MillLine

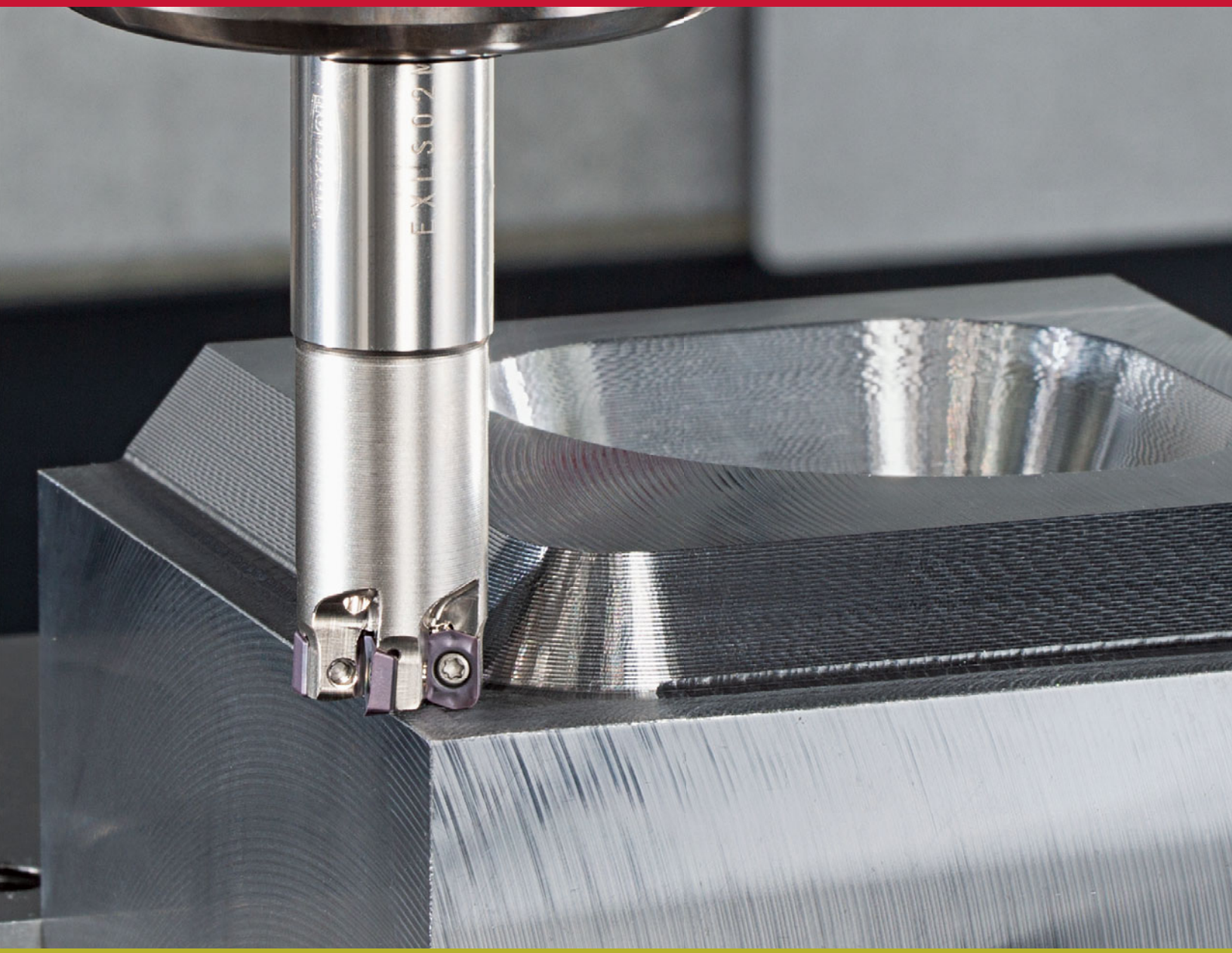
TUNGFORCEFEED

www.tungaloy.com/us

Tungaloy Report No. 521-US

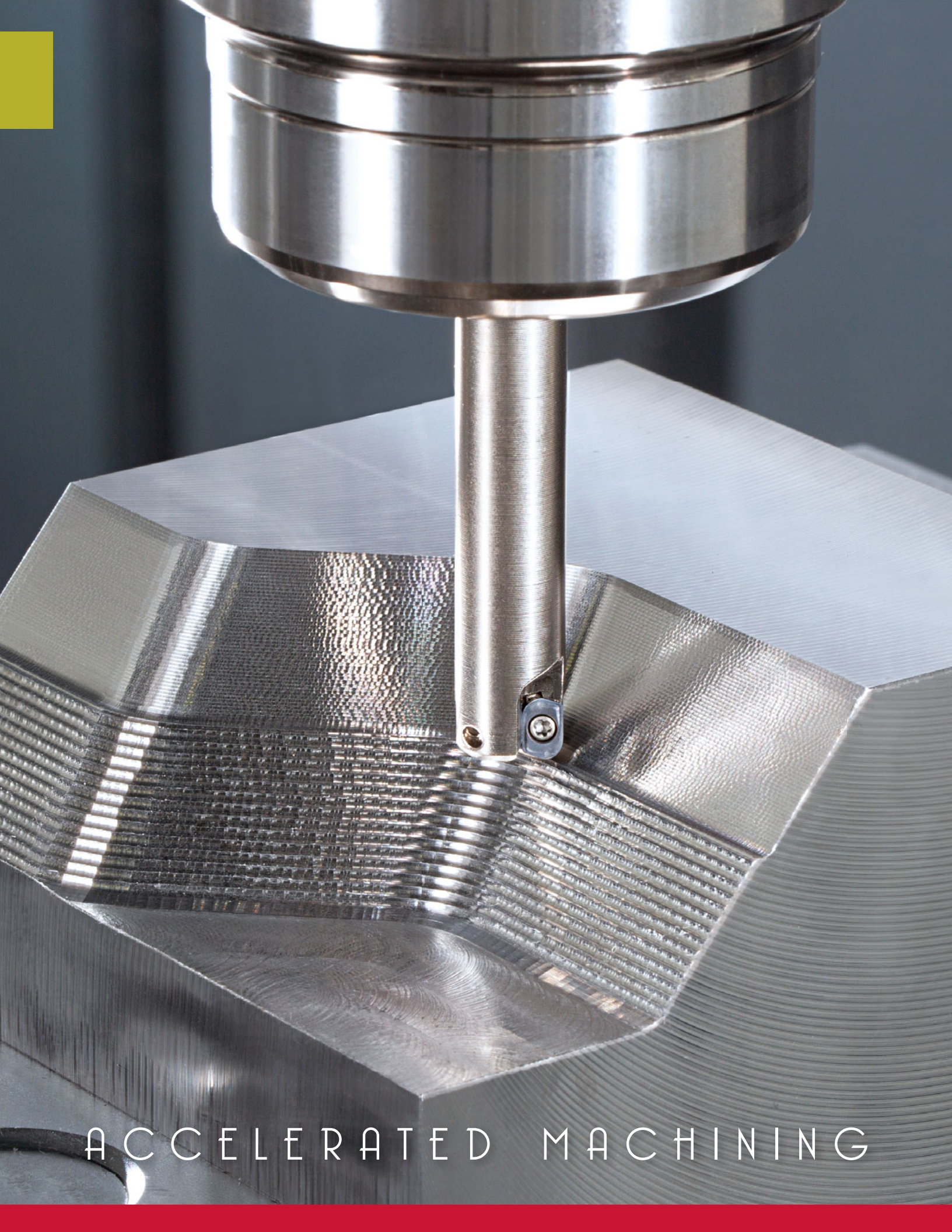
Small diameter high feed milling cutter

with robust design for stability and efficiency



INDUSTRY 4.0

FEED the SPEED!

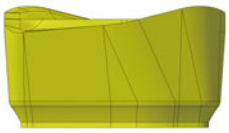

ACCELERATED MACHINING

TUNGFORCE MILL
ACCELERATED MACHINING

Indexable high feed milling cutter, available in as small as ø0.375" diameter, offers free cutting and effective chip control in a wide range of applications.

Small diameter high feed milling cutter with impressive machining efficiency and reliability

Built to perform at higher machining conditions



Thick insert corner
Max 10 % thicker
than competitors'

Strong insert corner for high feed operations

- Thick insert corner is designed to withstand fracturing force

Robust and easy-to-handle insert screws

- M2 screws reduce screw neck shears under high cutting forces. A larger screw enhances insert's fixation and easy handling.

TUNGFORCE-FEED (M2)

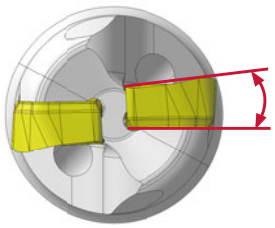
Competitor (M1.8)

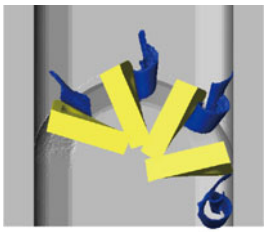
Proper chip formation assures a reliable machining process

Positive inclination angle of the insert promotes smooth chip evacuation

- The positive cutting edge position contributes to a controlled chip formation and easy chip evacuation when machining next to shoulder and slotting operations.

Positive inclination angle





Proper chip control eliminates recuts and premature insert failure

Chip formation

TUNGFORCE-FEED

Ideal curled chips

Competitor

Crushed chips

P

Cutter	: EXLS02U0.50C0.50LH2.00R02
Insert	: LSMT0202ZER-HM AH3225
Workpiece material	: 1055
Cutting speed	: *Vc* = 656 sfm
Application	: Slotting
Depth of cut	: *ap* = 0.020 mm × 20 passes
Coolant	: Dry
Machine	: Vertical M/C, CAT40

Ensures high efficient machining in various operations

Effective in various 3D milling applications including helical interpolation and ramping

 Face milling

 Shoulder milling

 Helical interpolation

 Ramping

and more

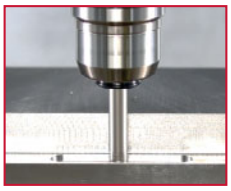
Improved machining efficiency thanks to close pitch design and wider application capability

MRR is improved as much as 5 times!

