MillLine

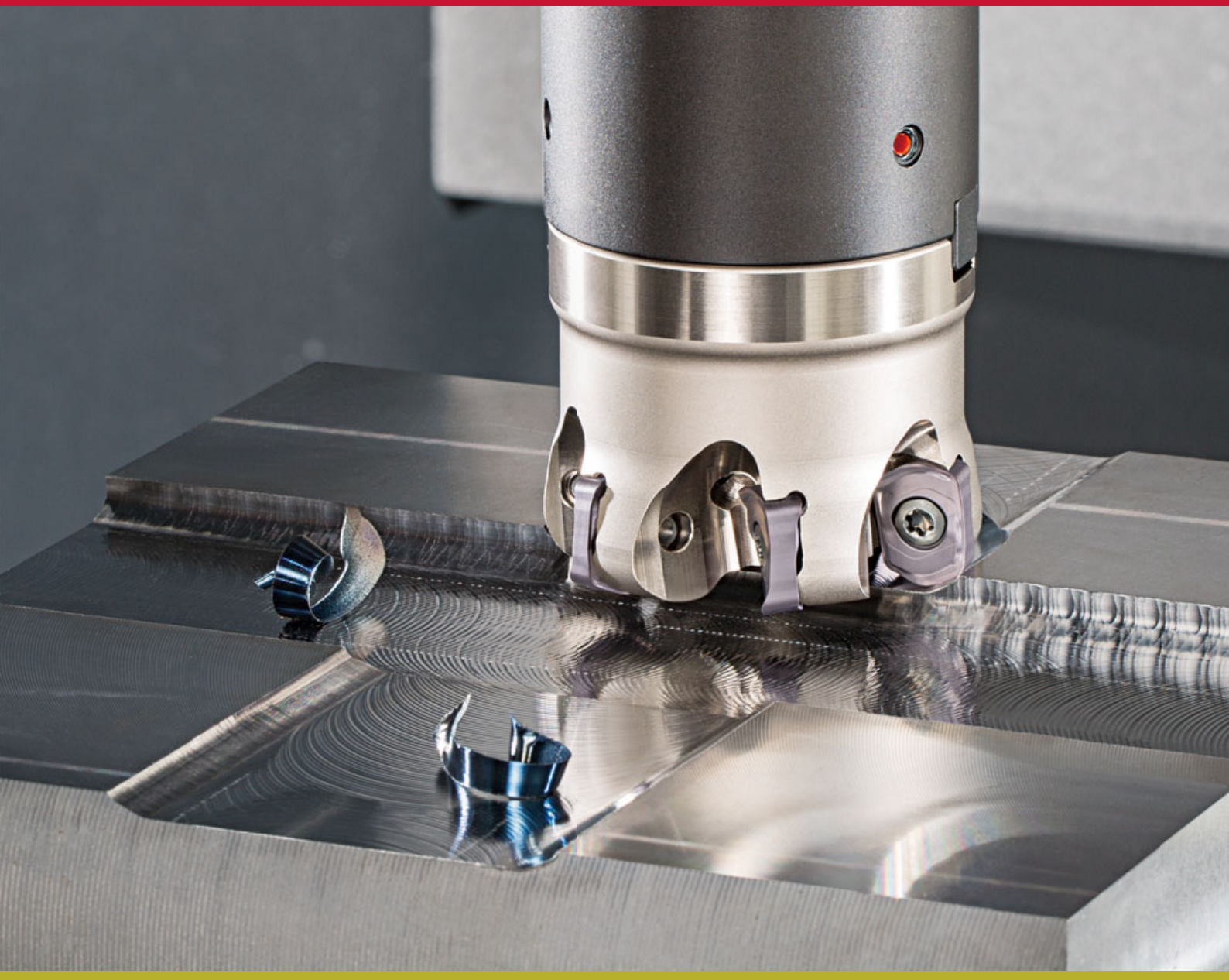
TWIST DOTBALL

www.tungaloy.com

Tungaloy Report No. 507-G

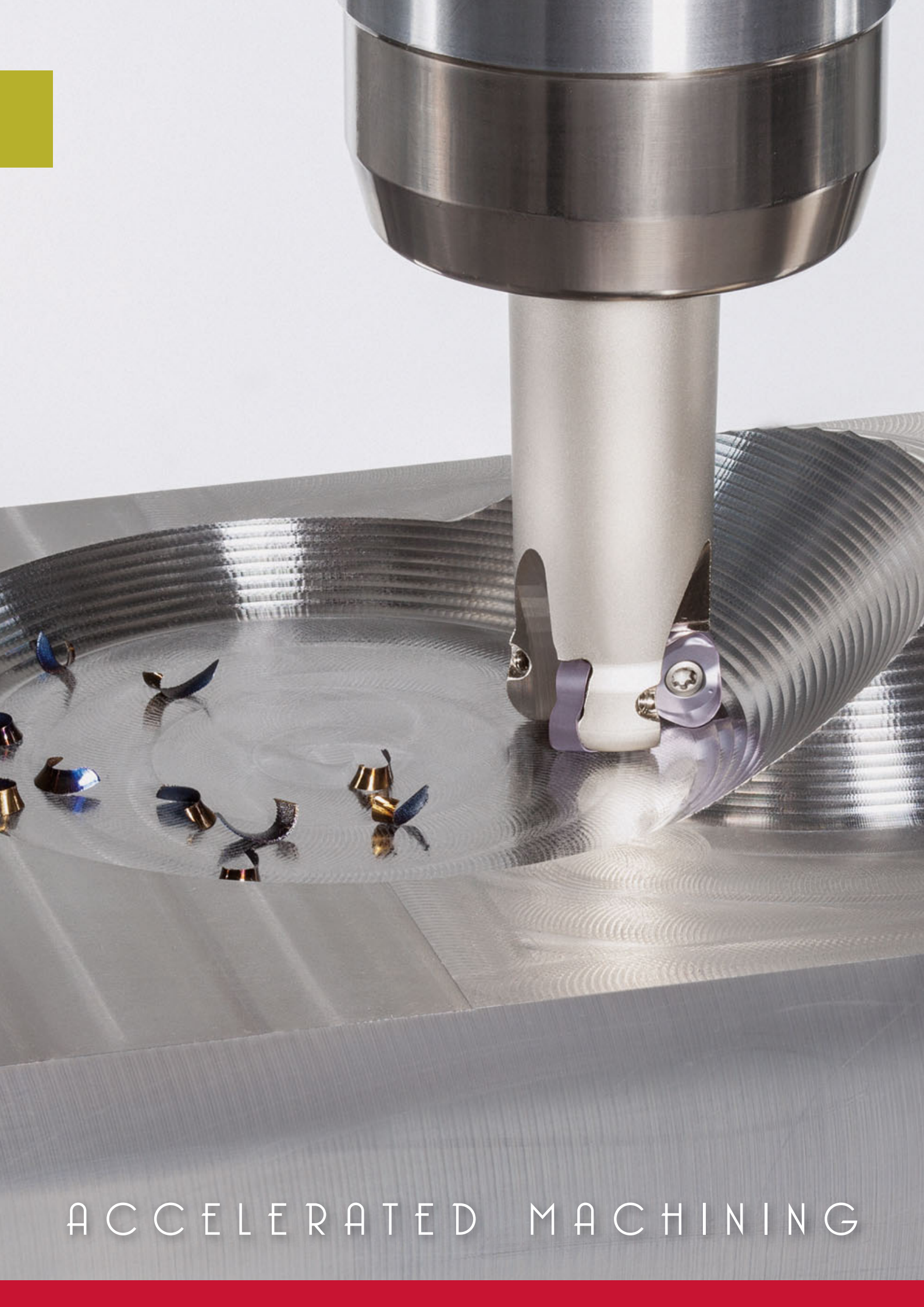
Member IMC Group Tungaloy

Profiling cutter for Accelerated Machining - now available with R5, R6 & large high feed inserts



INDUSTRY 4.0

FEED the SPEED!



ACCELERATED MACHINING

MillLine

TWIST DOTBALL

TUNGALOY

TUNGFORCE MILL

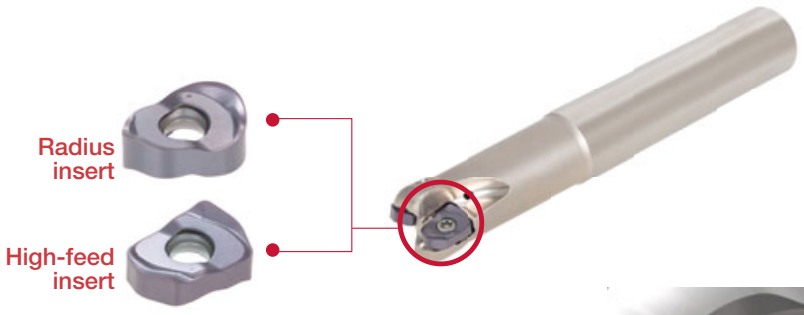
ACCELERATED MACHINING

Unique twisted insert in radius and high-feed geometries assures secure insert clamping for **high stability**.

High productive insert geometries: Reliable radius inserts + high feed insert with large depth of cut capability

Multi-functional cutter body with superior reliability

■ Two types of inserts fit one cutter: radius and high efficiency inserts



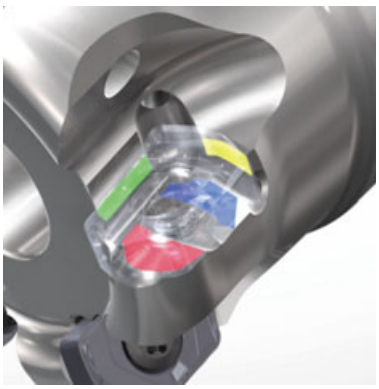
■ Secure insert clamping to prevent insert from moving during machining

- Insert is securely fixed on four supporting plains (Twist Clamping technology)
- No wedge is needed, providing extra space to allow smooth chip evacuation in various applications

 Profiling

 Pocketing

Slotting (with radii)



High-feed insert with greater depth of cut

■ High machining efficiency with 30% greater depth of cut

- LNMX04-HJ : APMX = 1.3 mm
- LNMX06-HJ : APMX = 2.0 mm

(Use DoFeed (TR403) for light depths of cut)

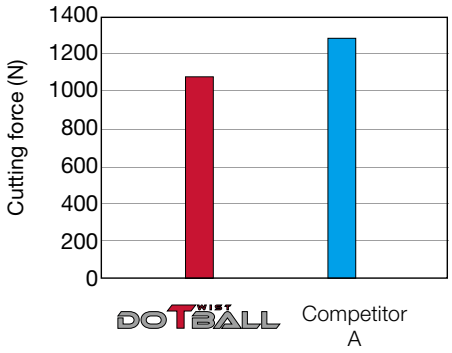
LNMX-HJ

■ Smooth chip control enables stable machining

- Chip is formed in a short spiral curl to avoid re-cutting during pocketing and slotting.

