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FRANKEN
TiNox-Cut

EMUGE
FRANKEN

TINOX-CUT END MILLS
FOR AEROSPACE MATERIALS

FRANKEN
TiNox-Cut

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:

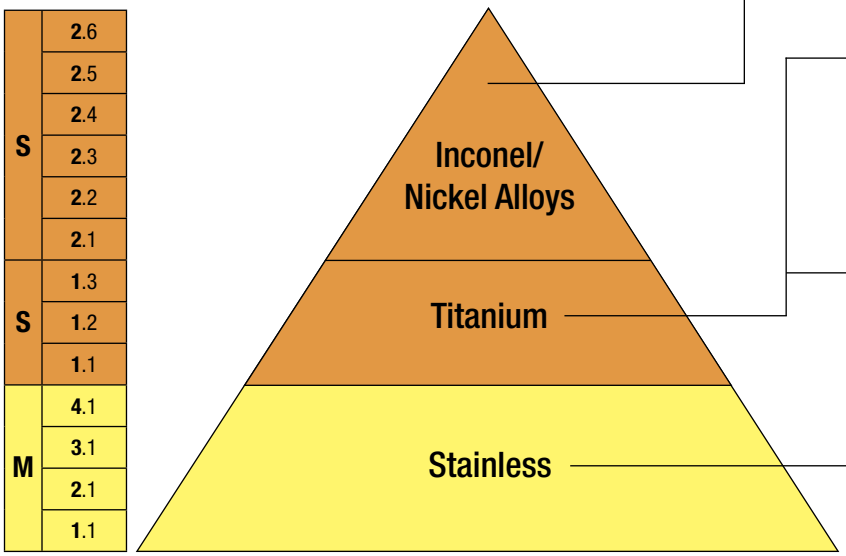
- High performance tool for trochoidal milling
- Preferable in Titanium and Stainless
- Newly developed geometry with chip breaker
- Low-vibration machining

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

FRANKEN TiNox-Cut



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

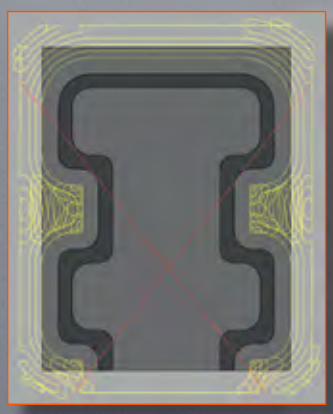
Trochoidal Milling

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 x D to 4 x 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.**

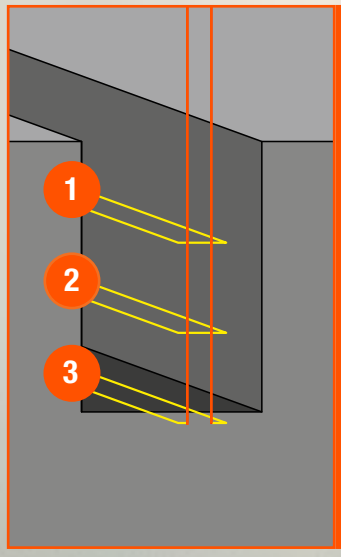
Advantages of EMUGE-FRANKEN Trochoidal Milling

- 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 x 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