Table below shows tool performance comparisons when machining 1055 carbon steel with a tool diameter of ø0.625"

	Metal removal rate ($inch^3$/min)	Number of teeth	Cutting speed (sfm)	Feed per tooth (ipt)	Depth of cut (inch)	Width of cut (inch)
TungForceFeed	4.836	5	656	0.031	0.020	0.390
Competitor's high feed cutter	0.998	4	656	0.008	0.020	0.390
Competitor's shoulder mill	3.744	4	656	0.003	0.200	0.390
Solid carbide endmill	2.340	5	328	0.003	0.200	0.390

High feed capability improves tool life and machining efficiency



Designed with a small entry angle for chatter stability, TungForceFeed's insert significantly improves efficiency and tool life even when machining in long reach areas

 Long reach areas

 Deep slots

 Deep shouldering

and more

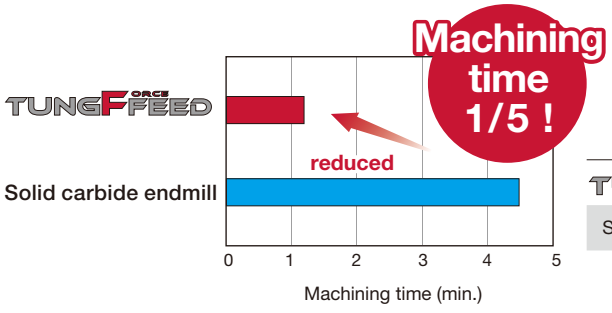
Applications requiring a long overhang tool to avoid fixture or workpiece interference

Problems with the conventional tool

- Chatter is more common with long reach areas, preventing higher parameters to be applied
- Chipping and fracture occurs due to chatter

TungForceFeed, with long overhang tool, performs at the highest efficiency and reliability in long reach machining application

Machining time compared with the conventional tool (L/D = 5, pocketing)



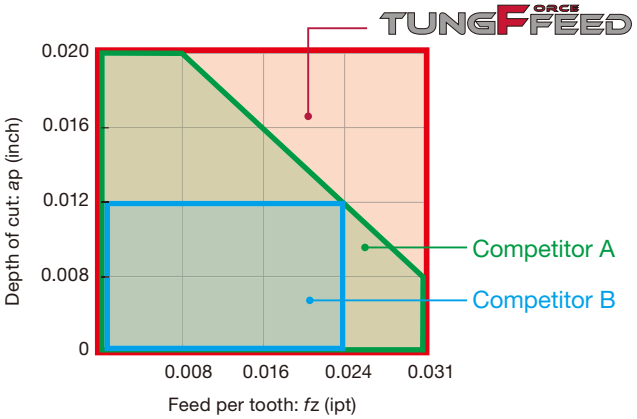
	Tool diameter	Number of teeth	Metal removal rate (in^3/min)	Over hang (inch)	Cutting speed (sfm)	Feed per tooth (ipt)	Depth of cut (inch)
TungForceFeed	ø0.5	2	1.159	2.362	492	0.016	0.020 × 20 passes
Solid carbide endmill	ø0.5	4	0.244	2.362	262	0.003	0.020 × 20 passes

2 insert styles for various applications

High feed insert (LSMT-HM)

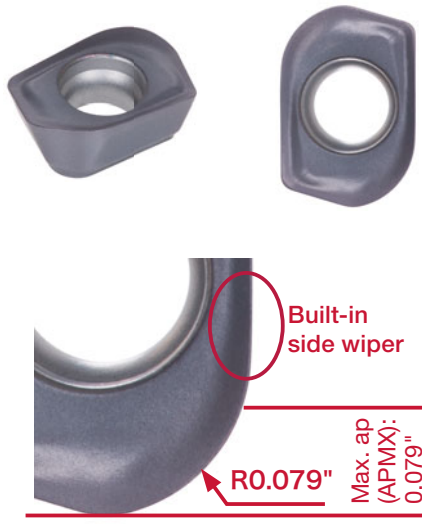
- Provides machining efficiency in a wide range of applications
- First choice insert for various applications including slotting, pocketing, or for long reach areas

Application range
(of standard length body)

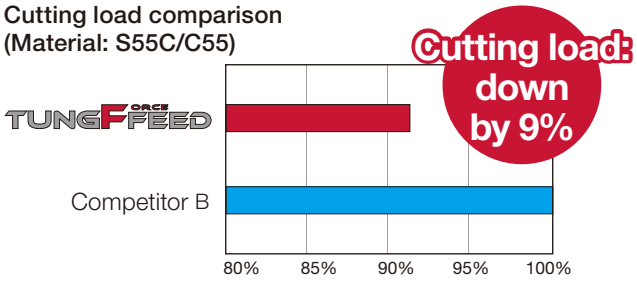


R0.079 insert (LSMT-MM) (To be released in 2019)