Helical cutting edge with large positive inclination angle reduces cutting load during machining

Cutting load comparison

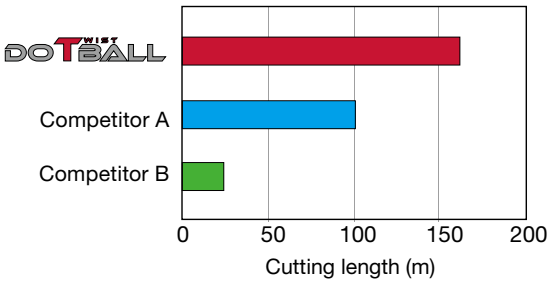


P Steel

Cutter	: EXLN04M025C25.0R03 (ø*D*c = 25 mm, z = 1)
Insert	: LNMX0405ZER-HJ AH3135
Workpiece material	: S55C / C55
Cutting speed	: *V*c = 200 m/min
Feed per tooth	: *f*z = 1.0 mm/t
Depth of cut	: *a*p = 1.0 mm
Width of cut	: *a*e = 17 mm
Coolant	: Dry

Stable tool life at large depths of cut

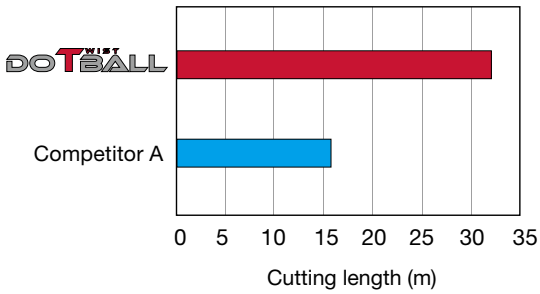
Tool life comparison in machining carbon steel



P Steel

Cutter	: TXLN06M050B22.0R05 (DCX = 50 mm, z = 1)
Insert	: LNMX0607ZER-HJ AH3135
Workpiece material	: S55C / C55 (205HB)
Cutting speed	: *V*c = 200 m/min
Feed per tooth	: *f*z = 1.0 mm/t
Depth of cut	: *a*p = 2.0 mm
Width of cut	: *a*e = 32 mm
Coolant	: Dry

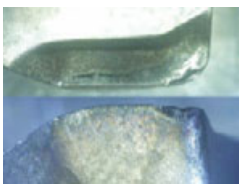
Tool life comparison in machining stainless steel



M Stainless

Cutter	: EXLN04M025C25.0R03 (ø25 mm, z = 1)
Insert	: LNMX0405ZER-HJ AH3135
Workpiece material	: SUS304 / X5CrNi18-9 (170HB)
Cutting speed	: *V*c = 150 m/min
Feed per tooth	: *f*z = 0.7 mm/t
Depth of cut	: *a*p = 1.0 mm
Width of cut	: *a*e = 15 mm
Coolant	: Dry (Air blow)

DOTBALL

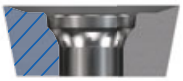


Competitor A

Radius insert with high reliability (R4, R5, R6)

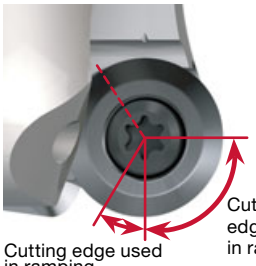
LNMX-MJ

- Insert cross section is designed to be 2 times as large as that of a round insert in an equivalent size for added robustness.



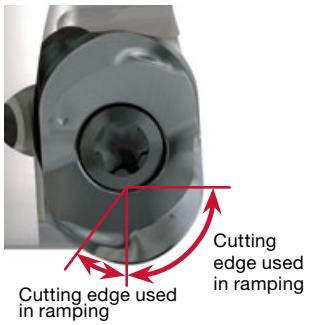
Conventional round insert

- 4 fully effective edges for ultimate insert economy
  - 4 cutting edges on the insert are located apart from one another, designed to ensure full usages of all 4 cutting edges in 3D profiling applications



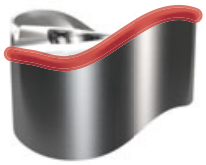
3 indexes are available in ramping

Conventional round insert



4 fully effective cutting edges per insert

- Excellent chip evacuation in various applications
  - Cutting edge features dynamic geometry which generates perfect chip form to improve machining reliability during slotting and pocketing operations, while promoting free cutting action.



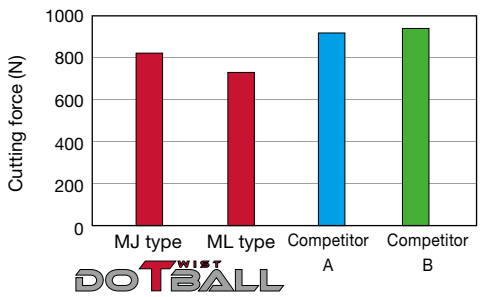
Chip formation comparison (slotting)

Chip re-cut	Chip re-cut	No chip re-cut
R5 insert, Shoulder mill	Round insert	

P Steel

Cutter	: TXLN06M050B22.0R05 (DCX = 50 mm, z = 5)
Insert	: LNMX0607ZER-HJ AH3135
Workpiece material	: S55C / C55 (205HB)
Cutting speed	: *Vc* = 150 m/min
Feed per tooth	: *fz* = 0.6 mm/t
Depth of cut	: *ap* = 2.0 mm
Width of cut	: *ae* = 50 mm
Coolant	: Dry

Cutting force comparison



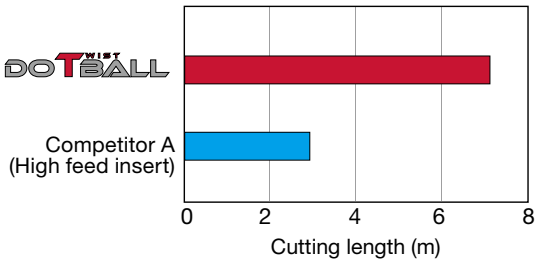
P Steel

Cutter	: EXLN04M025C25.0R03 (*ø*Dc = 25 mm, z = 1)
Insert	: LNMX0405R4-MJ AH3135 LNMX0405R4-ML AH3135
Workpiece material	: S55C / C55
Cutting speed	: *Vc* = 200 m/min
Feed per tooth	: *fz* = 0.3 mm/t
Depth of cut	: *ap* = 2.0 mm
Width of cut	: *ae* = 17 mm
Coolant	: Dry

- 2 types of chipbreakers are available for R4 insert
  MJ : First choice
  ML : Low cutting force

Insert life predictability – tool life comparison

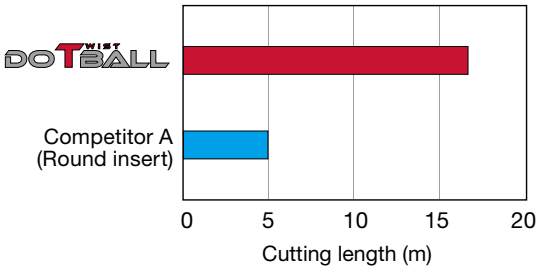
Tool steel



P
Steel

Cutter	: TXLN04M050B22.0R07 (DCX = 50 mm, z = 7)
Insert	: LNMX0405R4-MJ AH3135
Workpiece material	: SKD11 / 1.2379 (300HB)
Cutting speed	: *Vc* = 190 m/min
Feed per tooth	: *fz* = 0.5 mm/t
Depth of cut	: *ap* = 0.75 mm
Width of cut	: *ae* = 25 mm
Coolant	: Dry

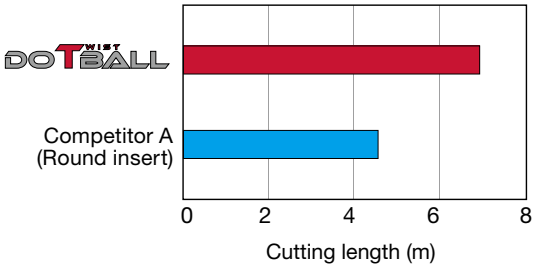
Tool steel (plastic molds)



P
Steel

Cutter	: TXLN05M040B16.0R05 (DCX = 40 mm, z = 1)
Insert	: LNMX0506R5-MJ AH3135
Workpiece material	: NAK80 (41HRC)
Cutting speed	: *Vc* = 150 m/min
Feed per tooth	: *fz* = 0.3 mm/t
Depth of cut	: *ap* = 1.5 mm
Width of cut	: *ae* = 27 mm
Coolant	: Dry

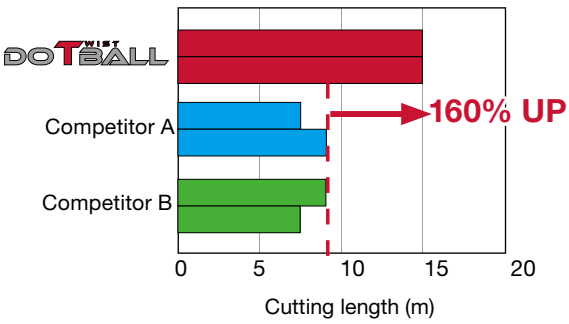
Hard steels



H
Hardness

Cutter	: TXLN06M050B22.0R05 (DCX = 50 mm, z = 1)
Insert	: LNMX0607R6-MJ AH120
Workpiece material	: SKD61 / 1.2344 (55HRC)
Cutting speed	: *Vc* = 70 m/min
Feed per tooth	: *fz* = 0.15 mm/t
Depth of cut	: *ap* = 1.0 mm
Width of cut	: *ae* = 32 mm
Coolant	: Dry

Stainless steel



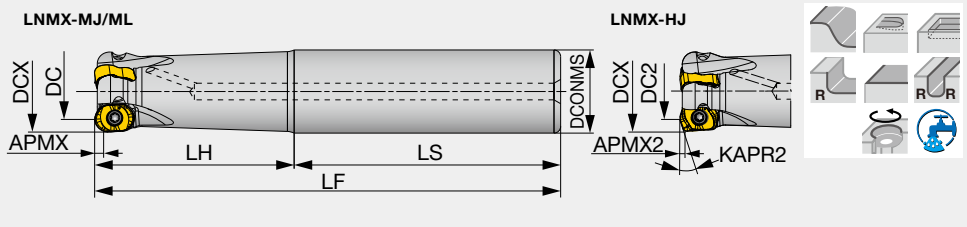
M
Stainless

Cutter	: EXLN04M025C25.0R03 (ø25 mm, z = 1)
Insert	: LNMX0405R4-MJ AH3135
Workpiece material	: SUS420J1 / X20Cr13 (300 - 315HB)
Cutting speed	: *Vc* = 300 m/min
Feed per tooth	: *fz* = 0.2 mm/t
Depth of cut	: *ap* = 2.0 mm
Width of cut	: *ae* = 12 mm
Coolant	: Dry (Air blow)

EXLN

Radius cutter with double-sided insert with 4 edges

A.R. = +3°, R.R. = -12° ~ -14°



Designation	APMX	APMX2	DCX	z	DC	DC2	KAPR2	DCONMS	LS	LH	LF	WT(kg)	Air hole	Insert
EXLN04M020C20.0R02	4	1.3	20	2	12.2	11.6	20	20	80	50	130	0.28	with	LNMX04...
EXLN04M025C25.0R03	4	1.3	25	3	17.2	16.6	20	25	80	60	140	0.46	with	LNMX04...
EXLN04M032C32.0R04	4	1.3	32	4	24.2	23.6	20	32	80	70	150	0.83	with	LNMX04...
EXLN04M032C32.0R05	4	1.3	32	5	24.2	23.6	20	32	80	70	150	0.83	with	LNMX04...
EXLN05M025C25.0R02	5	-	25	2	15	-	-	25	90	60	150	0.54	with	LNMX05..
EXLN05M032C32.0R04	5	-	32	4	21.9	-	-	32	80	70	150	0.87	with	LNMX05..
EXLN06M032C32.0R02	6	2	32	2	19.6	19.3	25	32	80	70	150	0.90	with	LNMX06..
EXLN06M040C32.0R04	6	2	40	4	27.6	27.3	25	32	100	50	150	0.95	with	LNMX06..

