

NEW!



COMPLETE
METALWORKING
SOLUTIONS

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FRANKEN
TiNox-Cut

TINOX-CUT END MILLS
FOR AEROSPACE MATERIALS

High Performance End Mills for Aerospace materials and other demanding applications.

TiNox-Cut End Mills are application-specific for the machining of tough materials and are guaranteed to deliver unmatched metal removal rates and tool life.



NEW TiNox-Cut N
5-Flute Design for
Roughing-Finishing
Applications
Ideal for
Titanium Alloys



TiNox-Cut NF
for Inconel
Applications



TiNox-Cut Base
for Stainless
Steel
Applications

NEW 5-Flute TiNox-Cut N:

- Made specifically for Titanium Alloys
- 5 flutes for high feed rates
- Raised land increases chip clearance

TiNox-Cut NF:

- Preferable in Inconel and Titanium
- Fine chip breaker reduces chip size, while reducing cutting forces

TiNox-Cut Base:

- Entry-level universal solution
- Preferable in Stainless steels and acid-resistant steels
- Roughing and finishing

TiNox-Cut Trochoidal:

- High performance tool for trochoidal milling
- Preferable in Titanium and Stainless
- Newly developed geometry with chip breaker
- Low-vibration machining

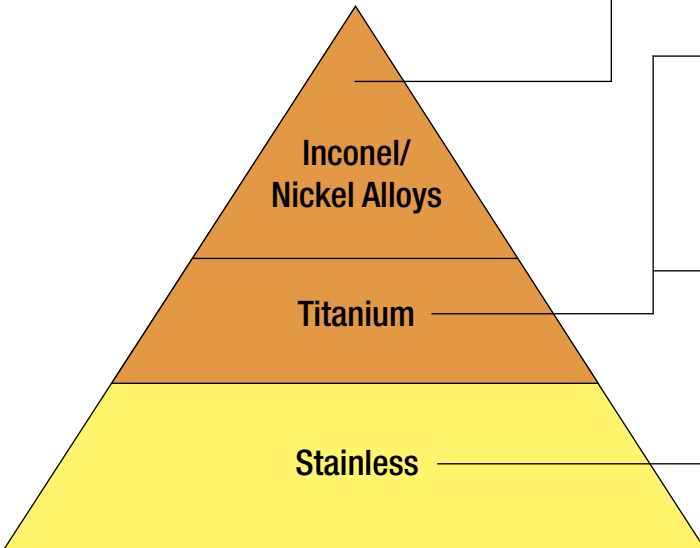
*German engineered
EMUGE-FRANKEN quality*

Four end mill types for semi-roughing and finishing applications

- **Impressive surface roughness results** when compared to traditional end mills
- **Advanced PVD applied coatings** for heat and wear resistance
- **Made from premium ultra-fine grade carbide** with a maximized transverse rupture strength for high impact applications
- **Axial internal coolant** channel design for maximum chip evacuation performance and chip cooling ability
- **Weldon flat** shank construction that mates with an anti-pullout pin lock system available in EMUGE-FRANKEN FPC Milling Chucks
- **Standard corner radius** offering available along with modification service located in the USA



S	2.6
	2.5
	2.4
	2.3
	2.2
S	2.1
	1.3
	1.2
M	1.1
	4.1
	3.1
	2.1
	1.1



TiNox-Cut NF



High performance roughing tool for difficult to machine Nickel Alloys

TiNox-Cut N



High performance tool specially designed for machining of Titanium and Titanium Alloys

TiNox-Cut Trochoidal

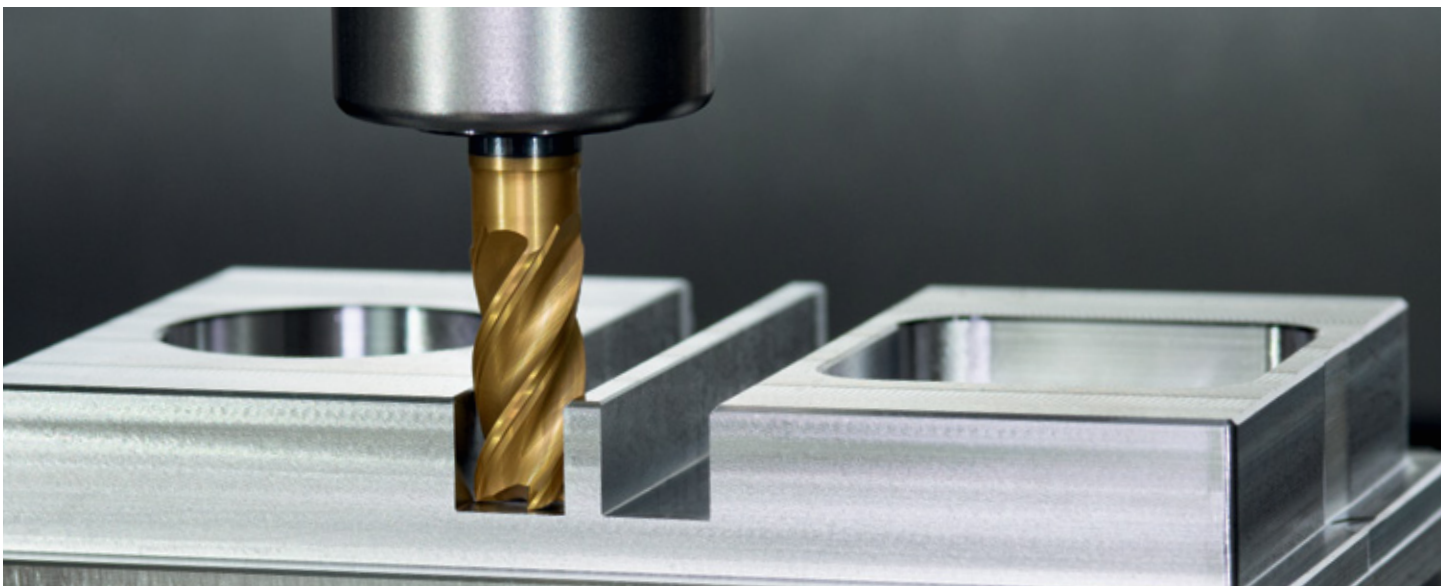


High metal removal rate reduces stress and vibration for difficult materials

TiNox-Cut Base



Universal tool for machining of Stainless- and acid-resistant steels



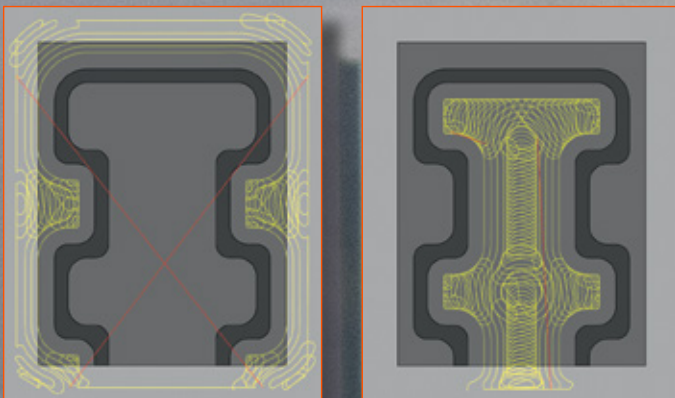
Trochoidal Milling

Trochoidal milling is the overlapping of a circular path with a linear movement and thus the conversion of slot milling into contour milling. Just as in finishing operations, the chip is peeled from the workpiece with a low radial depth of cut and a maximum axial depth of cut ($2 \times D$ to $4 \times D$). **The small contact angle reduces heat generation during machining and less thermal stress provides increased material removal and longer tool life.**