- Full profiling insert design ideal for semi-roughing and semi-finishing of die and mold parts
- Free cutting geometry eliminates chattering and improves surface finish quality
- Built-in side wiper helps reduce burr formation on walls and corners while improving wall accuracy



Cutting load comparison
(Material: S55C/C55)



Burr formations on exit

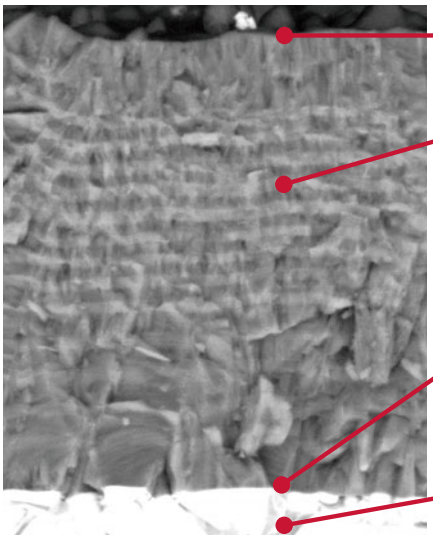
Grade lineup for various materials

New

AH3225

P M

- Nano multi-layer coating technology with three major properties for optimal cutting edge integrity
- Increased resistance to wear, fracture, oxidation, built-up edge, and delamination



Technology 1 - Resistance to built-up edge
The coating surface prevents built-up edge

Technology 2 - Resistance to wear, oxidation, and fracture
Multi-layered coating is designed to resist wear and oxidation, while preventing micro-cracks from propagating in the coating layer for improved resistance to edge chipping

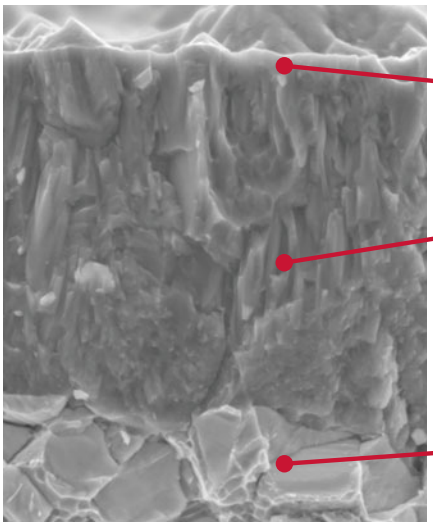
Technology 3 - Strong coating/substrate adhesion
Coating is optimized for strong adhesion property with substrate to maintain strong cutting edge integrity

Carbide substrate
High resistance to fracture

AH8015

H S K P

- Incorporates a hard coating layer and carbide substrate.
- Strong resistance to wear, heat, and built-up edge, ideal for machining hard or difficult materials.



Special surface technology

PREMIUMTEC
TUNGALOY

Smooth insert surface prevents chip adhesion!

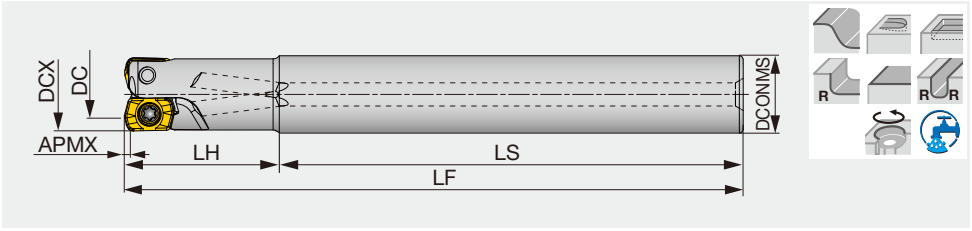
Extremely hard layer of nano multi-layered AlTiN coating with high Al content
Increases hardness by 20 %
Prevents micro cracks from developing

Carbide substrate
High resistance to wear

EXLS

Cylindrical type holder for high-feed milling, screw-on

GAMP = +4°, GAMF = -21° ~ -17°



Inch	APMX	DCX	CICT	DC	DCONMS	LS	LH	LF	WT (lbs)	Air hole	Insert
EXLS02U0.37C0.37LH0.75R01	0.019	0.375	1	0.228	0.375	2.250	0.750	3.000	0.088	With	LSMT02...
EXLS02U0.37C0.37LH1.25R01	0.019	0.375	1	0.228	0.375	2.250	1.250	3.500	0.110	With	LSMT02...
EXLS02U0.37C0.31LH0.75R01	0.019	0.375	1	0.228	0.3125	2.250	0.750	3.000	0.066	With	LSMT02...
EXLS02U0.50C0.50LH0.75R03	0.019	0.500	3	0.354	0.500	2.250	0.750	3.000	0.132	With	LSMT02...
EXLS02U0.50C0.50LH2.00R02	0.019	0.500	2	0.354	0.500	2.250	2.000	4.250	0.176	With	LSMT02...
EXLS02U0.50C0.37LH0.75R03	0.019	0.500	3	0.354	0.375	2.250	0.750	3.000	0.088	With	LSMT02...
EXLS02U0.62C0.62LH1.50R05	0.019	0.625	5	0.479	0.625	2.500	1.500	4.000	0.308	With	LSMT02...
EXLS02U0.62C0.62LH2.00R03	0.019	0.625	3	0.479	0.625	2.500	2.000	4.500	0.375	With	LSMT02...