SPARE PARTS

Designation	Clamping screw	Mono block type wrench	Torx bit	Grip
EXLN04...	CSPD-3	IP-10D	-	-
EXLN05...	CSPB-4S	-	BLDIP15/S7	H-TB2W
EXLN06...	CSPB-5	-	BLDIP20/S7	H-TB2W

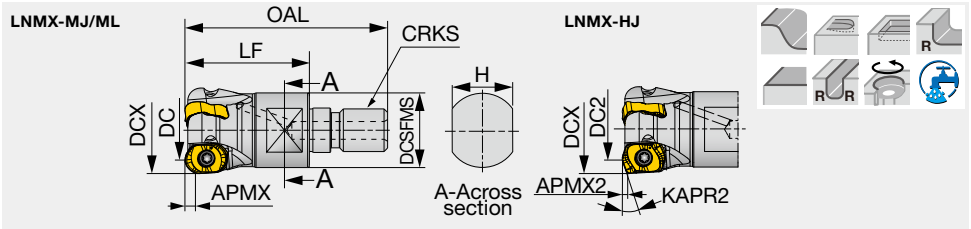
Recommended clamping torque (Torx size): CSPD-3 = 2.5 N·m, CSPB-4S = 3.5 N·m (15IP), CSPB-5 = 5 N·m (20IP)

TUNGFLEX

HXLN04-M

Radius cutter with double-sided insert with 4 edges, Modular head with metric thread connection

A.R. = +3°, R.R. = -12° ~ -14°



Designation	APMX	APMX2	DCX	z	DC	DC2	KAPR2	OAL	LF	H	DCSFMS	CRKS	WT(kg)	Air hole	Insert
HXLN04M020M10R02	4	1.3	20	2	12.2	11.6	20	49	30	15	18	M10	0.07	with	LNMX04...
HXLN04M025M12R03	4	1.3	25	3	17.2	16.6	20	57	35	17	21	M12	0.16	with	LNMX04...
HXLN04M032M16R04	4	1.3	32	4	24.2	23.6	20	63	40	22	29	M16	0.20	with	LNMX04...
HXLN05M025M12R02	5	-	25	2	15	-	-	57	35	17	21	M12	0.10	with	LNMX05...
HXLN05M032M16R04	5	-	32	4	21.9	-	-	63	40	22	28.8	M16	0.20	with	LNMX05...
HXLN06M032M16R02	6	2	32	2	19.6	19.3	25	63	40	22	28.8	M16	0.24	with	LNMX06...

SPARE PARTS

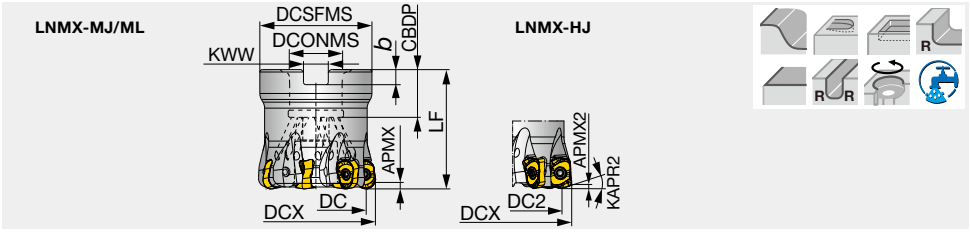
Designation	Clamping screw	Mono block type wrench	Torx bit	Grip
HXLN04...	CSPD-3	IP-10D	-	-
HXLN05...	CSPB-4S	-	BLDIP15/S7	H-TB2W
HXLN06...	CSPB-5	-	BLDIP20/S7	H-TB2W

Recommended clamping torque: CSPD-3 = 2.5 N·m, CSPB-4S = 3.5 N·m, CSPB-5 = 5 N·m

TXLN

Radius cutter with double-sided insert with 4 edges

A.R. = +3°, R.R. = -13°



	Designation	APMX	APMX2	DCX	CICT	DC	DC2	KAPR2	DCSFMS	LF	DCONMS	CBDP	KWW	b	WT(kg)	Air hole	Insert
	TXLN04M040B16.0R06	4	1.3	40	6	32.2	31.6	20	35	40	16	18	8.4	5.6	0.21	with	LNMX04...
New	TXLN04M042B16.0R06	4	1.3	42	6	34.2	33.6	20	35	40	16	18	8.4	5.6	0.21	with	LNMX04...
	TXLN04M050B22.0R07	4	1.3	50	7	42.2	41.6	20	47	50	22	20	10.4	6.3	0.45	with	LNMX04...
New	TXLN04M052B22.0R07	4	1.3	52	7	44.2	43.6	20	47	50	22	20	10.4	6.3	0.47	with	LNMX04...
New	TXLN04M063B22.0R07	4	1.3	63	7	55.2	54.6	20	59	50	22	20	10.4	6.3	0.76	with	LNMX04...
	TXLN05M040B16.0R05	5	-	40	5	29.8	-	-	35	40	16	18	8.4	5.6	0.26	with	LNMX05...
	TXLN05M050B22.0R06	5	-	50	6	39.8	-	-	47	50	22	20	10.4	6.3	0.50	with	LNMX05...
	TXLN06M050B22.0R05	6	2	50	5	37.6	37.3	25	47	50	22	20	10.4	6.3	0.50	with	LNMX06...
	TXLN06M052B22.0R05	6	2	52	5	39.6	39.3	25	49	50	22	20	10.4	6.3	0.55	with	LNMX06...
	TXLN06M063B22.0R06	6	2	63	6	50.6	50.3	25	59	50	22	20	10.4	6.3	0.82	with	LNMX06...

SPARE PARTS

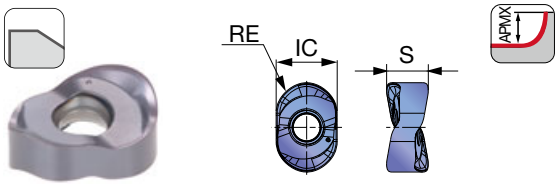



Designation	Clamping screw	Torx bit	Grip	Center bolt
TXLN04M04*B16.0R06	CSPD-3	BLD IP10/S7	SW6-SD	FSHM8-30H
TXLN04M05*B22.0R07	CSPD-3	BLD IP10/S7	SW6-SD	CM10X30H
TXLN04M063B22.0R07	CSPD-3	BLD IP10/S7	SW6-SD	CM10X30H
TXLN05M040B16.0R05	CSPB-4S	BLDIP15/S7	H-TB2W	FSHM8-30H
TXLN05M050B22.0R06	CSPB-4S	BLDIP15/S7	H-TB2W	CM10X30H
TXLN06M050B22.0R05	CSPB-5	BLDIP20/S7	H-TB2W	FSHM10-40H
TXLN06M052B22.0R05	CSPB-5	BLDIP20/S7	H-TB2W	CM10X30H
TXLN06M063B22.0R06	CSPB-5	BLDIP20/S7	H-TB2W	CM10X30H

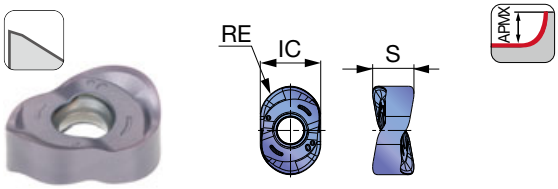
Recommended clamping torque: CSPD-3 = 2.5 N·m, CSPB-4S = 3.5 N·m, CSPB-5 = 5 N·m

INSERT

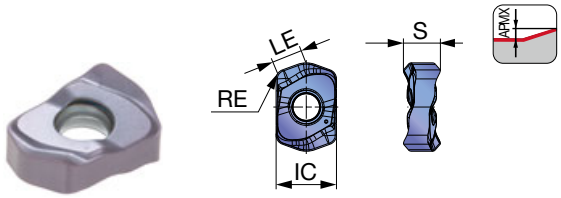
LNMX-MJ (Radius)



LNMX-ML (Radius)



LNMX-HJ (High feed)



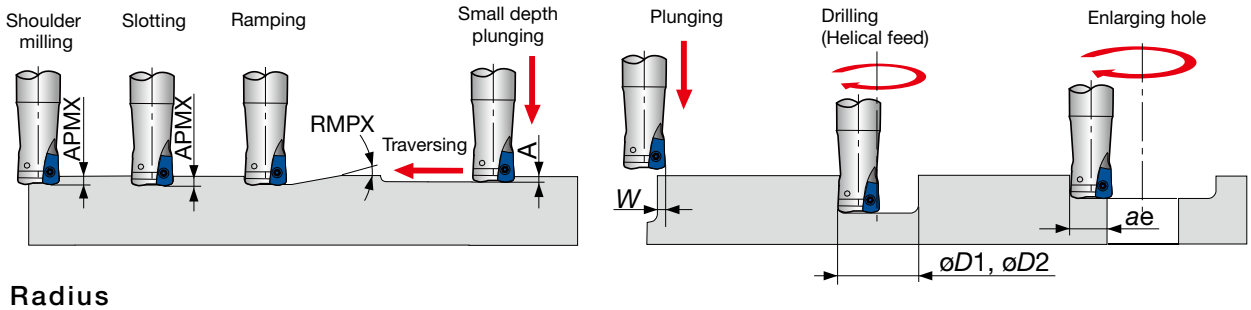
P	Steel	☆	★
M	Stainless		★
K	Cast iron	★	☆
N	Non-ferrous		
S	Superalloys	★	☆
H	Hard materials	★	★

★ : First choice
☆ : Second choice

Designation	RE	APMX	Coated		LE	IC	S
			AH120	AH3135			
LNMX0405R4-MJ	4	4	●	●	-	8.2	5.6
LNMX0405R4-ML	4	4	●	●	-	8.2	5.6
LNMX0405ZER-HJ	1.3	1.3	●	●	4.36	8.2	5
LNMX0506R5-MJ	5	5	●	●	-	10.4	6.1
LNMX0607R6-MJ	6	6	●	●	-	12.6	7.4
LNMX0607ZER-HJ	2	2	●	●	6.71	12.7	7.2