High metal removal rates can be generated even on low-powered machines and wear is reduced during full slot milling, particularly in difficult to machine materials. Plus, the end mill is utilized over the entire flute length, and as a result **wear is evenly spaced over the full cutting edge length, increasing tool life.**

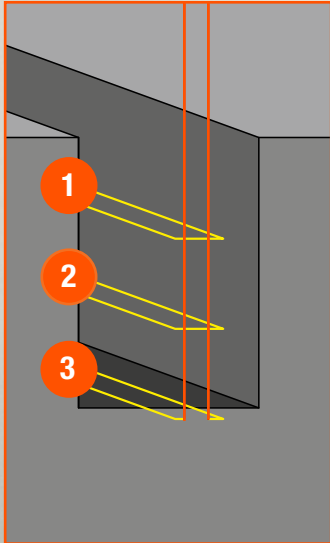
Advantages of EMUGE-FRANKEN Trochoidal Milling

- Particularly suitable for difficult to machine materials and thin-walled components
- Reduced stress on tools and machine
- Increased metal removal rate on low-powered dynamic machines
- Suitable for unstable workpiece clamping conditions
- Enables high axial depth of cut up to $4 \times D$



New CAD/CAM programming systems enable the machining of complex contours and deep pockets in 2D and 3D parts with a trochoidal milling strategy. **The objective of these new strategies is the optimized calculation of milling paths to avoid unproductive tool motion.**

Slot Milling Strategy Comparisons

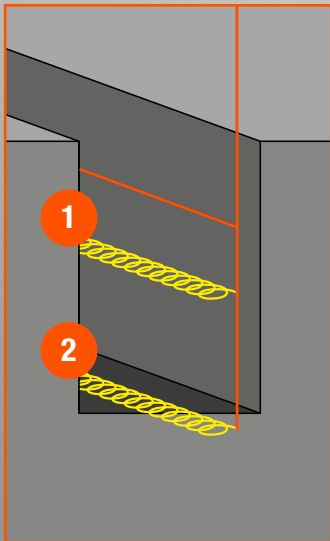


HPC Slot Milling with standard solid carbide end mill

Slot L x W x H:	18" x 3/4" x 1-3/4"
Material:	4140 Steel
Tool:	2994L.0625
Diameter:	5/8"
Cutting length:	1-1/4"
Flutes:	4
Cutting speed (V _c):	490 SFM
Feed per tooth (f _z):	.003"
Axial depth of cut (a _p):	.60"
Radial depth of cut (a _e):	5/8"

Machining time: 3:13 Minutes

**Milling strategy requires
3 tool paths**

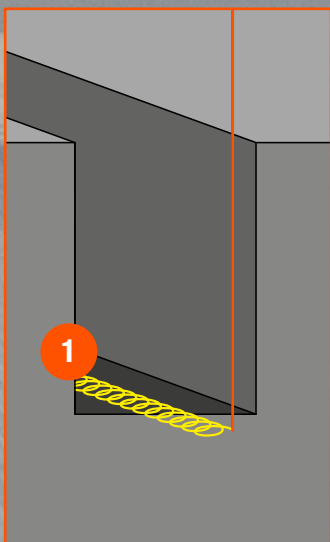


Trochoidal Slot Milling with standard solid carbide end mill

Slot L x W x H:	18" x 3/4" x 1-3/4"
Material:	4140 Steel
Tool:	2994L.0625
Diameter:	5/8"
Cutting length:	1-1/4"
Flutes:	4
Cutting speed (V _c):	655 SFM
Feed per tooth (f _z):	.005"
Axial depth of cut (a _p):	7/8"
Radial depth of cut (a _e):	.090"

Machining time: 2:57 Minutes

**Milling strategy requires
2 tool paths**



Trochoidal Slot Milling with EMUGE-FRANKEN Trochoidal Solid Carbide End Mill







Slot L x W x H:	18" x 3/4" x 1-3/4"
Material:	4140 Steel
Tool:	2573L.0625
Diameter:	5/8"
Flutes:	5
Cutting speed (V _c):	655 SFM
Feed per tooth (f _z):	.005"
Axial depth of cut (a _p):	1-3/4"
Radial depth of cut (a _e):	.050"

Machining time: 2:07 Minutes



**Milling strategy requires only
1 tool path**








						
		Corner Radius				
Tool	TiNox-Cut N	TiNox-Cut N	TiNox-Cut NF	TiNox-Cut NF Solid	TiNox-Cut Base / Stub	TiNox-Cut Base / Standard
Page	8	8	9	9	10	10
Length	Standard	Standard	Standard	Standard	Stub	Standard
Coating	ALCR	ALCR	TIN / TIALN	TIN / TIALN	TIN / TIALN	TIN / TIALN
Flutes	5	5	4-5	4	4	4
Size Range	1/4" - 1" \varnothing	1/4" - 1" \varnothing	1/4" - 1" \varnothing	1/4" - 1" \varnothing	1/8" - 3/4" \varnothing	1/8" - 3/4" \varnothing
Preferable Materials	Titanium Alloys	Titanium Alloys	Inconel	Inconel	Stainless Steel	Stainless Steel
Suitable Materials	Stainless Steels	Stainless Steels	Titanium Alloys	Titanium Alloys	Titanium Alloys	Titanium Alloys
Application	Rougher-Finisher	Rougher-Finisher with Corner Radius	Semi-Finisher	Semi-Finisher	Rougher-Finisher	Rougher-Finisher



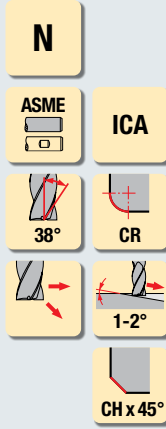
TiNox-Cut Base

TiNox-Cut Trochoidal

					
Tool	TiNox-Cut Trochoidal 2 x D	TiNox-Cut Trochoidal 3 x D	TiNox-Cut Trochoidal 4 x D	TiNox-Cut Trochoidal 3 x D Corner Radius	TiNox-Cut Trochoidal 4 x D Corner Radius
Page	11	11	11	12	12
Length	Standard	Long	Extra Long	Long	Extra Long
Coating	TIN / TIALN	TIN / TIALN	TIN / TIALN	TIN / TIALN	TIN / TIALN
Flutes	4-5	4-5	4-5	4-5	4-5
Size Range	1/4" - 3/4" ϕ	1/4" - 3/4" ϕ	1/4" - 3/4" ϕ	1/4" - 3/4" ϕ	1/4" - 3/4" ϕ
Preferable Materials	Titanium, Stainless Steel	Titanium, Stainless Steel	Titanium, Stainless Steel	Titanium, Stainless Steel	Titanium, Stainless Steel
Suitable Materials	Inconel	Inconel	Inconel	Inconel	Inconel
Application	Rougher-Finisher	Rougher-Finisher	Rougher-Finisher	Rougher-Finisher with Corner Radius	Rougher-Finisher with Corner Radius

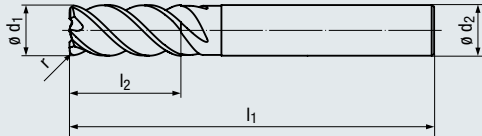
Rougher-Finisher

- High performance tool for roughing and finishing
- 5 flutes for high feed rates
- Raised land increases chip clearance
- Special geometry prevents vibration
- Axial coolant hole for better chip evacuation
- Internal coolant (ICA)



