

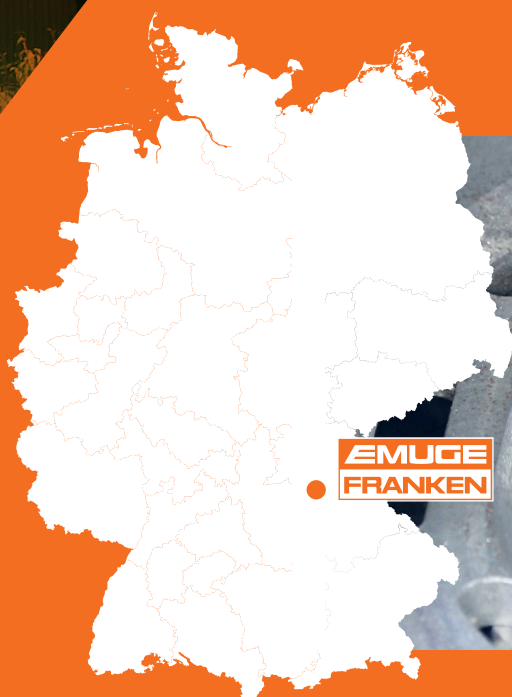
**EMUGE**  
**FRANKEN**

■ Made  
■ in  
■ Germany



**FRANKEN**  
*Dental*

FRANKEN-CIMT  
DENTAL TOOLS



Lauf an der Pegnitz, Hometown of EMUGE-FRANKEN.



## WE TAKE INNOVATION TO THE LIMIT.

Even our first threading tools impressed with the power of a new idea. A momentum that continues to inspire us to new levels of performance. Each innovation step leads to increased precision and higher quality – and results in solutions that provide key impulses for new production strategies. This constantly opens up new opportunities for value creation for our industrial partners worldwide.



## PRECISION IS IN OUR DNA. FOR MORE THAN 100 YEARS.

EMUGE and FRANKEN have been developing cutting-edge technology in the field of precision tools for over 100 years. Today, the family-run EMUGE-FRANKEN group of companies is one of the world's leading manufacturers of threading, testing, clamping and milling technology products – for customers from the automotive, power plant and aviation industries to mechanical and plant engineering as well as medical technology. We are close to our customers in 60 countries through our own subsidiaries or sales partners.



**24/7**  
at your service.

[franken-dental.com/en/](http://franken-dental.com/en/)

Scanning the QR code will take you directly to our website.

## DENTAL TOOLS FROM FRANKEN. END MILLS AT THEIR BEST.

Highest precision and meticulous handling of the material are the cornerstones of dental technology. This fits in with our core competences: since 2009, we have therefore made a name for ourselves with medical technology tools for a wide range of materials in dental technology.

The comprehensive range of end mills, grinding burrs, thread milling cutters and twist drills has been optimised for use in demanding dental technology. Today, over 600 different FRANKEN dental tools are available for machining in open and closed CAD/CAM process chains.



## MILLING IN A SYSTEM ENVIRONMENT: FOR HIGH-END SYNERGIES.

FRANKEN has developed the new FRANKEN-CIMT product line to utilise the extremely high dynamics of the CIMT Pi5 and Pi5 Turn dental milling machines: The tools were matched to the industrial performance level of the CIMT machines in terms of substrate, cutting edge geometry, finish treatment and coating. The result: Higher precision milling quality in significantly less time. Maximum accuracy of fit for dental workpieces – with minimised reworking thanks to extremely clean surface finishes. The ideal case of a perfectly balanced system for maximum efficiency with the highest quality.





## CIMT DENTAL MILLING MACHINES: CUTTING-EDGE TECHNOLOGY MADE IN GERMANY.

Bringing together what belongs together: The dental milling machine manufacturer CIMT Precision GmbH has been part of the EMUGE-FRANKEN group of companies since 2023. A match that is dedicated to precision and innovation. The industrial performance level of the CIMT Pi5 dental milling machine series enables full utilisation of the digital workflow in the dental laboratory.



## INTEGRATED SOLUTIONS ALSO IN TERMS OF ADVICE AND SERVICE.

The worldwide customer base is supported by our application engineers. This team of experts provides the following services for the products offered by EMUGE-FRANKEN:

- Worldwide phone consultation and support in solving technical problems
- Cooperation in the development of concepts and proposals to optimise the customer's production process
- Conducting tests with specific customer materials in a specially equipped test department to optimise tool selection and recommendation
- Development and design of customised special tools
- Deployment of service technicians
- Organisation of product-related training courses and seminars worldwide



## YOUR MATERIAL. OUR TOOL.

The dental precision tools in the FRANKEN-CIMT product line are optimised for the latest dental materials. The range of applications for end mills, ball-nose end mills, torus end mills and twist drills includes common dental materials such as cobalt-chrome, titanium, PMMA / PEEK, wax and zirconium oxide.