● : Line up

MACHINING APPLICATIONS



For Radius MJ, ML type

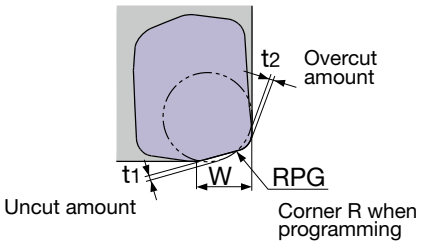
Designation	DCX	Max. depth of cut APMX	Max. ramping angle RMPX	Max. plunging A	Max. cutting width in plunging W	Min. machining dia. øD1	Max. machining dia. øD2	Max. cutting width in enlarging ae
E/HXLN04M020...	20	4	4.5°	0.75	4	28	38	15
E/HXLN04M025...	25	4	2.9°	0.75	4	38	48	20
E/HXLN04M032...	32	4	1.9°	0.75	4	52	62	27
TXLN04M040B16.0R06	40	4	1.2°	0.6	4	68	78	35
New TXLN04M042B16.0R06	42	4	1.1°	0.6	4	72	82	37
TXLN04M050B22.0R07	50	4	0.9°	0.6	4	88	98	45
New TXLN04M052B22.0R07	52	4	0.8°	0.6	4	92	102	47
New TXLN04M063B22.0R07	63	4	0.7°	0.7	4	114	124	58
E/HXLN05M025...	25	5	2.3°	0.5	5	35	48	17
E/HXLN05M032...	32	5	2.1°	0.6	5	48	62	24
TXLN05M040B16.0R05	40	5	2°	1	5	64	78	31
TXLN05M050B22.0R06	50	5	1.3°	1	5	84	98	41
E/HXLN06M032...	32	6	3.7°	1	6	52	62	22
EXLN06M040C32.0R04	40	6	3.4°	1	6	60	78	29
TXLN06M050B22.0R05	50	6	2.8°	1.7	6	79	98	39
TXLN06M052B22.0R05	52	6	2.5°	1.6	6	81	102	41
TXLN06M063B22.0R06	63	6	1.8°	1.6	6	105	124	52

For High feed HJ type

Designation	DCX	Max. depth of cut APMX	Max. ramping angle RMPX	Max. plunging A	Max. cutting width in plunging W	Min. machining øD1	Max. machining øD2	Max. cutting width in enlarging ae
E/HXLN04M020...	20	1.3	4.9°	0.7	4.1	27	38	15.5
E/HXLN04M025...	25	1.3	3°	0.7	4.1	37	48	20.5
E/HXLN04M032...	32	1.3	2°	0.7	4.1	51	62	27.5
TXLN04M040B16.0R06	40	1.3	1.4°	0.7	4.1	67	78	35.5
New TXLN04M042B16.0R06	42	1.3	1.3°	0.7	4.1	71	82	37.5
TXLN04M050B22.0R07	50	1.3	1°	0.7	4.1	87	98	45.5
New TXLN04M052B22.0R07	52	1.3	0.9°	0.7	4.1	91	102	47.5
New TXLN04M063B22.0R07	63	1.3	0.8°	0.7	4.1	113	124	58.5
E/HXLN06M032...	32	2	5.7°	1.4	6.1	42	62	20
EXLN06M040C32.0R04	40	2	3.8°	1.5	6.1	57	78	28
TXLN06M050B22.0R05	50	2	2.7°	1.6	6.1	77	98	38
TXLN06M052B22.0R05	52	2	2.5°	1.6	6.1	81	102	40
TXLN06M063B22.0R06	63	2	1.8°	1.5	6.1	104	124	51

TOOL GEOMETRY ON PROGRAMMING FOR HIGH FEED

The following table shows the amount left uncut (t1) and overcut (t2).



	Max. depth of cut APMX (mm)	W (mm)	Programmed corner R (mm)	Amount left uncut t1 (mm)	Amount left overcut t2 (mm)
LNMX04-HJ	1.3	4.1	R1.5	0.8	0
	1.3	4.1	R2.0	0.65	0
	1.3	4.1	R2.5	0.5	0.05
	1.3	4.1	R3.0	0.36	0.2
LNMX06-HJ	2.0	6.1	R2.0	1.4	-
	2.0	6.1	R3.0	1.1	-
	2.0	6.1	R3.5	0.91	-
	2.0	6.1	R4.0	0.74	0.05
	2.0	6.1	R5.0	0.41	0.35

STANDARD CUTTING CONDITIONS FOR RADIUS (MJ, ML)

ISO	Workpiece material		Hardness	Priority	Grade	Chip-breaker	Cutting speed *Vc* (m/min)	Feed per tooth *fz* (mm/t)
P	Low carbon steel C15, C20, etc.		- 200 HB	First choice	AH3135	MJ	100 - 300	0.2 - 0.6
			- 200 HB	For low cutting force	AH3135	ML	100 - 300	0.2 - 0.6
	Carbon steel, Alloy steel C55, 42CrMoS4, etc.		- 300 HB	First choice	AH3135	MJ	100 - 250	0.2 - 0.6
			- 300 HB	For low cutting force	AH3135	ML	100 - 250	0.2 - 0.6
	Prehardened steel NAK80, PX5, etc.		30 - 40 HRC	First choice	AH3135	MJ	100 - 200	0.15 - 0.4
			30 - 40 HRC	For low cutting force	AH3135	ML	100 - 200	0.15 - 0.4
M	Austenitic Stainless steel X5CrNi18-9, X5CrNiMo17-12-2, etc.		- 200 HB	First choice	AH3135	MJ	100 - 200	0.2 - 0.6
			- 200 HB	For low cutting force	AH3135	ML	100 - 200	0.2 - 0.6
	Martensitic Stainless steel X12Cr113, X20Cr13, etc.		- 200 HB	First choice	AH3135	ML	100 - 300	0.2 - 0.6
			- 200 HB	For impact resistance	AH3135	MJ	100 - 300	0.2 - 0.6
K	Grey cast iron 250, 300, etc.		150 - 250 HB	First choice	AH120	MJ	100 - 300	0.2 - 0.6
			150 - 250 HB	For low cutting force	AH120	ML	100 - 300	0.2 - 0.6
	Ductile cast iron 400-15, 600-3, etc.		150 - 250 HB	First choice	AH120	MJ	80 - 250	0.2 - 0.6
			150 - 250 HB	For low cutting force	AH120	ML	80 - 250	0.2 - 0.6
S	Titanium alloy Ti-6Al-4V, etc.		-	First choice	AH3135	ML	30 - 60	0.15 - 0.6
			-	For impact resistance	AH3135	MJ	30 - 60	0.15 - 0.6
	Superalloys Inconel718, etc.		-	First choice	AH120	ML	20 - 50	0.05 - 0.3
			-	For impact resistance	AH120	MJ	20 - 50	0.05 - 0.3
H	Hardened steel	SKD61, etc.	40 - 50 HRC	First choice	AH3135	MJ	50 - 150	0.1 - 0.3
			40 - 50 HRC	For wear resistance	AH120	MJ	50 - 150	0.1 - 0.3
		SKD11, etc.	50 - 60 HRC	First choice	AH120	MJ	50 - 70	0.05 - 0.15

STANDARD CUTTING CONDITIONS FOR HIGH FEED (HJ)

LNMX04-HJ

ISO	Workpiece material		Hardness	Priority	Grade	Chip-breaker	Cutting speed *Vc* (m/min)	Feed per tooth *fz* (mm/t)
P	Low carbon steel C15, C20, etc.		- 300HB	First choice	AH3135	HJ	100 - 300	0.5 - 1.3
				For wear resistance	AH120			
	Carbon steel, Alloy steel C55, 42CrMoS4, etc.		- 300HB	First choice	AH3135	HJ	100 - 250	0.5 - 1.3
				For wear resistance	AH120			
	Prehardened steel NAK80, PX5, etc.		30 - 40HRC	First choice	AH3135	HJ	100 - 200	0.4 - 1
				For wear resistance	AH120			
M	Austenitic Stainless steel X5CrNi18-9, X5CrNiMo17-12-2, etc.		- 200HB	First choice	AH3135	HJ	100 - 200	0.3 - 0.9
	Martensitic Stainless steel X12Cr113, X20Cr13, etc.		- 200HB	First choice	AH3135	HJ	100 - 300	0.3 - 0.9
K	Grey cast iron 250, 300, etc.		150 - 250HB	First choice	AH120	HJ	100 - 300	0.5 - 1.3
				For impact resistance	AH3135			
	Ductile cast iron 400-15, 600-3, etc.		150 - 250HB	First choice	AH120	HJ	80 - 250	0.5 - 1.3
				For impact resistance	AH3135			
S	Titanium alloy Ti-6Al-4V, etc.		150 - 250HB	First choice	AH3135	HJ	30 - 60	0.3 - 0.7
	Superalloys Inconel718, etc.		150 - 250HB	First choice	AH120	HJ	20 - 50	0.1 - 0.3
H	Hardened steel	SKD61, etc.	40 - 50HRC	First choice	AH3135	HJ	50 - 150	0.1 - 0.5
				For wear resistance	AH120			
		SKD11, etc.	50 - 60HRC	First choice	AH120	HJ	50 - 70	0.05 - 0.2

LNMX06-HJ

ISO	Workpiece material		Hardness	Priority	Grade	Chip-breaker	Cutting speed *Vc* (m/min)	Feed per tooth *fz* (mm/t)
P	Low carbon steel C15, C20, etc.		- 300HB	First choice	AH3135	HJ	100 - 300	0.3 - 1.1
				For wear resistance	AH120			
	Carbon steel, Alloy steel C55, 42CrMoS4, etc.		- 300HB	First choice	AH3135	HJ	100 - 250	0.3 - 1.1
				For wear resistance	AH120			
	Prehardened steel NAK80, PX5, etc.		30 - 40HRC	First choice	AH3135	HJ	100 - 200	0.2 - 0.7
				For wear resistance	AH120			
M	Austenitic Stainless steel X5CrNi18-9, X5CrNiMo17-12-2, etc.		- 200HB	First choice	AH3135	HJ	100 - 200	0.2 - 0.7
	Martensitic Stainless steel X12Cr113, X20Cr13, etc.		- 200HB	First choice	AH3135	HJ	100 - 300	0.2 - 0.7
K	Grey cast iron 250, 300, etc.		150 - 250HB	First choice	AH120	HJ	100 - 300	0.3 - 1.1
				For impact resistance	AH3135			
	Ductile cast iron 400-15, 600-3, etc.		150 - 250HB	First choice	AH120	HJ	80 - 250	0.3 - 1.1
				For impact resistance	AH3135			
S	Titanium alloy Ti-6Al-4V, etc.		150 - 250HB	First choice	AH3135	HJ	30 - 60	0.15 - 0.6
	Superalloys Inconel718, etc.		150 - 250HB	First choice	AH120	HJ	20 - 50	0.05 - 0.3
H	Hardened steel	SKD61, etc.	40 - 50HRC	First choice	AH3135	HJ	50 - 150	0.1 - 0.3
				For wear resistance	AH120			
		SKD11, etc.	50 - 60HRC	First choice	AH120	HJ	50 - 70	0.05 - 0.15