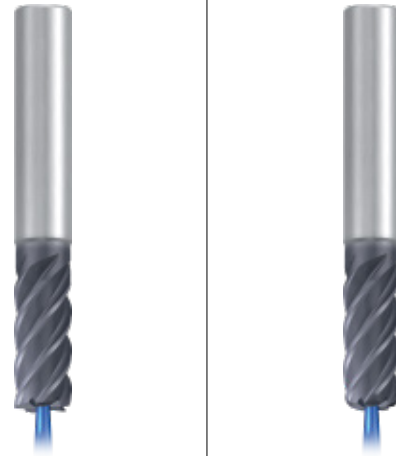
Rougher-Finisher with Corner Radius

- Different corner radii per diameter



Icon descriptions (see page 17)

Corner Radius



Coating

ALCR

Applications / Materials and Cutting Data (see page 13)

- Especially made for Titanium Alloys
- Suitable for HPC roughing and finishing
- For efficient machining of Stainless Steel

M	1.1-4.1
S	1.1-1.3
S	2.1-2.6

Standard length

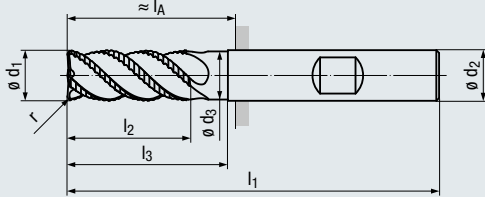
$\varnothing d_1$ h10	l_2	l_1	$\varnothing d_2$ h6	Chamfer	# Flutes	Tool No. Straight Shank
1/4	3/4	2 1/2	1/4	0.005	5	2962LZ.0250
5/16	3/4	2 1/2	5/16	0.005	5	2962LZ.03125
3/8	7/8	2 1/2	3/8	0.008	5	2962LZ.0375
1/2	1 1/4	3	1/2	0.008	5	2962LZ.0500
5/8	1 1/4	3 1/2	5/8	0.008	5	2962LZ.0625
3/4	1 1/2	4	3/4	0.012	5	2962LZ.0750
1	1 3/4	4 1/2	1	0.012	5	2962LZ.1000

Standard length – Corner Radius

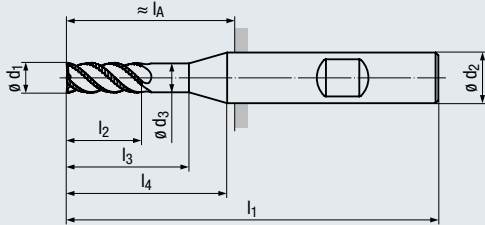
$\varnothing d_1$ h11	l_2	l_1	$\varnothing d_2$ h6	r ± 0.0004	# Flutes	Tool No. Straight Shank
1/4	3/4	2 1/2	1/4	0.015	5	2966LZ.025015
1/4	3/4	2 1/2	1/4	0.030	5	2966LZ.025030
5/16	3/4	2 1/2	5/16	0.015	5	2966LZ.031015
5/16	3/4	2 1/2	5/16	0.030	5	2966LZ.031030
3/8	7/8	2 1/2	3/8	0.015	5	2966LZ.037015
3/8	7/8	2 1/2	3/8	0.030	5	2966LZ.037030
1/2	1 1/4	3	1/2	0.015	5	2966LZ.050015
1/2	1 1/4	3	1/2	0.030	5	2966LZ.050030
1/2	1 1/4	3	1/2	0.060	5	2966LZ.050060
1/2	1 1/4	3	1/2	0.090	5	2966LZ.050090
1/2	1 1/4	3	1/2	0.120	5	2966LZ.050120
5/8	1 1/4	3 1/2	5/8	0.015	5	2966LZ.062015
5/8	1 1/4	3 1/2	5/8	0.030	5	2966LZ.062030
5/8	1 1/4	3 1/2	5/8	0.060	5	2966LZ.062060
3/4	1 1/2	4	3/4	0.015	5	2966LZ.075015
3/4	1 1/2	4	3/4	0.030	5	2966LZ.075030
3/4	1 1/2	4	3/4	0.060	5	2966LZ.075060
3/4	1 1/2	4	3/4	0.090	5	2966LZ.075090
3/4	1 1/2	4	3/4	0.120	5	2966LZ.075120
1	1 3/4	4 1/2	1	0.015	5	2966LZ.100015
1	1 3/4	4 1/2	1	0.030	5	2966LZ.100030
1	1 3/4	4 1/2	1	0.060	5	2966LZ.100060
1	1 3/4	4 1/2	1	0.090	5	2966LZ.100090
1	1 3/4	4 1/2	1	0.120	5	2966LZ.100120

Semi-Finisher

- Fine semi-finishing profile
- Variable index
- TiN/TIALN PVD multi-layer coating increases tool life
- Sub-micro grain carbide
- Axial coolant hole for better chip evacuation
- Axial internal coolant supply (ICA)



Design I₄:



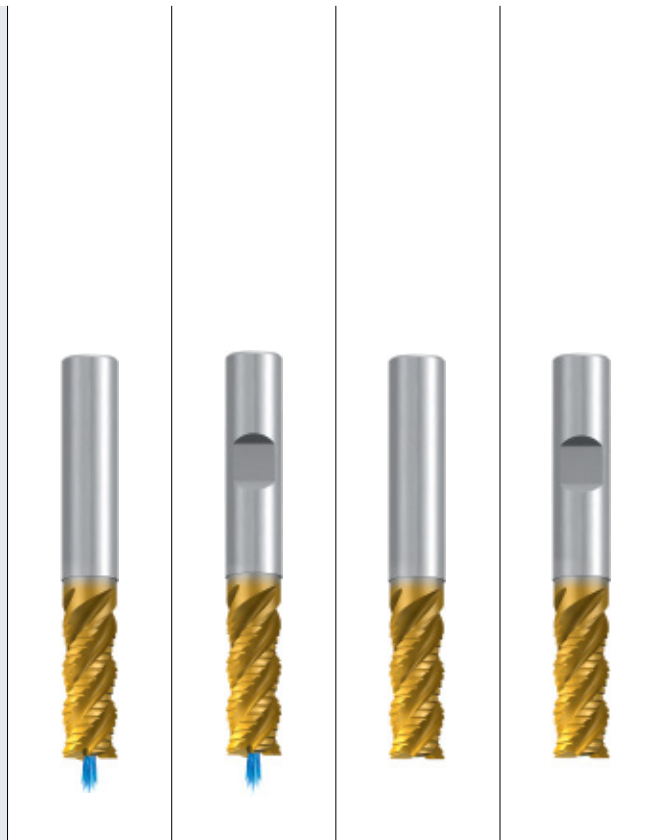
Icon descriptions (see page 17)

NF fine

ASME **ICA**

45° 45°

3-5°



Coating

TIN / TIALN

Applications / Materials and Cutting Data (see page 14)

- Ideal for difficult to cut materials such as nickel alloys and Titanium, preferable in Inconel
- Suitable for high productivity cutting, roughing

