	.55	.60	R .312
45X-7560TRRA07	2	.750	T10	.66	.71	R .375

Operating guidelines on page 82.

HARDWARE


Wrench


Optional Torque Wrench

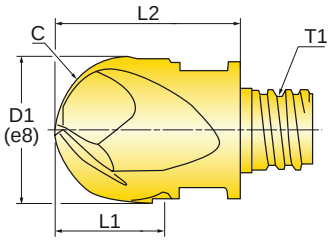
Thread Size	Wrench	Optional Torque Wrench
T05	WS-0043	DT-60-04
T06	WS-0030	DT-90-07
T08	WS-0044	DT-130-08
T10	WS-0044	DT-130-08

When assembling, be sure carbide tip is seated firmly on shank with no gap.
Note: DO NOT apply lubricant to the thread connection. Wrench not included with carbide tip or shank purchase.

CHIPSURFER™ HIGH PRECISION BALL NOSE TIP - 45B, 47B

HELICAL BALL NOSE

Contour | Channeling | Ramping | Corkscrew | Pocketing



GRADES	P	M	K	N (K)	S (M)	H (P/K)
IN2005	+	+	+		+	0

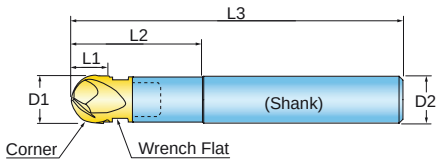
+ Good 0 Bad

λ = 30° | ≤54 HRC

Cutter Number	# Effective	D1 Nominal Diameter	L1 Cutting Edge Length	T1 Thread Size	L2 Extension Length	C Corner	Tolerance
45B-3120TQRB03	2	.312	.20	T05	.39	R .156	.0004
47B-3120TQRB03	4	.312	.20	T05	.39	R .156	.0004
45B-3727T6RB05	2	.375	.27	T06	.51	R .187	.0004
47B-3727T6RB05	4	.375	.27	T06	.51	R .187	.0004
45B-5037T8RB06	2	.500	.37	T08	.65	R .250	.0005
47B-5037T8RB06	4	.500	.37	T08	.65	R .250	.0005
45B-6235TRRB08	2	.625	.35	T10	.80	R .312	.0005
47B-6247TRRB08	4	.625	.47	T10	.80	R .312	.0005
45B-7550TSRB10	2	.750	.50	T12	1.00	R .374	.0005
47B-7562TSRB10	4	.750	.62	T12	1.00	R .374	.0005

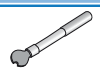
Operating guidelines on page 82.

CHIPSURFER PAKS



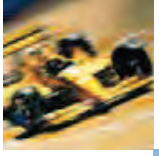
ORDER THIS Pak Number	(QTY) Ball Nose Tip	Straight Shank	D1 Ball Nose Dia.	Ball Nose Corner	D2 Shank Adaption	L1 Length of Cut	L2 Projection Length	L3 Assem. Length	Wrench
S037T06KA-06-05	(2) 47B-3727T6RB05	S037T06SA-06 (Steel)	.375	.187	.375 Cyl	.27	1.00	3.50	WS-0029
S037T06KA-20-05	(2) 47B-3727T6RB05	S037T06CA-20 (Carbide)	.375	.187	.375 Cyl	.27	2.45	5.25	WS-0029
S050T08KA-06-05	(2) 47B-5037T8RB06	S050T08SA-06 (Steel)	.500	.250	.500 Cyl	.37	1.18	4.15	WS-0030
S050T08KA-25-05	(2) 47B-5037T8RB06	S050T08CA-25 (Carbide)	.500	.250	.500 Cyl	.37	3.10	6.15	WS-0030

HARDWARE



Thread Size	Wrench	Optional Torque Wrench
T05	WS-0043	DT-60-06
T06	WS-0029	DT-90-08
T08	WS-0030	DT-130-10
T10	WS-0044	DT-250-13
T12	WS-0059	DT-250-16

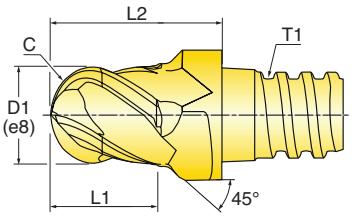
When assembling, be sure carbide tip is seated firmly on shank with no gap.
Note: DO NOT apply lubricant to the thread connection. Wrench not included with carbide tip or shank purchase.



CHIPSURFER™ HIGH PRECISION BALL NOSE TIP - 47B

HELICAL BALL NOSE

Contour | Channeling | Ramping | Corkscrew | Pocketing



GRADES	
IN2005	

P	M	K	N (K)	S (M)	H (P/K)
+	+	+		+	0

+ Good 0 Bad

λ = 30° | ≤54 HRC

Cutter Number	# Effective	D1 Nominal Diameter	L1 Length of Cut	T1 Thread Size	L2 Extension Length	Corner	Tolerance
47B-2520TQRB03	4	0.250	0.20	T5	0.39	0.125	0.0004

Operating guidelines on page 82.

HARDWARE

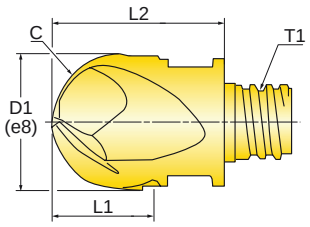

Thread Size	Wrench	Optional Torque Wrench
T05	WS-0043	DT-60-06
T06	WS-0029	DT-90-08
T08	WS-0030	DT-130-10
T10	WS-0044	DT-250-13
T12	WS-0059	DT-250-16

When assembling, be sure carbide tip is seated firmly on shank with no gap.
Note: DO NOT apply lubricant to the thread connection. Wrench not included with carbide tip or shank purchase.

CHIPSURFER™ HIGH PRECISION BALL NOSE TIP FOR ALUMINUM - 45B

HELICAL BALL NOSE

Contour | Channeling | Ramping | Corkscrew | Pocketing



GRADES	P	M	K	N (K)	S (M)	H (P/K)
IN05S				+		

+ Good 0 Bad

λ ≤ 30° | ALU

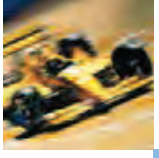
Cutter Number	# Effective	D1 Nominal Diameter	L1 Cutting Edge Length	T1 Thread Size	L2 Extension Length	C Corner	Tolerance
45B-3120TQRB03-P	2	.312	.20	T05	.39	R .156	.0004
45B-3727T6RB05-P	2	.375	.27	T06	.51	R .187	.0004
45B-5037T8RB06-P	2	.500	.37	T08	.65	R .250	.0005
45B-6247TRRB08-P	2	.625	.47	T10	.80	R .312	.0005
45B-7550TSRB10-P	2	.750	.50	T12	1.00	R .375	.0005

Operating guidelines on page 82.

HARDWARE

Thread Size	Wrench	Optional Torque Wrench
T05	WS-0043	DT-60-06
T06	WS-0029	DT-90-08
T08	WS-0030	DT-130-10
T10	WS-0044	DT-250-13
T12	WS-0059	DT-250-16

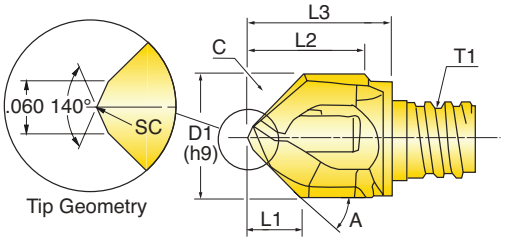
When assembling, be sure carbide tip is seated firmly on shank with no gap.
Note: DO NOT apply lubricant to the thread connection. Wrench not included with carbide tip or shank purchase.



CHIPSURFER™ CHAMFER AND SPOTTING TIP - 45N, 45M, 45P

30°, 45°, 60°, 72°, CENTER CUTTING

Spot Drilling | Chamfer



GRADES	P	M	K	N (K)	S (M)	H (P/K)
IN2005	+	+	+	0	+	0

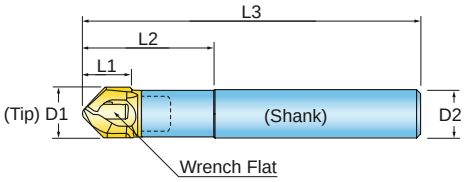
+ Good 0 Bad

λ = 0° | ≤54 HRC

Cutter Number	A Nominal Chamfer Angle	# Effective	D1 Nominal Diameter	L1 Cutting Edge Length	T1 Thread Size	L2 Depth	L3 Extension Length
45N08007TQRA45	45°	2	.315	.14	T05	.27	.38
45N10009T6RA45	45°	2	.390	.18	T06	.35	.50
45N10009T6RA72	72°	2	.390	.06	T06	.35	.50
45N16015TRRA45	45°	2	.625	.29	T10	.59	.75
45M10009T6RA30	30°	2	.390	.26	T06	.37	.50
45P10009T6RA60	60°	2	.390	.10	T06	.39	.50

Operating guidelines on page 82.

CHIPSURFER PAKS



ORDER THIS PAK NUMBER	(QTY) Chamfer/Spotter Tip	Straight Shank	D_1 End Mill Dia.	Included Angle	D_2 Shank Adaption	L_1 Length of Cut	L_2 Projection Length	L_3 Assem. Length	Wrench
S037T06KA-06-07	(2) 45N-10009T6RA45	S037T06SA-06 (Steel)	.400	90°	.375 Cylindrical	.46	.96	3.50	WS-0029

HARDWARE

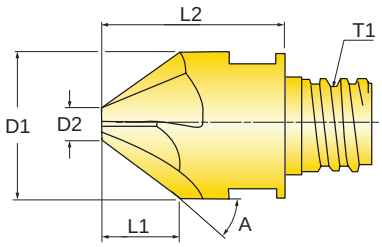
Thread Size	Wrench	Optional Torque Wrench
T05	WS-0043	DT-60-04
T06	WS-0029	DT-90-05
T10	WS-0044	DT-250-08

When assembling, be sure carbide tip is seated firmly on shank with no gap.
Note: DO NOT apply lubricant to the thread connection. Wrench not included with carbide tip or shank purchase.

CHIPSURFER™ SOLID CARBIDE CHAMFER AND COUNTERSINK - 47N, 48N

NOT CENTER CUTTING

Chamfer | Countersink



GRADES	P	M	K	N (K)	S (M)	H (P/K)
IN2005	+	+	+	0	+	0

+ Good 0 Bad

λ = 0° | ≤54 HRC

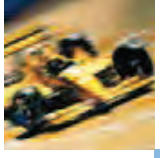
Cutter Number	A Nominal Chamfer Angle	# Effective	D1 Nominal Diameter	D2 Inner Diameter	T1 Thread Size	L1 Length of Cut	L2 Extension Length
47N-5006T8RA45	45°	4	.500	.078	T08	0.20	.65
48N20025TSRA45	45°	6	.787	.197	T12	0.29	1.00

Operating guidelines on page 82.

HARDWARE

Thread Size	Wrench	Optional Torque Wrench
T08	WS-0030	DT-130-10
T12	WS-0059	DT-250-16

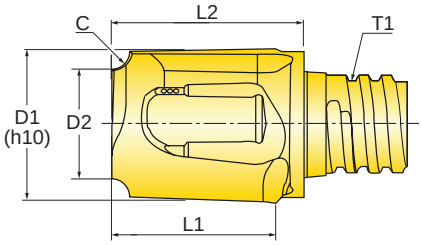
When assembling, be sure carbide tip is seated firmly on shank with no gap.
Note: DO NOT apply lubricant to the thread connection. Wrench not included with carbide tip or shank purchase.



CHIPSURFER™ SOLID CARBIDE CORNER ROUNDING TIP - 45R

CORNER .062", .094", .125", .156" and .187"R (O.D. Radius)

Corner | Countersink



GRADES	P	M	K	N (K)	S (M)	H (P/K)
IN2005	+	+	+	0	+	0

+ Good 0 Bad

λ = 10° | ≤54 HRC

Cutter Number	# Effective	D1 Nominal Diameter	D2 Inner Diameter	L1 Length	T1 Thread Size	L2 Extension Length	C Corner
45R10009T6RA16	2	0.394 (10mm)	.268	.425	T06	.49	R .06 (1.6mm)
45R10009T6RA25	2	0.394 (10mm)	.200	.395	T06	.49	R .09 (2.5mm)
45R12012T8RA30	2	0.472 (12mm)	.256	.485	T08	.61	R .12 (3.0mm)
45R12012T8RA40	2	0.472 (12mm)	.185	.455	T08	.61	R .15 (4.0mm)
45R16015TRRA50	2	0.630 (16mm)	.244	.560	T10	.75	R .19 (5.0mm)

Operating guidelines on page 82.

HARDWARE

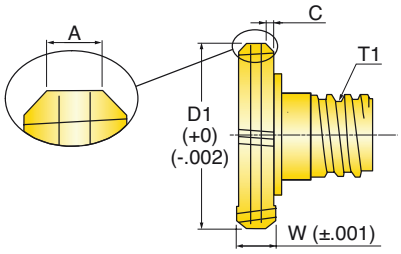
Thread Size	Wrench	Optional Torque Wrench
T06	WS-0029	DT-90-05
T08	WS-0030	DT-130-07
T10	WS-0044	DT-250-08

When assembling, be sure carbide tip is seated firmly on shank with no gap.
Note: DO NOT apply lubricant to the thread connection. Wrench not included with carbide tip or shank purchase.

CHASEline

CHIPSURFER™ FRONT/BACK CHAMFER, V-FORM TIP - 18T

CHAMFER .062" x 45°



GRADES	P	M	K	N (K)	S (M)	H (P/K)
IN1030	+	+	+		+	0

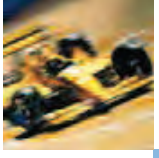
+ Good 0 Bad

Cutter Number	# Effective	D1 Nominal Diameter	Max. Radial Depth of Cut	T1 Thread Size	A Width	W Width	C Corner
18T-6216T6RN06	6	.625	.13	T06	.030	.156	.062 x 45°

Operating guidelines on page 90.

HARDWARE		
Driver Size	Torx Driver	Optional Torque Bit
1	DS-T20T	DS-T20B

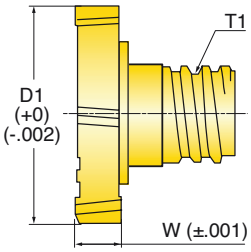
When assembling, be sure carbide tip is seated firmly on shank with no gap.
Note: DO NOT apply lubricant to the thread connection. Wrench not included with carbide tip or shank purchase.



CHIPSURFER™ PRECISION T-SLOT MILLING TIP - 18T

CORNER .015"R, CHAMFER .006" x 45°

Slotting | Slotting



GRADES	P	M	K	N (K)	S (M)	H (P/K)
IN1030	+	+	+		+	0

+ Good 0 Bad

≤44 HRC

Cutter Number	# Effective	D1 Nominal Diameter	W Width	Max. Radial Depth of Cut	T1 Thread Size	C Corner	Driver Size/ Torque Value (in. lbs.)
18T-5006TQRN00	6	.500	.062	.09	T05	.006 x 45°	1 / 60
18T-5012TQRN00	6	.500	.125	.09	T05	R .015	1 / 60
18T-6205T6RN02	6	.625	.056	.10	T06	R .015	1 / 90
18T-6206T6RN01	6	.625	.062	.13	T06	R .015	1 / 90
18T-6206T6RN02	6	.625	.068	.11	T06	R .015	1 / 90
18T-6208T6RN01	6	.625	.078	.13	T06	R .015	1 / 90
18T-6208T6RN02	6	.625	.086	.12	T06	R .015	1 / 90
18T-6210T6RN01	6	.625	.105	.13	T06	R .015	1 / 90
18T-6212T6RN01	6	.625	.125	.13	T06	R .015	2 / 90
18T-6216T6RN01	6	.625	.156	.13	T06	R .015	2 / 90
18T-7516T8RN01	6	.750	.156	.13	T08	R .015	3 / 130
18T-7519T8RN01	6	.750	.187	.13	T08	R .015	3 / 130
18T-7525T8RN01	6	.750	.250	.13	T08	R .015	3 / 130
18T-8718T8RN01	6	.875	.187	.19	T08	R .015	4 / 130
18T-8725T8RN01	6	.875	.250	.19	T08	R .015	4 / 130
18T-8731T8RN01	6	.875	.312	.19	T08	R .015	4 / 130
18T-10018TRRN02	6	1.000	.187	.19	T10	R .015	5 / 250
18T-10025TRRN02	6	1.000	.250	.19	T10	R .015	5 / 250
18T-10037TRRN02	6	1.000	.375	.19	T10	R .015	5 / 250

Operating guidelines on page 90.

HARDWARE

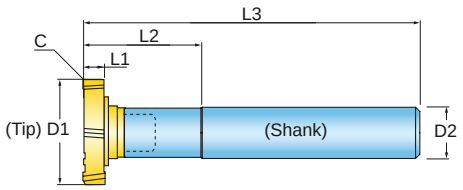

Driver Size	Driver	Optional Torque Bit
1	DS-T20T	DS-T20B / .250"
2	DS-T25T	DS-T25B / .250"
3	DS-T30T	DS-T30B / .250"
4	DS-T40T	DS-T40B / .250"
5	DS-T50L	DS-T50B / .312"

When assembling, be sure carbide tip is seated firmly on shank with no gap.
Note: DO NOT apply lubricant to the thread connection. Wrench not included with carbide tip or shank purchase.

CHASEline

CHIPSURFER™ PAKS FOR PRECISION T-SLOT MILLING TIP - 18T

CHIPSURFER PAKS



ORDER THIS PAK NUMBER	(QTY) T-Slot Tip	Straight Shank	D1 T-Slot Dia.	T-Slot Corner	D2 Shank Adaption	L1 Length of Cut	L2 Projection Length	L3 Assem. Length	Wrench
S037T06KA-06-08	(2) 18T-6208T6RN01	S037T06SA-06 (Steel)	.625	.15	.375 Cylindrical	.078	.70	3.10	DS-T20T
S037T06KA-06-18	(2) 18T-6212T6RN01	S037T06SA-06 (Steel)	.625	.15	.375 Cylindrical	.125	.75	3.15	DS-T20T
S037T06KA-06-28	(2) 18T-6216T6RN01	S037T06SA-06 (Steel)	.625	.15	.375 Cylindrical	.156	.80	3.19	DS-T20T
S050T08KA-06-38	(2) 18T-7519T8RN01	S050T08SA-06 (Steel)	.750	.15	.500 Cylindrical	.187	.85	3.72	DS-T30T
S050T08KA-06-48	(2) 18T-7525T8RN01	S050T08SA-06 (Steel)	.750	.15	.500 Cylindrical	.250	.91	3.78	DS-T30T

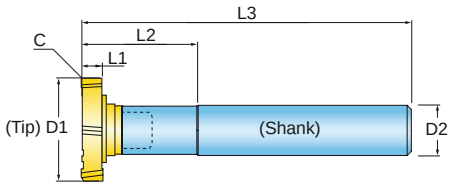
CHIPSURFER™ PAK FOR SNAP RING GROOVES - 18T

CONTENTS: 4 DIFFERENT TIPS, 1 SHANK AND 1 WRENCH

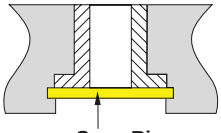

Slotting


Slotting

T-Slot Pak
(6 Flutes) Multi-Purpose, PVD - TiAlN-Coated IN1030

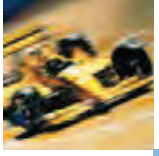


Order This Pak Number	Shank	(Qty) T-Slot Tips	L1 Width of Cut	D1 Nominal Diameter	L2 Projection Length	L3 Assm Length	Corner	D2 Shank Adaption	Wrench
S037T06KA-12-98	S037T06CA-12(Carbide)	(1) 18T-6205T6RN02	.056	.625	1.45	4.190	.015R	.375 Cyl	DS-T20T
		(1) 18T-6206T6RN02	.068						
		(1) 18T-6208T6RN02	.086						
		(1) 18T-6212T6RN01	.125						


Snap Ring Groove


Internal Snap Ring

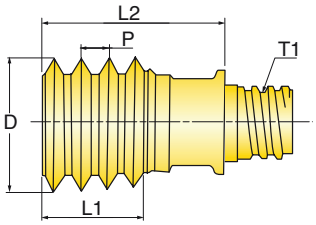
When assembling, be sure carbide tip is seated firmly on shank with no gap.
Note: DO NOT apply lubricant to the thread connection. Wrench not included with carbide tip or shank purchase.

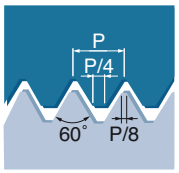


CHIPSURFER™ SOLID CARBIDE THREAD MILLING TIP - 47Y

THREAD MILL

Thread





GRADES	P	M	K	N (K)	S (M)	H (P/K)
IN2005	+	+	+		+	

+ Good 0 Bad

INCH

Cutter Number	P Pitch (TPI)	UNC	UNF	UNEF	D Nominal Diameter	# Effective	T1 Thread Size	L1 Length of Cut	L2 Extension Length
47Y-24UNTQRA13	24	-	-	9/16 & 5/8	.394	4	T05	.252	.526
47Y-20UNTQRA13	20	-	1/2	-	.394	4	T05	.252	.526
47Y-18UNTQRA13	18	-	9/16 & 5/8	1-1/8 & 1-5/8	.394	4	T05	.220	.526
47Y-16UNT6RA17	16	-	3/4	-	.472	4	T06	.315	.671
47Y-14UNT8RA21	14	-	7/8	-	.630	5	T08	.500	.821
47Y-12UNT8RA21	12	-	1 & 1-1/2	-	.630	5	T08	.500	.821
47Y-10UNT8RA21	10	3/4	-	-	.602	4	T08	.500	.821
46Y-09UNT8RA21	9	7/8	-	-	.630	3	T08	.445	.821

METRIC

Cutter Number	P Pitch (mm)	M Coarse	M Fine	D Nominal Diameter	# Effective	T1 Thread Size	L1 Length of Cut	L2 Extension Length
47Y075ISTQRA13	.75	-	Ø≥12	.394	4	T05	.236	.526
47Y100ISTQRA13	1.0	-	Ø≥12	.394	4	T05	.236	.526
47Y150ISTQRA13	1.5	-	Ø≥14	.394	4	T05	.236	.526
47Y150IST6RA17	1.5	-	Ø≥16	.472	4	T06	.295	.671
48Y150IST8RA21	1.5	-	Ø≥20	.630	6	T08	.472	.821
47Y200IST6RA17	2.0	M16	Ø≥17	.472	4	T06	.315	.671
47Y200IST8RA21	2.0	-	Ø≥19	.630	5	T08	.472	.821
47Y250IST8RA20	2.5	M20	Ø≥22	.606	5	T08	.492	.821
46Y300IST8RA21	3.0	M24	Ø≥25	.630	3	T08	.472	.821

Operating guidelines on page 88.