Metric	APMX	DCX	CICT	DC	DCONMS	LS	LH	LF	WT (kg)	Air hole	Insert
EXLS02M008C08.0LH16R01	0.5	8	1	4.29	8	59	16	75	0.02	With	LSMT02...
EXLS02M008C08.0LH30R01	0.5	8	1	4.29	8	59	31	90	0.03	With	LSMT02...
EXLS02M010C10.0LH20R02	0.5	10	2	6.28	10	60	20	80	0.04	With	LSMT02...
EXLS02M010C10.0LH40R02	0.5	10	2	6.28	10	60	40	100	0.05	With	LSMT02...
EXLS02M010C08.0LH20R02	0.5	10	2	6.28	8	60	20	80	0.03	With	LSMT02...
EXLS02M012C12.0LH20R03	0.5	12	3	8.31	12	60	20	80	0.06	With	LSMT02...
EXLS02M012C12.0LH50R02	0.5	12	2	8.31	12	60	50	110	0.08	With	LSMT02...
EXLS02M012C10.0LH20R03	0.5	12	3	8.31	10	60	20	80	0.04	With	LSMT02...
EXLS02M016C16.0LH30R05	0.5	16	5	12.31	16	70	30	100	0.14	With	LSMT02...
EXLS02M016C16.0LH50R03	0.5	16	3	12.31	16	70	50	120	0.17	With	LSMT02...

SPARE PARTS



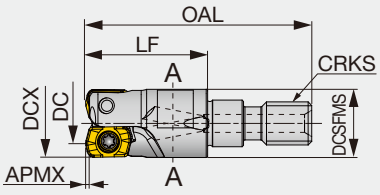
Designation	Clamping screw	Lubricant	Wrench
EXLS02U...	CSPB-2H	M-1000	IP-6DB

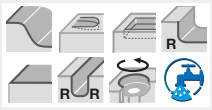
TUNGFLEX

HXLS

Modular head for high-feed milling, screw-on (TungFlex)

GAMP = +4°, GAMF = -21° ~ -17°





Metric	APMX	DCX	CICT	DC	OAL	LF	H	DCSFMS	CRKS	WT (kg)	Air hole	Insert
HXLS02M008M06R01	0.5	8	1	4.29	33.5	19	7	9.5	M6	0.01	With	LSMT02...
HXLS02M010M06R02	0.5	10	2	6.28	31.5	17	7	9.5	M6	0.01	With	LSMT02...
HXLS02M012M06R03	0.5	12	3	8.31	31.5	17	7	10	M6	0.01	With	LSMT02...
HXLS02M012M06R02	0.5	12	2	8.31	31.5	17	7	10	M6	0.01	With	LSMT02...
HXLS02M016M08R05	0.5	16	5	12.31	40	23	10	13	M8	0.03	With	LSMT02...
HXLS02M016M08R03	0.5	16	3	12.31	40	23	10	13	M8	0.03	With	LSMT02...

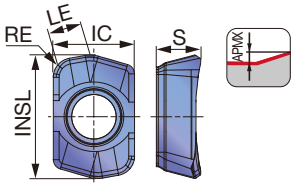
SPARE PARTS



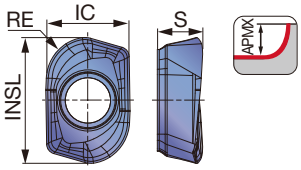
Designation	Clamping screw	Lubricant	Wrench
HXLS02M...	CSPB-2H	M-1000	IP-6DB

INSERTS

LSMT-HM (High feed)



LSMT-MM (Radius)



		Coated	
		AH3225	AH8015
P	Steel	★	☆
M	Stainless	★	
K	Cast iron	☆	★
N	Non-ferrous		
S	Superalloys	☆	★
H	Hard materials		★

★ : First choice
☆ : Second choice

Designation	RE	APMX	Coated AH3225	Coated AH8015	LE	INSL	IC	S
LSMT0202ZER-HM	0.039	0.019	●	●	0.067	0.252	0.165	0.091
LSMT0202R2-MM	0.079	0.079	●	●	-	0.252	0.169	0.091