S 2.1-2.6

S 1.1-1.3

Standard length – with Coolant Through

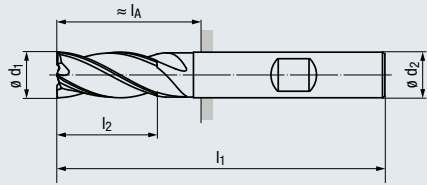
ϕd_1 h11	l_2	l_3	l_1	ϕd_3	l_4	ϕd_2 h6	l_A	# Flutes	Tool No. Straight Shank	Tool No. Weldon Shank
1/4	17/32	3/4	2 1/2	0.236	7/8	3/8	15/16	4	2648TZ.0250	2649TZ.0250
5/16	3/4	7/8	2 1/2	0.295	15/16	3/8	15/16	4	2648TZ.03125	2649TZ.03125
3/8	7/8	1 1/8	2 3/4	0.358	–	3/8	1 3/16	4	2648TZ.0375	2649TZ.0375
1/2	1 1/8	1 3/8	3 1/4	0.480	–	1/2	1 15/32	4	2648TZ.0500	2649TZ.0500
5/8	1 1/4	1 1/2	3 1/2	0.605	–	5/8	1 19/32	4	2648TZ.0625	2649TZ.0625
3/4	1 1/2	1 7/8	4	0.730	–	3/4	1 31/32	4	2648TZ.0750	2649TZ.0750
1	1 3/4	2 5/8	5	0.969	–	1	2 23/32	5	2648TZ.1000	2649TZ.1000

Standard length – Solid

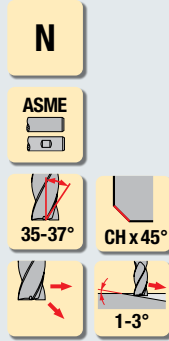
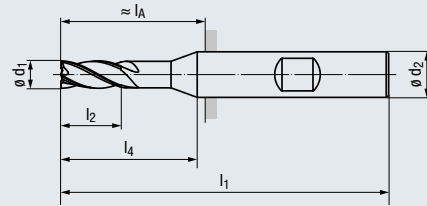
ϕd_1 h11	l_2	l_1	ϕd_3	ϕd_2 h6	# Flutes	Tool No. Straight Shank	Tool No. Weldon Shank
1/4	17/32	2 1/2	0.236	1/4	4	2958T.0250	–
5/16	3/4	2 1/2	0.295	5/16	4	2958T.03125	–
3/8	7/8	2 3/4	0.358	3/8	4	2958T.0375	–
1/2	1 1/8	3 1/4	0.480	1/2	4	2958T.0500	2959T.0500
5/8	1 1/4	3 1/2	0.605	5/8	4	2958T.0625	2959T.0625
3/4	1 1/2	4	0.730	3/4	4	2958T.0750	2959T.0750
1	1 3/4	5	0.969	1	5	2958T.1000	2959T.1000

Rougher-Finisher

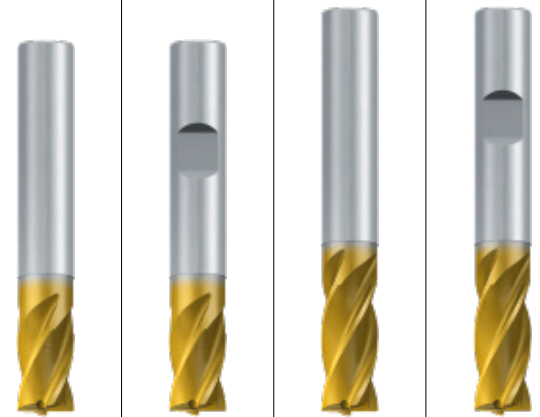
- Ideal entry-level universal tool solution
- High performance tool
- Finishing end mill for tough materials
- Special geometry prevents vibration
- Variable spacing



Design l₄:



Icon descriptions (see page 17)



Coating

TiN / TiAlN

Applications / Materials and Cutting Data (see page 15)

- Especially suitable for Stainless Steel materials
- Suitable for Titanium, Alloyed Steels, HPC roughing and finishing

M	1.1-4.1
S	1.1-1.3

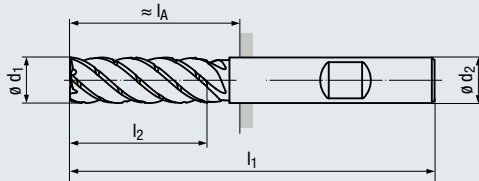
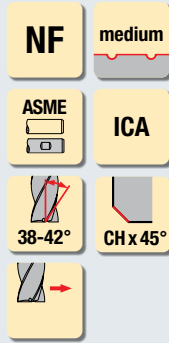
Stub length

$\varnothing d_1$ h10	l_2	l_1	l_4	$\varnothing d_2$ h6	l_A 	Chamfer	# Flutes	Tool No. Straight Shank	Tool No. Weldon Shank
1/8	1/4	2	5/8	1/4	5/8	0.003	4	2975T.0125	-
3/16	3/8	2	5/8	1/4	5/8	0.005	4	2975T.01875	-
1/4	1/2	2	-	1/4	5/8	0.005	4	2975T.0250	-
5/16	9/16	2 1/4	-	5/16	7/8	0.005	4	2975T.03125	-
3/8	5/8	2 1/2	-	3/8	15/16	0.008	4	2975T.0375	-
1/2	5/8	2 3/4	-	1/2	31/32	0.008	4	2975T.0500	2976T.0500
5/8	3/4	3	-	5/8	1 3/32	0.008	4	2975T.0625	2976T.0625
3/4	1	3 1/2	-	3/4	1 15/32	0.012	4	2975T.0750	2976T.0750

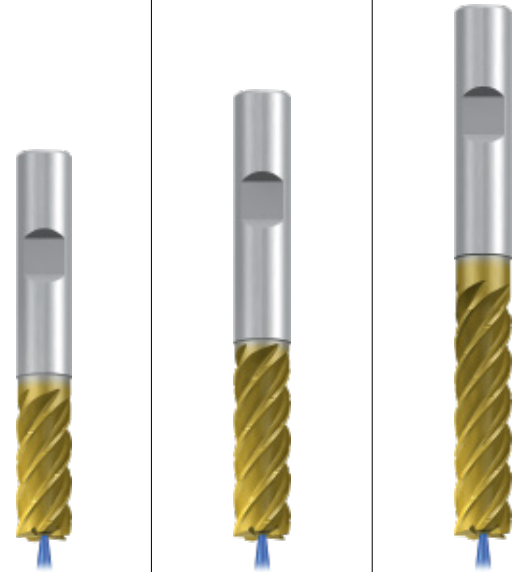
Standard length

$\varnothing d_1$ h10	l_2	l_1	l_4	$\varnothing d_2$ h6	l_A 	Chamfer	# Flutes	Tool No. Straight Shank	Tool No. Weldon Shank
1/8	3/8	2 1/4	7/8	1/4	7/8	0.003	4	2977T.0125	-
3/16	9/16	2 1/4	7/8	1/4	7/8	0.005	4	2977T.01875	-
1/4	3/4	2 1/2	-	1/4	1 1/8	0.005	4	2977T.0250	-
5/16	13/16	2 1/2	-	5/16	1 1/8	0.005	4	2977T.03125	-
3/8	7/8	2 3/4	-	3/8	1 3/16	0.008	4	2977T.0375	-
1/2	1	3	-	1/2	1 7/32	0.008	4	2977T.0500	2978T.0500
5/8	1 1/4	3 1/2	-	5/8	1 19/32	0.008	4	2977T.0625	2978T.0625
3/4	1 1/2	4	-	3/4	1 31/32	0.012	4	2977T.0750	2978T.0750