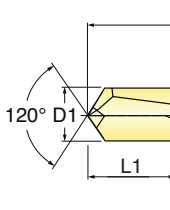
HARDWARE

Thread Size	Wrench	Optional Torque Wrench
T05	WS-0043	DT-60-06
T06	WS-0029	DT-90-08
T08	WS-0030	DT-130-10

When assembling, be sure carbide tip is seated firmly on shank with no gap.
Note: DO NOT apply lubricant to the thread connection. Wrench not included with carbide tip or shank purchase.

CHIPSURFER™ CENTER DRILL - 45Z

120° INCLUDED POINT ANGLE, 10°-15° HELICAL FLUTE



GRADES	P	M	K	N (K)	S (M)	H (P/K)
IN2005	+	+	+	0	+	

+ Good 0 Bad

Cutter Number	Size Designation (ANSI B94)	D1 Drill Diameter	D2 Flange Diameter	T1 Thread Size	L1 Drill Length	L2 Extension Length
45Z03208TQRA15	#4	0.129	0.315	T5	0.181	0.59
45Z-1851T8RA09	#5	0.187	0.500*	T8	0.242	0.90
45Z-2152T8RA09	#6	0.218	0.500	T8	0.281	0.90
45Z06517TRRA28	#7	0.254	0.630	T10	0.350	1.10

*Diameter is larger than ANSI standard.

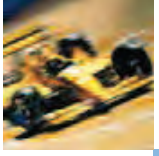
Operating guidelines on page 87.

HARDWARE


Thread Size	Wrench	Optional Torque Wrench
T05	WS-0043	DT-60-06
T08	WS-0030	DT-130-10
T10	WS-0044	DT-250-13

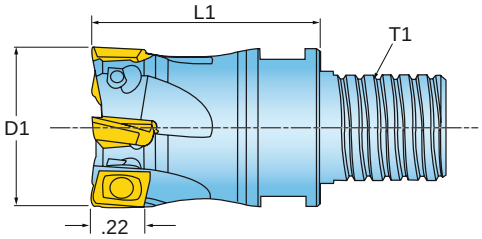
When assembling, be sure carbide tip is seated firmly on shank with no gap.

Note: DO NOT apply lubricant to the thread connection. Wrench not included with carbide tip or shank purchase.



CHIPSURFER™ 0 DEGREE LEAD END MILL - 12J1D

DIAMETERS	MAX. DEPTH OF CUT	INSERT CORNER
.375" TO .750"	.22"	.008", .015", .031" AND .062" R

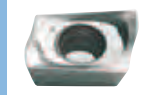


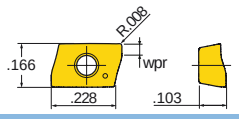
Cutter Number	D1 Nominal Diameter	# Inserts	T1 Thread Size	L1 Extension Length	Ramp Angle
12J1D-03006T6R01	.375	2	T06	0.625	9.6
12J1D-05006T8R01	.500	2	T08	0.650	6.0
12J1D-05006T8R02	.500	3	T08	0.650	6.0
12J1D-06008TRR01	.625	4	T10	0.800	4.0
12J1D-07010TSR01	.750	5	T12	1.000	2.6
12J1D-07010TSR02	.750	3	T12	1.000	2.6

HARDWARE	 Wrench	 Optional Torque Wrench
Thread Size		
T06	WS-0029	DT-90-08
T08	WS-0030	DT-130-10
T10	WS-0044	DT-250-13
T12	WS-0059	DT-250-16

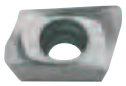
INSERTS

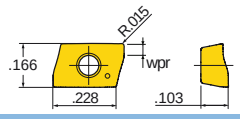
AOMT060202R



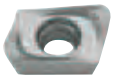


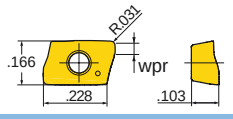
AOMT060204R



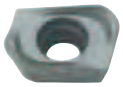


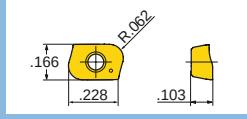
AOMT060208R



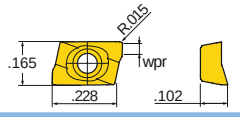


AOMT060216R

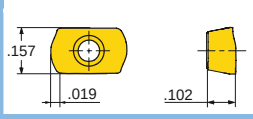




AOCT060204FR-P



UOMT0602TR



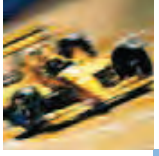
Insert Number	Application	Corner	GRADE	IN2005	IN2030	IN1030	IN05S	IN2505				
AOMT060202R	Multi-Purpose	.008r		●	●	●						
AOMT060204R	Multi-Purpose	.015r		●	●							
AOMT060208R	Multi-Purpose	.031r		●	●							
AOMT060216R*	Multi-Purpose	.062r		●	●							
AOCT060204FR-P	Ground/Polished (for Alum.)	.015r					●					
UOMT0602TR	Hi Feed	.040r			●			●				

* Cutter body should be relieved to accept .062"R insert.

● = P ● = M ● = K ● = N ● = S ○ = H

HARDWARE

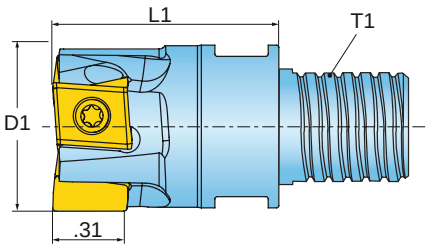
Insert Screw	Torx Driver	Optional Torque Handle	Optional Torque Bit
SM18-041-00	DS-TP06S (Tx Plus 06)	DTN005S	DS-TP06TB



0 DEGREE END MILL (CHIP SURFER STYLE) - 1SJ1Y

0 DEGREE LEAD END MILL

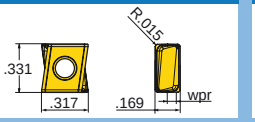
Shoulder | Channelling | Facing | Slabbing | Coolant



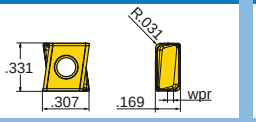
Cutter Number	D1 Nominal Diameter	T1 Adaption	L1 Extension Length	Number of Inserts
1SJ1Y-07010TSR01	0.750	T12	1.00	3
1SJ1Y-10012TUR01	1.000	T15	1.25	4

INSERTS

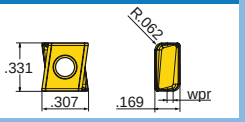
DGM212R100



DGM212R101

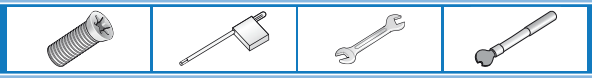


DGM212R103



Part Number	Applications	Grade	IN2005	IN2015	IN2030
DGM212R100	Multi-Purpose - 0.015" R		●	●	●
DGM212R101	Multi-Purpose - 0.031" R		●	●	●
DGM212R103	Multi-Purpose - 0.062" R		●	●	●

HARDWARE

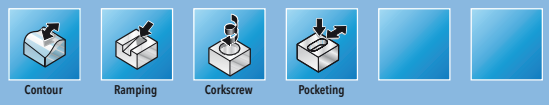


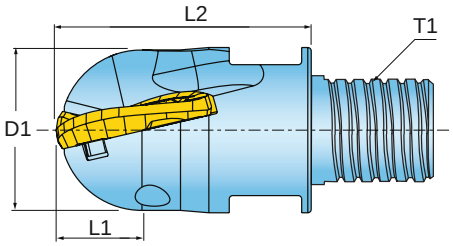
Insert Screw | Driver | Wrench | Optional Torque Wrench

1SJ1Y-07010TSR01	SM30-074-21	DS-T08W	WS-0059	DT-250-16
1SJ1Y-10012TUR01	SM30-082-21	DS-T08W	WS-0061	

PROBALL™ BALL NOSE END MILL (CHIP SURFER STYLE) - 1BW7

DIAMETERS	DEPTH OF CUT
.500" TO .750"	.250" TO .375"





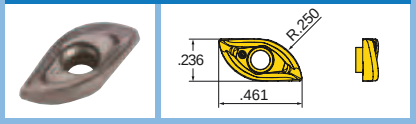
Cutter Number	D1 Nominal Diameter	L1 Depth of Cut	L2 Extension Length	T1 Thread Size
1BW7T-05007T8R01	.500	0.250	.750	T08
1BW7V-07010TSR01	.750	0.375	1.000	T12

HARDWARE

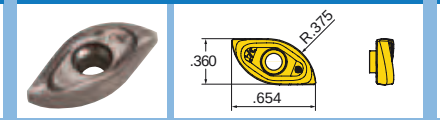
Thread Size	Wrench	Optional tourque wrench
T08	WS-0030	DT-130-10
T12	WS-0059	DT-250-16

INSERTS

NKET120200R



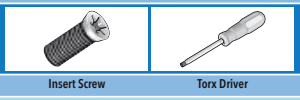
NKET180300R



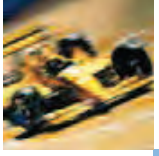
Cutter Diameter	Insert Number	Insert Radius	Number of Indexes	GRADE	IN2005	IN2030
.500	NKET120200R	0.250	2		●	●
.750	NKET180300R	0.375	2			●

● = P ● = M ● = K ● = N ● = S ○ = H

HARDWARE



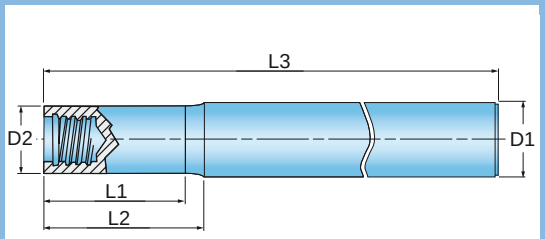
Insert Screw	Torx Driver
SM25-052-80	DS-0038
SM30-080-10	DS-0022



CHIPSURFER™ NECKED DOWN STRAIGHT SHANKS

THREAD CONNECTIONS
T05, T06, T08, T10, T12 AND T15

SHANK MATERIALS
CARBIDE, STEEL, HEAVY METAL



T1 Thread Size	Part Number	L1 Projection Length	L2 Extension Length	L3 Overall Length	D1 Shank Diameter	D2 Mating Diameter
STEEL SHANKS						
T05	S031T05SA-05	.51	.59	2.50	.312 CYL	.300
T06	S037T06SA-06	.50	.60	3.00	.375 CYL	.364
T08	S050T08SA-06	.53	.63	3.50	.500 CYL	.480
T08	*S050T08SA-061	.53	.63	3.50	.500 CYL	.455
T10	S075T10SA-00	-	.13	2.75	.750 CYL	.750
T10	S062T10SA-06	.68	.78	4.00	.625 CYL	.600
T12	S075T12SA-08	.88	1.00	5.00	.750 CYL	.720
T12	WB100T12SA-00	-	.24	3.00	1.000 WELDON	.720
T15	S100T15SA-13	1.30	1.40	5.30	1.000 CYL	.940
T15	WB125T15SA-00	-	.35	4.00	1.250 WELDON	.940

T1 Thread Size	Part Number	L1 Projection Length	L2 Extension Length	L3 Overall Length	D1 Shank Diameter	D2 Mating Diameter
CARBIDE SHANKS						
T05	S031T05CA-09	.95	1.00	3.00	.312 CYL	.300
T05	S031T05CA-19	1.95	2.00	4.00	.312 CYL	.300
T06	S037T06CA-12	1.20	1.25	4.00	.375 CYL	.364
T06	S037T06CA-20	1.95	2.00	4.75	.375 CYL	.364
T08	S012T08CA040	1.52	1.57	3.54	12mm CYL	.455
T08	S012T08CA080	3.10	3.15	5.12	12mm CYL	.455
T08	S050T08CA-15	1.45	1.50	4.00	.500 CYL	.480
T08	*S050T08CA-151	1.45	1.50	4.00	.500 CYL	.455
T08	S050T08CA-25	2.45	2.50	5.50	.500 CYL	.480
T08	*S050T08CA-251	2.45	2.50	5.50	.500 CYL	.455
T10	S062T10CA-34	3.43	3.50	5.50	.625 CYL	.600
T10	S062T10CA-49	4.93	5.00	7.00	.625 CYL	.600
T12	S075T12CA-14	1.43	1.50	4.00	.750 CYL	.720
T12	S075T12CA-29	2.93	3.00	5.50	.750 CYL	.720
T12	S075T12CA-44	4.43	4.50	8.00	.750 CYL	.720
T15	S100T15CA-24	2.40	2.50	5.00	1.000 CYL	.940
T15	S100T15CA-39	3.90	4.00	7.00	1.000 CYL	.940

*Necked down shanks for 12mm tips.

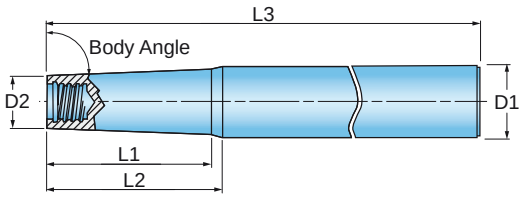
T1 Thread Size	Part Number	L1 Projection Length	L2 Extension Length	L3 Overall Length	D1 Shank Diameter	D2 Mating Diameter
HEAVY METAL SHANKS w/Coolant						
T08	S012T08HA040	1.55	1.57	3.54	12mm CYL	.455

When assembling, be sure carbide tip is seated firmly on shank with no gap.
Note: DO NOT apply lubricant to the thread connection.

CHIPSURFER™ CONICAL SHANKS

THREAD CONNECTIONS
T05, T06, T08, T10, T12 AND T15

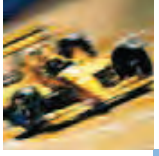
SHANK MATERIALS
CARBIDE OR STEEL



T1 Thread Size	° Body Angle	Part Number	L1 Projection Length	L2 Extension Length	L3 Overall Length	D1 Shank Diameter	D2 Mating Diameter
STEEL SHANKS							
T06	85°	S062T06SK-13	1.25	1.37	5.00	.625 CYL	.364
T06	89°	S062T06SK-21	1.75	2.15	6.30	.625 CYL	.364
T08	85°	S062T08SK-08	.75	.85	5.50	.625 CYL	.480
T08	89°	S075T08SK-31	2.75	3.15	6.50	.750 CYL	.480
T12	85°	S100T12SK-16	-	1.60	6.30	1.000 CYL	.720
T12	89°	S100T12SK-34	3.40	3.75	8.00	1.000 CYL	.720
T12	85°	S125T12SK-31	-	3.15	7.50	1.250 CYL	.720
T15	85°	WB150T15SK-34	-	3.40	10.00	1.500 WELDON	.940
T15	85°	S125T15SK-18	-	1.80	8.00	1.250 CYL	.940
T15	89°	S125T15SK-40	-	4.00	10.00	1.250 CYL	.940

T1 Thread Size	° Body Angle	Part Number	L1 Projection Length	L2 Extension Length	L3 Overall Length	D1 Shank Diameter	D2 Mating Diameter
CARBIDE SHANKS							
T05	89°	S037T05CK-15	-	1.50	3.50	.375 CYL	.300
T05	89°	S062T05CK-39	3.90	4.00	6.00	.625 CYL	.300
T06	88.5°	S050T06CK-25	2.50	2.50	5.50	.500 CYL	.364
T06	88.5°	S062T06CK-35	3.37	3.50	6.50	.625 CYL	.364
T08	89°	S062T08CK-35	3.45	3.50	6.50	.625 CYL	.480
T08	88.5°	S075T08CK-40	3.90	4.00	7.00	.750 CYL	.480
T10	89°	S075T10CK-40	-	4.00	6.50	.750 CYL	.600
T10	89°	S075T10CK-62	6.24	6.30	8.80	.750 CYL	.600
T12	89°	S100T12CK-55	-	5.50	10.00	1.000 CYL	.720
T15	89°	S125T15CK-50	-	5.00	8.00	1.250 CYL	.940
T15	89°	S125T15CK-80	-	8.00	12.00	1.250 CYL	.940

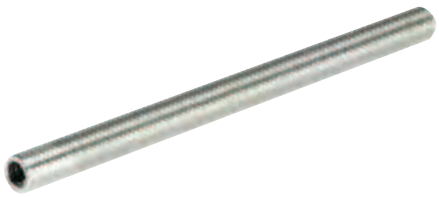
When assembling, be sure carbide tip is seated firmly on shank with no gap.
Note: DO NOT apply lubricant to the thread connection.

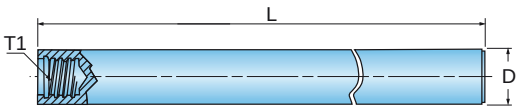


CHIPoSURFER™ STRAIGHT SHANKS WITH NO NECK

THREAD CONNECTIONS
T05, T06, T08, T10 AND T12

SHANK MATERIALS
CARBIDE, STEEL, HEAVY METAL





T1 Thread Size	Part Number	L Length	D Shank Diameter
CARBIDE SHANKS			
T05	S031T05CA-40	4.00	.312 CYL
T05	S031T05CA-65	6.50	.312 CYL
T06	S037T06CA-40	4.00	.375 CYL
T06	S037T06CA-70	7.00	.375 CYL
T08	S050T08CA-40	4.00	.500 CYL
T08	S050T08CA-75	7.50	.500 CYL
T10	S062T10CA-40	4.00	.625 CYL
T10	S062T10CA-80	8.00	.625 CYL
T12	S075T12CA-40	4.00	.750 CYL
T12	S075T12CA-80	8.00	.750 CYL

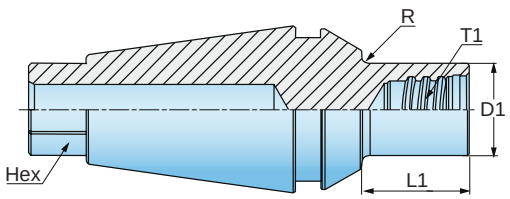
T1 Thread Size	Part Number	L Length	D Shank Diameter
STEEL SHANKS			
T05	S031T05SA-27	2.75	.312 CYL
T06	S037T06SA-21	2.13	.375 CYL
T06	S037T06SA-32	3.25	.375 CYL
T08	S050T08SA-37	3.75	.500 CYL
T10	S062T10SA-40	4.00	.625 CYL

T1 Thread Size	Part Number	L Length	D Shank Diameter
HEAVY METAL SHANKS w/Coolant			
T05	S031T05HA-35	3.50	.312 CYL
T06	S037T06HA-45	4.50	.375 CYL
T08	S012T08HA078	3.94	12mm CYL
T08	S050T08HA-55	5.50	.500 CYL
T10	S062T10HA-65	6.50	.625 CYL
T12	S075T12HA-75	7.50	.750 CYL

When assembling, be sure carbide tip is seated firmly on shank with no gap.
Note: DO NOT apply lubricant to the thread connection.

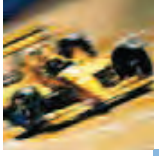
CHIPSURFER™ INTEGRAL ER-ADAPTOR

THREAD CONNECTIONS	SHANK MATERIALS
T05, T06, T08, T10, T12 AND T15	STEEL

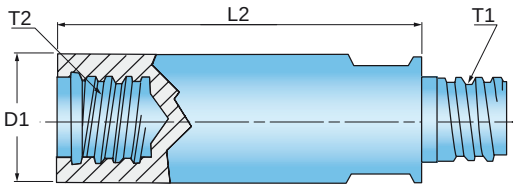


Part Number	ER Size	T1 Thread Size (End Mill Dia)	L1 Length	D1 Diameter	Hex	R	Coolant
ER11T05SA-02	11	T05 (.312)	0.157	.300	0.312	-	-
ER11T05SA-05	11	T05 (.312)	0.413	.300	0.312	-	-
ER16T05SA-02	16	T05 (.312)	0.157	.300	0.312	0.03	-
ER16T05SA-05	16	T05 (.312)	0.413	.300	0.312	0.03	-
ER16T06SA-02	16	T06 (.375)	0.157	.354	0.312	0.03	-
ER16T06SA-05	16	T06 (.375)	0.413	.354	0.312	0.03	-
ER16T08SA-02	16	T08 (.500)	0.157	.472	0.312	-	-
ER16T08SA-06	16	T08 (.500)	0.512	.472	0.312	-	-
ER20T05SA-02	20	T05 (.312)	0.157	.300	0.437	0.03	-
ER20T05SA-05	20	T05 (.312)	0.413	.300	0.437	0.03	-
ER20T06SA-02	20	T06 (.375)	0.157	.354	0.437	0.03	-
ER20T06SA-05	20	T06 (.375)	0.413	.354	0.437	0.03	-
ER20T08SA-02	20	T08 (.500)	0.157	.472	0.437	0.03	-
ER20T08SA-06	20	T08 (.500)	0.512	.472	0.437	0.03	-
ER20T10SA-02	20	T10 (.625)	0.157	.598	0.437	-	-
ER20T10SA-07	20	T10 (.625)	0.630	.598	0.437	-	-
ER32T05SA-10	32	T05 (.312)	0.984	.300	0.750	0.20	Yes
ER32T05SA-20	32	T05 (.312)	1.968	.300	0.750	0.32	Yes
ER32T06SA-10	32	T06 (.375)	0.984	.354	0.750	0.20	Yes
ER32T06SA-20	32	T06 (.375)	1.968	.354	0.750	0.24	Yes
ER32T08SA-10	32	T08 (.500)	0.984	.472	0.750	0.08	Yes
ER32T08SA-20	32	T08 (.500)	1.968	.472	0.750	0.20	Yes
ER32T10SA-10	32	T10 (.625)	0.984	.598	0.750	0.08	Yes
ER32T10SA-20	32	T10 (.625)	1.968	.598	0.750	0.12	Yes
ER32T12SA-10	32	T12 (.750)	0.984	.700	0.750	0.12	Yes
ER32T12SA-20	32	T12 (.750)	1.968	.700	0.750	0.12	Yes
ER32T15SA-10	32	T15 (1.000)	0.984	.950	0.750	0.03	Yes
ER32T15SA-20	32	T15 (1.000)	1.968	.950	0.750	0.03	Yes

When assembling, be sure carbide tip is seated firmly on shank with no gap.
Note: DO NOT apply lubricant to the thread connection.