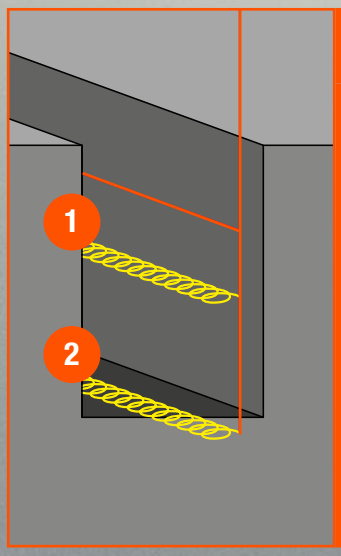


HPC Slot Milling with standard solid carbide end mill

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

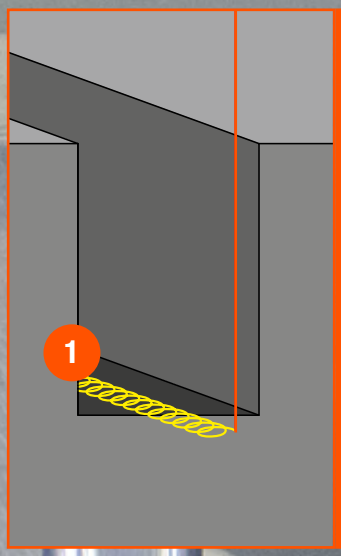


Trochoidal Slot Milling with standard solid carbide end mill

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

EMUGE FRANKEN

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" ø	1/4" - 1" ø	1/4" - 1" ø	1/4" - 1" ø	1/8" - 3/4" ø	1/8" - 3/4" ø
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

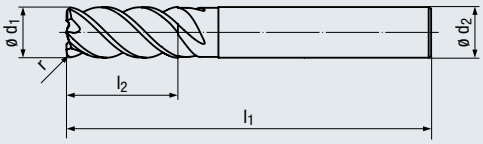
				 Corner Radius	 Corner Radius
Tool	TiNox-Cut Trochoidal 2 x D	TiNox-Cut Trochoidal 3 x D	TiNox-Cut Trochoidal 4 x D	TiNox-Cut Trochoidal 3 x D	TiNox-Cut Trochoidal 4 x D
Page	11	11	11	12	12
Length	Standard	Long	Extra Long	Long	Extra Long
Coating	TIN / TIALN	TIN / TIALN	TIN / TIALN	TIN / TIALN	TIN / TIALN
Flutes	4-5	4-5	4-5	4-5	4-5
Size Range	1/4" - 3/4" ø	1/4" - 3/4" ø	1/4" - 3/4" ø	1/4" - 3/4" ø	1/4" - 3/4" ø
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

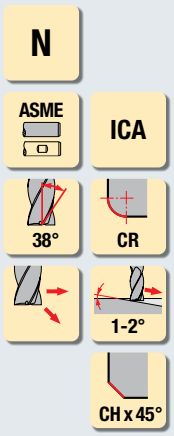
Rougher-Finisher

- 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)

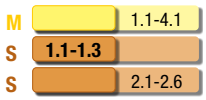
Corner Radius

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



Standard length

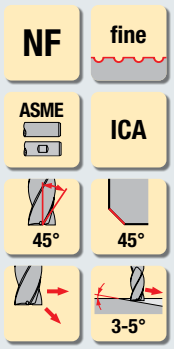
ø d_1 h10	l_2	l_1	ø d_2 h6	Chamfer	# Flutes	Tool No. Straight Shank
1/4	3/4	2 1/2	1/4	0.005	**5**	**2962LZ.0250**
5/16	3/4	2 1/2	5/16	0.005	**5**	**2962LZ.03125**
3/8	7/8	2 1/2	3/8	0.008	**5**	**2962LZ.0375**
1/2	1 1/4	3	1/2	0.008	**5**	**2962LZ.0500**
5/8	1 1/4	3 1/2	5/8	0.008	**5**	**2962LZ.0625**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

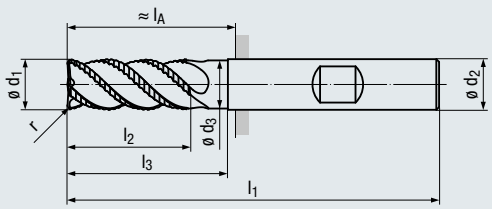
Standard length – Corner Radius

ø d_1 h11	l_2	l_1	ø 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**

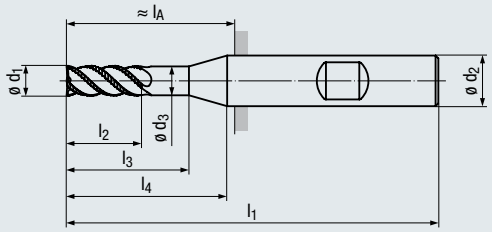
Semi-Finisher

- 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)