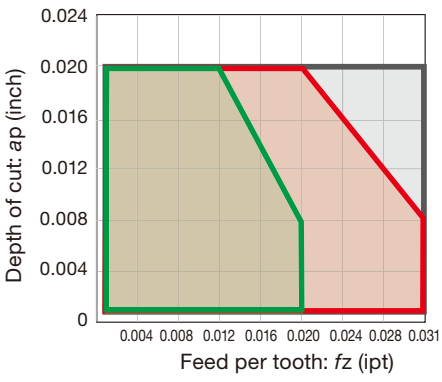
●: To be released in 2019
●: Line up

STANDARD CUTTING CONDITIONS

ISO	Workpiece materials		Hardness	Priority	Grades	Cutting speed *Vc* (sfm)	Feed per tooth *fz* (ipt)
P	Carbon steels (1045, 1055, etc.)		- 300HB	First choice	AH3225	330 - 990	0.008 - 0.031
			- 300HB	For wear resistance	AH8015	330 - 990	0.008 - 0.031
	Alloy steels (4140, SCr415, etc.)		- 300HB	First choice	AH3225	330 - 990	0.008 - 0.031
			- 300HB	For wear resistance	AH8015	330 - 990	0.008 - 0.031
	Prehardened steels (NAK80, PX5, etc.)		30 - 40HRC	First choice	AH8015	330 - 660	0.008 - 0.020
			30 - 40HRC	For impact resistance	AH3225	330 - 660	0.008 - 0.020
M	Stainless steels (304, 316, etc.)		- 200HB	First choice	AH3225	330 - 660	0.008 - 0.020
K	Gray cast irons (No.250B, etc.)		150 - 250HB	First choice	AH8015	330 - 990	0.008 - 0.031
			150 - 250HB	For impact resistance	AH3225	330 - 990	0.008 - 0.031
	Ductile cast irons (65-45-12, etc.)		150 - 250HB	First choice	AH8015	260 - 660	0.008 - 0.031
			150 - 250HB	For impact resistance	AH3225	260 - 660	0.008 - 0.031
S	Titanium alloy (Ti-6Al-4V, etc)		- 40HRC	First choice	AH3225	100 - 200	0.004 - 0.012
			- 40HRC	For wear resistance	AH8015	100 - 200	0.004 - 0.012
	Heat resistance alloy (Inconel, Hastelloy, etc)		- 40HRC	First choice	AH8015	70 - 170	0.004 - 0.012
			- 40HRC	For impact resistance	AH3225	70 - 170	0.004 - 0.012
H	Hardened steel	H13, etc	40 - 50HRC	First choice	AH8015	260 - 490	0.004 - 0.020
		D2/ D3, etc	50~60HRC	First choice	AH8015	160 - 230	0.004 - 0.012

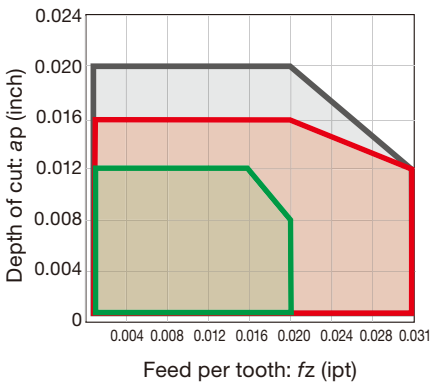
APPLICATION

LSMT02-HM



- For standard shanks in ≤ 3xD
- For long-neck shanks in ≥ 4xD
- For modular head shanks in ≥ 7xD

LSMT02-MM

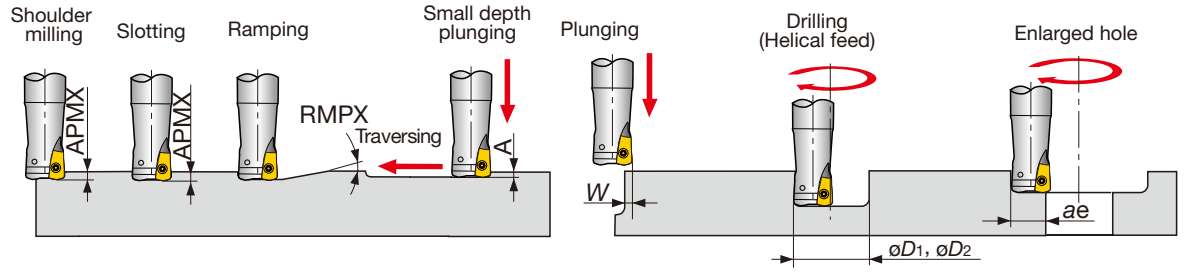


- For standard shanks in ≤ 3xD
- For long-neck shanks in ≥ 4xD
- For modular head shanks in ≥ 7xD

* When the DOC is 0.020" or more, the feed less than 0.006 ipt is recommended.