THREAD CONNECTIONS
T05, T06, T08, T10, T12 AND T15



Part Number	D1 Nominal Diameter	T1 Thread Size	T2 Female Thread	L Extension Length
T05T05SA-10	.300	T05	T05	1.000
T06T06SA-10	.366	T06	T06	1.000
T08T08SA-10	.453	T08	T08	1.000
T10T10SA-15	.600	T10	T10	1.500
T12T12SA-15	.720	T12	T12	1.500
T15T15SA-17	.940	T15	T15	1.770

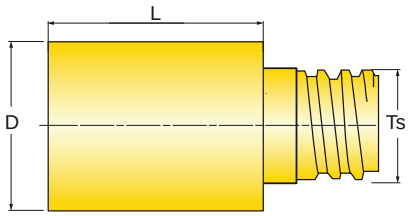
HARDWARE

Thread Size	Wrench	Optional Torque Wrench
T05	WS-0043	DT-60-06
T06	WS-0029	DT-90-08
T08	WS-0030	DT-130-10
T10	WS-0044	DT-250-13
T12	WS-0059	DT-250-16
T15	WS-0061	-

When assembling, be sure carbide tip is seated firmly on shank with no gap.
Note: DO NOT apply lubricant to the thread connection. Wrench not included with carbide tip or shank purchase.

CHIPSURFER™ BLANKS

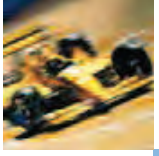
THREAD SIZE
T05, T06, T08, T10, T12 AND T15



GRADES	P	M	K	N (K)	S (M)	H (P/K)
IN05S	+	+	+	+	+	+

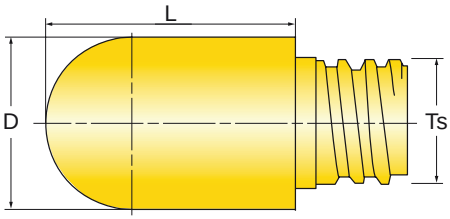
+ Good 0 Bad

D Diameter	Part Number	L Length	Ts Thread Size
.315	4RJ08000TQ-S100	.407	T05
.394	4RJ10000T6-S140	.525	T06
.501	4RJ-5000T8-S060	.670	T08
.630	4RJ16000TR-S210	.820	T10
.787	4RJ20000TS-S260	1.025	T12
1.001	4RJ-1000TU-S140	1.475	T15



CHIPSURFER™ BALL NOSE BLANKS

THREAD SIZE
T05, T06, T08 AND T10

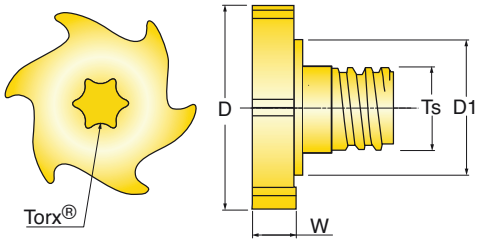


GRADES	P	M	K	$N_{(K)}$	$S_{(M)}$	$H_{(P/K)}$
IN05S	+	+	+	+	+	+

+ Good 0 Bad

D Diameter	Part Number	L Length	Ts Thread Size
.315	4RB08000TQ-S100	.407	T05
.394	4RB10000T6-S140	.525	T06
.501	4RB-5000T8-S060	.670	T08
.630	4RB16000TR-S210	.820	T10

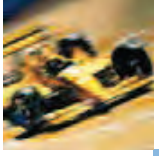
THREAD SIZE T05, T06, T08 AND T10
UNGROUND



GRADES	P	M	K	N (K)	S (M)	H (P/K)
IN30M	+	+	+	+	+	0

+ 0

D Nominal Diameter	Part Number	W Width	Ts Thread Size	D1 Hub Diameter	Torx	Number of Teeth
.551	18T14019TQRS000	.075	T05	.320	T20	6
.551	18T14028TQRS000	.110	T05	.320	T20	6
.551	18T14033TQRS000	.130	T05	.320	T20	6
.551	18T14043TQRS000	.169	T05	.320	T20	6
.641	18T16323T6RS000	.090	T06	.364	T20	6
.641	18T16333T6RS000	.130	T06	.364	T25	6
.641	18T16343T6RS000	.169	T06	.364	T25	6
.762	18T19439T8RS000	.149	T08	.480	T30	6
.762	18T19444T8RS000	.173	T08	.480	T30	6
.762	18T19451T8RS000	.200	T08	.480	T30	6
.762	18T19467T8RS000	.263	T08	.480	T30	6
.779	18T19844T8RS000	.173	T08	.480	T30	6
.779	18T19854T8RS000	.212	T08	.480	T30	6
.779	18T19863T8RS000	.251	T08	.480	T30	6
.919	18T23453T8RS000	.208	T08	.480	T40	6
.919	18T23463T8RS000	.248	T08	.480	T40	6
.919	18T23483T8RS000	.327	T08	.480	T40	6
.919	18T23499T8RS000	.387	T08	.480	T40	6
1.015	18T25826TRRS000	.102	T10	.630	T50	6
1.015	18T25840TRRS000	.157	T10	.630	T50	6
1.015	18T25850TRRS000	.197	T10	.630	T50	6
1.015	18T25866TRRS000	.260	T10	.630	T50	6
1.015	18T25883TRRS000	.327	T10	.630	T50	6
1.015	18T25899TRRS000	.390	T10	.630	T50	6
1.125	18T28628TRRS000	.110	T10	.630	T40	6
1.125	18T28636TRRS000	.141	T10	.630	T40	6
1.125	18T28656TRRS000	.220	T10	.630	T40	6
1.125	18T28610TRRS000	.405	T10	.630	T40	6
1.400	16T35612TSRS000	.472	T12	.720	T50	3
1.400	16T35616TSRS000	.472	T12	.720	T50	3



CHIP SURFER™ WRENCH KIT

6 DIFFERENT WRENCHES

ORDER THIS Pak Number	(QTY) Wrench P/N	Wrench Opening Sizes (mm)
KIT CHIP SURFER WRENCH	(1) WS-0043	4 and 6
	(1) WS-0029	5 and 8
	(1) WS-0030	7 and 10
	(1) WS-0044	8 and 13
	(1) WS-0059	9 and 16
	(1) WS-0061	20

CHIPSURFER™

Indexable Solid Carbide SPECIALS

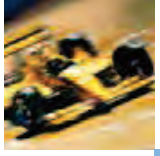
- Crankshaft Oil Grooves

- Engine Blocks
- Con Rod Bearing Locks
- Lock Notch Groove

- Differential Case
- O-Ring Groove
- Axle Tubes
- Bushing Retention

Carbide Blanks For Your Next Project

See page 92 for product worksheets.




ARM YOURSELF!!
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ROUND
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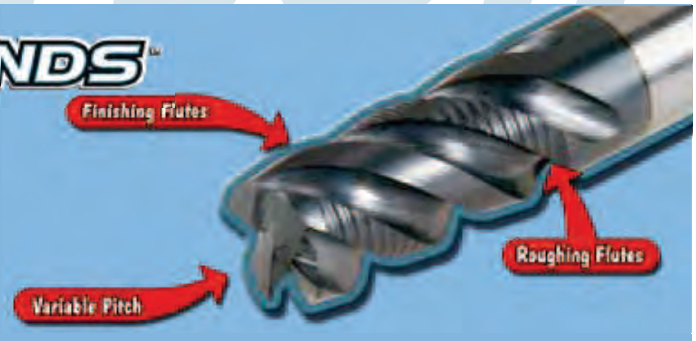
200 CAL .50 CARTRIDG
API M20 LINKED M9
LOT WRA
2207

ROUGHFIN•ROUNDS™

- Breaks up harmonics for less chatter
- For roughing and finishing



PRO•ROUNDS™

- Flute options
- Geometry for all materials

FEED•ROUNDS™

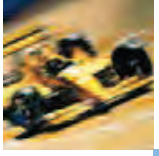
- Aggressive roughing
- Great for pocketing and contour work

3N1•ROUNDS™

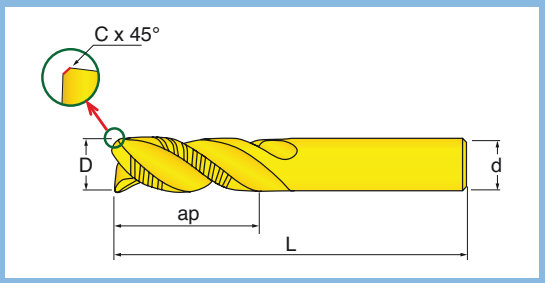
- Eliminate tool changes
- Aggressive hi-feed roughing and pocketing
- Well suited for trichoidal milling

STEDI•ROUNDS™

- Breaks up harmonics
- Exceptional finishes



ROUGHING END MILLS, 3-FLUTE, 38 DEGREE HELIX, W/CHIPSPLITTERS



Grade
IN2005

P	M	K	N (K)	S (M)	H (P/K)
+	+	+	+		

+ Preferred choice ○ Second choice

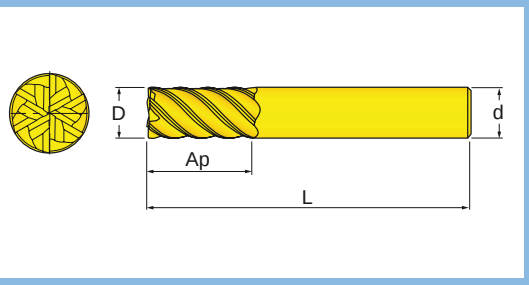
△	e9
□	h6

Cutter Number		Helix (deg)	D Diameter	Z Flutes	C Chamfer	L Overall Length	Ap Cut Length	d Shank Size/Style
46C-2505R6RM00	IN2005	38.0	0.250	3	.010x45	2.50	0.50	.250" Cylindrical
46C-3106R7RM01	IN2005	38.0	0.312	3	.015x45	2.50	0.63	.312" Cylindrical
46C-3707R8RM01	IN2005	38.0	0.375	3	.015x45	3.00	0.75	.375" Cylindrical
46C-5010S4RM01	IN2005	38.0	0.500	3	.020x45	3.50	1.00	.500" Cylindrical
46C-6212S6RM02	IN2005	38.0	0.625	3	.020x45	3.50	1.25	.625" Cylindrical
46C-7515S7RM02	IN2005	38.0	0.750	3	.020x45	4.00	1.50	.750" Cylindrical
46C-1020S1RM02	IN2005	38.0	1.000	3	.024x45	6.00	2.00	1.000" Cylindrical

Operating guidelines on page 82.

PRECISION END MILLS, MEDIUM & LONG LENGTH, 45 DEGREE HELIX

Ramping Corkscrew



Grade	P	M	K	N (K)	S (M)	H (P/K)
IN2005	+	+	+		+	

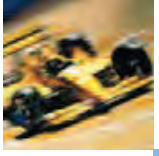
+ Preferred choice ○ Second choice

△ e8
□ h6

λ = 45° ≤54 HRC

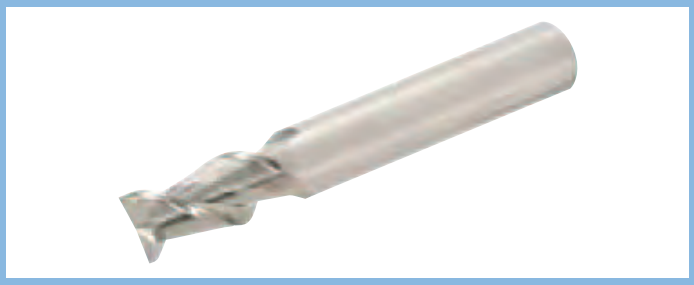
Cutter Number		Length	Helix (deg)	D Diameter	Z Flutes	C Corner	L Overall Length	Ap Cut Length	d Shank Size/Style
47J-1203R4RD15	IN2005	Medium	45	0.125	4	Sharp	1.50	0.37	.125" Cylindrical
47J-1805R5RD20	IN2005	Medium	45	0.188	4	Sharp	2.00	0.50	.188" Cylindrical
47J-2506R6RD25	IN2005	Medium	45	0.250	4	Sharp	2.50	0.62	.250" Cylindrical
47J-3107R7RD25	IN2005	Medium	45	0.312	4	Sharp	2.50	0.75	.312" Cylindrical
47J-3708R8RD25	IN2005	Medium	45	0.375	4	Sharp	2.50	0.87	.375" Cylindrical
47J-4310R9RD27	IN2005	Medium	45	0.437	4	Sharp	2.75	1.00	.438" Cylindrical
47J-5010S4RD30	IN2005	Medium	45	0.500	4	Sharp	3.00	1.00	.500" Cylindrical
47J-6212S6RD35	IN2005	Medium	45	0.625	4	Sharp	3.50	1.25	.625" Cylindrical
47J-7515S7RD40	IN2005	Medium	45	0.750	4	Sharp	4.00	1.50	.750" Cylindrical
48J-2506R6RD25	IN2005	Medium	45	0.250	6	Sharp	2.50	0.62	.250" Cylindrical
48J-2510R6RD30	IN2005	Long	45	0.250	6	Sharp	3.00	1.00	.250" Cylindrical
48J-3107R7RD25	IN2005	Medium	45	0.312	6	Sharp	2.50	0.75	.312" Cylindrical
48J-3112R7RD30	IN2005	Long	45	0.312	6	Sharp	3.00	1.25	.312" Cylindrical
48J-3708R8RD25	IN2005	Medium	45	0.375	6	Sharp	3.00	0.87	.375" Cylindrical
48J-3715R8RD40	IN2005	Long	45	0.375	6	Sharp	4.00	1.50	.375" Cylindrical
48J-4310R9RD30	IN2005	Medium	45	0.438	6	Sharp	3.00	1.00	.438" Cylindrical
48J-5010S4RD30	IN2005	Medium	45	0.500	6	Sharp	3.00	1.00	.500" Cylindrical
48J-5020S4RD42	IN2005	Long	45	0.500	6	Sharp	4.25	2.00	.500" Cylindrical
48J-6212S6RD35	IN2005	Medium	45	0.625	6	Sharp	3.50	1.25	.625" Cylindrical
48J-6225S6RD50	IN2005	Long	45	0.625	6	Sharp	5.00	2.50	.625" Cylindrical
48J-7515S7RD40	IN2005	Medium	45	0.750	6	Sharp	4.00	1.50	.750" Cylindrical
48J-7525S7RD50	IN2005	Long	45	0.750	6	Sharp	5.00	2.50	.750" Cylindrical
48J-1017S1RD45	IN2005	Medium	45	1.000	6	Sharp	4.50	1.75	1.000" Cylindrical

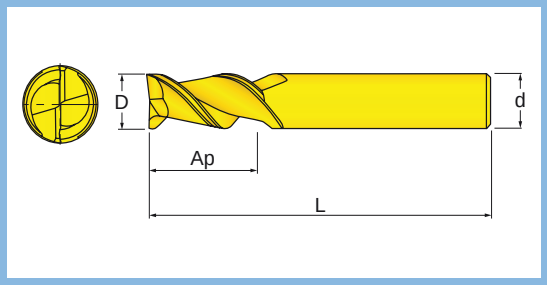
Operating guidelines on page 82.



PRECISION END MILLS FOR ALUMINUM, 45 DEGREE HELIX

Shoulder | Slabbing | Channel | Ramping | Corkscrew | Pocket | Facing





Grade	P	M	K	N (K)	S (M)	H (P/K)
IN05S				+		

+ Preferred choice ○ Second choice

△	h6
□	h6

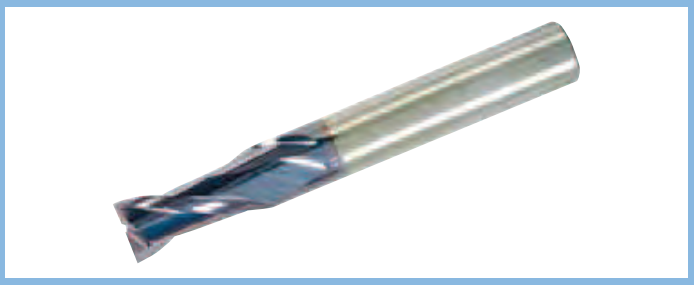
λ = 45° | ALU

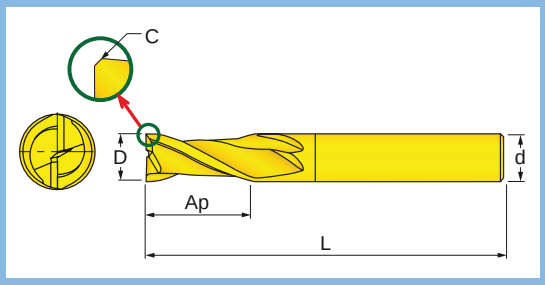
Cutter Number	Grade	Length	Helix (deg)	D Diameter	Z Flutes	C Corner	L Overall Length	Ap Cut Length	d Shank Size/Style
45J-2505R6RD25	IN05S	Medium	45	0.250	2	Sharp	2.50	0.50	.250" Cylindrical
45J-3106R7RD25	IN05S	Medium	45	0.312	2	Sharp	2.50	0.63	.312" Cylindrical
45J-3707R8RD30	IN05S	Medium	45	0.375	2	Sharp	3.00	0.75	.375" Cylindrical
45J-5010S4RD30	IN05S	Medium	45	0.500	2	Sharp	3.00	1.00	.500" Cylindrical
45J-6210S6RD35	IN05S	Medium	45	0.625	2	Sharp	3.50	1.00	.625" Cylindrical
45J-7512S7RD40	IN05S	Medium	45	0.750	2	Sharp	4.00	1.25	.750" Cylindrical
45J-1015S1RD45	IN05S	Medium	45	1.000	2	Sharp	4.50	1.50	1.000" Cylindrical
46J-2505R6RD25	IN05S	Medium	45	0.250	3	.008	2.50	0.50	.250" Cylindrical
46J-3106R7RD25	IN05S	Medium	45	0.312	3	.008	2.50	0.63	.312" Cylindrical
46J-3707R8RD30	IN05S	Medium	45	0.375	3	.008	3.00	0.75	.375" Cylindrical
46J-5010S4RD35	IN05S	Medium	45	0.500	3	.008	3.50	1.00	.500" Cylindrical
46J-6210S6RD35	IN05S	Medium	45	0.625	3	.008	3.50	1.00	.625" Cylindrical
46J-7512S7RD40	IN05S	Medium	45	0.750	3	.008	4.00	1.25	.750" Cylindrical
46J-1015S1RD45	IN05S	Medium	45	1.000	3	.008	4.50	1.50	1.000" Cylindrical

Operating guidelines on page 82.

PRECISION CENTER-CUTTING END MILLS, 2-FLUTE, 30 DEGREE HELIX

Shoulder | Slabbing | Channel | Ramping | Corkscrew | Pocket | Facing





Grade	P	M	K	$N_{(K)}$	$S_{(M)}$	$H_{(P/K)}$
IN2005	+	+	+		+	

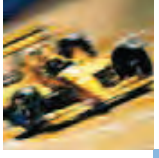
△ e8
□ h6

λ = 30° | ≤54 HRC

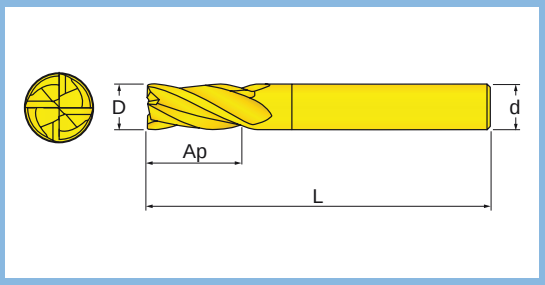
+ Preferred choice ○ Second choice

Cutter Number		Helix (deg)	D Diameter	Z Flutes	C Chamfer	L Overall Length	Ap Cut Length	d Shank Size/Style
45C-1205R4RB00	IN2005	30.0	0.125	2	0.040-0.010 x 45	1.50	0.50	.125" Cylindrical
45C-1803R5RB00	IN2005	30.0	0.188	2	0.040-0.010 x 45	2.00	0.38	.188" Cylindrical
45C-2505R6RB00	IN2005	30.0	0.250	2	0.040-0.010 x 45	2.50	0.50	.250" Cylindrical
45C-2507R6RB00	IN2005	30.0	0.250	2	0.040-0.010 x 45	2.50	0.75	.250" Cylindrical
45C-3108R7RB00	IN2005	30.0	0.312	2	0.040-0.010 x 45	2.50	0.81	.312" Cylindrical
45C-3707R8RB00	IN2005	30.0	0.375	2	0.040-0.010 x 45	2.50	0.75	.375" Cylindrical
45C-370777RB00	IN2005	30.0	0.375	2	0.040-0.010 x 45	2.50	0.75	.375" Weldon
45C-3710R8RB00	IN2005	30.0	0.375	2	0.040-0.010 x 45	2.50	1.00	.375" Cylindrical
45C-4310R9RB00	IN2005	30.0	0.437	2	0.040-0.010 x 45	2.75	1.00	.438" Cylindrical
45C-5010S4RB00	IN2005	30.0	0.500	2	0.040-0.010 x 45	3.00	1.00	.500" Cylindrical
45C-501078RB00	IN2005	30.0	0.500	2	0.040-0.010 x 45	3.00	1.00	.500" Weldon
45C-6210S6RB00	IN2005	30.0	0.625	2	0.040-0.010 x 45	3.50	1.00	.625" Cylindrical
45C-7584S7RB00	IN2005	30.0	0.750	2	0.040-0.010 x 45	4.00	1.25	.750" Cylindrical

Operating guidelines on page 82.