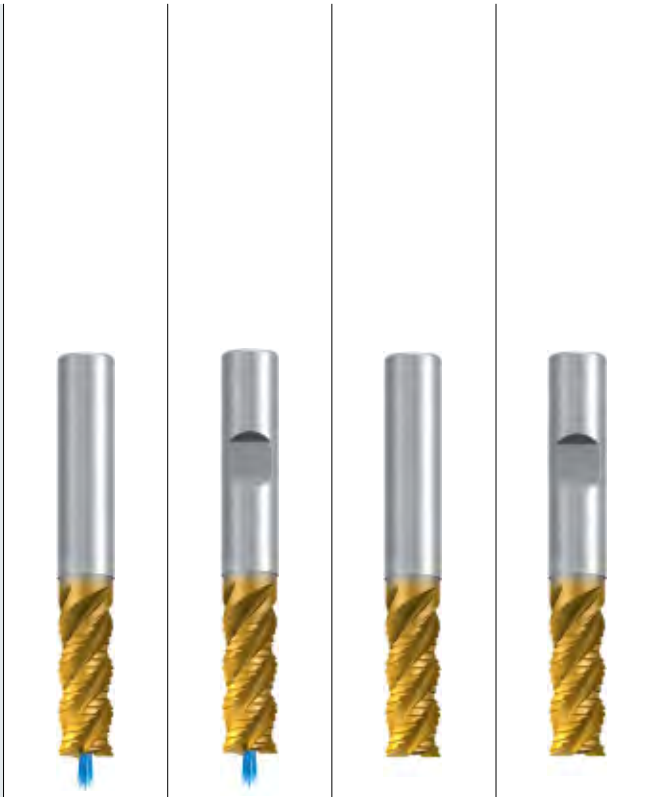




Design l_4:



Icon descriptions (see page 17)



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

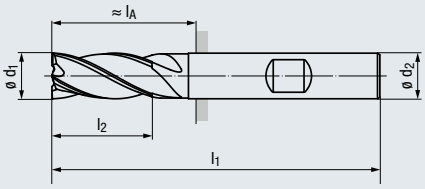
ø d_1 h11	l_2	l_3	l_1	ø d_3	l_4	ø d_2 h6	l_A	# Flutes	Tool No. Straight Shank	Tool No. Weldon Shank
1/4	17/32	3/4	2 1/2	0.236	7/8	3/8	15/16	**4**	**2648TZ.0250**	**2649TZ.0250**
5/16	3/4	7/8	2 1/2	0.295	15/16	3/8	15/16	**4**	**2648TZ.03125**	**2649TZ.03125**
3/8	7/8	1 1/8	2 3/4	0.358	–	3/8	1 3/16	**4**	**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

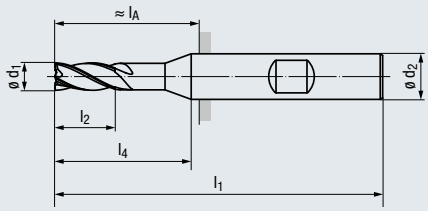
ø d_1 h11	l_2	l_1	ø d_3	ø d_2 h6	# Flutes	Tool No. Straight Shank	Tool No. Weldon Shank
1/4	17/32	2 1/2	0.236	1/4	**4**	**2958T.0250**	**–**
5/16	3/4	2 1/2	0.295	5/16	**4**	**2958T.03125**	**–**
3/8	7/8	2 3/4	0.358	3/8	**4**	**2958T.0375**	**–**
1/2	1 1/8	3 1/4	0.480	1/2	**4**	**2958T.0500**	**2959T.0500**
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**