- High performance tool for trochoidal milling
- Newly developed geometry with chip breaker
- Low-vibration machining
- Axial depths of cut up to 4 x D
- Axial internal coolant supply (ICA)



Icon descriptions (see page 17)



Coating

TIN/TIALN

Applications / Materials and Cutting Data (see page 16)

- For process-reliable trochoidal roughing operations
- Suitable for finishing
- Especially suitable for difficult-to-cut materials such as Titanium

M	1.1-4.1
S	1.1-1.3
S	2.1-2.6

2 x D – Standard length

$\varnothing d_1$ h10	l_2	l_1	$\varnothing d_2$ h6	l_A 	Chamfer	# Flutes	Tool No. Weldon Shank
1/4	1/2	2 1/4	1/4	7/8	0.005	4	2577TZ.0250
5/16	13/16	2 1/2	5/16	1 1/8	0.005	5	2577TZ.03125
3/8	7/8	3	3/8	1 7/16	0.008	5	2577TZ.0375
1/2	1	3 1/4	1/2	1 15/32	0.008	5	2577TZ.0500
5/8	1 1/4	3 3/4	5/8	1 27/32	0.008	5	2577TZ.0625
3/4	1 1/2	4 1/4	3/4	2 7/32	0.012	5	2577TZ.0750

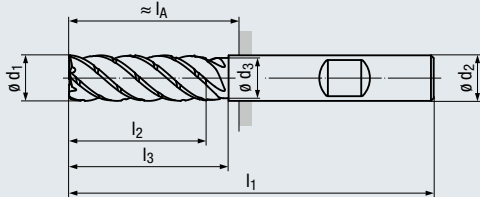
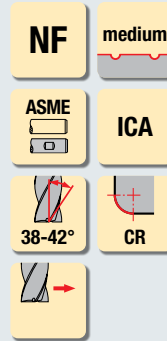
3 x D – Long length

$\varnothing d_1$ h10	l_2	l_1	$\varnothing d_2$ h6	l_A 	Chamfer	# Flutes	Tool No. Weldon Shank
1/4	3/4	2 1/2	1/4	1 1/8	0.005	4	2579TZ.0250
5/16	1	2 3/4	5/16	1 3/8	0.005	5	2579TZ.03125
3/8	1 1/8	3 1/4	3/8	1 11/16	0.008	5	2579TZ.0375
1/2	1 1/2	3 3/4	1/2	1 31/32	0.008	5	2579TZ.0500
5/8	1 7/8	4 1/4	5/8	2 11/32	0.008	5	2579TZ.0625
3/4	2 1/4	5	3/4	2 31/32	0.012	5	2579TZ.0750

4 x D – Extra long length

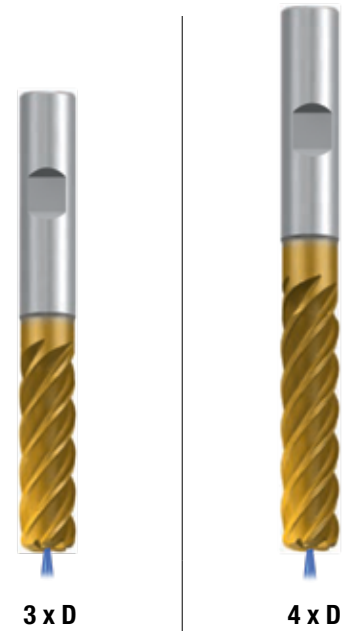
$\varnothing d_1$ h10	l_2	l_1	$\varnothing d_2$ h6	l_A 	Chamfer	# Flutes	Tool No. Weldon Shank
1/4	1	2 3/4	1/4	1 3/8	0.005	4	2581TZ.0250
5/16	1 1/4	3	5/16	1 5/8	0.005	5	2581TZ.03125
3/8	1 1/2	3 3/4	3/8	2 3/16	0.008	5	2581TZ.0375
1/2	2	4 1/4	1/2	2 15/32	0.008	5	2581TZ.0500
5/8	2 1/2	5	5/8	3 3/32	0.008	5	2581TZ.0625
3/4	3	6	3/4	3 31/32	0.012	5	2581TZ.0750

- High performance tool for trochoidal milling
- Newly developed geometry with chip breaker
- Low-vibration machining
- Axial depths of cut up to 4 x D
- Axial internal coolant supply (ICA)



Icon descriptions (see page 17)

Corner Radius



Coating

TIN / TiAlN

Applications / Materials and Cutting Data (see page 16)

- For process-reliable trochoidal roughing operations
- Suitable for finishing
- Especially suitable for difficult-to-cut materials such as Titanium

M	1.1-4.1
S	1.1-1.3
S	2.1-2.6

3 x D and 4 x D – Corner Radius

$\varnothing d_1$ h10	r	Long length 3 x D			Extra long length 4 x D			$\varnothing d_2$ h6	# Flutes	Tool No. Weldon Shank	Tool No. Weldon Shank
		l_1	l_2	l_A 	l_1	l_2	l_A 				
1/4	0.010	2 1/2	3/4	1 1/8	2 3/4	1	1 3/8	1/4	4	3911TZ.025010	3913TZ.025010
1/4	0.015	2 1/2	3/4	1 1/8	2 3/4	1	1 3/8	1/4	4	3911TZ.025015	3913TZ.025015
1/4	0.020	2 1/2	3/4	1 1/8	2 3/4	1	1 3/8	1/4	4	3911TZ.025020	3913TZ.025020
1/4	0.030	2 1/2	3/4	1 1/8	2 3/4	1	1 3/8	1/4	4	3911TZ.025030	3913TZ.025030
1/4	0.060	2 1/2	3/4	1 1/8	2 3/4	1	1 3/8	1/4	4	3911TZ.025060	3913TZ.025060
5/16	0.015	2 3/4	1	1 3/8	3	1 1/4	1 5/8	5/16	5	3911TZ.031015	3913TZ.031015
5/16	0.030	2 3/4	1	1 3/8	3	1 1/4	1 5/8	5/16	5	3911TZ.031030	3913TZ.031030
5/16	0.060	2 3/4	1	1 3/8	3	1 1/4	1 5/8	5/16	5	3911TZ.031060	3913TZ.031060
3/8	0.010	3 1/4	1 1/8	1 11/16	3 3/4	1 1/2	2 3/16	3/8	5	3911TZ.037010	3913TZ.037010
3/8	0.015	3 1/4	1 1/8	1 11/16	3 3/4	1 1/2	2 3/16	3/8	5	3911TZ.037015	3913TZ.037015
3/8	0.020	3 1/4	1 1/8	1 11/16	3 3/4	1 1/2	2 3/16	3/8	5	3911TZ.037020	3913TZ.037020
3/8	0.030	3 1/4	1 1/8	1 11/16	3 3/4	1 1/2	2 3/16	3/8	5	3911TZ.037030	3913TZ.037030
3/8	0.060	3 1/4	1 1/8	1 11/16	3 3/4	1 1/2	2 3/16	3/8	5	3911TZ.037060	3913TZ.037060
3/8	0.090	3 1/4	1 1/8	1 11/16	3 3/4	1 1/2	2 3/16	3/8	5	3911TZ.037090	3913TZ.037090
1/2	0.010	3 3/4	1 1/2	1 31/32	4 1/4	2	2 15/32	1/2	5	3911TZ.050010	3913TZ.050010
1/2	0.015	3 3/4	1 1/2	1 31/32	4 1/4	2	2 15/32	1/2	5	3911TZ.050015	3913TZ.050015
1/2	0.020	3 3/4	1 1/2	1 31/32	4 1/4	2	2 15/32	1/2	5	3911TZ.050020	3913TZ.050020
1/2	0.030	3 3/4	1 1/2	1 31/32	4 1/4	2	2 15/32	1/2	5	3911TZ.050030	3913TZ.050030
1/2	0.060	3 3/4	1 1/2	1 31/32	4 1/4	2	2 15/32	1/2	5	3911TZ.050060	3913TZ.050060
1/2	0.090	3 3/4	1 1/2	1 31/32	4 1/4	2	2 15/32	1/2	5	3911TZ.050090	3913TZ.050090
1/2	0.120	3 3/4	1 1/2	1 31/32	4 1/4	2	2 15/32	1/2	5	3911TZ.050120	3913TZ.050120
5/8	0.030	4 1/4	1 7/8	2 11/32	5	2 1/2	3 3/32	5/8	5	3911TZ.062030	3913TZ.062030
5/8	0.060	4 1/4	1 7/8	2 11/32	5	2 1/2	3 3/32	5/8	5	3911TZ.062060	3913TZ.062060
5/8	0.090	4 1/4	1 7/8	2 11/32	5	2 1/2	3 3/32	5/8	5	3911TZ.062090	3913TZ.062090
5/8	0.120	4 1/4	1 7/8	2 11/32	5	2 1/2	3 3/32	5/8	5	3911TZ.062120	3913TZ.062120
3/4	0.020	5	2 1/4	2 31/32	6	3	3 31/32	3/4	5	3911TZ.075020	3913TZ.075020
3/4	0.030	5	2 1/4	2 31/32	6	3	3 31/32	3/4	5	3911TZ.075030	3913TZ.075030
3/4	0.060	5	2 1/4	2 31/32	6	3	3 31/32	3/4	5	3911TZ.075060	3913TZ.075060
3/4	0.090	5	2 1/4	2 31/32	6	3	3 31/32	3/4	5	3911TZ.075090	3913TZ.075090
3/4	0.120	5	2 1/4	2 31/32	6	3	3 31/32	3/4	5	3911TZ.075120	3913TZ.075120
3/4	0.190	5	2 1/4	2 31/32	6	3	3 31/32	3/4	5	3911TZ.075190	3913TZ.075190