PRECISION CENTER-CUTTING END MILLS, 4-FLUTE, 38 DEGREE HELIX



Grade	P	M	K	N (K)	S (M)	H (P/K)
IN2005	+	+	+		+	

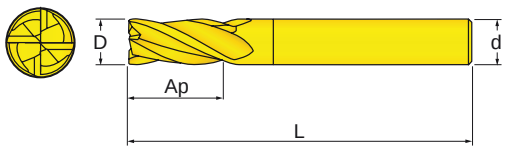
+ Preferred choice ○ Second choice

△	e8
□	h6

Cutter Number	Helix (deg)	D Diameter	Z Flutes	C Corner	L Overall Length	Ap Cut Length	d Shank Size/Style
47J-1203R4RC15 IN2005	38.0	0.125	4	Sharp	1.50	0.38	.125" Cylindrical
47D-1203R4RC001 IN2005	38.0	0.125	4	.010	1.50	0.38	.125" Cylindrical
47J-1503R2RC15 IN2005	38.0	0.156	4	Sharp	1.50	0.38	.156" Cylindrical
47D-1203R4RC00 IN2005	38.0	0.156	4	.010	1.50	0.38	.156" Cylindrical
47J-1803R5RC15 IN2005	38.0	0.188	4	Sharp	2.00	0.38	.188" Cylindrical
47D-1203R5RC00 IN2005	38.0	0.188	4	.010	2.00	0.38	.188" Cylindrical
47J-2103R3RC20 IN2005	38.0	0.218	4	Sharp	2.00	0.38	.218" Cylindrical
47D-2103R3RC00 IN2005	38.0	0.218	4	.010	2.00	0.38	.218" Cylindrical
47J-2505R6RC25 IN2005	38.0	0.250	4	Sharp	2.50	0.50	.250" Cylindrical
47D-2505R6RC00 IN2005	38.0	0.250	4	.010	2.50	0.50	.250" Cylindrical
47D-2505R6RC02 IN2005	38.0	0.250	4	.020	2.50	0.50	.250" Cylindrical
47D-2505R6RC03 IN2005	38.0	0.250	4	.030	2.50	0.50	.250" Cylindrical
47D-2505R6RC06 IN2005	38.0	0.250	4	.060	2.50	0.50	.250" Cylindrical
47J-3106R7RC25 IN2005	38.0	0.312	4	Sharp	2.50	0.63	.312" Cylindrical
47D-3106R7RC00 IN2005	38.0	0.312	4	.010	2.50	0.63	.312" Cylindrical
47D-3106R7RC02 IN2005	38.0	0.312	4	.020	2.50	0.63	.312" Cylindrical
47D-3106R7RC03 IN2005	38.0	0.312	4	.030	2.50	0.63	.312" Cylindrical
47D-3106R7RC06 IN2005	38.0	0.312	4	.060	2.50	0.63	.312" Cylindrical
47J-3707R8RC25 IN2005	38.0	0.375	4	Sharp	2.50	0.75	.375" Cylindrical
47J-370777RC25 IN2005	38.0	0.375	4	Sharp	2.50	0.75	.375" Weldon
47D-3707R8RC00 IN2005	38.0	0.375	4	.010	2.50	0.75	.375" Cylindrical
47D-3707R8RC02 IN2005	38.0	0.375	4	.020	2.50	0.75	.375" Cylindrical
47J-3707R8RC03 IN2005	38.0	0.375	4	.030	2.50	0.75	.375" Cylindrical
47J-3707R8RC06 IN2005	38.0	0.375	4	.060	2.50	0.75	.375" Cylindrical
47D-4307R9RC27 IN2005	38.0	0.438	4	Sharp	2.75	0.75	.438" Cylindrical
47J-4307R9RC02 IN2005	38.0	0.438	4	.020	2.75	0.75	.438" Cylindrical
47D-5010S4RC30 IN2005	38.0	0.500	4	Sharp	3.00	1.00	.500" Cylindrical
47D-501078RC30 IN2005	38.0	0.500	4	Sharp	3.00	1.00	.500" Weldon
47J-5010S4RC30 IN2005	38.0	0.500	4	.010	3.00	1.00	.500" Cylindrical
47J-5010S4RC02 IN2005	38.0	0.500	4	.020	3.00	1.00	.500" Cylindrical
47J-5010S4RC03 IN2005	38.0	0.500	4	.030	3.00	1.00	.500" Cylindrical
47J-5010S4RC06 IN2005	38.0	0.500	4	.060	3.00	1.00	.500" Cylindrical

PRECISION CENTER-CUTTING END MILLS, 4-FLUTE, 38 DEGREE HELIX

Shoulder | Slabbing | Channel | Ramping | Corkscrew | Pocket | Facing



Grade	P	M	K	N (K)	S (M)	H (P/K)
IN2005	+	+	+		+	

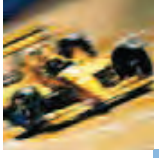
+ Preferred choice ○ Second choice

△	e8
□	h6

λ = 38° | ≤54 HRC

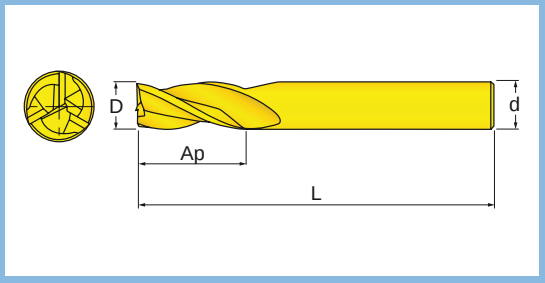
Cutter Number	Helix (deg)	D Diameter	Z Flutes	C Corner	L Overall Length	Ap Cut Length	d Shank Size/Style
47D-6210S6RC35 IN2005	38.0	0.625	4	Sharp	3.50	1.00	.625" Cylindrical
47D-621079RC35 IN2005	38.0	0.625	4	Sharp	3.50	1.00	.625" Weldon
47J-6210S6RC00 IN2005	38.0	0.625	4	.010	3.50	1.00	.625" Cylindrical
47J-6210S6RC03 IN2005	38.0	0.625	4	.030	3.50	1.00	.625" Cylindrical
47J-6210S6RC06 IN2005	38.0	0.625	4	.060	3.50	1.00	.625" Cylindrical
47D-7510S7RC40 IN2005	38.0	0.750	4	Sharp	4.00	1.50	.750" Cylindrical
47D-751584RC40 IN2005	38.0	0.750	4	Sharp	4.00	1.50	.750" Weldon
47J-7515S7RC00 IN2005	38.0	0.750	4	.010	4.00	1.50	.750" Cylindrical
47J-7515S7RC02 IN2005	38.0	0.750	4	.020	4.00	1.50	.750" Cylindrical
47J-7515S7RC03 IN2005	38.0	0.750	4	.030	4.00	1.50	.750" Cylindrical
47J-7515S7RC06 IN2005	38.0	0.750	4	.060	4.00	1.50	.750" Cylindrical

Operating guidelines on page 82.



PRECISION CENTER-CUTTING END MILLS, 3-FLUTE, 38 DEGREE HELIX

Shoulder | Slabbing | Channel | Ramping | Corkscrew | Pocket | Facing



Grade	P	M	K	N (K)	S (M)	H (P/K)
IN2005	+	+	+		+	

△ e8
□ h6

λ = 38° | ≤44 HRC

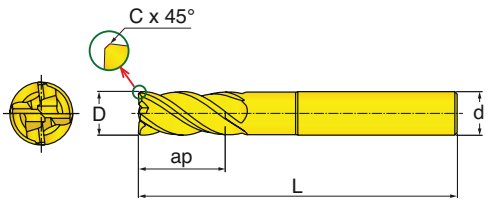
+ Preferred choice ○ Second choice

46J-1202R4RC15	IN2005	38.0	0.125	3	Sharp	1.50	0.25	.125" Cylindrical
46D-1202R4RC00	IN2005	38.0	0.125	3	.010	1.50	0.25	.125" Cylindrical
46J-1803R5RC20	IN2005	38.0	0.188	3	Sharp	2.00	0.38	.188" Cylindrical
46D-1803R5RC00	IN2005	38.0	0.188	3	.010	2.00	0.38	.188" Cylindrical
46J-2505R6RC25	IN2005	38.0	0.250	3	Sharp	2.50	0.50	.250" Cylindrical
46D-2505R6RC02	IN2005	38.0	0.250	3	.020	2.50	0.50	.250" Cylindrical
46J-3106R7RC25	IN2005	38.0	0.312	3	Sharp	2.50	0.63	.312" Cylindrical
46D-3106R7RC02	IN2005	38.0	0.312	3	.020	2.50	0.63	.312" Cylindrical
46J-3707R8RC25	IN2005	38.0	0.375	3	Sharp	2.50	0.75	.375" Cylindrical
46J-370777RC25	IN2005	38.0	0.375	3	Sharp	2.50	0.75	.375" Weldon
46D-3707R8RC02	IN2005	38.0	0.375	3	.020	2.50	0.75	.375" Cylindrical
46D-3710S4RC30	IN2005	38.0	0.500	3	Sharp	3.00	1.00	.500" Cylindrical
46D-501078RC30	IN2005	38.0	0.500	3	Sharp	3.00	1.00	.500" Weldon
46J-5010S4RC03	IN2005	38.0	0.500	3	.030	3.00	1.00	.500" Cylindrical
46J-6210R4RC35	IN2005	38.0	0.625	3	Sharp	3.50	1.00	.625" Cylindrical
46J-621079RC35	IN2005	38.0	0.625	3	Sharp	3.50	1.00	.625" Weldon
46D-6210R4RC03	IN2005	38.0	0.625	3	.030	3.50	1.00	.625" Cylindrical
46J-7512S7RC40	IN2005	38.0	0.750	3	Sharp	4.00	1.25	.750" Cylindrical
46J0751284RC40	IN2005	38.0	0.750	3	Sharp	4.00	1.25	.750" Weldon
46D-7512S7RC03	IN2005	38.0	0.750	3	.030	4.00	1.25	.750" Cylindrical
46JE1015S1RC15	IN2005	38.0	1.000	3	Sharp	4.00	1.50	1.000" Cylindrical
46JE1015S1RC40	IN2005	38.0	1.000	3	Sharp	4.00	1.50	1.000" Weldon
46DE1015S1RC03	IN2005	38.0	1.000	3	.030	4.00	1.50	1.000" Cylindrical

Operating guidelines on page 82.

SOLID CARBIDE END MILLS FOR ROUGHING & FINISHING, VARIABLE PITCH

Shoulder | Slabbing | Channel | Ramping | Corkscrew | Pocket | Facing



Grade	P	M	K	N (K)	S (M)	H (P/K)
IN2005	+	+	+		+	

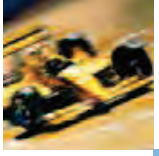
+ Preferred choice ○ Second choice

△	e8
□	h6

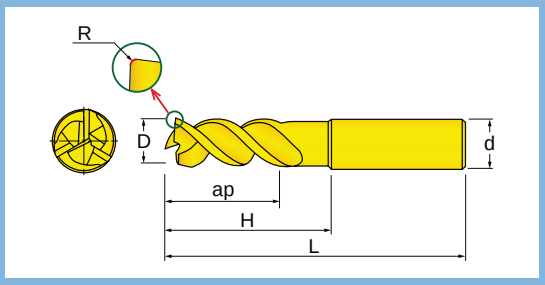
λ = 38° | ≤54 HRC

Cutter Number		Helix (deg)	D Diameter	Z Flutes	C Chamfer	L Overall Length	Ap Cut Length	d Shank Size/Style
47C-1202R4RQ00	IN2005	38.0	0.125	4	.004x45	1.50	0.25	.125" Cylindrical
47C-1803R5RQ00	IN2005	38.0	0.188	4	.006x45	2.00	0.38	.188" Cylindrical
47C-2563R6RQ08	IN2005	38.0	0.250	5	.008x45	2.50	0.63	.250" Cylindrical
47C-2505R6RQ01	IN2005	38.0	0.250	4	.010x45	2.50	0.50	.250" Cylindrical
47C-3178R7RQ01	IN2005	38.0	0.312	5	.010x45	2.50	0.78	.312" Cylindrical
47C-3106R7RQ01	IN2005	38.0	0.312	4	.012x45	2.50	0.63	.312" Cylindrical
47C-3794R8RQ01	IN2005	38.0	0.375	5	.012x45	3.00	0.94	.375" Cylindrical
47C-379477RQ01	IN2005	38.0	0.375	5	.012x45	3.00	0.94	.375" Weldon
47C-3707R8RQ01	IN2005	38.0	0.375	4	.015x45	3.00	0.75	.375" Cylindrical
47C-370777RQ01	IN2005	38.0	0.375	4	.015x45	3.00	0.75	.375" Weldon
47C-5012S4RQ01	IN2005	38.0	0.500	5	.016x45	3.50	1.25	.500" Cylindrical
47C-501278RQ01	IN2005	38.0	0.500	5	.016x45	3.50	1.25	.500" Weldon
47C-5010S4RQ02	IN2005	38.0	0.500	4	.020x45	3.50	1.00	.500" Cylindrical
47C-501078RQ02	IN2005	38.0	0.500	4	.020x45	3.50	1.00	.500" Weldon
47C-6215S6RQ02	IN2005	38.0	0.625	5	.020x45	4.00	1.56	.625" Cylindrical
47C-621579RQ02	IN2005	38.0	0.625	5	.020x45	4.00	1.56	.625" Weldon
47C-6212S6RQ02	IN2005	38.0	0.625	4	.024x45	4.00	1.25	.625" Cylindrical
47C-621279RQ02	IN2005	38.0	0.625	4	.024x45	4.00	1.25	.625" Weldon
47C-7518S7RQ02	IN2005	38.0	0.750	5	.020x45	5.00	1.87	.750" Cylindrical
47C-751884RQ02	IN2005	38.0	0.750	5	.020x45	5.00	1.87	.750" Weldon
47C-7515S7RQ02	IN2005	38.0	0.750	4	.024x45	5.00	1.50	.750" Cylindrical
47C-751584RQ02	IN2005	38.0	0.750	4	.024x45	5.00	1.50	.750" Weldon
47C-1020S1RQ02	IN2005	38.0	1.000	4	.024x45	5.00	2.00	1.000" Cylindrical
47C-102080RQ02	IN2005	38.0	1.000	4	.024x45	5.00	2.00	1.000" Weldon

Operating guidelines on page 82.



SOLID CARBIDE END MILLS FOR ALUMINIUM, 3-FLUTE, VARIABLE HELIX

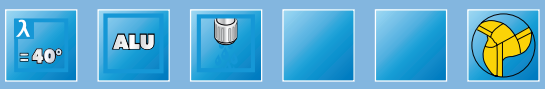


Grade	
IN05S	

P	M	K	N (K)	S (M)	H (P/K)
			+		

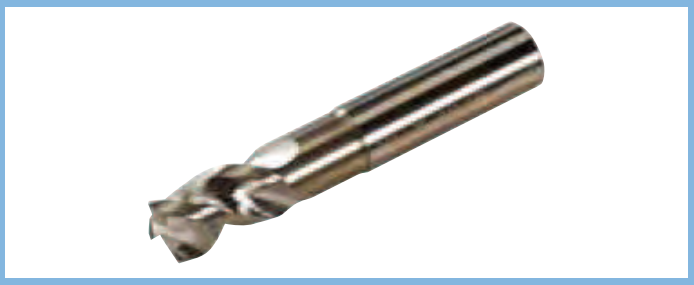
+ Preferred choice ○ Second choice

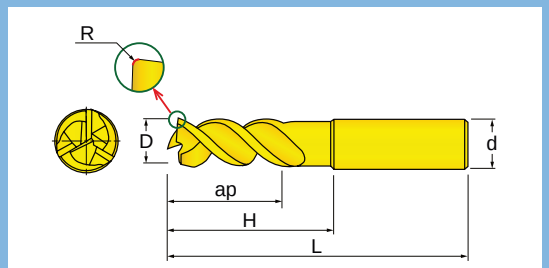
△	e8
□	h6



Cutter Number	Helix (deg)	D Diameter	Z Flutes	R Radius	L Overall Length	H Height	Ap Cut Length	d Shank Size/Style
46D-2535R6RQ020 IN05S	39-41	0.250	3	0.020	2.50	0.750	0.35	.250" Cylindrical
46D-2535R6RQ030 IN05S	39-41	0.250	3	0.030	2.50	0.750	0.35	.250" Cylindrical
46D-2535R6RQ02 IN05S	39-41	0.250	3	0.020	2.50	1.250	0.35	.250" Cylindrical
46D-2535R6RQ03 IN05S	39-41	0.250	3	0.030	2.50	1.250	0.35	.250" Cylindrical
46D-3150R7RQ02 IN05S	39-41	0.312	3	0.020	2.50	0.900	0.50	.312" Cylindrical
46D-3150R7RQ03 IN05S	39-41	0.312	3	0.030	2.50	0.900	0.50	.312" Cylindrical
46D-3150R7RQ020 IN05S	39-41	0.312	3	0.020	2.50	1.560	0.50	.312" Cylindrical
46D-3150R7RQ030 IN05S	39-41	0.312	3	0.030	2.50	1.560	0.50	.312" Cylindrical
46D-3760R8RQ02 IN05S	39-41	0.375	3	0.020	2.50	1.125	0.60	.375" Cylindrical
46D-3760R8RQ03 IN05S	39-41	0.375	3	0.030	2.50	1.125	0.60	.375" Cylindrical
46D-3760R8RQ06 IN05S	39-41	0.375	3	0.060	2.50	1.125	0.60	.375" Cylindrical
46D-3760R8RQ020 IN05S	39-41	0.375	3	0.020	3.00	1.875	0.60	.375" Cylindrical
46D-3760R8RQ030 IN05S	39-41	0.375	3	0.030	3.00	1.875	0.60	.375" Cylindrical
46D-3760R8RQ060 IN05S	39-41	0.375	3	0.060	3.00	1.875	0.60	.375" Cylindrical
46D-5075S4RQ02 IN05S	39-41	0.500	3	0.020	3.00	1.500	0.75	.500" Cylindrical
46D-5075S4RQ03 IN05S	39-41	0.500	3	0.030	3.00	1.500	0.75	.500" Cylindrical
46D-5075S4RQ06 IN05S	39-41	0.500	3	0.060	3.00	1.500	0.75	.500" Cylindrical
46D-5075S4RQ020 IN05S	39-41	0.500	3	0.020	4.50	2.500	0.75	.500" Cylindrical
46D-5075S4RQ030 IN05S	39-41	0.500	3	0.030	4.50	2.500	0.75	.500" Cylindrical
46D-5075S4RQ060 IN05S	39-41	0.500	3	0.060	4.50	2.500	0.75	.500" Cylindrical
46D-6210S6RQ02 IN05S	39-41	0.625	3	0.020	3.50	1.870	1.00	.625" Cylindrical
46D-6210S6RQ03 IN05S	39-41	0.625	3	0.030	3.50	1.870	1.00	.625" Cylindrical
46D-6210S6RQ06 IN05S	39-41	0.625	3	0.060	3.50	1.870	1.00	.625" Cylindrical
46D-6210S6RQ09 IN05S	39-41	0.625	3	0.090	3.50	1.870	1.00	.625" Cylindrical
46D-6210S6RQ020 IN05S	39-41	0.625	3	0.020	5.00	3.125	1.00	.625" Cylindrical
46D-6210S6RQ030 IN05S	39-41	0.625	3	0.030	5.00	3.125	1.00	.625" Cylindrical
46D-6210S6RQ060 IN05S	39-41	0.625	3	0.060	5.00	3.125	1.00	.625" Cylindrical
46D-6210S6RQ090 IN05S	39-41	0.625	3	0.090	5.00	3.125	1.00	.625" Cylindrical
46D-7512S7RQ02 IN05S	39-41	0.750	3	0.020	5.00	2.250	1.20	.750" Cylindrical
46D-7512S7RQ03 IN05S	39-41	0.750	3	0.030	5.00	2.250	1.20	.750" Cylindrical
46D-7512S7RQ06 IN05S	39-41	0.750	3	0.060	5.00	2.250	1.20	.750" Cylindrical
46D-7512S7RQ09 IN05S	39-41	0.750	3	0.090	5.00	2.250	1.20	.750" Cylindrical
46D-7512S7RQ020 IN05S	39-41	0.750	3	0.020	6.00	3.750	1.20	.750" Cylindrical
46D-7512S7RQ030 IN05S	39-41	0.750	3	0.030	6.00	3.750	1.20	.750" Cylindrical
46D-7512S7RQ060 IN05S	39-41	0.750	3	0.060	6.00	3.750	1.20	.750" Cylindrical
46D-7512S7RQ090 IN05S	39-41	0.750	3	0.090	6.00	3.750	1.20	.750" Cylindrical

SOLID CARBIDE END MILLS FOR ALUMINIUM, 3-FLUTE, VARIABLE HELIX





Grade	P	M	K	N (K)	S (M)	H (P/K)
IN05S				+		

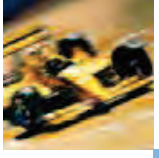
e8
h6

λ = 40°
ALU

+ Preferred choice ○ Second choice

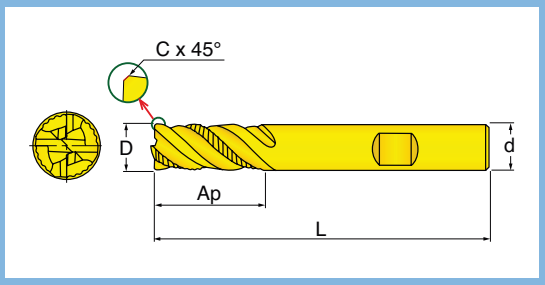
Cutter Number	Helix (deg)	D Diameter	Z Flutes	R Radius	L Overall Length	H Height	Ap Cut Length	d Shank Size/Style
46D-1015S1RQ02 IN05S	39-41	1.000	3	0.020	5.00	3.000	1.50	1.000" Cylindrical
46D-1015S1RQ03 IN05S	39-41	1.000	3	0.030	5.00	3.000	1.50	1.000" Cylindrical
46D-1015S1RQ06 IN05S	39-41	1.000	3	0.060	5.00	3.000	1.50	1.000" Cylindrical
46D-1015S1RQ09 IN05S	39-41	1.000	3	0.090	5.00	3.000	1.50	1.000" Cylindrical
46D-1015S1RQ12 IN05S	39-41	1.000	3	0.120	5.00	3.000	1.50	1.000" Cylindrical
46D-1015S1RQ020 IN05S	39-41	1.000	3	0.020	7.20	5.000	1.50	1.000" Cylindrical
46D-1015S1RQ030 IN05S	39-41	1.000	3	0.030	7.20	5.000	1.50	1.000" Cylindrical
46D-1015S1RQ060 IN05S	39-41	1.000	3	0.060	7.20	5.000	1.50	1.000" Cylindrical
46D-1015S1RQ090 IN05S	39-41	1.000	3	0.090	7.20	5.000	1.50	1.000" Cylindrical
46D-1015S1RQ120 IN05S	39-41	1.000	3	0.120	7.20	5.000	1.50	1.000" Cylindrical

Operating guidelines on page 82.