Tool dia: DCX (mm), Number of revolution: *n* (min^{-1}), Feed speed: *Vf* (mm/min), Max. depth of cut: APMX = 1.3 mm, Number of teeth: z

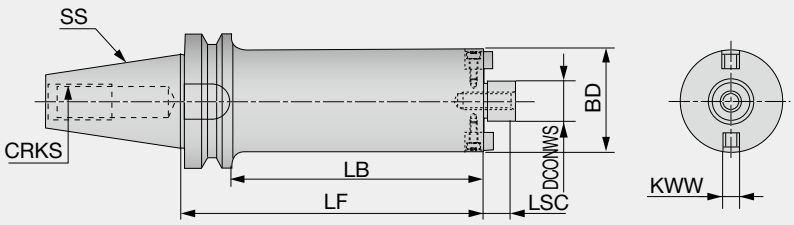
ø20, CICT = 2		ø25, CICT = 3		ø32			ø40, CICT = 6		ø42, CICT = 6		ø50, CICT = 7		ø52, CICT = 7		ø63, CICT = 7	
n	*Vf*	*n*	*Vf*	*n*	*Vf* Coarse pitch (CICT = 4)	*Vf* Close pitch (CICT = 5)	*n*	*Vf*	*n*	*Vf*	*n*	*Vf*	*n*	*Vf*	*n*	*Vf*
3,180	5,720	2,550	6,890	1,990	7,160	8,960	1,590	8,590	1,520	8,210	1,270	8,000	1,220	7,690	1,010	6,360
Vc = 200 m/min, *fz* = 0.9 mm/t																
2,860	5,150	2,290	6,180	1,790	6,440	8,060	1,430	7,720	1,360	7,340	1,150	7,250	1,100	6,930	910	5,730
Vc = 180 m/min, *fz* = 0.9 mm/t																
2,390	3,350	1,910	4,010	1,490	4,170	5,220	1,190	5,000	1,140	4,790	950	4,660	920	4,510	760	3,720
Vc = 150 m/min, *fz* = 0.7 mm/t																
2,390	2,870	1,910	3,440	1,490	3,580	4,470	1,190	4,280	1,140	4,100	950	3,990	920	3,860	760	3,190
Vc = 150 m/min, *fz* = 0.6 mm/t																
3,180	3,820	2,550	4,590	1,990	4,780	5,970	1,590	5,720	1,520	5,470	1,270	5,330	1,220	5,120	1,010	4,240
Vc = 200 m/min, *fz* = 0.6 mm/t																
3,180	5,720	2,550	6,890	1,990	7,160	8,960	1,590	8,590	1,520	8,210	1,270	8,000	1,220	7,690	1,010	6,360
Vc = 200 m/min, *fz* = 0.9 mm/t																
2,550	4,590	2,040	5,510	1,590	5,720	7,160	1,270	6,860	1,210	6,530	1,020	6,430	980	6,170	810	5,100
Vc = 160 m/min, *fz* = 0.9 mm/t																
720	720	570	860	450	900	1,130	360	1,080	340	1,020	290	1,020	280	980	230	810
Vc = 45 m/min, *fz* = 0.5 mm/t																
480	190	380	230	300	240	300	240	290	230	280	190	270	180	250	150	210
Vc = 30 m/min, *fz* = 0.2 mm/t																
1,590	950	1,270	1,140	990	1,190	1,490	800	1,440	760	1,370	640	1,340	610	1,280	510	1,070
Vc = 100 m/min, *fz* = 0.3 mm/t																
950	240	760	290	600	300	380	480	360	450	340	380	330	370	320	300	260
Vc = 60 m/min, *fz* = 0.12 mm/t																

Tool dia: DCX (mm), Number of revolution: *n* (min^{-1}), Feed speed: *Vf* (mm/min), Max. depth of cut: APMX = 2mm, Number of teeth: z

ø32, CICT = 2		ø40, CICT = 4		ø50, CICT = 5		ø52, CICT = 5		ø63, CICT = 6	
n	*Vf*	*n*	*Vf*	*n*	*Vf*	*n*	*Vf*	*n*	*Vf*
1,990	2,790	1,590	4,450	1,270	4,450	1,220	4,270	1,010	4,240
Vc = 200 m/min, *fz* = 0.7 mm/t									
1,790	2,510	1,430	4,000	1,150	4,030	1,100	3,850	910	3,820
Vc = 180 m/min, *fz* = 0.7 mm/t									
1,490	1,340	1,190	2,140	950	2,140	920	2,070	760	2,050
Vc = 150 m/min, *fz* = 0.45 mm/t									
1,490	1,340	1,190	2,140	950	2,140	920	2,070	760	2,050
Vc = 150 m/min, *fz* = 0.45 mm/t									
1,990	1,790	1,590	2,860	1,270	2,860	1,220	2,750	1,010	2,730
Vc = 200 m/min, *fz* = 0.45 mm/t									
1,990	2,790	1,590	4,450	1,270	4,450	1,220	4,270	1,010	4,240
Vc = 200 m/min, *fz* = 0.7 mm/t									
1,590	2,230	1,270	3,560	1,020	3,570	980	3,430	810	3,400
Vc = 160 m/min, *fz* = 0.7 mm/t									
450	320	360	500	290	510	280	490	230	480
Vc = 45 m/min, *fz* = 0.35 mm/t									
300	90	240	140	190	140	180	140	150	140
Vc = 30 m/min, *fz* = 0.15 mm/t									
990	400	800	640	640	640	610	610	510	610
Vc = 100 m/min, *fz* = 0.2 mm/t									
600	120	480	190	380	190	370	190	300	180
Vc = 60 m/min, *fz* = 0.1 mm/t									

BT50-FM (Shell mill holder for long overhang)

Face mill holder with BT shank

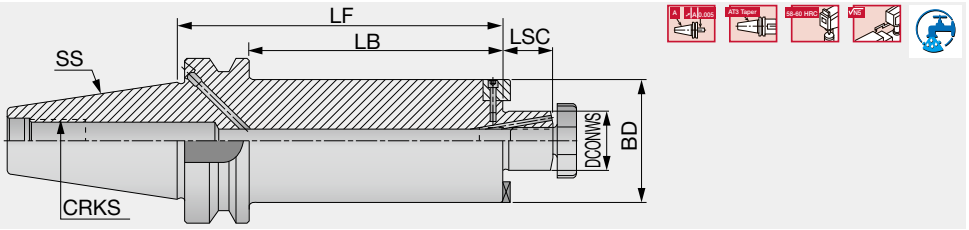


Designation	SS	DCONWS	BD	LSC	LF	LB	CRKS	KWW	WT (kg)
BT50-FMC22-138-47	50	22	47	18	138	100	M24	10	5.2
BT50-FMC22-188-47	50	22	47	18	188	150	M24	10	5.9
BT50-FMC22-243-47	50	22	47	18	243	205	M24	10	6.5
BT50-FMC22-293-47	50	22	47	18	293	255	M24	10	7.2
BT50-FMC22-178-59	50	22	59	18	178	140	M24	10	6.8
BT50-FMC22-238-59	50	22	59	18	238	200	M24	10	8
BT50-FMC22-308-59	50	22	59	18	308	270	M24	10	9.5
BT50-FMC22-373-59	50	22	59	18	373	335	M24	10	10.9
BT50-FMA31.75-215-76	50	31.75	76	30	215	177	M24	12.7	10
BT50-FMA31.75-295-76	50	31.75	76	30	295	257	M24	12.7	12.9
BT50-FMA31.75-375-76	50	31.75	76	30	375	337	M24	12.7	15.8
BT50-FMA31.75-275-96	50	31.75	96	30	275	237	M24	12.7	16.8
BT50-FMA31.75-375-96	50	31.75	96	30	375	337	M24	12.7	23

Option:Wrench for lock screw

BT-SEM-C (Shell mill holder)

Shell mill holder with coolant hole with BT shank (Extra long type)



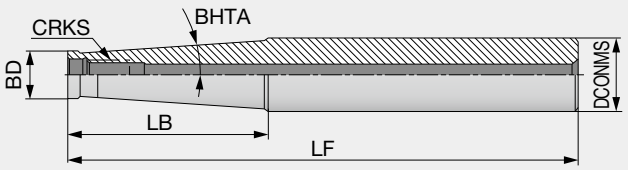
Designation	SS	DCONWS	BD	LF	LB	LSC	CRKS
BT50SEM22X48X220C	50	22	48	220	182	19	M24
BT50SEM22X61X320C	50	22	61	320	282	19	M24
BT50SEM27X61X320C	50	27	61	320	282	21	M24

- Applicable for 10 MPa pressure coolant
- If the "B type" option is required, the plug screw must be removed from the flange cooling hole (use a 2 mm hex key).

Option:Wrench for lock screw

TUNGFLEX
SM

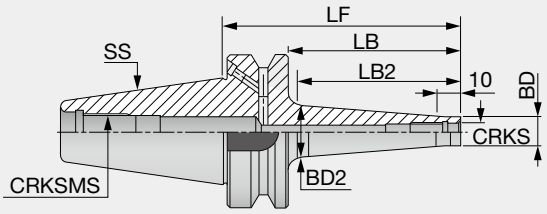
TungFlex - Modular shank



Designation	DCONMS	BD	LF	LB	BHTA	CRKS
SM06-L60C10	10	9.7	60	20	0°	M6
SM06-L105-C12	12	9.7	105	60	1.2°	M6
SM06-L125-C16	16	9.7	125	60	3.3°	M6
SM08-L73C16	16	13	73	25	0°	M8
SM08-L128-C16	16	13	128	80	0.9°	M8
SM08-L170-C20	20	13	170	66.8	3.3°	M8
SM10-L80-C20	20	18	80	30	0°	M10
SM10-L130-C20	20	18	130	80	0.6°	M10
SM10-L200-C25	25	19	200	57.2	3.3°	M10
SM12-L86-C25	25	21	86	30	5.1°	M12
SM12-L200-C32	32	21	200	78	4.4°	M12
SM16-L95-C32	32	29	95	35	1.7°	M16
SM16-L230-C32	32	29	230	50	1.8°	M16

TUNGFLEX
BT-ODP(Screw clamping head holder)

TungFlex modular tooling system with BT shank



Designation	SS	CRKS	BD	BD2	LF	LB	LB2	CRKSMS
BT40ODP6X66	40	M6	9.8	13	66	39	30	M16
BT40ODP6X106	40	M6	9.8	23	106	79	70	M16
BT40ODP8X66	40	M8	13	15	66	39	30	M16
BT40ODP8X106	40	M8	13	23	106	79	70	M16
BT40ODP10X66	40	M10	18	20	66	39	30	M16
BT40ODP10X106	40	M10	18	28	106	79	70	M16
BT40ODP12X66	40	M12	21	24	66	39	30	M16
BT40ODP12X106	40	M12	21	31	106	79	70	M16
BT40ODP16X66	40	M16	29	28.6	66	39	-	M16
BT40ODP16X106	40	M16	29	34	106	79	70	M16
BT50ODP12X94	50	M12	23	30	94	56	50	M24
BT50ODP12X144 (1)	50	M12	23	40	144	106	100	M24
BT50ODP12X194 (1)	50	M12	23	40	194	156	150	M24
BT50ODP12X244 (1)	50	M12	23	46	244	206	200	M24
BT50ODP16X94 (1)	50	M16	29	34	94	56	50	M24
BT50ODP16X144 (1)	50	M16	29	40	144	106	100	M24
BT50ODP16X194 (1)	50	M16	29	55	194	156	150	M24
BT50ODP16X244 (1)	50	M16	29	60	244	206	200	M24