STANDARD LENGTH - WITH COOLANT THROUGH

Valid for Tool No:

2962LZ

HELPFUL FORMULAS:

SFM = (RPM x D in) / 3.82

RPM = (SFM x 3.82) / D in

f_z feed/tooth = IPM / (#teeth x RPM)

IPM = RPM x #teeth x f_z



v_c = Cutting speed
f_z = Feed per tooth

	v _c [sfm]	f _z [inch]	v _c [sfm]	f _z [inch]	v _c [sfm]	f _z [inch]	v _c [sfm]	f _z [inch]
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Suitable	M	Stainless Steel Materials									
		1.1	Ferritic, Martensitic: 410 / 440 / 440C / 17-4 PH	295	0.003 x d ₁	360	0.004 x d ₁	425	0.004 x d ₁	460	0.005 x d ₁
	2.1	Austenitic: 303 / 304 / 316 / 316L / 321	260	0.003 x d ₁	325	0.003 x d ₁	360	0.004 x d ₁	425	0.004 x d ₁	
	3.1	Austenitic-ferritic (Duplex)	130	0.003 x d ₁	165	0.003 x d ₁	195	0.004 x d ₁	195	0.004 x d ₁	
	4.1	Austenitic-ferritic heat-resistant (Super Duplex)	100	0.002 x d ₁	130	0.003 x d ₁	130	0.003 x d ₁	165	0.004 x d ₁	
Preferable	S	Special Materials									
		Titanium Alloys									
		1.1	Pure Titanium	195	0.003 x d ₁	230	0.004 x d ₁	260	0.004 x d ₁	325	0.005 x d ₁
		1.2	Titanium Alloys	165	0.002 x d ₁	195	0.003 x d ₁	230	0.003 x d ₁	260	0.004 x d ₁
	1.3	Titanium Alloys	100	0.002 x d ₁	130	0.002 x d ₁	130	0.003 x d ₁	165	0.003 x d ₁	

STANDARD LENGTH - WITH CORNER RADIUS - WITH COOLANT THROUGH

Valid for Tool No:

2966LZ

HELPFUL FORMULAS:

SFM = (RPM x D in) / 3.82

RPM = (SFM x 3.82) / D in

f_z feed/tooth = IPM / (#teeth x RPM)

IPM = RPM x #teeth x f_z



v_c = Cutting speed
f_z = Feed per tooth

	v _c [sfm]	f _z [inch]	v _c [sfm]	f _z [inch]	v _c [sfm]	f _z [inch]	v _c [sfm]	f _z [inch]
--	----------------------	-----------------------	----------------------	-----------------------	----------------------	-----------------------	----------------------	-----------------------

Suitable	M	Stainless Steel Materials									
		1.1	Ferritic, Martensitic: 410 / 440 / 440C / 17-4 PH	325	0.004 x d ₁	395	0.004 x d ₁	460	0.005 x d ₁	525	0.006 x d ₁
	2.1	Austenitic: 303 / 304 / 316 / 316L / 321	260	0.004 x d ₁	325	0.004 x d ₁	360	0.005 x d ₁	425	0.006 x d ₁	
	3.1	Austenitic-ferritic (Duplex)	165	0.003 x d ₁	195	0.003 x d ₁	230	0.004 x d ₁	260	0.004 x d ₁	
	4.1	Austenitic-ferritic heat-resistant (Super Duplex)	130	0.003 x d ₁	165	0.003 x d ₁	195	0.004 x d ₁	195	0.004 x d ₁	
Preferable	S	Special Materials									
		Titanium Alloys									
		1.1	Pure Titanium	230	0.005 x d ₁	260	0.005 x d ₁	325	0.006 x d ₁	360	0.007 x d ₁
		1.2	Titanium Alloys	195	0.004 x d ₁	230	0.004 x d ₁	260	0.005 x d ₁	325	0.006 x d ₁
	1.3	Titanium Alloys	100	0.003 x d ₁	130	0.003 x d ₁	130	0.004 x d ₁	165	0.004 x d ₁	

Note: All cutting data serve for orientation only and should be adapted individually to the technical conditions on location.