SOLID CARBIDE END MILLS, COMBINATION ROUGHING/FINISHING

Shoulder | Slabbing | Channel | Ramping | Corkscrew | Pocket | Facing



Grade	P	M	K	N (K)	S (M)	H (P/K)
IN2005	+	+	+	+		

+ Preferred choice ○ Second choice

△	e9
□	h6

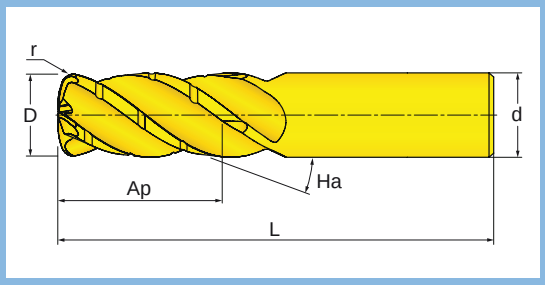
λ = 45° | ≤44 HRC

47C-2550R6RU01	IN2005	45	0.250	4	.010x45	2.50	0.50	.250" Cylindrical
47C-3162R7RU01	IN2005	45	0.312	4	.012x45	2.50	0.63	.312" Cylindrical
47C-3775R8RU01	IN2005	45	0.375	4	.012x45	3.00	0.75	.375" Cylindrical
47C-377577RU01	IN2005	45	0.375	4	.012x45	3.00	0.75	.375" Weldon
47C-5010S4RU01	IN2005	45	0.500	4	.016x45	3.00	1.00	.500" Cylindrical
47C-501078RU01	IN2005	45	0.500	4	.016x45	3.00	1.00	.500" Weldon
47C-6212S6RU02	IN2005	45	0.625	4	.024x45	3.50	1.00	.625" Cylindrical
47C-621279RU02	IN2005	45	0.625	4	.024x45	3.50	1.00	.625" Weldon
47C-7515S7RU02	IN2005	45	0.750	4	.024x45	4.00	1.25	.750" Cylindrical
47C-751584RU02	IN2005	45	0.750	4	.024x45	4.00	1.25	.750" Weldon
47C-1020S1RU02	IN2005	45	1.000	4	.024x45	5.00	1.50	1.000" Cylindrical
47C-102080RU02	IN2005	45	1.000	4	.024x45	5.00	1.50	1.000" Weldon

Operating guidelines on page 82.

4 & 5 FLUTE HI FEED ROUGHING END MILL W/ VARIABLE PITCH & CHIP SPLITTERS

Shoulder | Slabbing | Channel | Ramping | Corkscrew | Pocket | Facing



Grade	P	M	K	N (K)	S (M)	H (P/K)
IN2005	+	+	0		+	

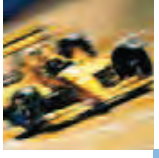
+ Preferred choice ○ Second choice

△	e9
□	h6

λ = 45° | ≤63 HRC

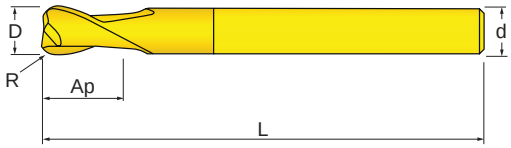
Cutter Number		Helix (deg)	D Diameter	Z Flutes	R Radius	L Overall Length	Ap Cut Length	d Shank Size/Style
45D-2550S3RP05	IN2005	38.0	0.250	4	0.050	2.50	0.500	.250" Cylindrical
45D-3162R7RP06	IN2005	38.0	0.312	4	0.060	2.50	0.625	.312" Cylindrical
45D-3775R8RP07	IN2005	38.0	0.375	4	0.070	3.00	0.750	.375" Cylindrical
45D-3793R8RP70	IN2005	38.0	0.375	5	0.070	3.00	0.938	.375" Cylindrical
45D-5010S4RP10	IN2005	38.0	0.500	4	0.100	3.00	1.000	.500" Cylindrical
45D-5012S4RP10	IN2005	38.0	0.500	4	0.100	3.00	1.250	.500" Cylindrical
45D-6212S6RP13	IN2005	38.0	0.625	4	0.130	3.50	1.200	.625" Cylindrical
45D-6215S6RP13	IN2005	38.0	0.625	5	0.130	3.00	1.560	.625" Cylindrical
45D-7515S7RP15	IN2005	38.0	0.750	4	0.150	4.00	1.500	.750 Cylindrical
45D-7518S7RP15	IN2005	38.0	0.750	5	0.150	4.00	1.870	.750" Cylindrical

Operating guidelines on page 82.



BULL NOSE SOLID CARBIDE ENDMILLS, 2-FLUTES

Shoulder | Channel | Ramping | Corkscrew | Contour



Grade	P	M	K	N (K)	S (M)	H (P/K)
IN2005	+	+	+		+	

e8
h6

λ = 30°

≤54 HRC

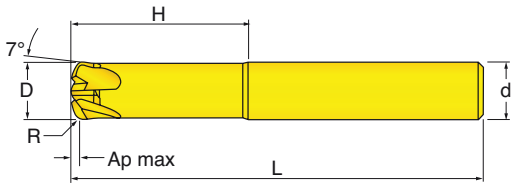
+ Preferred choice ○ Second choice

Cutter Number	Helix (deg)	D Diameter	Z Flutes	R Radius	L Overall Length	Ap Cut Length	d Shank Size/Style
45U-0600R0RB01 IN2005	30.0	0.062	2	0.015	2.50	0.03	.062" Cylindrical
45U-0900R1RB03 IN2005	30.0	0.093	2	0.031	3.00	0.08	.093" Cylindrical
45U-1200R4RB03 IN2005	30.0	0.125	2	0.031	3.00	0.08	.125" Cylindrical
45U-2501R6RB06 IN2005	30.0	0.250	2	0.062	3.00	0.12	.250" Cylindrical
45U-2501R6RB061 IN2005	30.0	0.250	2	0.062	4.00	0.16	.250" Cylindrical
45U-3701R8RB06 IN2005	30.0	0.375	2	0.062	4.00	0.16	.375" Cylindrical
45U-3701R8RB061 IN2005	30.0	0.375	2	0.062	5.00	0.16	.375" Cylindrical
45U-5002S4RB12 IN2005	30.0	0.500	2	0.125	5.00	0.25	.500" Cylindrical
45U-5002S4RB121 IN2005	30.0	0.500	2	0.125	6.50	0.25	.500" Cylindrical

Operating guidelines on page 82.

HI-FEED SOLID CARBIDE ENDMILLS, 4-FLUTES

Shoulder | Channel | Ramping | Corkscrew | Pocket | Facing | Contour



Grade	P	M	K	$N_{(K)}$	$S_{(M)}$	$H_{(P/K)}$
IN2005	+	+	+		+	

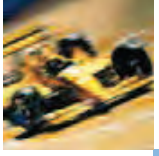
e8
h6

λ = 30° | ≤54 HRC

+ Preferred choice ○ Second choice

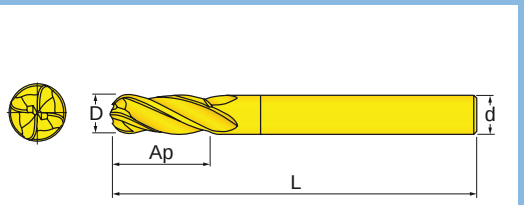
Cutter Number		D Diameter	Z Flutes	C Radius	L Overall Length	H Height	Ap Cut Length	d Shank Size/Style
45A-2500R6RA03	IN2005	0.250	4	0.040	2.48	0.780	0.12	.250" Cylindrical
45A-3100R7RA05	IN2005	0.312	4	0.050	2.48	1.030	0.13	.312" Cylindrical
45A-3700R8RA06	IN2005	0.375	4	0.060	2.98	1.230	0.15	.375" Cylindrical
45A-5000S4RA07	IN2005	0.500	4	0.080	2.98	1.320	0.18	.500" Cylindrical

Operating guidelines on page 86.



BALL NOSE SOLID CARBIDE END MILLS, MULTI-PURPOSE

Shoulder | Channel | Ramping | Corkscrew | Pocket | Contour



Grade	P	M	K	N (K)	S (M)	H (P/K)
IN2005	+	+	+		+	

+ Preferred choice ○ Second choice

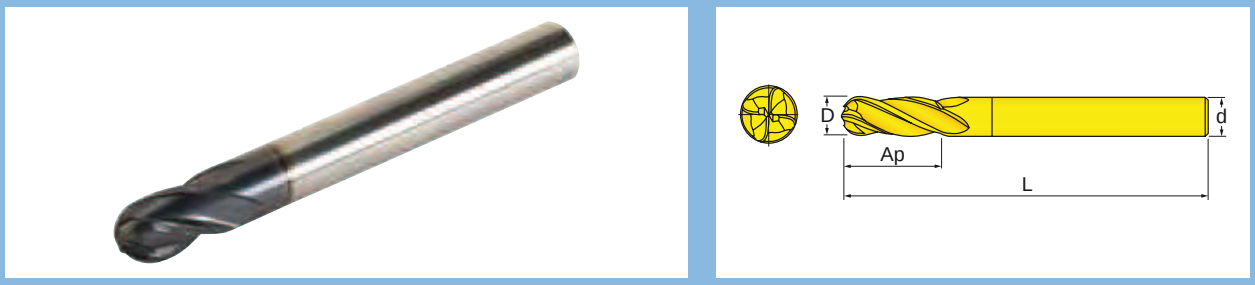
△	e8
□	h6

λ = 30° | ≤63 HRC

Cutter Number		Length	Helix (deg)	D Diameter	Z Flutes	R Radius	L Overall Length	Ap Cut Length	d Shank Size/Style
45B-1201R4RB15	IN2005	Short	30.0	0.125	2	0.063	1.50	0.19	.125" Cylindrical
45B-1802R5RB20	IN2005	Short	30.0	0.188	2	0.094	2.00	0.25	.188" Cylindrical
45B-2503R6RB25	IN2005	Short	30.0	0.250	2	0.125	2.50	0.31	.250" Cylindrical
45B-3103R7RB25	IN2005	Short	30.0	0.312	2	0.157	2.50	0.38	.312" Cylindrical
45B-3704R8RB25	IN2005	Short	30.0	0.375	2	0.188	2.50	0.44	.375" Cylindrical
45B-4305R9RB27	IN2005	Short	30.0	0.438	2	0.219	2.75	0.50	.438" Cylindrical
45B-5005S4RB30	IN2005	Short	30.0	0.500	2	0.250	3.00	0.56	.500" Cylindrical
45B-6206S6RB35	IN2005	Short	30.0	0.625	2	0.313	3.50	0.69	.625" Cylindrical
46B-1201R4RB15	IN2005	Short	30.0	0.125	3	0.063	1.50	0.19	.125" Cylindrical
46B-1802R5RB20	IN2005	Short	30.0	0.188	3	0.094	2.00	0.25	.188" Cylindrical
46B-2503R6RB25	IN2005	Short	30.0	0.250	3	0.125	2.50	0.31	.250" Cylindrical
46B-3103R7RB25	IN2005	Short	30.0	0.312	3	0.157	2.50	0.38	.312" Cylindrical
46B-3704R8RB25	IN2005	Short	30.0	0.375	3	0.188	2.50	0.44	.375" Cylindrical
46B-5005S4RB30	IN2005	Short	30.0	0.500	3	0.250	3.00	0.56	.500" Cylindrical
46B-6206S6RB35	IN2005	Short	30.0	0.625	3	0.313	3.50	0.69	.625" Cylindrical
47B-1201R4RB15	IN2005	Short	30.0	0.125	4	0.063	1.50	0.02	.125" Cylindrical
47B-1205R4RB15	IN2005	Medium	30.0	0.125	4	0.063	1.50	0.69	.125" Cylindrical
47B-1202R4RB22	IN2005	Long	30.0	0.125	4	0.063	2.25	0.25	.125" Cylindrical
47B-1802R5RB20	IN2005	Short	30.0	0.188	4	0.094	2.00	0.25	.188" Cylindrical
47B-1806R5RB20	IN2005	Medium	30.0	0.188	4	0.094	2.00	0.50	.188" Cylindrical
47B-1803R5RB25	IN2005	Long	30.0	0.188	4	0.094	2.50	0.38	.188" Cylindrical
47B-2503R6RB25	IN2005	Short	30.0	0.250	4	0.125	2.50	0.31	.250" Cylindrical
47B-2507R6RB25	IN2005	Medium	30.0	0.250	4	0.125	2.50	0.63	.250" Cylindrical
47B-2505R6RB40	IN2005	Long	30.0	0.250	4	0.125	4.00	0.50	.250" Cylindrical
47B-3103R7RB25	IN2005	Short	30.0	0.312	4	0.157	2.50	0.38	.312" Cylindrical
47B-3108R7RB25	IN2005	Medium	30.0	0.312	4	0.157	2.50	0.75	.312" Cylindrical
47B-3107R7RB40	IN2005	Long	30.0	0.312	4	0.157	4.00	0.75	.312" Cylindrical
47B-3704R8RB25	IN2005	Short	30.0	0.375	4	0.188	2.50	0.44	.375" Cylindrical
47B-3710R8RB30	IN2005	Medium	30.0	0.375	4	0.188	3.00	0.81	.375" Cylindrical
47B-0308R8RB40	IN2005	Long	30.0	0.375	4	0.188	4.00	0.88	.375" Cylindrical
47B-4305R9RB27	IN2005	Short	30.0	0.438	4	0.219	2.75	0.50	.438" Cylindrical
47B-4310R9RB30	IN2005	Medium	30.0	0.438	4	0.219	3.00	1.00	.438" Cylindrical
47B-5005S4RB30	IN2005	Short	30.0	0.500	4	0.250	3.00	0.56	.500" Cylindrical
47B-5010S4RB30	IN2005	Medium	30.0	0.500	4	0.250	3.00	1.00	.500" Cylindrical
47B-5010S4RB45	IN2005	Long	30.0	0.500	4	0.250	4.50	1.00	.500" Cylindrical

BALL NOSE SOLID CARBIDE END MILLS, MULTI-PURPOSE

Shoulder | Channel | Ramping | Corkscrew | Pocket | Contour



Grade	P	M	K	$N_{(K)}$	$S_{(M)}$	$H_{(P/K)}$
IN2005	+	+	+		+	

+ Preferred choice ○ Second choice

e8
h6

λ = 30° | ≤63 HRC

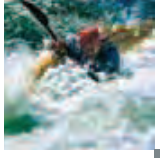
Cutter Number	Length	Helix (deg)	D Diameter	Z Flutes	R Radius	L Overall Length	Ap Cut Length	d Shank Size/Style
47B-6206S6RB35 IN2005	Short	30.0	0.625	4	0.313	3.50	0.69	.625" Cylindrical
47B-6212S6RB35 IN2005	Medium	30.0	0.625	4	0.313	3.50	1.00	.625" Cylindrical
47B-6212S6RB50 IN2005	Long	30.0	0.625	4	0.313	5.00	1.25	.625" Cylindrical
47B-7515S7RB40 IN2005	Medium	30.0	0.750	4	0.375	4.00	1.25	.750" Cylindrical
47B-7515R8RB50 IN2005	Long	30.0	0.750	4	0.375	5.00	1.50	.750" Cylindrical

Operating guidelines on page 82.

Ingersoll

TECHNICAL INFORMATION.

Member IMC Group
Ingersoll Cutting Tools



DESIGNATION SYSTEM SOLID CARBIDE MILLING CUTTERS

X 1	X 2	A 3	XXX 4
1 TOOL TYPE	**2 DENSITY**	**3 STYLE**	**4 TOOL DIAMETER**
4 Solid carbide end mills & screw on	**5** Solid carbide, 1 & 2 no. of flutes, large spacing	**ABCDJY**	3-digit number e.g. diameter .250" = 25
	6 Solid carbide, 3 no. of flutes, normal spacing		
	7 Solid carbide, 4 & 5 no. of flutes, narrow spacing		
	8 Solid carbide, 6 - 9 no. of flutes, extra narrow spacing		

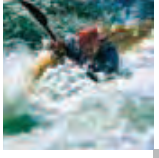
A = Letter
X = Number
E = Number or letter
H = Letter
0 = Standard or special design

* = Depending on tool type up to 4 digits can be used on this position when detailed designation is required.

XX	EE	H	00
5	6	7	8

5 CUTTING LENGTH OR TOOL HEIGHT	6 ADAPTION CODE	7 ROTATING DIRECTION	8 STANDARD OR SPECIAL TOOLS
	70 0.750 Weldon **71** 0.312 Weldon **77** 0.375 Weldon **78** .0500 Weldon **79** 0.625 Weldon **80** 1.000 Weldon **81** 1.250 Weldon **82** 2.000 Weldon **83** 2.500 Weldon **84** 0.750 Weldon **85** 0.875 Weldon **86** 1.500 Weldon **R4** 0.125 Straight Shank **R5** 0.187 Straight Shank **R6** 0.250 Straight Shank **R7** 0.312 Straight Shank **R8** 0.375 Straight Shank **R9** 0.437 Straight Shank **S1** 1.000 Straight Shank **S2** 2.000 Straight Shank **S3** 2.500 Straight Shank **S4** 0.500 Straight Shank **S5** 1.500 Straight Shank **S6** 0.625 Straight Shank **S7** 0.750 Straight Shank **S8** 0.875 Straight Shank **S9** 1.250 Straight Shank **TQ** T05 Chip Sufer **T6** T06 Chip Sufer **T8** T08 Chip Sufer **TR** T10 Chip Sufer **TS** T12 Chip Sufer **TU** T15 Chip Sufer	**R** R.H. mills **L** L.H. mills **-** neutral (R.H./L.H.)	**A** 0°–25° pos. helical angle **B** 26°–34° pos. helical angle **C** 35°–44° pos. helical angle **D** pos. helical angle > 45° **N** > 45° pos. helical angle with chip breaker resp. neutral slot mill **Q** HPC divers spacing **U** 45° roughing and finishing

Subject to technical changes



CHIP SURFER & ROUND LINE

GRADES

UNCOATED CARBIDES

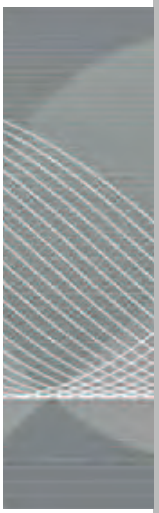
IN05S	M10–M20	Micro-grain carbide grade, well suitable for machining titanium and super alloys of the ISO material group S. Also applied successfully for non-ferrous metals as well as for light-duty milling in gray cast iron.

COATED CARBIDES

IN2005	P15–P30 M15–M35 K20–K40	Coated micro-grain carbide grade with good toughness and excellent wear resistance for machining steels with increased tenacity, stainless steels, titanium as well as gray cast iron and nodular cast iron.
IN2006	P05–P20 M10–M20	Coated micro-grain carbide grade with good toughness and excellent wear resistance for machining hardened steels up to 62 HRC.
IN1030	P20–P40 M20–M40 K15–K30	Universal grade for all steels. Wet milling of stainless steel at medium cutting speed. Very tough and resistant to chipping.
IN3005		Diamond coated for milling graphite.