• Applicable for 10 MPa pressure coolant (1) Balanced to G6.3 at 12,000 min-1

RED screw arbor

(Manufactured by MST Corporation)

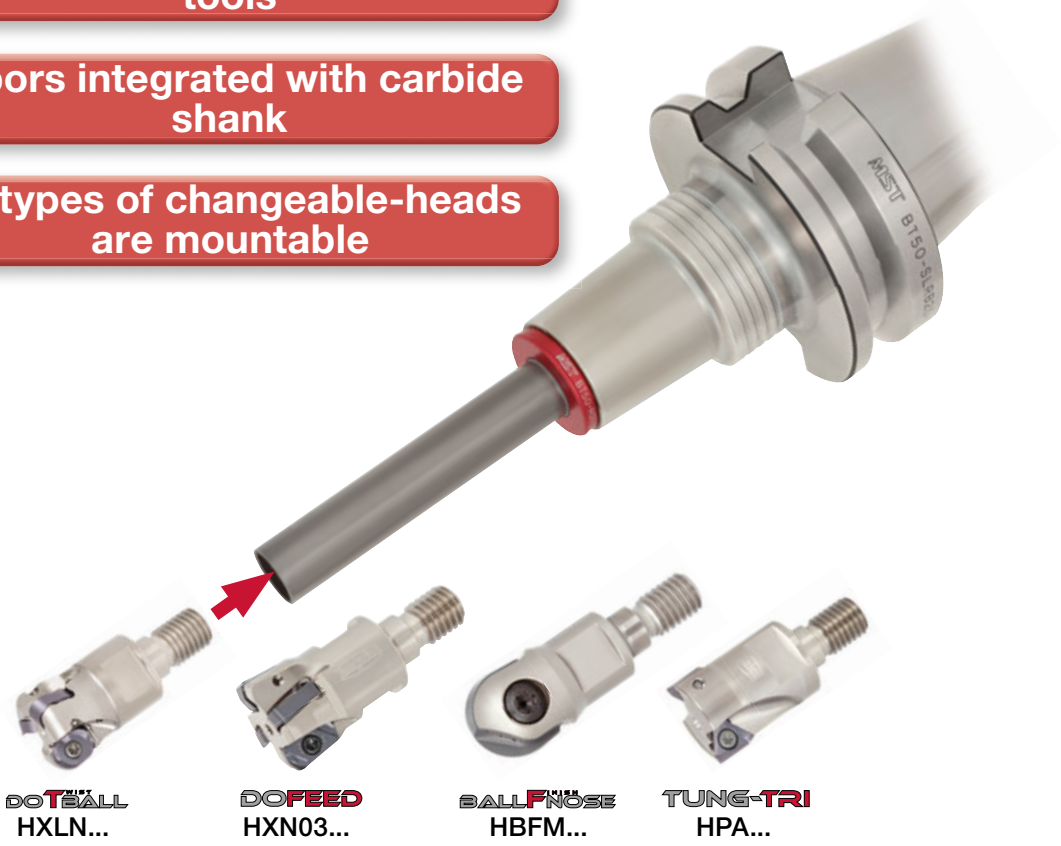
- Arbor integrated with carbide shank
- Carbide shank provides high rigidity
- Eliminates shank slip-off when rotated at high torque thanks to integrated shank-arbor design
- Chatter-free machining is possible even with long overhang

Ensures the highest performance with changeable-head tools

Optimized for changeable-head tools

Arbors integrated with carbide shank

All types of changeable-heads are mountable



DOTBALL HXLN...

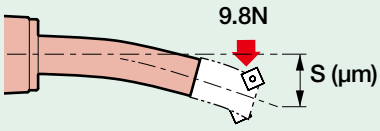
DOFEED HXN03...

BALLFNOSE HBFM...

TUNG-TRI HPA...

Tool rigidity index

Values in "S" colmun in the table on page 19 indicates the amount of deflection at the tool tip when working load of 9.8N is applied. The smaller the value is, the more rigid the tool is.

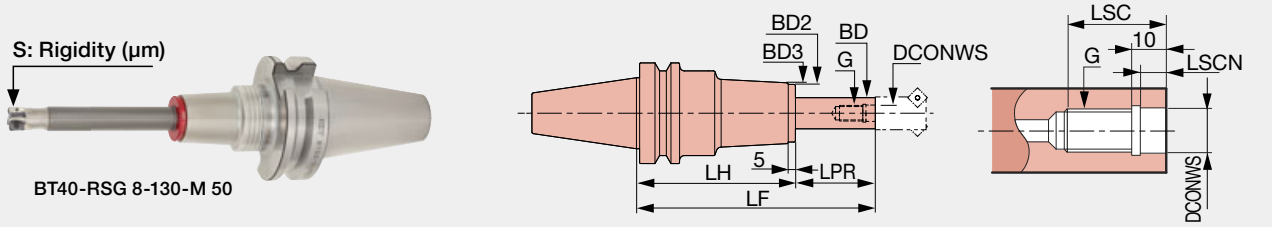


Manufactured by: MST corporation

TUNGFLEX

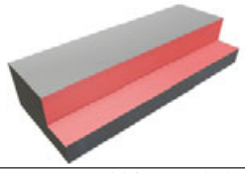
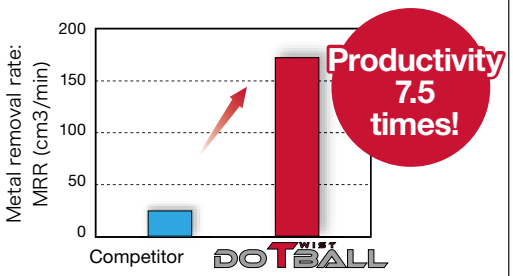
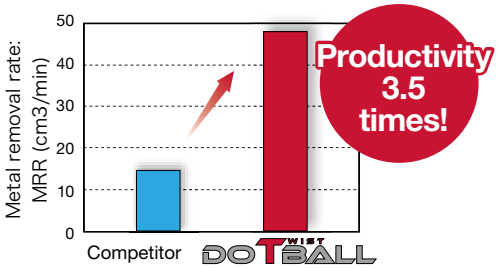
BT-RSG (Screw clamping head holder)

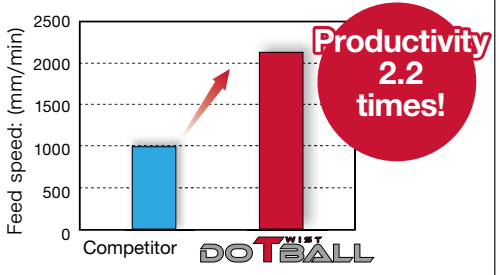
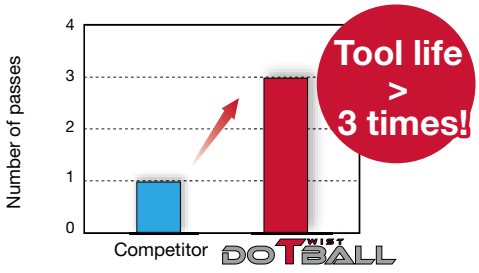
TungFlex modular tooling system with BT shank

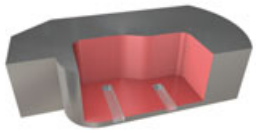
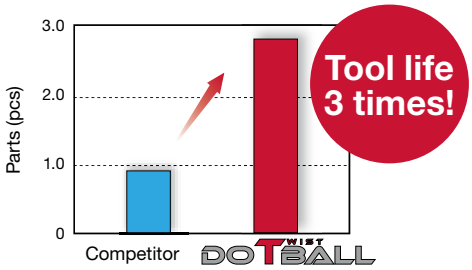
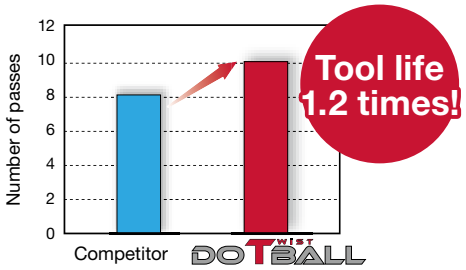