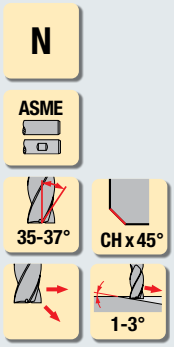
Rougher-Finisher

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

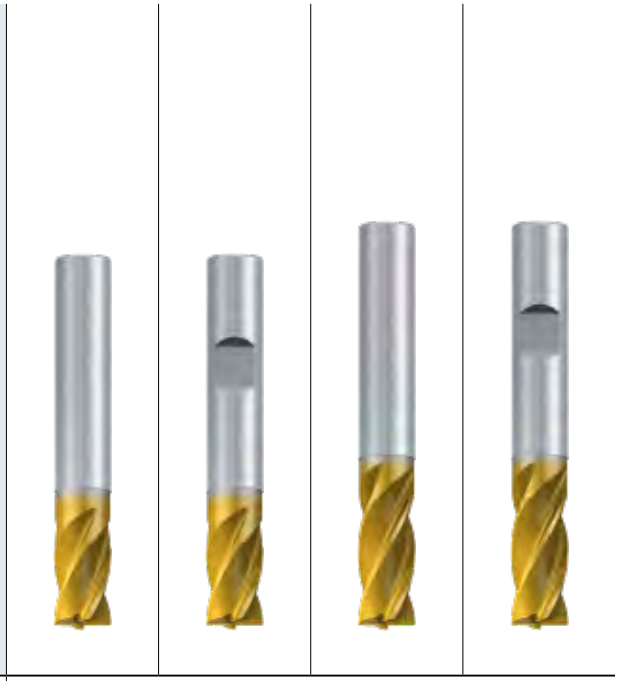


Design l_4:





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

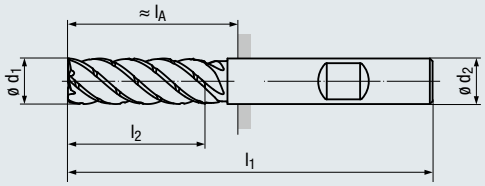
ø d_1 h10	l_2	l_1	l_4	ø d_2 h6	l_A	Chamfer	# Flutes	Tool No. Straight Shank	Tool No. Weldon Shank
1/8	1/4	2	5/8	1/4	5/8	0.003	**4**	**2975T.0125**	**–**
3/16	3/8	2	5/8	1/4	5/8	0.005	**4**	**2975T.01875**	**–**
1/4	1/2	2	–	1/4	5/8	0.005	**4**	**2975T.0250**	**–**
5/16	9/16	2 1/4	–	5/16	7/8	0.005	**4**	**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

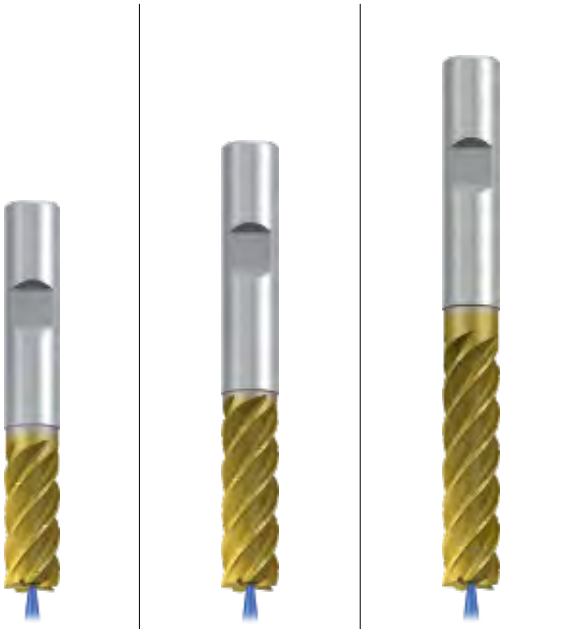
ø d_1 h10	l_2	l_1	l_4	ø d_2 h6	l_A	Chamfer	# Flutes	Tool No. Straight Shank	Tool No. Weldon Shank
1/8	3/8	2 1/4	7/8	1/4	7/8	0.003	**4**	**2977T.0125**	**–**
3/16	9/16	2 1/4	7/8	1/4	7/8	0.005	**4**	**2977T.01875**	**–**
1/4	3/4	2 1/2	–	1/4	1 1/8	0.005	**4**	**2977T.0250**	**–**
5/16	13/16	2 1/2	–	5/16	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)