PCD

IN80B	K01–K20	Cubic Boron Nitride (CBN) for maching iron and hard steel.

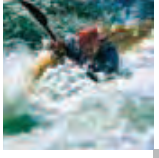


CHIP SURFER & ROUND LINE

GENERAL FORMULA FOR MILLING OPERATIONS

Value	Unit	Formula
RPM	min^{-1}	$n = \frac{v_c \times 1000}{D \cdot \pi}$
Cutting speed	ft/min	$v_c = \frac{D \cdot \pi \cdot n}{1000}$
Feed rate	inch/min	$v_f = f_z \cdot Z_{eff} \cdot n$
Feed per tooth	inch	$f_z = \frac{v_f}{Z_{eff} \cdot n}$
Chip removal rate	cm^3/min	$Q = \frac{a_e \cdot a_p \cdot v_f}{1000}$
Average chip thickness	mm	$h_m = f_z \cdot \sqrt{a_e}/D$

Calculation example shoulder milling	
Workpiece material:	4340
Cutter type:	HPC
Cutter designation:	47D-3707R8RC02
Cutter diameter:	.375
Effective no. of teeth:	4
Cutting depth a_p:	.125
Cutting width a_e:	.10
Cutting speed v_c:	450 SFM
Feed per tooth f_z:	.004
Calculation of no. of revolutions:	$n = \frac{450 \cdot 12}{.375 \cdot \pi} = 4584\ min^{-1}$
Calculation of feed rate:	$v_f = .004 \cdot 4 \cdot 4584 = 73.3$ ipm
Calculation of chip removal rate:	$Q = 4584 \times .125 \times .10 \times .004 \times 4 = .91\ in^3/min$
Calculation of average chip thickness:	$h_m = .004 \cdot \sqrt{.10}/.375 = .002$ in



GENERAL FORMULA FOR MILLING OPERATIONS

Explanation of catalog parameters and formula symbols		
Symbol	Unit	Designation
D	inch	Nominal diameter
n	min^{-1}	RPM
a_e	inch	Width of cut
a_p	inch	Cutting depth
f_z	inch	Feed per tooth
f	mm/U	Feed per revolution
h_m	inch	Average chip thickness
P_c	kW	Spindle power consumption
Q	ft^3/min	Chip removal rate
v_c	ft/min	Cutting speed
v_f	in/min	Feed rate
C	x 45°	Chamfer
R	–	Radius

MARKING OF SOLID CARBIDE MILLING CUTTERS

Example

EXAMPLE 1

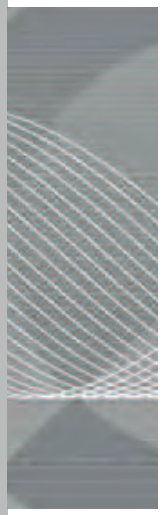
Designation	47C-370777RQ01
Marking	D.375 L.75 R.015 C.375

D	Diameter
0.375	Nominal cutter diameter in inches
Ap	Cutting length
0.750	Nominal cutting length in inches
C	Chamfer
0.015	Nominal size of chamfer in inches
W	Weldon-shank
0.375	Nominal diameter of shank in inches

EXAMPLE 2

Designation	47J-5010S4RC06
Marking	D.500 L1.00 R.060 C.500

D	Diameter
0.500	Nominal cutter diameter in inches
Ap	Cutting length
1.000	Nominal cutting length in inches
R	Radius
0.060	Nominal corner radius in inches
C	Weldon-shank
0.500	Nominal diameter of shank in inches



SYMBOLS

Helix angle

Milling of hard materials up to HRC (Rockwell hardness)

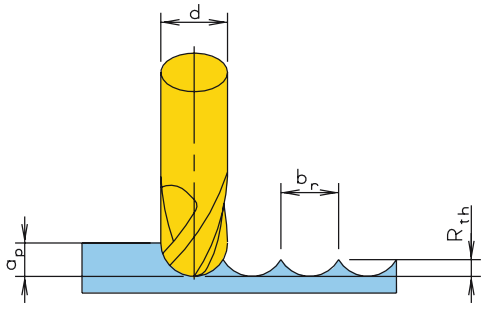
Qualified for wet machining

Dry machining

Non-ferrous machining

CHIP SURFER & ROUND LINE

APPLICATION EXAMPLE



Influence of cutting line width on surface roughness

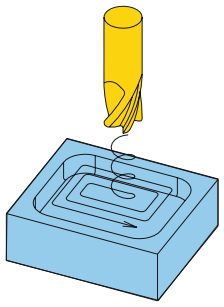
Calculation of cutting line width:

$$b_r = 2 \times \sqrt{a_p \times (d - a_p)}$$

Kinematic roughness:

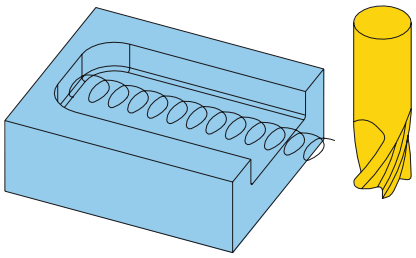
$$R_{th} = \frac{d}{2} - \sqrt{\frac{d^2 - b_r^2}{4}}$$

MILLING OF HARD MATERIALS



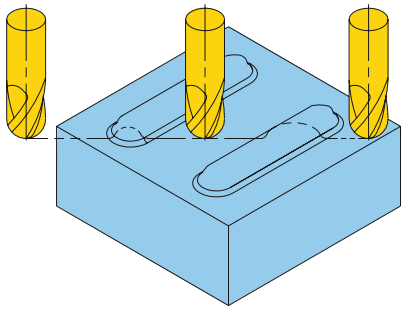
Roughing 3D

- Center plunging with circular interpolation
- Climb milling ae ≤ cutter radius
- Edge honing
- Small widths of cut
- Constant feed rates



Milling of full slots in hardened steel ≥ 54 HRC

- Spiral-type machining (trochoidal milling)
- Constant feed
- Constant cutting conditions
- Good chip flow (air)



Finishing 3D

- Avoid complete arc of contact of cutter
- Diagonal machining
- Hone edges, if radius of geometry is ≤ than cutter radius
- Pay attention to bevel angle of ball nose cutters (15°–20°) to avoid eff $v_c \leq 0$

INDEXING CHIP SURFER® TIP GUIDELINES

Step 1: Screw tip into shank until finger tight (Figure 1a). Note a .010" gap (Figure 1b).
Step 2: Use wrench to torque approximately 1/4 turn, creating a simultaneous fit (Figure 2).
Step 3: Use .001" shim stock to check the simultaneous fit at the intersection of the tip and the shank.
The shim should not be able to enter the intersection (Figure 3a).
If it does, tighten further with the wrench until there is no gap (Figure 3b).

Note: Pre-set torque wrenches (series DT-. . .) can be purchased.

Figure 1a. Finger tight

Figure 1b. .010" gap

Figure 2. 1/4 turn

Figure 3a. Shim should NOT enter intersection

Figure 3b. Proper fit

Series DT-. . . Optional Torque Wrench

GENERAL TECHNICAL INFORMATION

DATA FOR REGRINDING SOLID CARBIDE MILLS

	d1	a	RA	Pra/Rra	SRa	tA	aA	PA	SA	W	A	A1	Lw	Aw	P	B
End mill																
2 flutes	<.300"	30	12	13	-	2.5	5	10	17	.007xd1	11.5	-	-	.004xd1	-	-
	<.300"	30	10	12	-	2	5	10	17	.007xd1	11.0	-	-	.004xd1	-	-
3 flutes	<.300"	38-45	12	13	-	2	6	8	16	.007xd1	10.5	-	-	.004xd1	-	-
	<.300"	38-45	10	12	-	1.5	6	7	16	.006xd1	9.5	-	-	.004xd1	-	-
4 flutes	<.300"	30-45	11	13.5	-	1.5	5	8	16	.0065xd1	10.8	-	-	.004xd1	-	-
	<.300"	30-45	10	12	-	1.5	5	7	16	.006xd1	9.5	-	-	.004xd1	-	-
6 flutes	<.300"	45	10	11	-	1.5	5	7	16	.0055xd1	9.0	-	-	.003xd1	-	-
	<.300"	45	10	10	-	1.5	5	7	16	.005xd1	8.5	-	-	.003xd1	-	-
Ball nose mill																
2 flutes	<.300"	30	12	11	22	-	7	11	22	.007xd1	11.0	22	.0023xd1	.004xd1	(.017xd1)/2	.0060xd1
	<.300"	30	11	11	22	-	6	11	22	.0065xd1	11.0	22	.002xd1	.004xd1	(.017xd1)/2	.0058xd1
3 flutes	<.300"	30	12	11	22	-	7	11	22	.007xd1	11.0	22	.0023xd1	.004xd1	(.017xd1)/2	.0060xd1
	<.300"	30	11	11	22	-	6	11	22	.0065xd1	11.0	22	.002xd1	.004xd1	(.017xd1)/2	.0058xd1
4 flutes	<.300"	30	12	11	23	-	7	11	23	.007xd1	11.0	23	.0023xd1	.004xd1	(.017xd1)/2	.0060xd1
	<.300"	30	11	11	22	-	6	11	22	.0065xd1	11.0	22	.002xd1	.004xd1	(.017xd1)/2	.0058xd1
End mill with corner radius																
	<.300"	38-45	12	13.5	25	3	8	8	17	.007xd1	10.8	21	.0023xd1	.004xd1	(.017xd1)/2	.0060xd1
3 flutes	<.300"	38-45	10	12	25	3	8	8	17	.0065xd1	10.0	21	.002xd1	.004xd1	(.017xd1)/2	.0058xd1
4 flutes	<.300"	30-45	11	13.5	25	3	8	8	17	.007xd1	10.8	21	.0023xd1	.004xd1	(.017xd1)/2	.0060xd1
	<.300"	30-45	10	12	25	3	8	8	17	.0065xd1	10.0	21	.002xd1	.004xd1	(.017xd1)/2	.0058xd1
6 flutes	<.300"	45	10	11	16	2	8	7	16	.0055xd1	9.0	16	.0023xd1	.004xd1	(.017xd1)/2	.0050xd1
	<.300"	45	10	10	18	1.5	7	7	16	.005xd1	8.5	17	.002xd1	.004xd1	(.017xd1)/2	.0046xd1
Rough mill																
	<.300"	45	12	10	-	2.5	7	7	17	.008xd1	9.0	-	-	.008xd1	-	-
	<.300"	45	11	9	-	2.5	5	7	17	.008xd1	8.0	-	-	.006xd1	-	-
Aluminum mill																
	<.300"	45-55	18	14	27	4	11	12	25	.0065xd1	13.0	26	.0023xd1	.004xd1	(.017xd1)/2	.0060xd1
2 flutes	<.300"	45-55	17	13	26	4	11	11	24	.0075xd1	12.0	25	.002xd1	.004xd1	(.017xd1)/2	.0067xd1

Parameters / Paramètres:

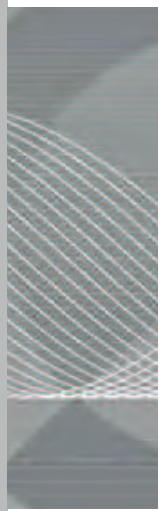
d1	=	Cutter diameter	PA	=	Axial primary relief angle
a	=	Helix angle	SA	=	Axial secondary clearance angle
Ra	=	Radial rake angle	aA	=	Axial rake angle
PRa	=	Radial primary relief anglel	Aw	=	Axial land width
SRa	=	Radial secondary clearance angle	A	=	Radius / chamfer primary relief angle
W	=	Radial flute width	A1	=	Radius / chamfer 2nd clearance angle
Lw	=	Radial land width	P	=	Radius / Chamfer land
tA	=	Dish angle	B	=	Radius / chamfer flute land

Regrinding and surface coating of end mills

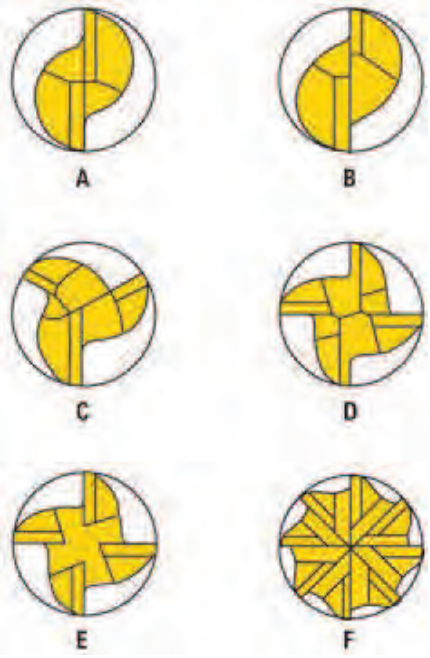
1. Regrinding may not influence the original composition of surface substrate.

2. End mills have to be cleansed after regrinding, to remove oil or other dirt. Areas that have to be coated should be cleaned once more shortly before.

3. Thickness of coating to be 2 - 4 µm for TiCN- and TiAlN-alloys.



CHIP GULLET AND FRONT FLUTE DESIGN



The number of flutes depends on:

- workpiece material.
- size of workpiece.
- milling conditions and profile shape.

Cutters with higher number of flutes have to be preferred, as long as chip flow is guaranteed.

Geometry of front flutes

A = 2 flutes, 2 flutes cutting to center.

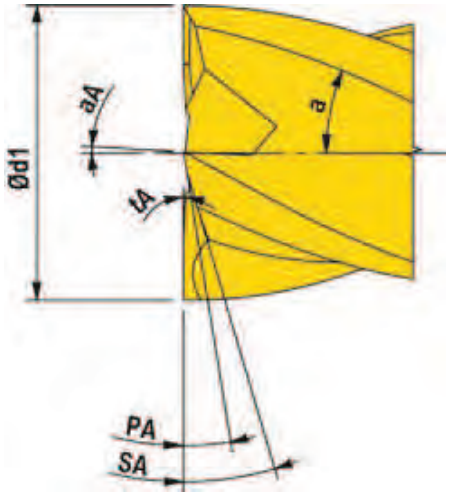
B = 2 flutes, 1 flute cutting above center.

C = 3 flutes, 1 flute cutting above center.

D = 4 flutes, 2 flutes cutting to center.

E = 2 or 4 flutes, not cutting above center.

F = 5 or 6 flutes, not cutting above center.



Geometry of front edges

PA = Axial primary relief angle

SA = Axial secondary clearance angle

Ra = Radial rake angle

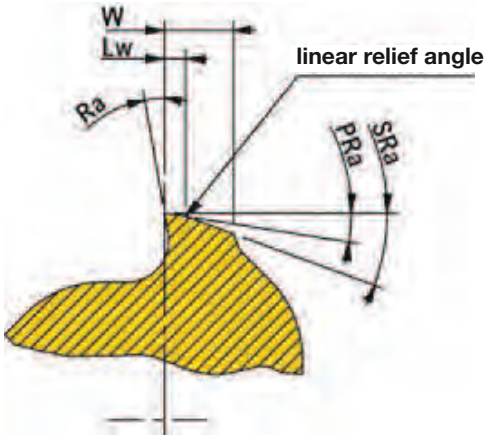
aA = Axial rake angle

tA = Dish angle

d1 = Cutter diameter

a = Helix angle

RELIEF GRIND AND TOOL FLANK DESIGN



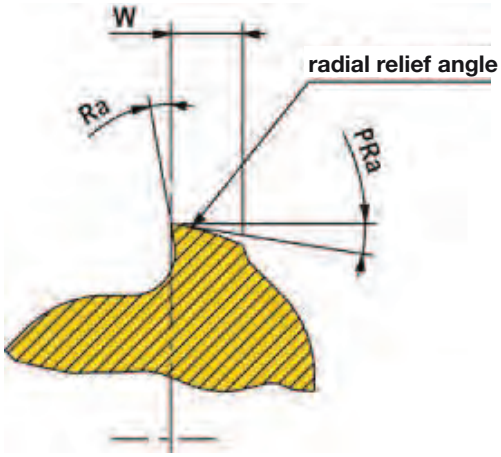
1.

2 types of relief grinding:

1. 2-chamfered linear relief grinding with primary and secondary flute.
2. Radial relief grinding

The 2-chamfered surface relief grinding is the most common and easy to measure or to determine by the size of the relief angle.

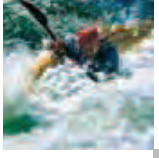
The radial relief angle can be clearly indicated only over a determined measuring length, but the convex shape that reduces the angle, has to be taken into account also. This kind of grinding can offer considerable advantages, for example if regrinding shall only be carried out on the rake face.



2.

Milling performance and tool life of the cutter are very much influenced by the primary relief angle of the flutes. The primary relief angle depends on the application of the cutter (workpiece material etc.) as well as the suitable feed rate of the respective diameter. This is important especially for regrinding, because the performance of standard tools can thus be optimized.

W = Radial flute width
LW = Radial land width
PRa = Radial primary relief angle
SRa = Radial secondary relief angle
Ra = Radial rake angle



CHIP SURFER, ROUNDline - STANDARD BALL NOSE AND END MILLS

Series 45B, 45D, 45J, 45M, 45N, 45P, 45X, 46D, 47C, 47D, 47J, 47N, 48C, 48D, 48J, 48N, 48U, 49D, 49J

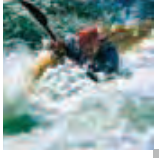
Workpiece Material		Cutting speed vc in/min				Feed rate per tooth fz ft/min			
		Ball nose mill		End mill		Ball nose mill		End mill	
	DC in	Roughing copy milling	Finishing copy milling	Full slot	Shoulder	Roughing copy milling	Finishing copy milling	Full slot	Shoulder
Unalloyed steel P	.125-.250	525-725	725-975	300-600	450-800	.0015 - .0030	.0007 - .0020	.0006 - .0010	.0018 - .0030
	.312-.500	450-650	725-975	300-600	450-800	.0060 - .0080	.0040 - .0060	.0025 -.0040	.0040 - .0055
	.625-1.00	450-650	725-975	300-600	450-800	.0080 - .0100	.0060 - .0080	.0030 - .0040	.0060 - .0090
High Carbon steel P	.125-.250	400-600	325-600	250-500	325-725	.0013 - .0030	.0007 - .0020	.0006 - .0018	.0007 - .0025
	.312-.500	400-600	600-850	300-600	400-650	.0040 - .0070	.0030 - .0040	.0020 -.0030	.0030 - .0040
	.625-1.00	400-600	600-850	300-600	400-650	.0065 - .0090	.0040 - .0080	.0025 - .0040	.0040 - .0080
Alloyed / Tool steel P	.125-.250	325-525	500-800	250-450	325-525	.0018 - .0030	.0007 - .0020	.0006 - .0018	.0007 - .0020
	.312-.500	325-525	500-800	250-450	325-600	.0030 - .0055	.0028 - .0040	.0015 -.0028	.0028 - .0040
	.625-1.00	325-525	500-800	250-450	325-600	.0055 - .0080	.0040 - .0070	.0020 - .0030	.0040 - .0070
Stainless steel M	.125-.250	250-450	300-600	165-300	250-450	.0007 - .0015	.0007 - .0015	.0040 - .0007	.0040 - .0013
	.312-.500	250-450	300-600	165-300	250-450	.0030 - .0040	.0030 - .0040	.0015 - .0025	.0028 - .0040
	.625-1.00	250-450	300-600	165-300	250-450	.0040 - .0080	.0040 - .0080	.0025 - .0040	.0040 - .0080
Gray cast iron K	.125-.250	500-750	700-950	325-525	500-975	.0015 - .0030	.0007 - .0020	.0006 - .0010	.0018 - .0030
	.312-.500	500-750	700-950	325-525	500-900	.0060 - .0080	.0040 - .0060	.0025 -.0040	.0040 - .0055
	.625-1.00	500-750	700-950	250-550	500-900	.0080 - .0100	.0060 - .0080	.0030 - .0040	.0060 - .0090
Cast alloys K	.125-.250	400-650	600-850	250-550	400-650	.0013 - .0030	.0007 - .0020	.0006 - .0018	.0007 - .0025
	.312-.500	400-650	600-850	250-550	400-650	.0040 - .0070	.0030 - .0040	.0020 -.0030	.0030 - .0040
	.625-1.00	400-650	600-850	250-550	400-650	.0065 - .0090	.0040 - .0080	.0025 - .0040	.0040 - .0080
Aluminum N	.125-.250	825-2500	825-2500	825-2500	825-2500	.0015 - .0030	.0010 - .0025	.0007 - .0015	.0010 - .0030
	.312-.500	2500-3500	3000-5000	2500-3500	3000-5000	.0040 - .0070	.0040 - .0070	.0035 - .0040	.0040 - .0070
	.625-1.00	2500-3500	3000-5000	2500-3500	5000-6500	.0080 - .0100	.0060 - .0090	.0060 - .0070	.0070 - .0090
Plastics N	.125-.250	500-975	650-1300	400-650	650-1300	.0007 - .0015	.0007 - .0015	.0040 - .0018	.0070 - .0015
	.312-.500	500-975	650-1300	400-650	650-1300	.0030 - .0040	.0030 - .0040	.0020 - .0030	.0028 - .0040
	.625-1.00	500-975	650-1300	400-650	650-1300	.0040 - .0080	.0040 - .0080	.0028 - .0040	.0040 - .0080
Super alloys S	.125-.250	65-165	100-225	65-165	100-200	.0006 - .0010	.0007 - .0015	.0040 - .0006	.0040 - .0010
	.312-.500	65-165	100-225	65-165	100-200	.0020 - .0030	.0030 - .0040	.0010 - .0020	.0020 - .0040
	.625-1.00	65-165	100-225	65-165	100-200	.0030 - .0060	.0040 - .0080	.0020 - .0030	.0040 - .0070
Hardened steel 48 - 54 HRC	.125-.250	130-225	250-650	130-325	200-400	.0018 - .0030	.0007 - .0020	.0006 - .0018	.0007 - .0020
	.312-.500	130-225	250-650	130-325	200-400	.0030 - .0055	.0028 - .0040	.0015 -.0028	.0028 - .0040
	.625-1.00	130-225	250-650	130-325	200-400	.0055 - .0080	.0040 - .0070	.0020 - .0030	.0040 - .0070
Hardened steel 54 - 63 HRC	.125-.250	100-165	250-650	65-165	150-250	.0007 - .0025	.0007 - .0015	.0040 - .0007	.0040 - .0015
	.312-.500	100-165	250-650	65-200	150-250	.0025 - .0040	.0025 - .0030	.0010 -.0020	.0020 - .0030
	.625-1.00	100-165	250-650	65-200	150-250	.0040 - .0070	.0030 - .0040	.0015 - .0028	.0030 - .0060
Hardened steel > 63 HRC	.125-.250	65-165	100-350	65-100	100-200	.0006 - .0015	.0007 - .0010	.0040 - .0040	.0040 - .0010
	.312-.500	65-165	100-350	65-130	100-200	.0015 - .0040	.0015 - .0028	.0007 -.0015	.0015 - .0025
	.625-1.00	65-165	100-350	65-130	100-200	.0040 - .0060	.0028 - .0040	.0010 - .0025	.0025 - .0060

General Information:
Machining of aluminum and duroplastics with grade IN05S, any other materials with IN2005 / IN2006. Max. cutting depth of end mills is determined by cutting length.
Please consider the limitation of max. RPM of the machine.