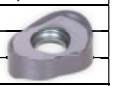
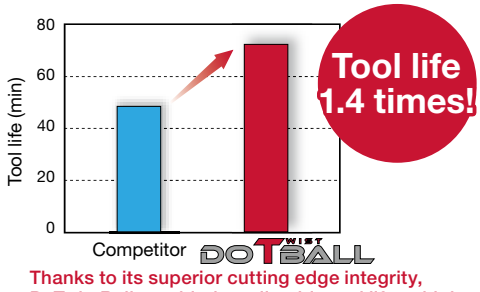
Designation	DCONWS	LSC	LSCN	BD	LF	LPR	LH	BD2	BD3	S	WT (kg)	G
BT40-RSG 8-105-M 25	8.5	18	6.5	15	105	25	80	30	32	0.6	1.4	M8
BT40-RSG 8-135-M 25	8.5	18	6.5	15	135	25	110	30	32	0.7	1.8	M8
BT40-RSG 8-130-M 50	8.5	18	6.5	15	130	50	80	30	32	1.5	1.4	M8
BT40-RSG 8-160-M 50	8.5	18	6.5	15	160	50	110	30	32	1.7	1.8	M8
BT40-RSG 8-155-M 75	8.5	18	6.5	15	155	75	80	30	32	3.1	1.5	M8
BT40-RSG 8-185-M 75	8.5	18	6.5	15	185	75	110	30	32	3.4	1.9	M8
BT40-RSG 8-165-M 85	8.5	18	6.5	15	165	85	80	30	32	4	1.5	M8
BT40-RSG 10-125-M 25	10.5	22	6.5	19	125	25	100	36	38	0.4	1.8	M10
BT40-RSG 10-155-M 25	10.5	22	6.5	19	155	25	130	36	38	0.5	2.2	M10
BT40-RSG 10-150-M 50	10.5	22	6.5	19	150	50	100	36	38	0.9	1.9	M10
BT40-RSG 10-180-M 50	10.5	22	6.5	19	180	50	130	36	38	1	2.3	M10
BT40-RSG 10-175-M 75	10.5	22	6.5	19	175	75	100	36	38	1.6	2	M10
BT40-RSG 10-205-M 75	10.5	22	6.5	19	205	75	130	36	38	1.8	2.4	M10
BT40-RSG 10-200-M100	10.5	22	6.5	19	200	100	100	36	38	2.8	2	M10
BT40-RSG 10-230-M100	10.5	22	6.5	19	230	100	130	36	38	3	2.4	M10
BT40-RSG 12-125-M 25	12.5	22	6	24	125	25	100	43	45	0.3	2	M12
BT40-RSG 12-155-M 25	12.5	22	6	24	155	25	130	43	45	0.4	2.4	M12
BT40-RSG 12-150-M 50	12.5	22	6	24	150	50	100	43	45	0.5	2.1	M12
BT40-RSG 12-180-M 50	12.5	22	6	24	180	50	130	43	45	0.7	2.5	M12
BT40-RSG 12-175-M 75	12.5	22	6	24	175	75	100	43	45	0.9	2.3	M12
BT40-RSG 12-205-M 75	12.5	22	6	24	205	75	130	43	45	1.1	2.7	M12
BT40-RSG 12-200-M100	12.5	22	6	24	200	100	100	43	45	1.4	2.4	M12
BT40-RSG 12-230-M100	12.5	22	6	24	230	100	130	43	45	1.6	2.8	M12
BT50-RSG 8-120-M 25	8.5	18	6.5	15	120	25	95	30	32	0.6	4	M8
BT50-RSG 8-150-M 25	8.5	18	6.5	15	150	25	125	30	32	0.7	4.3	M8
BT50-RSG 8-145-M 50	8.5	18	6.5	15	145	50	95	30	32	1.5	4	M8
BT50-RSG 8-175-M 50	8.5	18	6.5	15	175	50	125	30	32	1.7	4.3	M8
BT50-RSG 8-170-M 75	8.5	18	6.5	15	170	75	95	30	32	3	4.1	M8
BT50-RSG 8-200-M 75	8.5	18	6.5	15	200	75	125	30	32	3.3	4.4	M8
BT50-RSG 8-180-M 85	8.5	18	6.5	15	180	85	95	30	32	3.9	4.1	M8
BT50-RSG 10-140-M 25	10.5	22	6.5	19	140	25	115	36	38	0.4	4.3	M10
BT50-RSG 10-170-M 25	10.5	22	6.5	19	170	25	145	36	38	0.5	4.6	M10
BT50-RSG 10-165-M 50	10.5	22	6.5	19	165	50	115	36	38	0.8	4.4	M10
BT50-RSG 10-195-M 50	10.5	22	6.5	19	195	50	145	36	38	0.9	4.7	M10
BT50-RSG 10-190-M 75	10.5	22	6.5	19	190	75	115	36	38	1.6	4.5	M10
BT50-RSG 10-220-M 75	10.5	22	6.5	19	220	75	145	36	38	1.7	4.8	M10
BT50-RSG 10-215-M100	10.5	22	6.5	19	215	100	115	36	38	2.7	4.5	M10
BT50-RSG 10-245-M100	10.5	22	6.5	19	245	100	145	36	38	2.9	4.8	M10
BT50-RSG 12-140-M 25	12.5	22	6	24	140	25	115	43	45	0.2	4.6	M12
BT50-RSG 12-170-M 25	12.5	22	6	24	170	25	145	43	45	0.3	5	M12
BT50-RSG 12-165-M 50	12.5	22	6	24	165	50	115	43	45	0.5	4.7	M12
BT50-RSG 12-195-M 50	12.5	22	6	24	195	50	145	43	45	0.6	5.1	M12
BT50-RSG 12-190-M 75	12.5	22	6	24	190	75	115	43	45	0.8	4.9	M12
BT50-RSG 12-220-M 75	12.5	22	6	24	220	75	145	43	45	1	5.3	M12
BT50-RSG 12-215-M100	12.5	22	6	24	215	100	115	43	45	1.3	5	M12
BT50-RSG 12-245-M100	12.5	22	6	24	245	100	145	43	45	1.5	5.4	M12
BT50-RSG 12-240-M125	12.5	22	6	24	240	125	115	43	45	2	5.2	M12
BT50-RSG 16-140-M 25	17	25	6	29	140	25	115	52	54	0.2	5.4	M16
BT50-RSG 16-165-M 50	17	25	6	29	165	50	115	52	54	0.3	5.6	M16
BT50-RSG 16-190-M 75	17	25	6	29	190	75	115	52	54	0.5	5.8	M16
BT50-RSG 16-215-M100	17	25	6	29	215	100	115	52	54	0.7	6	M16
BT50-RSG 16-240-M125	17	25	6	29	240	125	115	52	54	1.1	6.2	M16

PRACTICAL EXAMPLES

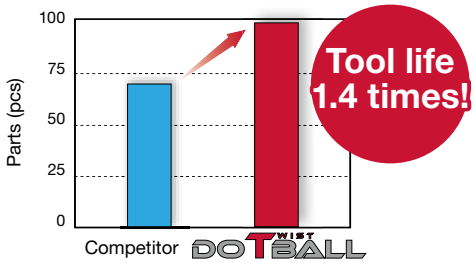
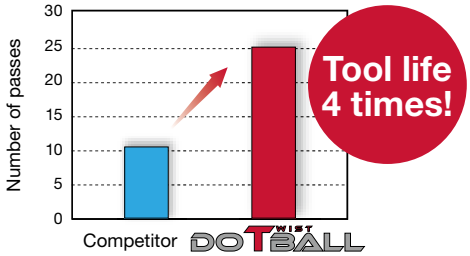
Workpiece type		Fixture part	Slide core
Cutter		EXLN04M025C25.0R03 (ø25, z = 3)	EXLN04M025C25.0R03 (ø25, z = 3)
Insert		LNMX0405R4-MJ	LNMX0405R4-MJ
Grade		AH3135	AH3135
Workpiece material		SUS304	NAK80 (40HRC)
		 M	 P
Cutting conditions	Cutting speed : *Vc* (m/min)	220 ← 120	150
	Feed per tooth: *fz* (mm/t)	0.4 ← 0.1	0.3 ← 0.15
	Feed speed : *Vf* (mm/min)	3360 ← 535	1720 ← 573
	Depth of cut : *ap* (mm)	3.5 ← 3	4 ← 5
	Width of cut : *ae* (mm)	15	7 ← 5
	Machining	Shoulder milling	Shoulder milling
	Coolant	External supply	External supply
	Machine	Vertical M/C	Vertical M/C
Results		 Feed per tool is improved by 4x, MRR by 7.5 times.	 A combination of large insert radius and tough AH3135 grade eliminated chipping even when machined at higher feed per tooth.

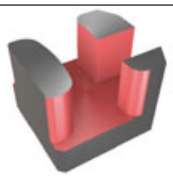
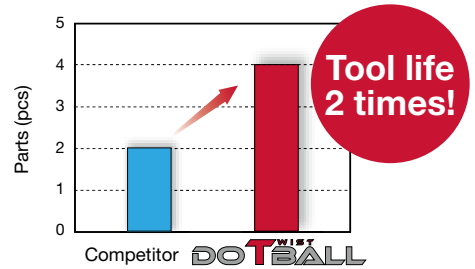
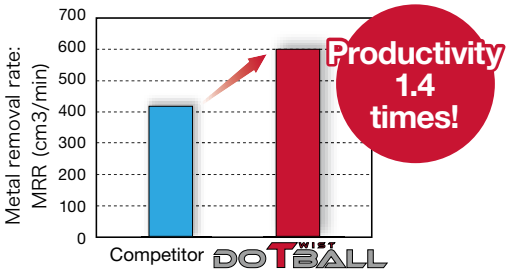
Workpiece type		Attachment	Fixture part
Cutter		TXLN05M050B22.0R06 (ø50, z = 6)	TXLN06M063B22.0R06 (ø63, z = 6)
Insert		LNMX0506R5-MJ	LNMX0607R6-MJ
Grade		AH120	AH120
Workpiece material		EH360A (48HRC)	Stellite (60HRC)
		 H	 H
Cutting conditions	Cutting speed : *Vc* (m/min)	190 ← 150	50
	Feed per tooth: *fz* (mm/t)	0.3 ← 0.2	0.2
	Feed speed : *Vf* (mm/min)	2150 ← 1000	200 ← 100
	Depth of cut : *ap* (mm)	1.5	2
	Width of cut : *ae* (mm)	-	40
	Machining	Helical interpolation	Face milling
	Coolant	External supply	Air
	Machine	Vertical M/C (BT50)	Vertical M/C (BT50)
Results		 Excellent chip evacuation and tough cutting edge improved feed rate by 2.2x with stability.	 Superior cutting edge integrity eliminated fracture, improving tool life reliability.

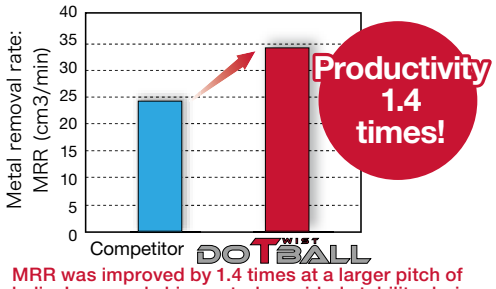
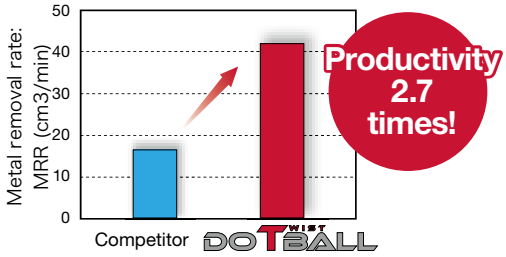
Workpiece type		Turbine blade	Die and Mold
Cutter		EXLN04M032C32.0R04 (ø32, z = 4)	EXLN04M032C32.0R05 (ø32, z = 5)
Insert		LNMX0405R4-MJ 	LNMX0405R4-MJ 
Grade		AH3135	AH120
Workpiece material		13Cr-Mo stainless steel  M	DAC-MAGIC (48HRC)  H
Cutting conditions	Cutting speed : *Vc* (m/min)	220	150 ← 132
	Feed per tooth: *fz* (mm/t)	0.30	0.33
	Feed speed : *Vf* (mm/min)	2,626	2,478
	Depth of cut : *ap* (mm)	1.0	0.3
	Machining	Profile milling	Contour machining
	Coolant	Dry	Dry
	Machine	Turning center	Vertical M/C (HSK63)
Results		 DoTwistBall's tool life is 3 times longer than the competitor's.	 DoTwistBall's tool life is 1.2 times longer than the competitor's.

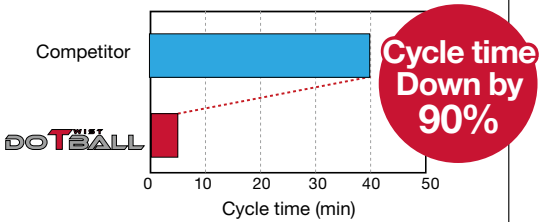
Workpiece type		Stamping die part
Cutter		TXLN05M050B22.0R06 (ø50, z = 6)
Insert		LNMX0506R5-MJ 
Grade		AH3135
Workpiece material		SKD11 (35HRC)  P
Cutting conditions	Cutting speed : *Vc* (m/min)	200 ← 180
	Feed per tooth: *fz* (mm/t)	0.9 ← 0.8
	Feed speed : *Vf* (mm/min)	7000 ← 5500
	Depth of cut : *ap* (mm)	1
	Width of cut : *ae* (mm)	22
	Machining	Pocketing
	Coolant	Air
	Machine	Vertical M/C (BT50)
Results		 Thanks to its superior cutting edge integrity, DoTwistBall provided predictable tool life at high feed rates, improving MRR by 1.3 times.