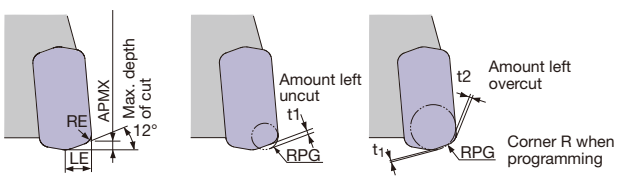
Tool dia.: øDc (inch), Number of revolutions: n (rpm), Feed speed: Vf (ipm), Max. depth of cut: ap = 0.020", Number of teeth: CICT							
ø0.375", CICT = 1		ø0.5"			ø0.625"		
n	Vf	n	Vf		n	Vf	
			CICT = 2	CICT = 3		CICT = 3	CICT = 5
6682	134	5011	200	301	4009	241	401
			Vc = 656 sfm, fz = 0.020 ipt				
6682	134	5011	200	301	4009	241	401
			Vc = 656 sfm, fz = 0.020 ipt				
5011	80	3759	120	180	3007	144	241
			Vc = 492 sfm, fz = 0.016 ipt				
4013	64	3010	96	144	2408	116	193
			Vc = 394 sfm, fz = 0.016 ipt				
6682	134	5011	200	301	4009	241	401
			Vc = 656 sfm, fz = 0.020 ipt				
5011	100	3759	150	226	3007	180	301
			Vc = 492 sfm, fz = 0.020 ipt				
1334	11	1001	16	24	801	19	32
			Vc = 131 sfm, fz = 0.008 ipt				
998	8	749	12	18	599	14	24
			Vc = 98 sfm, fz = 0.008 ipt				
4013	48	3010	72	108	2408	87	144
			Vc = 394 sfm, fz = 0.012 ipt				
2007	16	1505	24	36	1204	29	48
			Vc = 197 sfm, fz = 0.008 ipt				

MACHINING APPLICATIONS



Designation	DC	Max. depth of cut APMX	Max. ramping angle RMPX	Max. plunging depth A	Max. cutting width in plunging W	Min. machining øD1	Max. machining øD2	Max. cutting width in enlarged hole ae
EXLS02U0.37…	0.375	0.019	3.6°	0.007	0.078	0.513	0.730	0.292
EXLS02U0.50…	0.500	0.019	1.8°	0.007	0.078	0.763	0.980	0.417
EXLS02U0.62…	0.625	0.019	1.3°	0.007	0.078	1.013	1.230	0.542

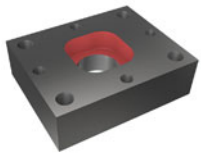
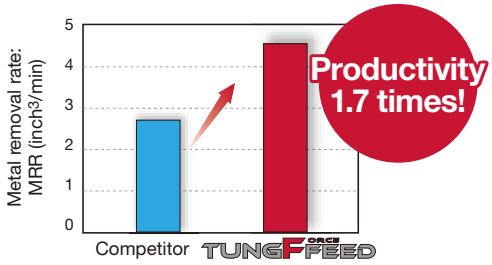
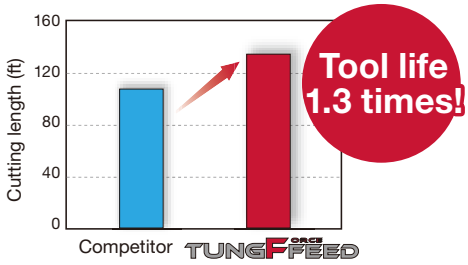
Tool geometry on programming

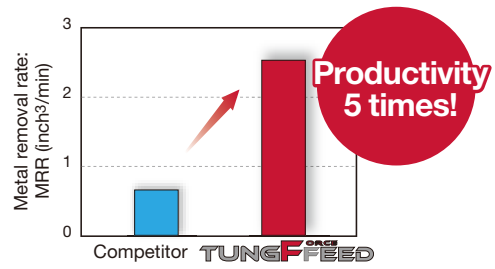
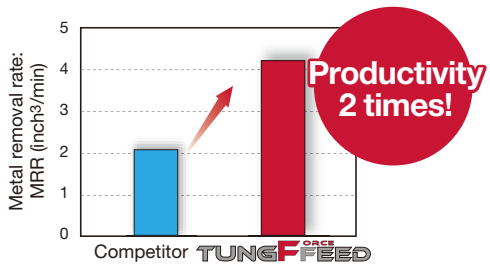


LSMT02…-HM

Corner R when programming: RPG	Amount left uncut t1 (inch)	Amount left overcut t2 (inch)
0.039 Recommend	0.006	0
0.059	0.003	0.006
0.079	0	0.013