NF | medium | ASME | ICA | 38-42° | CH x 45°



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

ø d_1 h10	l_2	l_1	ø 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**

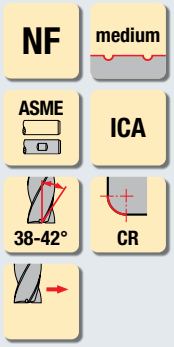
3 x D – Long length

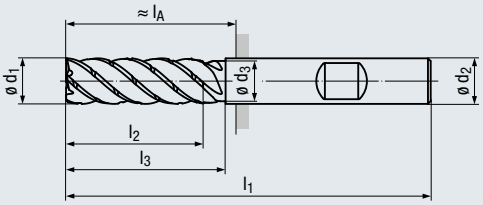
ø d_1 h10	l_2	l_1	ø d_2 h6	l_A	Chamfer	# Flutes	Tool No. Weldon Shank
1/4	3/4	2 1/2	1/4	1 1/8	0.005	**4**	**2579TZ.0250**
5/16	1	2 3/4	5/16	1 3/8	0.005	**5**	**2579TZ.03125**
3/8	1 1/8	3 1/4	3/8	1 11/16	0.008	**5**	**2579TZ.0375**
1/2	1 1/2	3 3/4	1/2	1 31/32	0.008	**5**	**2579TZ.0500**
5/8	1 7/8	4 1/4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

ø d_1 h10	l_2	l_1	ø 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**

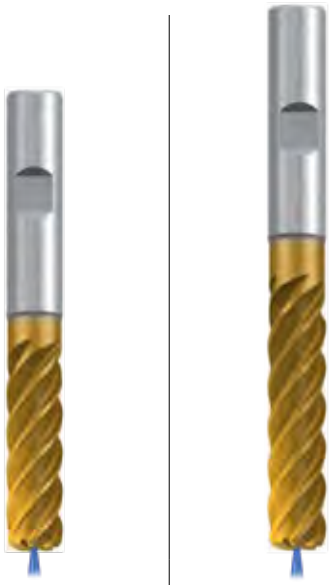
- High performance tool for trochoidal milling
- Newly developed geometry with chip breaker
- Low-vibration machining
- Axial depths of cut up to 4 x D
- Axial internal coolant supply (ICA)





Icon descriptions (see page 17)

Corner Radius



3 x D 4 x D

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

ø d_1 h10	r	Long length 3 x D l_1	l_2	l_A	Extra long length 4 x D l_1	l_2	l_A	ø d_2 h6	# Flutes	Tool No. Weldon Shank	Tool No. Weldon Shank
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**

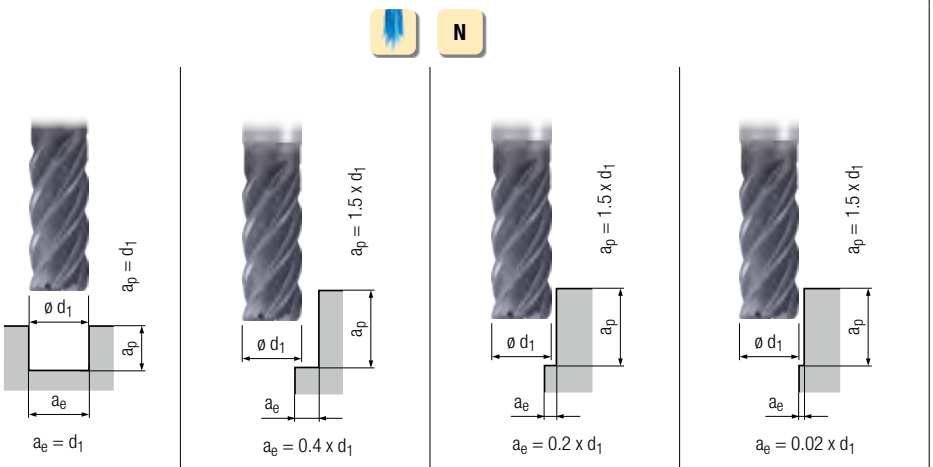
STANDARD LENGTH - WITH COOLANT THROUGH

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

			Material	v_c [sfm]	f_z [inch]	v_z [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	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			**Special Materials**								
	S		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		100	0.002 x d_1	130	0.002 x d_1	130	0.003 x d_1	165	0.003 x d_1