CHIP SURFER, ROUNDline - STANDARD BALL NOSE AND END MILLS

Workpiece Material	DC in	Cutting depth ap recomm. for Ball nose mill in	Cutting depth ap recomm. for End mill in	Cutting width Recommended ae %			
Unalloyed steel P	.125-.250	.004 x D	.0500 x D	40%			
	.312-.500	.004 x D	.0500 x D	40%			
	.625-1.00	.004 x D	.0500 x D	40%			
High Carbon steel P	.125-.250	.003 x D	.030 x D	30%			
	.312-.500	.003 x D	.030 x D	30%			
	.625-1.00	.003 x D	.030 x D	30%			
Alloyed / Tool steel P	.125-.250	.0025 x D	.030 x D	25%			
	.312-.500	.0025 x D	.030 x D	25%			
	.625-1.00	.0025 x D	.030 x D	25%			
Stainless steel M	.125-.250	.003 x D	.030 x D	30%			
	.312-.500	.003 x D	.030 x D	30%			
	.625-1.00	.003 x D	.030 x D	30%			
Gray cast iron K	.125-.250	.003 x D	.030 x D	40%			
	.312-.500	.003 x D	.030 x D	40%			
	.625-1.00	.003 x D	.030 x D	40%			
Cast alloys K	.125-.250	.003 x D	.030 x D	30%			
	.312-.500	.003 x D	.030 x D	30%			
	.625-1.00	.003 x D	.030 x D	30%			
Aluminum N	.125-.250	.040 x D	.040 x D	30%			
	.312-.500	.040 x D	.040 x D	30%			
	.625-1.00	.040 x D	.040 x D	30%			
Plastics N	.125-.250	.0040 x D	.040 x D	10%			
	.312-.500	.0040 x D	.040 x D	10%			
	.625-1.00	.0040 x D	.040 x D	10%			
Super alloys S	.125-.250	.0040 x D	.020 x D	10%			
	.312-.500	.0040 x D	.020 x D	10%			
	.625-1.00	.0040 x D	.020 x D	10%			
Hardened steel 48 - 54 HRC	.125-.250	.0025 x D	.030 x D	25%			
	.312-.500	.0025 x D	.030 x D	25%			
	.625-1.00	.0025 x D	.030 x D	25%			
Hardened steel 54 - 63 HRC	.125-.250	.002 x D	.027 x D	20%			
	.312-.500	.002 x D	.027 x D	20%			
	.625-1.00	.002 x D	.027 x D	20%			
Hardened steel > 63 HRC	.125-.250	.002 x D	.024 x D	10%			
	.312-.500	.002 x D	.024 x D	10%			
	.625-1.00	.002 x D	.024 x D	10%			

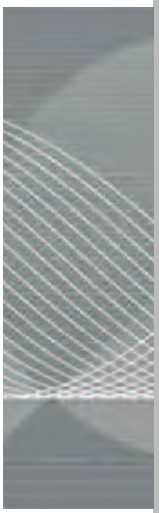
General Information:
Machining of aluminum and duroplastics with grade IN05S, any other materials with IN2005 / IN2006. Max. cutting depth of end mills is determined by cutting length.
Please consider the limitation of max. RPM of the machine.



CHIP•SURFER®, ROUNDline - HIGH FEED END MILL (4 AND/OR 6 FLUTE) OPERATING GUIDELINES

Series 47A, 48A

Workpiece Material	Diameter / Programming radius in	cutting speed Vc in/min	feed per tooth fz (in)	recommended cutting depth ap (in)	
Unalloyed steel P	.250 R.040	650 - 950	.012	.012	
	.312 R.065	650 - 950	.015	.015	
	.375 R.080	650 - 950	.020	.020	
	.500 R.100	650 - 950	.020	.025	
	.625 R.125	650 - 950	.025	.030	
	.750 R.160	650 - 950	.030	.040	
	1.00 R.145	650 - 950	.030	.045	
High Carbon steel P	.250 R.040	600 - 850	.012	.012	
	.312 R.065	600 - 850	.015	.015	
	.375 R.080	600 - 850	.020	.020	
	.500 R.100	600 - 850	.020	.025	
	.625 R.125	600 - 850	.025	.030	
	.750 R.160	600 - 850	.030	.040	
	1.00 R.145	600 - 850	.030	.045	
Alloyed / Tool steel P	.250 R.040	500 - 700	.012	.008	
	.312 R.065	500 - 700	.015	.012	
	.375 R.080	500 - 700	.020	.015	
	.500 R.100	500 - 700	.020	.020	
	.625 R.125	500 - 700	.025	.025	
	.750 R.160	500 - 700	.030	.030	
	1.00 R.145	500 - 700	.030	.040	
Stainless steel M	.250 R.040	450 - 650	.012	.008	
	.312 R.065	450 - 650	.015	.012	
	.375 R.080	450 - 650	.020	.015	
	.500 R.100	450 - 650	.020	.020	
	.625 R.125	450 - 650	.025	.025	
	.750 R.160	450 - 650	.030	.030	
	1.00 R.145	450 - 650	.030	.040	
Gray cast iron K	.250 R.040	650 - 950	.012	.012	
	.312 R.065	650 - 950	.015	.015	
	.375 R.080	650 - 950	.020	.020	
	.500 R.100	650 - 950	.020	.025	
	.625 R.125	650 - 950	.025	.030	
	.750 R.160	650 - 950	.030	.040	
	1.00 R.145	650 - 950	.030	.045	
Cast alloys K	.250 R.040	500 - 700	.012	.008	
	.312 R.065	500 - 700	.015	.012	
	.375 R.080	500 - 700	.020	.015	
	.500 R.100	500 - 700	.020	.020	
	.625 R.125	500 - 700	.025	.025	
	.750 R.160	500 - 700	.030	.030	
	1.00 R.145	500 - 700	.030	.040	

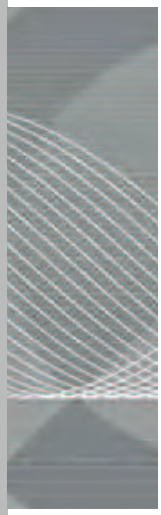


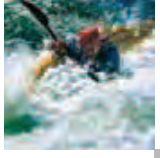
GENERAL TECHNICAL INFORMATION

CHIP SURFER®, ROUND line - HIGH FEED END MILL (4 AND/OR 6 FLUTE) OPERATING GUIDELINES

Series 47A, 48A

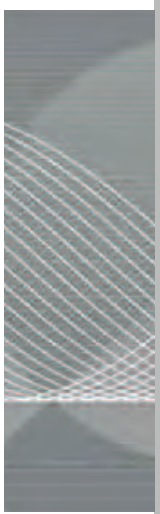
Workpiece Material	Diameter / Programming radius in	cutting speed Vc in/min	feed per tooth fz (in)	recommended cutting depth ap (in)	
Super alloys S	.250 R.040	130 - 250	.008	.004	
	.312 R.065	130 - 250	.008	.008	
	.375 R.080	130 - 250	.012	.012	
	.500 R.100	130 - 250	.012	.012	
	.625 R.125	130 - 250	.015	.020	
	.750 R.160	130 - 250	.015	.020	
	1.00 R.145	130 - 250	.018	.020	
Hardened steel < 50 HRC	.250 R.040	300 - 450	.012	.004	
	.312 R.065	300 - 450	.012	.008	
	.375 R.080	300 - 450	.015	.012	
	.500 R.100	300 - 450	.015	.012	
	.625 R.125	300 - 450	.020	.020	
	.750 R.160	300 - 450	.020	.020	
	1.00 R.145	300 - 450	.020	.020	
Hardened steel < 58 HRC	.250 R.040	150 - 250	.008	.004	
	.312 R.065	150 - 250	.008	.008	
	.375 R.080	150 - 250	.012	.008	
	.500 R.100	150 - 250	.012	.012	
	.625 R.125	150 - 250	.015	.015	
	.750 R.160	150 - 250	.015	.015	
	1.00 R.145	150 - 250	.015	.015	





HI FEED 2 FLUTE END MILLS OPERATING GUIDELINES - SERIES 45A

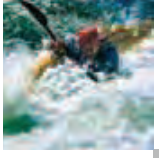
Workpiece Material	Diameter / Programming radius In	cutting speed Vc ft/min	feed per tooth fz (in)	recommended cutting depth ap (in)		
Unalloyed steel P	.375 R.08	650 - 950	.015 - .030	.020		
	.500 R.10	650 - 950	.020 - .040	.035		
	.625 R.12	650 - 950	.025 - .040	.040		
	.750 R.12	650 - 950	.025 - .040	.055		
High Carbon steel P	.375 R.08	600 - 850	.012 - .027	.018		
	.500 R.10	600 - 850	.015 - .030	.025		
	.625 R.12	600 - 850	.015 - .030	.027		
	.750 R.12	600 - 850	.020 - .030	.035		
Alloyed / Tool Steel P	.375 R.08	500 - 700	.012 - .027	.012		
	.500 R.10	500 - 700	.015 - .030	.015		
	.625 R.12	500 - 700	.015 - .030	.018		
	.750 R.12	500 - 700	.020 - .030	.027		
Stainless Steel M	.375 R.08	450 - 650	.012 - .025	.012		
	.500 R.10	450 - 650	.012 - .030	.015		
	.625 R.12	450 - 650	.020 - .030	.018		
	.750 R.12	450 - 650	.020 - .030	.027		
Gray Cast Iron K	.375 R.08	650 - 950	.015 - .030	.020		
	.500 R.10	650 - 950	.020 - .040	.035		
	.625 R.12	650 - 950	.025 - .040	.040		
	.750 R.12	650 - 950	.025 - .040	.055		
Cast alloys K	.375 R.08	500 - 700	.012 - .027	.018		
	.500 R.10	500 - 700	.015 - .030	.025		
	.625 R.12	500 - 700	.015 - .030	.027		
	.750 R.12	500 - 700	.020 - .030	.035		
Super alloys S	.375 R.08	130 - 250	.010 - .020	.007		
	.500 R.10	130 - 250	.010 - .020	.012		
	.625 R.12	130 - 250	.012 - .025	.015		
	.750 R.12	130 - 250	.012 - .025	.020		
Hardened Steel <50 HRC	.375 R.08	300 - 450	.010 - .015	.007		
	.500 R.10	300 - 450	.010 - .015	.012		
	.625 R.12	300 - 450	.012 - .020	.015		
	.750 R.12	300 - 450	.012 - .020	.020		
Hardened Steel <58 HRC	.375 R.08	150 - 250	.010 - .015	.007		
	.500 R.10	150 - 250	.010 - .015	.012		
	.625 R.12	150 - 250	.012 - .020	.015		
	.750 R.12	150 - 250	.012 - .020	.018		



CENTER DRILL OPERATING GUIDELINES - SERIES 45Z

ISO	Material Number	Cutting Speed (SFM)	Feed (in/rev) Ø.118 - Ø.185	Feed (in/rev) Ø.189 - Ø.292	Feed (in/rev) Ø.295 - Ø.396	Feed (in/rev) Ø.397 - Ø.500
P	1	250 - 450	.002" - .006"	.003" - .007"	.005" - .010"	.006" - .012"
	2	250 - 450	.002" - .006"	.003" - .007"	.005" - .010"	.006" - .012"
	3	150 - 400	.002" - .004"	.003" - .005"	.005" - .008"	.006" - .010"
	4	150 - 400	.002" - .004"	.003" - .005"	.005" - .008"	.006" - .010"
	5	150 - 400	.002" - .004"	.003" - .005"	.005" - .008"	.006" - .010"
	6	120 - 250	.002" - .004"	.002" - .005"	.004" - .007"	.005" - .009"
	7	120 - 250	.002" - .004"	.002" - .005"	.004" - .007"	.005" - .009"
	8	120 - 250	.002" - .004"	.002" - .005"	.004" - .007"	.005" - .009"
	9	120 - 250	.002" - .004"	.002" - .005"	.004" - .007"	.005" -.009"
	10	100 - 240	.002" - .004"	.002" - .004"	.004" - .006"	.005" - .009"
	11	100 - 240	.002" - .004"	.002" - .004"	.004" - .006"	.005" - .009"
M	12	190 - 230	.002" - .004"	.002" - .004"	.003" - .006"	.005" - .008"
	13	160 - 200	.002" - .004"	.002" - .005"	.004" - .007"	.006" - .009"
	14	110 - 200	.002" - .004"	.002" - .004"	.003" - .006"	.005" - .008"
K	15	230 - 300	.005" - .008"	.007" - .011"	.009" - .015"	.012" - .020"
	16	230 - 300	.005" - .008"	.007" - .011"	.009" - .015"	.012" - .020"
	17	260 - 330	.006" - .010"	.008" - .013"	.011" - .017"	.013" - .024"
	18	260 - 330	.006" - .010"	.008" - .013"	.011" - .017"	.013" - .024"
	19	260 - 330	.006" - .010"	.008" - .013"	.011" - .017"	.013" - .024"
	20	260 - 330	.006" - .010	.008" - .013"	.011" - .017"	.013" - .024"
N	21	300 - 400	.004" - .010"	.007" - .014"	.009" - .017"	.012" - .020"
	22	300 - 400	.004" - .010"	.007" - .014"	.009" - .017"	.012" - .020"
	23	300 - 400	.004" - .010"	.007" - .014"	.009" - .017"	.012" - .020"
	24	300 - 400	.004" - .010	.007" - .014"	.009" - .017"	.012" - .020"
	25	300 - 400	.004" - .010"	.007" - .014"	.009" - .017"	.012" - .020"
	26	300 - 400	.003" - .007"	.007" - .014"	.009" - .017"	.012" - .020"
	27	300 - 400	.003" - .007"	.007" - .014"	.009" - .017"	.012" - .020"
	28	300 - 400	.003" - .007"	.007" - .014"	.009" - .017"	.012" - .020"
	29					
	30					
S	31	30 - 80	.001" - .003"	.002" - .003"	.003" - .004"	.004" - .005"
	32	30 - 80	.001" - .003"	.002" - .003"	.003" - .004"	.004" - .005"
	33	30 - 80	.001" - .003"	.002" - .003"	.003" - .004"	.004" - .005"
	34	30 - 80	.001" - .003"	.002" - .003"	.003" - .004"	.004" - .005"
	35	30 - 80	.001" - .003"	.002" - .003"	.003" - .004"	.004" - .005"
	36	70 - 140	.001" - .003"	.002" - .004"	.003" - .006"	.004" - .008"
	37	70 - 140	.001" - .003"	.002" - .004"	.003" - .006"	.004" - .008"
H	38	50 - 100	.001" - .002"	.001" - .003"	.001" - .003"	.002" - .004"
	39	50 - 100	.001" - .002"	.001" - .003"	.001" - .003"	.002" - .004"
	40	50 - 100	.001" - .002"	.001" - .003"	.001" - .003"	.002" - .004"
	41	50 - 100	.001" - .002"	.001" - .003"	.001" - .003"	.002" - .004"

○=P ○=M ○=K ○=N ○=S ○=H



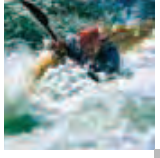
OPERATING GUIDELINES FOR SOLID CARBIDE THREAD MILLS - SERIES 47Y

Main ISO-group	Workpiece Material	Remark	Tensile Strength	Hardness	Machin. Group
P	< 0,25 % C	Annealed	420	125	1
	Unalloyed steel >= 0,25 % C	Annealed	650	190	2
	Cast steel < 0,25 % C	Tempered	850	250	3
	Free cutting steel >= 0,55 % C	Annealed	750	220	4
		Tempered	1000	300	5
	Steel medium tensile strength	Annealed	600	200	6
	and cast steel	Tempered	930	275	7
	(with less than 5 % C)	Tempered	1000	300	8
		Tempered	1200	350	9
	High-alloyed cast steel	Annealed	680	200	10
	Steel and tool steel	Tempered	1100	325	11
M	Stainless steel	Ferritic, martensitic	680	200	12
	and cast steel	Martensitic	820	240	13
		Austenitic	600	180	14
K	Nodular gray cast iron	Ferritic, pearlitic	-	180	15
	(GGG)	Pearlitic	-	260	16
	Gray cast iron	Ferritic	-	160	17
	(GG)	Pearlitic	-	250	18
	Malleable cast iron	Ferritic	-	130	19
	Malleable cast iron	Pearlitic	-	230	20
N	Aluminum-wrought alloy	Untreated	-	60	21
	Aluminum-wrought alloy	Forged, alloyed	-	100	22
	Aluminum cast alloy	Untreated	-	75	23
	Aluminum cast alloy	Forged, alloyed	-	90	24
	Aluminum cast alloy >12 % Si	High temp. resist.	-	130	25
	Copper alloys	Easy to machine	-	110	26
	CuZn-alloys (brass)		-	90	27
	Elektrolytic copper		-	100	28
	Duroplastics		-	90	29
	Graphite		-	-	30
	Ebonite		-	-	-
S	High temp. resisting alloys .	Fe-base, tempered	-	200	31
	Superalloys	Ni/Co-base, treated	-	280	32
	Superalloys	Ni/Co-base, tempered	-	250	33
	Superalloys	Ni/Co-base, treated	-	350	34
	Titanium, cast		-	320	35
	Titanium		400	-	36
	Titanium alloys	Alpha & beta alloy, treated	1050	-	37
H	Hardened steel	Hardened	-	55 HRC	38
	Hardened steel	Hardened	-	60 HRC	39
	Chill casting	Cast	400	-	40
	Cast iron	Hardened	-	55 HRC	41

OPERATING GUIDELINES FOR SOLID CARBIDE THREAD MILLS - SERIES 47Y

IN 2005	Feed (in/tooth) - Cutting Diameter											
(ft/min)	Ø 0.078	Ø 0.125	Ø 0.156	Ø 0.250	Ø 0.312	Ø 0.390	Ø 0.484	Ø 0.562	Ø 0.625	Ø 0.781	Ø 0.984	Ø 1.181
330-1085	0.001	0.002	0.002	0.002	0.003	0.003	0.004	0.004	0.005	0.006	0.007	0.008
265-690	0.001	0.002	0.002	0.002	0.003	0.003	0.004	0.004	0.005	0.006	0.007	0.008
215-600	0.001	0.002	0.002	0.002	0.003	0.003	0.004	0.004	0.005	0.006	0.007	0.008
360-590	0.001	0.001	0.001	0.002	0.002	0.003	0.003	0.004	0.004	0.005	0.006	0.007
315-525	0.001	0.001	0.001	0.002	0.002	0.003	0.003	0.004	0.004	0.005	0.006	0.007
300-525	0.001	0.001	0.001	0.001	0.002	0.002	0.002	0.002	0.003	0.003	0.004	0.004
215-660	0.001	0.001	0.001	0.001	0.002	0.002	0.002	0.002	0.003	0.003	0.004	0.004
230-690	0.001	0.001	0.001	0.001	0.002	0.002	0.002	0.002	0.003	0.003	0.004	0.004
315-525	0.001	0.001	0.001	0.001	0.002	0.002	0.002	0.002	0.003	0.003	0.004	0.004
430-600	0.001	0.001	0.001	0.001	0.002	0.002	0.002	0.002	0.003	0.003	0.004	0.004
245-330	0.001	0.001	0.001	0.001	0.002	0.002	0.002	0.002	0.003	0.003	0.004	0.004
360-600	0.001	0.001	0.001	0.001	0.002	0.002	0.002	0.002	0.003	0.003	0.004	0.004
230-510	0.001	0.001	0.001	0.001	0.002	0.002	0.002	0.002	0.003	0.003	0.004	0.004
280-330	0.001	0.001	0.001	0.001	0.002	0.002	0.002	0.002	0.003	0.003	0.004	0.004
230-495	0.001	0.002	0.002	0.002	0.003	0.003	0.004	0.004	0.005	0.006	0.007	0.008
360-500	0.001	0.002	0.002	0.002	0.003	0.003	0.004	0.004	0.005	0.006	0.007	0.008
400-525	0.001	0.002	0.002	0.002	0.003	0.003	0.004	0.004	0.005	0.006	0.007	0.008
245-525	0.001	0.002	0.002	0.002	0.003	0.003	0.004	0.004	0.005	0.006	0.007	0.008
400-525	0.001	0.002	0.002	0.002	0.003	0.003	0.004	0.004	0.005	0.006	0.007	0.008
360-500	0.001	0.002	0.002	0.002	0.003	0.003	0.004	0.004	0.005	0.006	0.007	0.008
525-985	0.001	0.002	0.002	0.002	0.003	0.003	0.004	0.004	0.005	0.006	0.007	0.008
-	-	-	-	-	-	-	-	-	-	-	-	-
-	-	-	-	-	-	-	-	-	-	-	-	-
-	-	-	-	-	-	-	-	-	-	-	-	-
-	-	-	-	-	-	-	-	-	-	-	-	-
-	-	-	-	-	-	-	-	-	-	-	-	-
-	-	-	-	-	-	-	-	-	-	-	-	-
-	-	-	-	-	-	-	-	-	-	-	-	-
-	-	-	-	-	-	-	-	-	-	-	-	-
330-1315	0.002	0.002	0.003	0.004	0.004	0.004	0.005	0.005	0.006	0.007	0.009	0.010
-	-	-	-	-	-	-	-	-	-	-	-	-
-	-	-	-	-	-	-	-	-	-	-	-	-
-	-	-	-	-	-	-	-	-	-	-	-	-
65-265	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.002	0.002	0.002	0.002	0.002
-	-	-	-	-	-	-	-	-	-	-	-	-
-	-	-	-	-	-	-	-	-	-	-	-	-
-	-	-	-	-	-	-	-	-	-	-	-	-
65-265	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.002	0.002	0.002	0.002	0.002
180-215	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.002	0.002	0.002	0.002	0.002
150-180	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.002	0.002	0.002	0.002	0.002
300-345	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.002	0.002	0.002	0.002	0.002
180-215	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.002	0.002	0.002	0.002	0.002

For cutters with long cutting flute reduce feed rate by 40 %.