PRACTICAL EXAMPLES

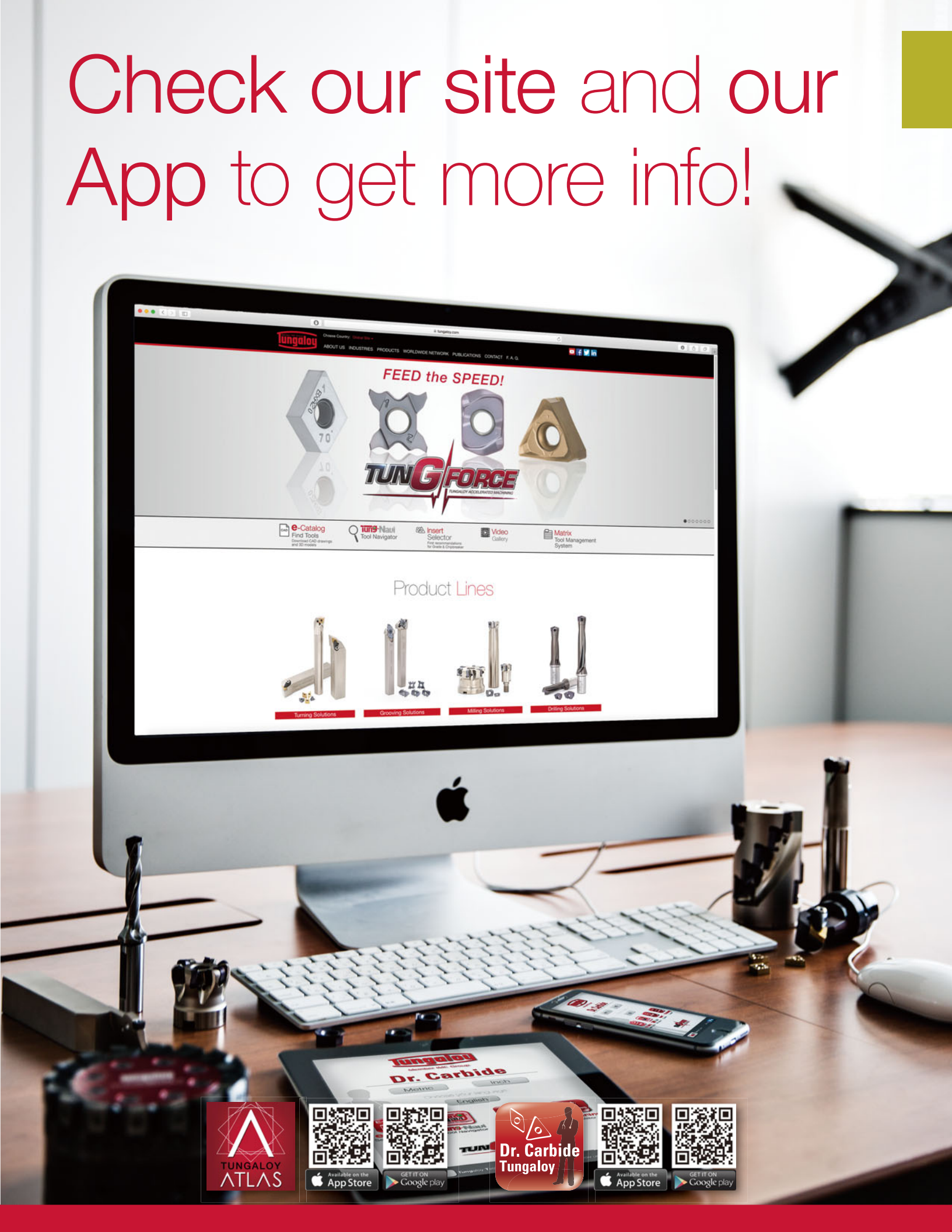
	Workpiece type	Stator shaft	Stamping die part
	Cutter	EXLS02U0.37C0.31LH0.75R01 (ø0.375", CICT = 1)	HXLS02M010M06R02 (ø10mm, CICT = 2)
	Insert	LSMT0202ZER-HM	LSMT0202ZER-HM
	Grade	AH3225	AH3225
	Workpiece material	1045  P	H13(before hardening)  P
Cutting conditions	Cutting speed : *Vc* (sfm)	492	394
	Feed per tooth: *fz* (ipt)	0.020 (Competitor : *fz* = 0.012)	0.024
	Depth of cut : *ap* (inch)	0.012	0.012
	Width of cut : *ae* (inch)	0.315	0.197
	Machining	Grooving	Pocketing
	Coolant	Wet	Dry
	Machine	Vertical M/C, CAT30	Vertical M/C, CAT40
	Results	 TungForceFeed insert's light cutting action ensured reliable high feed milling improving MRR by 1.7x	 AH3225 prevented wear and chipping, while improving tool life by 1.3 times.

	Workpiece type	Stamping die part	Turbine blade
	Cutter	EXLS02U0.50C0.50LH2.00R02 (ø0.5", CICT = 2)	EXLS02U0.37C0.31LH0.75R01 (ø0.375", CICT = 1)
	Insert	LSMT0202ZER-HM	LSMT0202ZER-HM
	Grade	AH3225	AH8015
	Workpiece material	H13 (45HRC)  H	Inconel 939  S
Cutting conditions	Cutting speed : *Vc* (sfm)	371	98
	Feed per tooth: *fz* (ipt)	0.020 (Competitor : *fz* = 0.004)	0.008 (Competitor : *fz* = 0.002)
	Depth of cut : *ap* (inch)	0.012	0.012
	Width of cut : *ae* (inch)	0.472	0.315
	Machining	Face milling	Grooving
	Coolant	Air	Dry
	Machine	Vertical M/C, CAT50	Vertical M/C, CAT50
	Results	 Strong TungForceFeed inserts ensured reliable machining of hard material, improving MRR by 5 times.	 Higher feed per tooth improved MRR by double, while reducing tool cost thanks to indexability.

MEMO

MEMO

Check our site and our App to get more info!



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