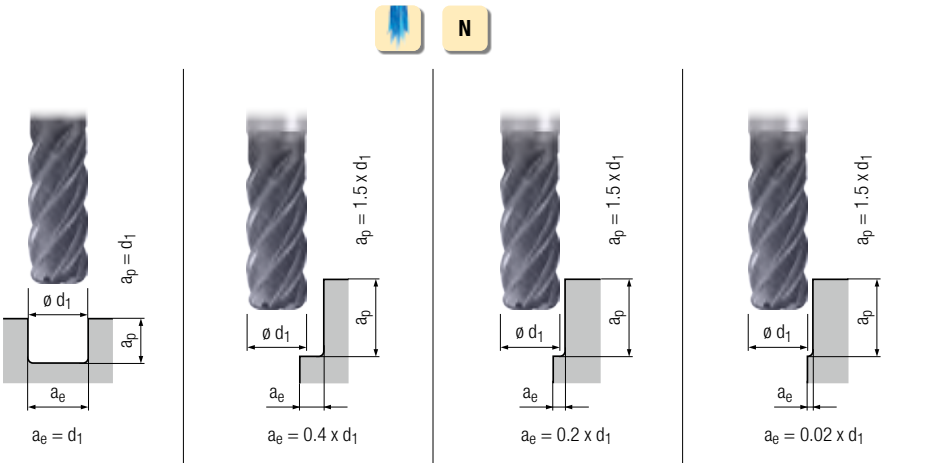
STANDARD LENGTH – WITH CORNER RADIUS - WITH COOLANT THROUGH

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

			Material	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			**Special Materials**								
	S		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		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

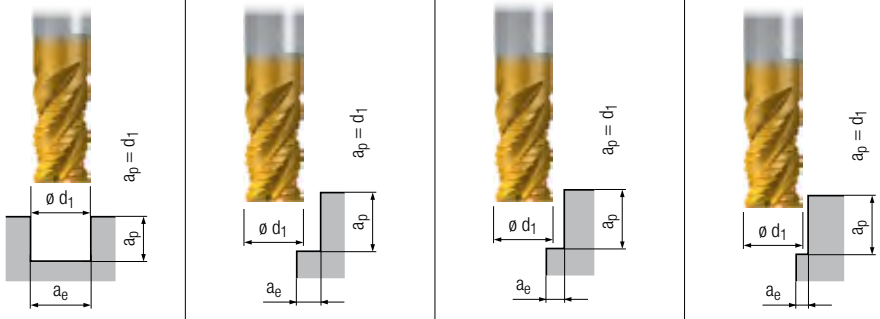
Valid for Tool Nos:

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

NF



v_c = Cutting speed
f_z = Feed per tooth

			v_c [sfm]	f_z [inch]	v_z [sfm]	f_z [inch]	v_c [sfm]	f_z [inch]	v_c [sfm]	f_z [inch]
Suitable / 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			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			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

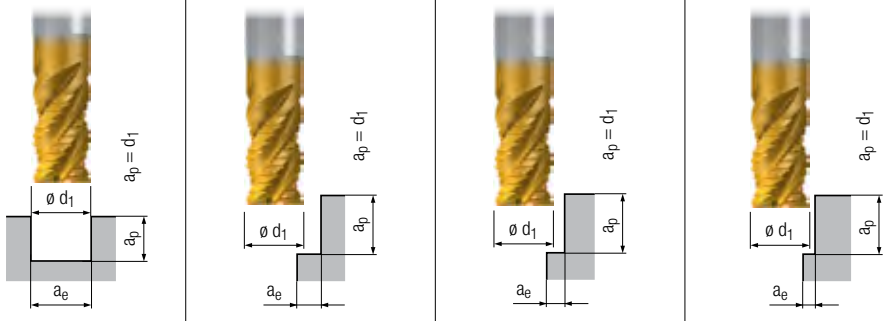
Valid for Tool Nos:

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

NF



v_c = Cutting speed
f_z = Feed per tooth

			v_c [sfm]	f_z [inch]	v_z [sfm]	f_z [inch]	v_c [sfm]	f_z [inch]	v_c [sfm]	f_z [inch]
Suitable / Preferable	S		**Special Materials**									
			Titanium Alloys									
		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			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			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

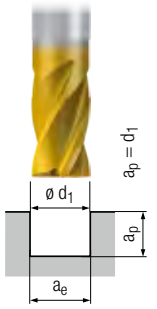
Valid for Tool Nos:

2975T
2976T

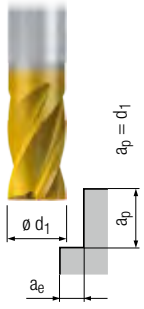
HELPFUL FORMULAS:

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

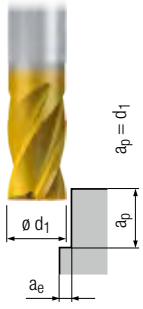
N



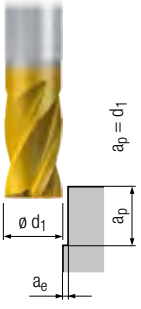
$a_e = d_1$



$a_e = 0.4 \times d_1$



$a_e = 0.2 \times d_1$



$a_e = 0.02 \times d_1$

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]
Preferable	M	1.1	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
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		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

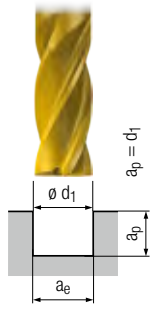
Valid for Tool Nos:

2977T
2978T

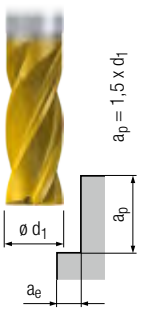
HELPFUL FORMULAS:

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

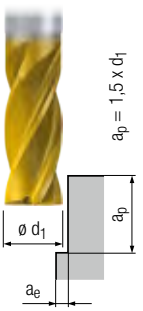
N



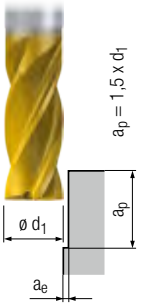
$a_e = d_1$



$a_e = 0.4 \times d_1$



$a_e = 0.2 \times d_1$



$a_e = 0.02 \times d_1$

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]
Preferable	M	1.1	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
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		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 NF

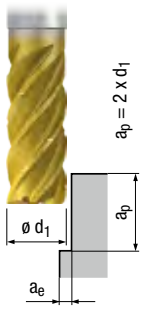
Valid for Tool Nos:

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

HELPFUL FORMULAS:

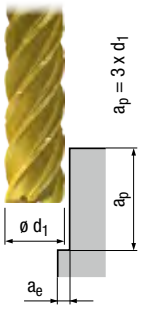
SFM	= (RPM x D in) / 3.82
RPM	= (SFM x 3.82) / D in
f_z feed/tooth	= IPM / (#teeth x RPM)
IPM	= RPM x #teeth x f_z

2 X D



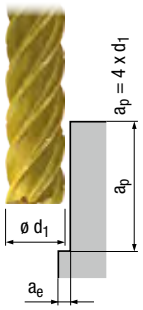
max. $a_e = 0.15 \times d_1$

3 X D



max. $a_e = 0.1 \times d_1$

4 X D



max. $a_e = 0.05 \times d_1$

v_c = Cutting speed
f_z = Feed per tooth

				2 X D		3 X D		4 X D	
				v_c [sfm]	f_z [inch]	v_c [sfm]	f_z [inch]	v_c [sfm]	f_z [inch]
Preferable	M		**Stainless Steel Materials**						
		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
Preferable	S		**Special materials**						
			Titanium alloys						
		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
Suitable			Nickel Alloys, Cobalt Alloys and Iron Alloys						
		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	0.004 x d1

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

Icon Descriptions

N

Tool type
Finishing end mill design without chip breaker

NF

Tool type
Semi-finishing end mill design with flat chip breaker

ICA

Internal coolant supply
ICA = Internal coolant supply, axial exit

Coolant through

Shank design
The shank designs to be found on the respective page are marked in gray.

ASME

Shank design for inch straight tools

ASME

Shank design for inch weldon shank

ASME

Shank design for inch straight and weldon shank

Chip breaker

medium

fine

Depending on form (e.g. round or flat) and size (coarse, medium, fine) of the chip breakers, end mills generate appropriate milling marks shown.

30°

Helix angle
The helix angle of tools is shown.
If there are variable helix angles, they are also shown.

CR

Corner radius

45°

CH x 45°

Chamfer

3-5°

Ramping angle
The specified angle is the recommended angle for ramping applications.

Feed direction
The red arrows mark the recommended feed directions of the respective cutters.

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