PRACTICAL EXAMPLES

Workpiece type		Machine part	Die and mold
Cutter		EXLN04M032C32.0R05 (ø32, z = 5)	TXLN04M050B22.0R07 (ø50, z = 7)
Insert		LNMX0405ZER-HJ	LNMX0405ZER-HJ
Grade		AH3135	AH120
Workpiece material		S50C / C50	DAC10 (48HRC)
		 P	 H
Cutting conditions	Cutting speed : *Vc* (m/min)	200	100
	Feed per tooth: *fz* (mm/t)	0.8	0.44 ← 0.39
	Feed speed : *Vf* (mm/min)	8,000	1,961
	Depth of cut : *ap* (mm)	0.8	0.5
	Width of cut : *ae* (mm)	32	-
	Machining	Helical contouring	Contour machining
	Coolant	Dry	Air
	Machine	BT40	Vertical M/C (BT50)
Results		 DoTwistBall provides excellent chip evacuation, preventing chip packing.	 DoTwistBall extends tool life by 4 times compared to the competitor.

Workpiece type		Planetary carrier	Stamping die part
Cutter		EXLN04M032C32.0R05 (ø32, z = 5)	TXLN06M050B22.0R05 (ø50, z = 5)
Insert		LNMX0405ZER-HJ	LNMX0607ZER-HJ
Grade		AH3135	AH3135
Workpiece material		X5CrNiNb 18-10 Austenitic stainless steels	FC250
		 M	 K
Cutting conditions	Cutting speed : *Vc* (m/min)	140 ← 120	150
	Feed per tooth: *fz* (mm/t)	0.7 ← 0.2	1.2
	Feed speed : *Vf* (mm/min)	4,874 ← 716	6000
	Depth of cut : *ap* (mm)	1.2 ← 4	2 ← 1.5
	Width of cut : *ae* (mm)	32	50
	Machining	Profile milling	Profile and face milling
	Coolant	Air	None (dry)
	Machine	Vertical M/C (BT50)	Double column (BT50)
Results		 DoTwistBall's tool life is 2 times longer than the competitor's.	 Chip re-cutting was eliminated, while tool life was doubled. MRR was also doubled.

	Workpiece type	Arm part for heavy equipment	Base plate
	Cutter	EXLN04M032C32.0R04 (ø32, z = 4)	EXLN04M032C32.0R04 (ø32, z = 4)
	Insert	LNMX0405ZER-HJ	LNMX0405ZER-HJ
	Grade	AH3135	AH3135
	Workpiece material	SC480	Steel (20HRC)
		 P	 P
Cutting conditions	Cutting speed : *Vc* (m/min)	200	150
	Feed per tooth: *fz* (mm/t)	0.36 ← 0.46	0.8 ← 0.6
	Feed speed : *Vf* (mm/min)	2865 ← 2440	4775 ← 1791
	Depth of cut : *ap* (mm)	1.2 ← 1 (per pitch of helix)	0.5
	Width of cut : *ae* (mm)	10	18
	Machining	Helical interpolation	Ramping and pocketing
	Coolant	External supply	External supply
	Machine	Horizontal M/C	Vertical M/C
	Results	 MRR was improved by 1.4 times at a larger pitch of helix. Improved chip control provided stability during machining.	 High density cutter with low cutting force geometry improved MRR by 2.7x and tool life by 2.3 times.

	Workpiece type	Stamping die part
	Cutter	EXLN04M025C25.0R03 (ø25, z = 3)
	Insert	LNMX0405ZER-HJ
	Grade	AH3135
	Workpiece material	YXR3 (before hardening)
		 P
Cutting conditions	Cutting speed : *Vc* (m/min)	190 ← 235
	Feed per tooth: *fz* (mm/t)	0.78 ← 0.4
	Feed speed : *Vf* (mm/min)	5600 ← 2400
	Depth of cut : *ap* (mm)	1.3 ← 0.3
	Width of cut : *ae* (mm)	25
	Machining	Slotting and face milling
	Coolant	External supply
	Machine	Vertical M/C
	Results	 Increased cutting depth and feed per tooth reduced the cycle time to 1/10.

Tungaloy Corporation (Head office)
11-1 Yoshima-Kogyodanchi
Iwaki-city, Fukushima 970-1144 Japan
Phone: +81-246-36-8501
Fax: +81-246-36-8542
www.tungaloy.co.jp

Tungaloy-NTK America Inc.
3726 N Ventura Drive
Arlington Heights,IL 60004, U.S.A.
Phone: +1-888-554-8394
Fax: +1-888-554-8392
www.tungaloy.com/us

Tungaloy Canada
432 Elgin St. Unit 3
Brantford, Ontario N3S 7P7, Canada
Phone: +1-519-758-5779
Fax: +1-519-758-5791
www.tungaloy.com/ca

Tungaloy-NTK De Mexico S.A.
C Los Arellano 113,
Parque Industrial Siglo XXI
Aguascalientes, AGS, Mexico 20290
Phone: +52-449-929-5410
Fax: +52-449-929-5411
www.tungaloy.com/mx

Tungaloy-NTK do Brasil Ltda.
Avd. Independencia N4158 Residencial Flora
13280-000 Vinhedo, São Paulo, Brasil
Phone: +55-19-38262757
Fax: +55-19-38262757
www.tungaloy.com/br

Tungaloy-NTK Germany GmbH.
Katzbergstr. 3a
D-40764 Langenfeld, Germany
Phone: +49-2173-90420-0
Fax: +49-2173-90420-19
www.tungaloy.com/de

Tungaloy France s.a.s
Les Fjords
19 avenue de Norvège
91140 Villebon Sur Yvette, France
Phone: +33-1-6486-4300
Fax: +33-1-6907-7817
www.tungaloy.com/fr

Tungaloy Italia S.r.l.
Viale Sarca 336/Edificio 13
20126 Milano, Italy
Phone: +39-02-252012-1
Fax: +39-02-252012-65
www.tungaloy.com/it

Tungaloy Czech s.r.o.
Turanka 1583/115g,
627 00 Brno, Czech Republic
Phone: +420-532 123 391
www.tungaloy.com/cz

Tungaloy Ibérica S.L.
C/Miquel Servet, 43B, Nau 7
Pol. Ind. Bufalvent
ES-08243 Manresa (BCN), Spain
Phone: +34 93 113 1360
www.tungaloy.com/es

Tungaloy Scandinavia AB
Bultgatan 38
442 40 Kungälv, Sweden
Phone: +46-462119200
Fax: +46-462119207
www.tungaloy.com/se

Tungaloy Rus, LLC
Andropova avenue, h.18/7,
11 floor, office 3, 115432,
Moscow, Russia
Phone: +7-499-683-01-80
Fax: +7-499-683-01-81
www.tungaloy.com/ru

Tungaloy Polska Sp. z o.o.
Ul. Irysowa 1, 55-040 Bielany
Wrocławskie, Poland
Phone: +48 607 907 237
www.tungaloy.com/pl

Tungaloy-NTK UK Ltd.
Suite 3, Pioneer House, Mill Street,
Cannock, WS11 0EF, UK
Phone: +44 121 4000 231
Fax: +44 121 270 9694
www.tungaloy.com/uk

Tungaloy Hungary Kft
Erzsébet királyné útja 125
H-1142 Budapest, Hungary
Phone: +36 1 781-6846
Fax: +36 1 781-6866
www.tungaloy.com/hu

Tungaloy Turkey
Serifali Mah.bayraktar Bulvari Kule Sk. No:26
34775 Umraniye / Istanbul / Turkey
Phone: +90 216 540 04 67
Fax: +90 216 540 04 87
www.tungaloy.com/tr

Tungaloy Benelux b.v.
Tjalk 70
NL-2411 NZ Bodegraven, Netherlands
Phone: +31 172 630 420
Fax: +31 172 630 429
www.tungaloy.com/nl

Tungaloy Croatia
Ulica bana Josipa Jelačića 87,
10430, Samobor, Croatia
Phone: +385 1 3326 604
Fax: +385 1 3327 683
www.tungaloy.com/hr

Tungaloy Cutting Tool (Shanghai) Co. Ltd.
Room 701, 7th Floor,
No.1 Lane 388 Kang'an Road,
Pudong New Area, Shanghai, China
Phone: +86-21-3632-1880
Fax: +86-21-3621-1918
www.tungaloy.com/cn

Tungaloy Cutting Tools Taiwan Co. Ltd.
9F. No.293, Zhongyang Rd,
Xinzhuang Dist, New Taipei City,
24251 Taiwan
Phone: +886-2-8521-9986
Fax: +886-2-8521-8935
www.tungaloy.com/tw

Tungaloy-NTK Cutting Tool (Thailand) Co.,Ltd.
Interlink tower 4th Fl.
1858/5-7 Bangna-Trad Road
km.5 Bangna, Bangna, Bangkok 10260
Thailand
Phone: +66-2-751-5711
Fax: +66-2-751-5715
www.tungaloy.com/th

Tungaloy Singapore (Pte.), Ltd.
62 Ubi Road 1, #08-09 Oxley BizHub 2
Singapore 408734
Phone: +65-6391-1833
Fax: +65-6299-4557
www.tungaloy.com/sg

Tungaloy-NTK Vietnam LLC
Floor 3, Licogi 13 Tower, No.164 Khuat Duy
Tien Street, Thanh Xuan Ward, Ha Noi,
Vietnam
Phone: +84 24 63282086
www.tungaloy.com/vn

Tungaloy India Pvt. Ltd.
One International Center,
Unit # 902-A, 9th Floor,
Tower 1, Senapati Bapat Marg,
Elphinstone Road (West),
Mumbai 400013, India
Phone: +91-22-6124-8803
Fax: +91-22-6124-8899
www.tungaloy.com/in

Tungaloy-NTK Korea
1040 Gachang-ro, Gachang-myeon,
Dalseong-gun, Daegu, 42936, Korea
Phone: +82-53-760-7698
Fax: +82-53-768-9912
www.tungaloy.com/kr

Tungaloy Malaysia Sdn Bhd
50 K-2, Kelana Mall, Jalan SS6/14
Kelana Jaya, 47301
Petaling Jaya, Selangor Darul Ehsan
Malaysia
Phone: +603-7805-3222
Fax: +603-7804-8563
www.tungaloy.com/my

Tungaloy Australia Pty Ltd
Unit 68 1470 Ferntree Gully Road
Knoxfield 3180 Victoria, Australia
Phone: +61-3-9755-8147
Fax: +61-3-9755-6070
www.tungaloy.com/au

PT. Tungaloy Indonesia
Ruko Blok AA.10 No3&5, Grand Wisata,
Lambangjaya, Tambun Selatan, Bekasi,
17510 Indonesia
Phone: +62-21-8261-5808
Fax: +62-21-8261-5809
www.tungaloy.com/id

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