STANDARD LENGTH – WITH COOLANT THROUGH

Valid for Tool Nos:

2648TZ
2649TZ

HELPFUL FORMULAS:

SFM = (RPM x D in) / 3.82

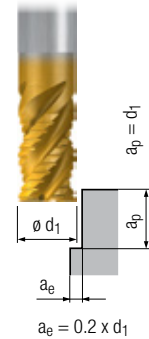
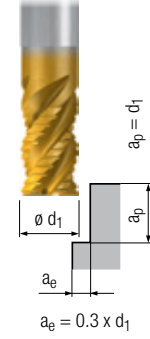
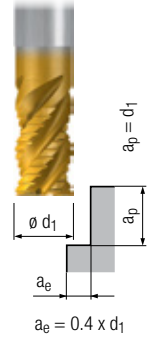
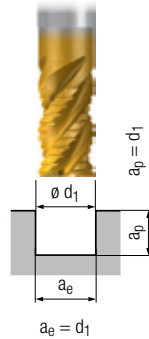
RPM = (SFM x 3.82) / D in

f_z feed/tooth = IPM / (#teeth x RPM)

IPM = RPM x #teeth x f_z

v_c = Cutting speed

f_z = Feed per tooth



	v _c [sfm]	f _z [inch]	v _c [sfm]	f _z [inch]	v _c [sfm]	f _z [inch]	v _c [sfm]	f _z [inch]
--	----------------------	-----------------------	----------------------	-----------------------	----------------------	-----------------------	----------------------	-----------------------

Suitable	Special Materials										
	Titanium Alloys										
Preferable	S	1.1	Pure Titanium	230	0.005 x d ₁	260	0.005 x d ₁	325	0.006 x d ₁	360	0.007 x d ₁
		1.2	Titanium Alloys	195	0.004 x d ₁	230	0.004 x d ₁	260	0.005 x d ₁	325	0.006 x d ₁
		1.3	Titanium Alloys	100	0.003 x d ₁	130	0.003 x d ₁	130	0.004 x d ₁	165	0.004 x d ₁
		Nickel Alloys, Cobalt Alloys and Iron Alloys									
		2.1	Pure Nickel	230	0.004 x d ₁	260	0.004 x d ₁	325	0.005 x d ₁	360	0.006 x d ₁
		2.2	Monel 500 / 718 Inconel annealed	65	0.003 x d ₁	65	0.004 x d ₁	80	0.004 x d ₁	100	0.005 x d ₁
2.3	Nickel-base Alloys: 718 Inconel	30	0.002 x d ₁	50	0.002 x d ₁	50	0.003 x d ₁	65	0.003 x d ₁		
2.4	Cobalt-base Alloys	65	0.003 x d ₁	80	0.003 x d ₁	115	0.004 x d ₁	100	0.004 x d ₁		
2.5	Cobalt-base Alloys	30	0.002 x d ₁	30	0.002 x d ₁	30	0.003 x d ₁	65	0.003 x d ₁		
2.6	Iron-base Alloys	30	0.003 x d ₁	30	0.003 x d ₁	30	0.004 x d ₁	65	0.004 x d ₁		

STANDARD LENGTH – SOLID SHANK

Valid for Tool Nos:

2958T
2959T

HELPFUL FORMULAS:

SFM = (RPM x D in) / 3.82

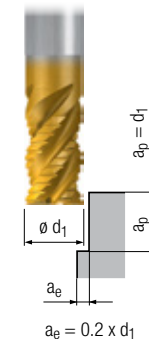
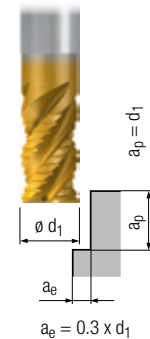
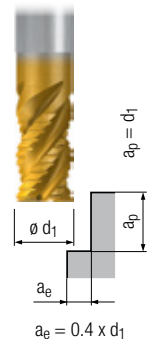
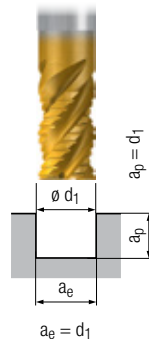
RPM = (SFM x 3.82) / D in

f_z feed/tooth = IPM / (#teeth x RPM)

IPM = RPM x #teeth x f_z

v_c = Cutting speed

f_z = Feed per tooth



	v _c [sfm]	f _z [inch]	v _c [sfm]	f _z [inch]	v _c [sfm]	f _z [inch]	v _c [sfm]	f _z [inch]
--	----------------------	-----------------------	----------------------	-----------------------	----------------------	-----------------------	----------------------	-----------------------

Suitable	Special Materials										
	Titanium Alloys										
Preferable	S	1.1	Pure Titanium	205	0.004 x d ₁	240	0.005 x d ₁	295	0.006 x d ₁	325	0.007 x d ₁
		1.2	Titanium Alloys	180	0.003 x d ₁	205	0.004 x d ₁	240	0.005 x d ₁	295	0.008 x d ₁
		1.3	Titanium Alloys	90	0.002 x d ₁	120	0.003 x d ₁	120	0.004 x d ₁	150	0.004 x d ₁
		Nickel Alloys, Cobalt Alloys and Iron Alloys									
		2.1	Pure Nickel	205	0.003 x d ₁	240	0.004 x d ₁	295	0.005 x d ₁	325	0.006 x d ₁
		2.2	Monel 500 / 718 Inconel annealed	60	0.002 x d ₁	60	0.004 x d ₁	75	0.004 x d ₁	90	0.005 x d ₁
2.3	Nickel-base Alloys: 718 Inconel	30	0.002 x d ₁	45	0.002 x d ₁	45	0.003 x d ₁	60	0.003 x d ₁		
2.4	Cobalt-base Alloys	60	0.002 x d ₁	75	0.003 x d ₁	105	0.004 x d ₁	90	0.004 x d ₁		
2.5	Cobalt-base Alloys	30	0.002 x d ₁	30	0.002 x d ₁	30	0.003 x d ₁	60	0.003 x d ₁		
2.6	Iron-base Alloys	30	0.002 x d ₁	30	0.003 x d ₁	30	0.004 x d ₁	60	0.004 x d ₁		

Note: All cutting data serve for orientation only and should be adapted individually to the technical conditions on location.

STUB LENGTH – SOLID SHANK

Valid for Tool Nos:

2975T
2976T

HELPFUL FORMULAS:

SFM = (RPM x D in) / 3.82

RPM = (SFM x 3.82) / D in

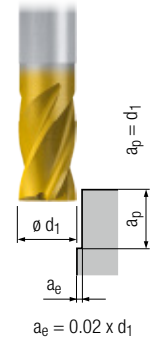
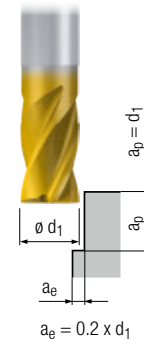
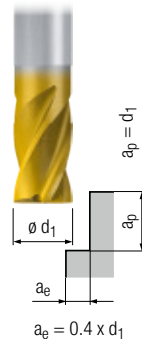
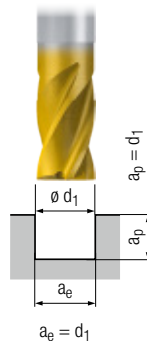
f_z feed/tooth = IPM / (#teeth x RPM)

IPM = RPM x #teeth x f_z

v_c = Cutting speed

f_z = Feed per tooth

N



		Stainless Steel Materials									
		v _c [sfm]	f _z [inch]	v _c [sfm]	f _z [inch]	v _c [sfm]	f _z [inch]	v _c [sfm]	f _z [inch]		
Preferable	M	1.1	Ferritic, Martensitic: 410 / 440 / 440C / 17-4 PH	325	0.004 x d ₁	395	0.004 x d ₁	460	0.005 x d ₁	525	0.006 x d ₁
		2.1	Austenitic: 303 / 304 / 316 / 316L / 321	260	0.004 x d ₁	325	0.004 x d ₁	360	0.005 x d ₁	425	0.006 x d ₁
		3.1	Austenitic-ferritic (Duplex)	165	0.003 x d ₁	195	0.003 x d ₁	230	0.004 x d ₁	260	0.004 x d ₁
		4.1	Austenitic-ferritic heat-resistant (Super Duplex)	130	0.003 x d ₁	165	0.003 x d ₁	195	0.004 x d ₁	195	0.004 x d ₁
Suitable	S	Special Materials									
		Titanium Alloys									
		1.1	Pure Titanium	230	0.005 x d ₁	260	0.005 x d ₁	325	0.006 x d ₁	360	0.007 x d ₁
		1.2	Titanium Alloys	195	0.004 x d ₁	230	0.004 x d ₁	260	0.005 x d ₁	325	0.006 x d ₁
	1.3	Titanium Alloys	100	0.003 x d ₁	130	0.003 x d ₁	130	0.004 x d ₁	165	0.004 x d ₁	