CHIPSURFER -T-SLOTTER (18T) OPERATING GUIDELINES

Workpiece Material	Full Slot		Side Cut	
	Cutting Speed	Feed rate per tooth	Cutting Speed	Feed rate per tooth
	Vc (ft)	Fz (in)	Vc (ft)	Fz (in)
Steel P	300-400	.002-.006	500-700	.001-.006
Tool Steel P	200-350	.001-.004	500-650	.001-.006
Stainless Steel M	250-400	.001-.006	250-450	.002-.006
Gray Cast Iron K	400-650	.001-.004	500-800	.002-.006
Super Alloys S	100-200	.001-.004	100-225	.001-.004
Aluminum N	1000-2500	.004-.008	1000-4000	.004-.008
Copper	250-350	.004-.006	450-800	.004-.008

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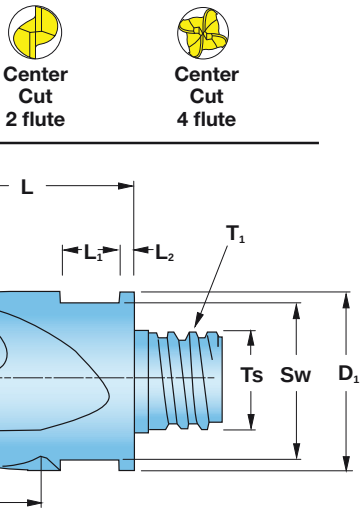
BALL NOSE
Product Worksheet
Quote Request

Specifications

	New
Diameter (D)	
Diameter Tolerance	(e8)
Extension Length (L)	
Cutting Length (a)	
Number of Flutes	
Neck Diameter (D_1)	(D-.02)
Helix Angle	
Grade	Circle One: Uncoated TiAln Diamond
Adaption (Ts)	



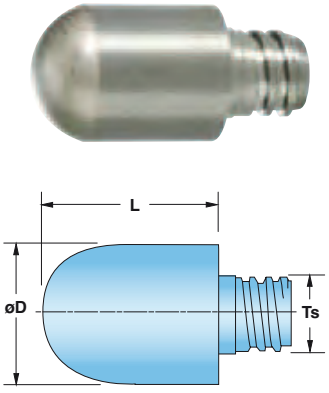
Additional Information

Reference Catalog Part #	
Quantity (min. 0f 6)	6,
Material to Machine	
Application	(Milling)

( ) INDICATES DEFAULT

Part Number	D	L	Ts	Sw	L1	L2
4RB08000TQ-S100	0.315	0.407	5	0.212	0.14	0.02
4RB10000T6-S140	0.394	0.525	6	0.311	0.17	0.02
4RB-5000T8-S060	0.501	0.670	8	0.390	0.21	0.02
4RB16000TR-S210	0.630	0.820	10	0.508	0.24	0.03
4RJ20000TS-S260	0.787	1.025	12	0.626	0.24	0.05
4RJ-1000TU-S140	1.001	1.475	15	0.782	0.27	0.07

Blank Information



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Email			
Quantity	Annual Quantity		
Sales Engineer			

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ENDMILL
Product Worksheet
Quote Request

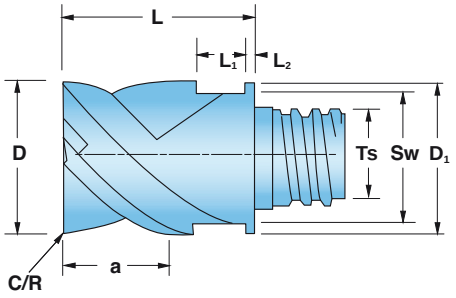
Specifications	New
Diameter (D)	
Diameter Tolerance	(e8)
Extension Length (L)	
Cutting Length (a)	
Number of Flutes	
Neck Diameter (D_1)	(D-.02)
Helix Angle	
Chamfer (C)	
Radius (R)	
Grade	Circle One: Uncoated TiAln Diamond
Adaption (Ts)	
Unequal Spaced Flutes	Yes or No
Serrated Edge	Yes or No

Additional Information

Reference Catalog Part #	
Quantity (min. 0f 6)	6,
Material to Machine	
Application	Circle One: Milling Boring

( ) INDICATES DEFAULT

Circle one of these:



Part Number	D	L	Ts	Sw	L1	L2
4RJ08000TQ-S100	0.315	0.407	5	0.212	0.14	0.02
4RJ10000T6-S140	0.394	0.525	6	0.311	0.17	0.02
4RJ-5000T8-S060	0.501	0.670	8	0.390	0.21	0.02
4RJ16000TR-S210	0.630	0.820	10	0.508	0.24	0.03
4RJ20000TS-S260	0.787	1.025	12	0.626	0.24	0.05
4RJ-1000TU-S140	1.001	1.475	15	0.782	0.27	0.07

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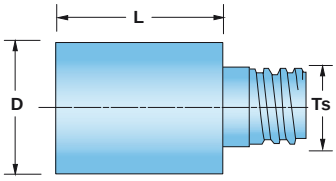

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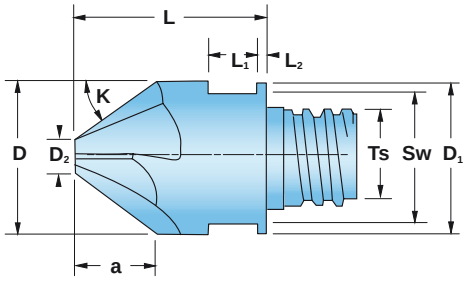
CHAMFER & FORM MILL
Product Worksheet
Quote Request

Specifications	New
Diameter (D)	
Diameter Tolerance	(e8)
Extension Length (L)	
Cutting Length (a)	
Number of Flutes	
Neck Diameter (D_1)	(D-.02)
Inner Diameter (D_2)	
Angle (K)	
Helix Angle	(0)
Coating	Circle One: Uncoated TiAln Diamond
Adaption (Ts)	

Circle one of these:

Center Cut

Not Center Cutting

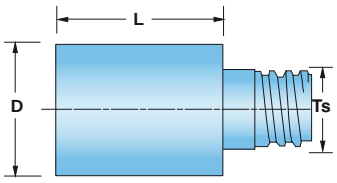


Additional Information

Reference Catalog Part #	
Quantity (min. 0f 6)	6,
Material to Machine	
Application	(Milling)

( ) INDICATES DEFAULT

Part Number	D	L	Ts	Sw	L1	L2
4RJ08000TQ-S100	0.315	0.407	5	0.212	0.14	0.02
4RJ10000T6-S140	0.394	0.525	6	0.311	0.17	0.02
4RJ-5000T8-S060	0.501	0.670	8	0.390	0.21	0.02
4RJ16000TR-S210	0.630	0.820	10	0.508	0.24	0.03
4RJ20000TS-S260	0.787	1.025	12	0.626	0.24	0.05
4RJ-1000TU-S140	1.001	1.475	15	0.782	0.27	0.07



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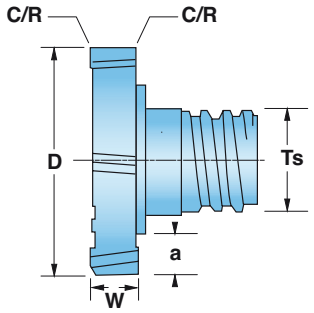
T-SLOTTER
Product Worksheet
Quote Request

Specifications	New
Diameter (D)	
Width of Cut (W)	(e8)
Number of Flutes	(6) or (3) (Circle One)
Depth of Cut (a)	[(D-D1)/2]
Chamfer (C)	
Radius (R)	(D-.02)
Coating	Circle One: Uncoated TiAln
Tolerance	(D-.002 / W±.002)
Adaption (Ts)	

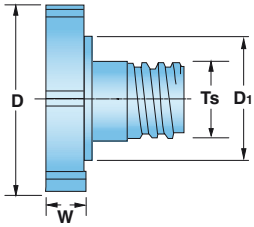


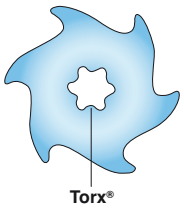
Additional Information

Reference Catalog Part #	
Quantity (min. 0f 6)	6,
Material to Machine	
Application	Circle One: Milling Boring

( ) INDICATES DEFAULT

Part Number	D	W	Ts	D1	Torx	Teeth
18T14019TQRS000	0.552	0.074	T5	0.320	T20	6
18T14028TQRS000	0.552	0.110	T5	0.320	T20	6
18T14033TQRS000	0.552	0.130	T5	0.320	T20	6
18T14043TQRS000	0.552	0.169	T5	0.320	T20	6
18T16323T6RS000	0.641	0.091	T6	0.364	T20	6
18T16333T6RS000	0.641	0.130	T6	0.364	T25	6
18T16343T6RS000	0.641	0.169	T6	0.364	T25	6
18T19439T8RS000	0.762	0.149	T8	0.480	T30	6
18T19444T8RS000	0.762	0.173	T8	0.480	T30	6
18T19451T8RS000	0.762	0.200	T8	0.480	T30	6
18T19467T8RS000	0.762	0.263	T8	0.480	T30	6
18T19844T8RS000	0.781	0.173	T8	0.480	T30	6
18T19854T8RS000	0.781	0.213	T8	0.480	T30	6
18T19863T8RS000	0.781	0.252	T8	0.480	T30	6
18T23453T8RS000	0.919	0.209	T8	0.480	T40	6
18T23463T8RS000	0.919	0.248	T8	0.480	T40	6
18T23483T8RS000	0.919	0.327	T8	0.480	T40	6
18T23499T8RS000	0.919	0.390	T8	0.480	T40	6
18T25826TRRS000	1.014	0.102	T10	0.630	T50	6
18T25840TRRS000	1.014	0.157	T10	0.630	T50	6
18T25850TRRS000	1.014	0.197	T10	0.630	T50	6
18T25866TRRS000	1.014	0.260	T10	0.630	T50	6
18T25883TRRS000	1.014	0.327	T10	0.630	T50	6
18T25899TRRS000	1.014	0.390	T10	0.630	T50	6
18T28628TRRS000	1.125	0.110	T10	0.630	T40	6
18T28636TRRS000	1.125	0.141	T10	0.630	T40	6
18T28656TRRS000	1.125	0.220	T10	0.630	T40	6
18T28610TRRS000	1.125	0.405	T10	0.630	T40	6
16T35612TSRS000	1.400	0.472	T12	0.720	T50	3
16T35616TSRS000	1.400	0.629	T12	0.720	T50	3





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CBN & PCD TIP ENDMILL
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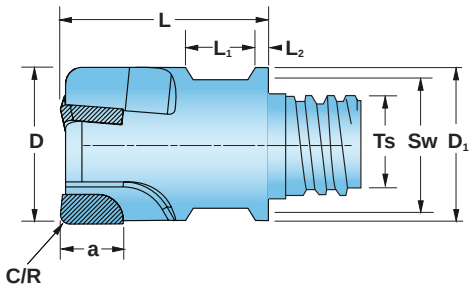
Quote Request

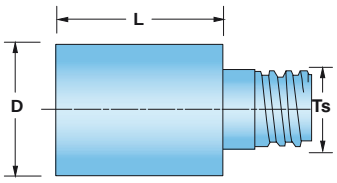
Specifications	New
Diameter (D)	
Diameter Tolerance	(±.002)
Extension Length (L)	
Cutting Length (a)	
Number of Flutes	
Neck Diameter (D_1)	(D-.02)
Chamfer (C)	
Radius (R)	
Grade	Circle One: CBN PCD
Adaption (Ts)	Circle One: Uncoated TiAln Diamond
Unequal Spaced Teeth	Yes or No



Additional Information	
Reference Part #	
Quantity (min. of 6)	6,
Material to Machine	
Application	Circle One: Milling Boring

( ) INDICATES DEFAULT

Part Number	D	L	Ts	Sw	L1	L2
4RJ08000TQ-S100	0.315	0.407	5	0.212	0.14	0.02
4RJ10000T6-S140	0.394	0.525	6	0.311	0.17	0.02
4RJ-5000T8-S060	0.501	0.670	8	0.390	0.21	0.02
4RJ16000TR-S210	0.630	0.820	10	0.508	0.24	0.03
4RJ20000TS-S260	0.787	1.025	12	0.626	0.24	0.05
4RJ-1000TU-S140	1.001	1.475	15	0.782	0.27	0.07



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Email			
Quantity	Annual Quantity		
Sales Engineer			

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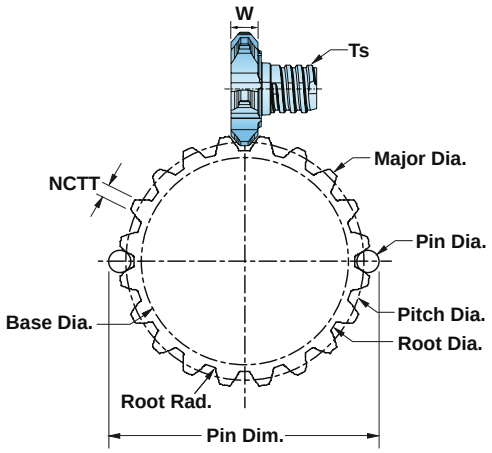
EXT. INVOLUTE SPLINE

Product Worksheet
Quote Request

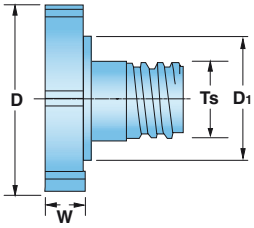
Specifications	New
Major Diameter (O.D.)	
Minor Diameter (Root)	(e8)
Number of Teeth	
Base Diameter	[(D-D1)/2]
Pitch Diameter	
Pressure Angle	(D-.02)
Root Radius	Circle One: Full Fillet Flat Root
NCTT	(D-.002 / W±.002)
Pin Dimension	Min: Max:
Pin Diameter	

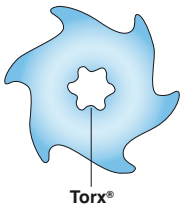
Additional Information	
Reference Catalog Part #	
Quantity (min. 0f 6)	6,
Material to Machine	

( ) INDICATES DEFAULT



Part Number	D	W	Ts	D1	Torx®	# Teeth
18T14019TQRS000	0.552	0.074	T5	0.320	T20	6
18T14028TQRS000	0.552	0.110	T5	0.320	T20	6
18T14033TQRS000	0.552	0.130	T5	0.320	T20	6
18T14043TQRS000	0.552	0.169	T5	0.320	T20	6
18T16323T6RS000	0.641	0.091	T6	0.364	T20	6
18T16333T6RS000	0.641	0.130	T6	0.364	T25	6
18T16343T6RS000	0.641	0.169	T6	0.364	T25	6
18T19439T8RS000	0.762	0.149	T8	0.480	T30	6
18T19444T8RS000	0.762	0.173	T8	0.480	T30	6
18T19451T8RS000	0.762	0.200	T8	0.480	T30	6
18T19467T8RS000	0.762	0.263	T8	0.480	T30	6
18T19844T8RS000	0.781	0.173	T8	0.480	T30	6
18T19854T8RS000	0.781	0.213	T8	0.480	T30	6
18T19863T8RS000	0.781	0.252	T8	0.480	T30	6
18T23453T8RS000	0.919	0.209	T8	0.480	T40	6
18T23463T8RS000	0.919	0.248	T8	0.480	T40	6
18T23483T8RS000	0.919	0.327	T8	0.480	T40	6
18T23499T8RS000	0.919	0.390	T8	0.480	T40	6
18T25826TRRS000	1.014	0.102	T10	0.630	T50	6
18T25840TRRS000	1.014	0.157	T10	0.630	T50	6
18T25850TRRS000	1.014	0.197	T10	0.630	T50	6
18T25866TRRS000	1.014	0.260	T10	0.630	T50	6
18T25883TRRS000	1.014	0.327	T10	0.630	T50	6
18T25899TRRS000	1.014	0.390	T10	0.630	T50	6
18T28628TRRS000	1.125	0.110	T10	0.630	T40	6
18T28636TRRS000	1.125	0.141	T10	0.630	T40	6
18T28656TRRS000	1.125	0.220	T10	0.630	T40	6
18T28610TRRS000	1.125	0.405	T10	0.630	T40	6
18T35612TSRS000	1.400	0.472	T12	0.720	T50	3
18T35616TSRS000	1.400	0.629	T12	0.720	T50	3





Customer		Customer No.	
Street	City	State	Zip
Contact Person	Phone	Fax	
Email			
Quantity	Annual Quantity		
Sales Engineer			

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ROUNDline

COPY PAGE AND FILL IN INFORMATION TO COMMUNICATE BASIC DESIGN REQUIREMENTS

BALL NOSE
Product Worksheet
Quote Request

Specifications	New
Diameter (D)	
Diameter Tolerance	(e8)
Overall Length (L)	
Cutting Length (a)	
Number of Flutes	
Helix Angle	
Coating	Circle One: Uncoated TiAln
Adaption (d)	
Unequal Spaced Flutes	Yes or No

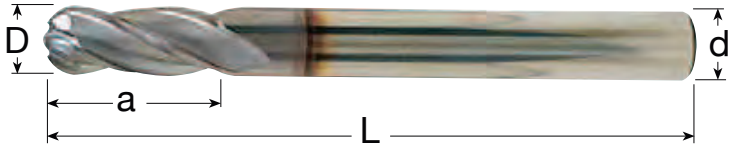
Additional Information	
Reference Catalog Part #	
Quantity (min. 0f 10)	
Material to Machine	
Application	Circle One: Milling Boring

( ) INDICATES DEFAULT

Circle one of these:

Center Cut 2 flute

Center Cut 4 flute



Customer		Customer No.	
Street	City	State	Zip
Contact Person	Phone	Fax	
Email			
Quantity	Annual Quantity		
Sales Engineer	Target Price		

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ROUNDline

COPY PAGE AND FILL IN INFORMATION TO COMMUNICATE BASIC DESIGN REQUIREMENTS

END MILL
Product Worksheet
Quote Request

Specifications	New
Diameter (D)	
Diameter Tolerance	(e8)
Overall Length (L)	
Cutting Length (a)	
Number of Flutes	
Helix Angle	
Chamfer (C)	
Radius (R)	
Coating	Circle One: Uncoated TiAln
Adaption (d)	
Serrated Edge	Yes or No
Unequal Spaced Flutes	Yes or No
Variable Helix	Yes or No

Circle one of these:

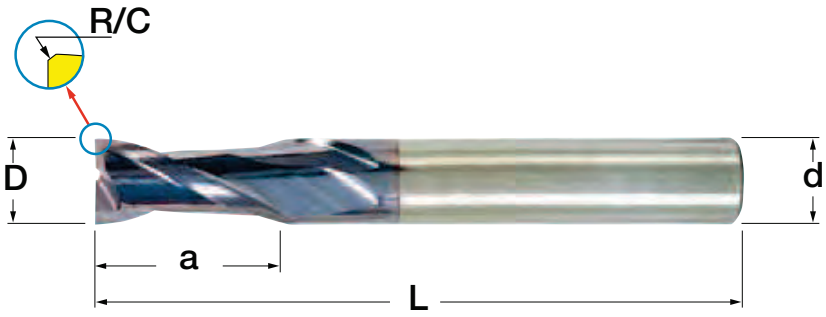
Center Cut

Not Center Cutting

Additional Information

Reference Catalog Part #	
Quantity (min. 0f 10)	
Material to Machine	
Application	Circle One: Milling Boring

( ) INDICATES DEFAULT



Customer		Customer No.	
Street	City	State	Zip
Contact Person	Phone	Fax	
Email			
Quantity	Annual Quantity		
Sales Engineer	Target Price		

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