STANDARD LENGTH – SOLID SHANK

Valid for Tool Nos:

2977T
2978T

HELPFUL FORMULAS:

SFM = (RPM x D in) / 3.82

RPM = (SFM x 3.82) / D in

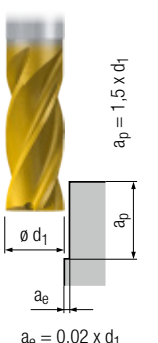
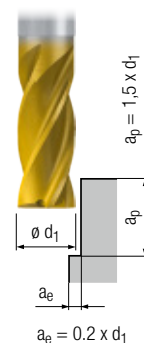
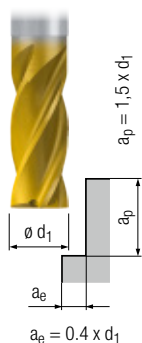
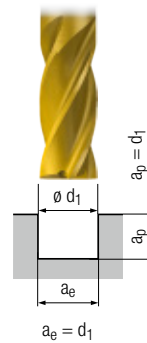
f_z feed/tooth = IPM / (#teeth x RPM)

IPM = RPM x #teeth x f_z

v_c = Cutting speed

f_z = Feed per tooth

N



		Stainless Steel Materials									
		v _c [sfm]	f _z [inch]	v _c [sfm]	f _z [inch]	v _c [sfm]	f _z [inch]	v _c [sfm]	f _z [inch]		
Preferable	M	1.1	Ferritic, Martensitic: 410 / 440 / 440C / 17-4 PH	325	0.004 x d ₁	395	0.004 x d ₁	460	0.005 x d ₁	525	0.006 x d ₁
		2.1	Austenitic: 303 / 304 / 316 / 316L / 321	260	0.004 x d ₁	325	0.004 x d ₁	360	0.005 x d ₁	425	0.006 x d ₁
		3.1	Austenitic-ferritic (Duplex)	165	0.003 x d ₁	195	0.003 x d ₁	230	0.004 x d ₁	260	0.004 x d ₁
		4.1	Austenitic-ferritic heat-resistant (Super Duplex)	130	0.003 x d ₁	165	0.003 x d ₁	195	0.004 x d ₁	195	0.004 x d ₁
Suitable	S	Special Materials									
		Titanium Alloys									
		1.1	Pure Titanium	230	0.005 x d ₁	260	0.005 x d ₁	325	0.006 x d ₁	360	0.007 x d ₁
		1.2	Titanium Alloys	195	0.004 x d ₁	230	0.004 x d ₁	260	0.005 x d ₁	325	0.006 x d ₁
	1.3	Titanium Alloys	100	0.003 x d ₁	130	0.003 x d ₁	130	0.004 x d ₁	165	0.004 x d ₁	

Note: All cutting data serve for orientation only and should be adapted individually to the technical conditions on location.

WITH COOLANT THROUGH



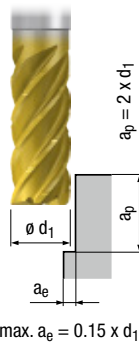
Valid for Tool Nos:

2577TZ WITH CORNER RADIUS:
 2579TZ 3911TZ
 2581TZ 3913TZ

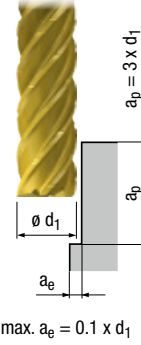
HELPFUL FORMULAS:

SFM = (RPM x D in) / 3.82
 RPM = (SFM x 3.82) / D in
 f_z feed/tooth = IPM / (#teeth x RPM)
 IPM = RPM x #teeth x f_z

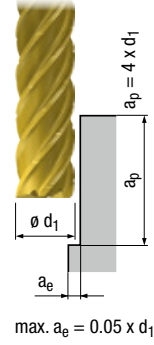
2 X D



3 X D



4 X D













v_c = Cutting speed
 f_z = Feed per tooth

		v_c [sfm]	f_z [inch]	v_c [sfm]	f_z [inch]	v_c [sfm]	f_z [inch]	
Stainless Steel Materials								
Preferable M	1.1	Ferritic, Martensitic: 410 / 440 / 440C / 17-4 PH	490	0.008 x d1	455	0.008 x d1	425	0.008 x d1
	2.1	Austenitic: 303 / 304 / 316 / 316L / 321	425	0.008 x d1	390	0.008 x d1	360	0.008 x d1
	3.1	Austenitic-ferritic (Duplex)	360	0.007 x d1	325	0.007 x d1	295	0.007 x d1
	4.1	Austenitic-ferritic heat-resistant (Super Duplex)	325	0.007 x d1	295	0.007 x d1	260	0.007 x d1
Special materials								
Titanium alloys								
Preferable	1.1	Pure Titanium	460	0.007 x d1	425	0.007 x d1	395	0.007 x d1
	1.2	Titanium Alloys	425	0.007 x d1	395	0.007 x d1	360	0.007 x d1
	1.3		395	0.006 x d1	360	0.006 x d1	325	0.006 x d1
Nickel Alloys, Cobalt Alloys and Iron Alloys								
Suitable S	2.1	Pure Nickel	325	0.004 x d1	295	0.004 x d1	260	0.004 x d1
	2.2	Monel 500 / 718 Inconel annealed	100	0.004 x d1	100	0.004 x d1	80	0.004 x d1
	2.3	Nickel-base Alloys: 718 Inconel	130	0.004 x d1	130	0.004 x d1	115	0.004 x d1
	2.4	Cobalt-base Alloys	130	0.004 x d1	130	0.004 x d1	115	0.004 x d1
	2.5		130	0.004 x d1	115	0.004 x d1	100	0.004 x d1
	2.6		Iron-base Alloys	100	0.004 x d1	100	0.004 x d1	80

Note: All cutting data serve for orientation only and should be adapted individually to the technical conditions on location.

Icon Descriptions

	<p>Tool type Finishing end mill design without chip breaker</p> 		<p>Tool type Semi-finishing end mill design with flat chip breaker</p> 
	<p>Internal coolant supply ICA = Internal coolant supply, axial exit</p>		<p>Coolant through</p>
 <p>Shank design for inch straight tools</p>  <p>Shank design for inch weldon shank</p>  <p>Shank design for inch straight and weldon shank</p>	<p>Shank design The shank designs to be found on the respective page are marked in gray.</p>	 <p>medium</p>  <p>fine</p>	<p>Chip breaker Depending on form (e.g. round or flat) and size (coarse, medium, fine) of the chip breakers, end mills generate appropriate milling marks shown.</p>
 <p>30°</p>	<p>Helix angle The helix angle of tools is shown. If there are variable helix angles, they are also shown.</p>	 <p>CR</p>	<p>Corner radius</p>
 <p>45°</p>  <p>CH x 45°</p>	<p>Chamfer</p>	 <p>3-5°</p>	<p>Ramping angle The specified angle is the recommended angle for ramping applications.</p>
	<p>Feed direction The red arrows mark the recommended feed directions of the respective cutters.</p>		



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Reconditioning examples – End Mills



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