## SYMBOLS FOR TOOL APPLICATION.

### Design of cutting corner and face contour



Ball-nose  
(full radius)



Torus



Radius to  
be programmed  
in CAM



Tool with  
corner radius

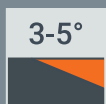
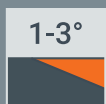


Sharp-edged

### Recommended feed direction



### Recommended plunge angle (ramp angle)



## FAST AND EASY GO TO THE WEBSHOP.

You can access the items in the webshop by scanning the QR code or entering the item number below in the search bar on the website [www.emuge-franken-group.com](http://www.emuge-franken-group.com). There you can find comprehensive tool information and cutting data.



Registration provides you access to additional product data and functions. These include standardised tool data (2D / 3D / characteristics), an order and quotation history and individual watch lists as well as other useful functions.



BALL-NOSE END MILLS

TORUS END MILLS

END MILLS

DRILLS

**COBALT-CHROME**



**PAGE**  
**8-10**

**1**

**TITANIUM**



**PAGE**  
**11**

**2**

**COBALT-CHROME  
TITANIUM**



**PAGE**  
**12-16**

**3**

**PMMA / PEEK  
WAX**



**PAGE**  
**17**

**4**

**ZIRKONIUM  
OXIDE**



**PAGE**  
**18**

**5**

### Carbide ball-nose end mills 2182AR

1

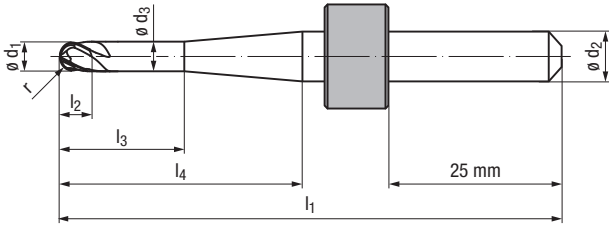
- For roughing, pre-finishing, finishing and machining residual material in cobalt-chrome.
- TIALN coating for longer tool life.
- High accuracy radius tolerance of  $\pm 5\mu\text{m}$  for precise machining results and maximum repeat accuracy.

Cobalt-chrome

1-3°

2182AR

2



Machining data: P. 19

$\phi d_1$	$r_1$	$l_2$	$l_3$	$l_1$	$\phi d_3$	$l_4$	$\phi d_2$	Flutes	T-number	Article number
$\pm 0.01$	$\pm 0.005$						<b>h6</b>			
2	1	4	8	50	1.85	15	6	4	T1011 -	2182AR.200608
3	1.5	6	10.5	50	2.8	16	6	4	T1016 -	2182AR.300610

3

### Carbide ball-nose end mills 2177AR

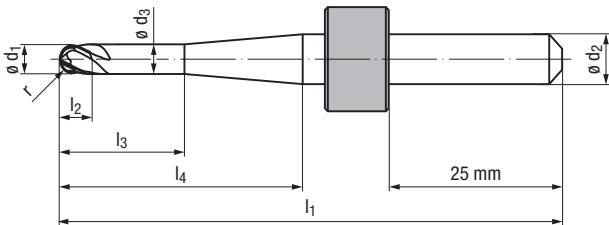
- For roughing, pre-finishing, finishing and machining residual material in cobalt-chrome.
- TIALN coating for longer tool life.
- High accuracy radius tolerance of  $\pm 5\mu\text{m}$  for precise machining results and maximum repeat accuracy.

Cobalt-chrome

1-3°

2177AR

4



Machining data: P. 19

5

$\phi d_1$	$r_1$	$l_2$	$l_3$	$l_1$	$\phi d_3$	$l_4$	$\phi d_2$	Flutes	T-number	Article number
$\pm 0.01$	$\pm 0.005$						<b>h6</b>			
2	1	3	8	57	1.8	20	6	4	T4211 -	2177AR.200608
3	1.5	3.5	10	57	2.8	20	6	4	T4216 -	2177AR.300610
3	1.5	3.5	14	57	2.8	20	6	4	T4218 -	2177AR.300614



## Carbide ball-nose end mills 2176AR

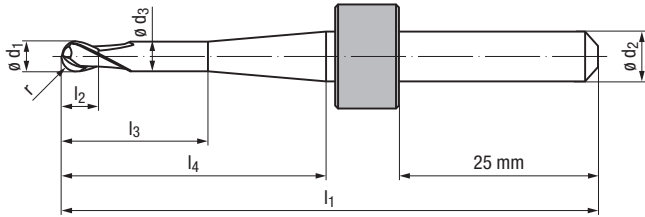
- For roughing, pre-finishing, finishing and residual material machining in cobalt-chrome.
- TiAlN coating for longer tool life.
- High accuracy radius tolerance of  $\pm 5\mu\text{m}$  for precise machining results and maximum repeat accuracy.

Cobalt-chrome



2176AR

1



Machining data: P. 19

2

$\phi d_1$	$r_1$	$l_2$	$l_3$	$l_1$	$\phi d_3$	$l_4$	$\phi d_2$	Flutes	T-number		Article number
$\pm 0.01$	$\pm 0.005$						<b>h6</b>				
0.6	0.3	0.6	3	57	0.55	21	6	2	T4217	T5217	2176AR.060603
1	0.5	1	8	57	0.95	21	6	2	T4220	-	2176AR.100608
1	0.5	1	10	57	0.95	21	6	2	T4215	-	2176AR.100610
1.5	0.75	1.25	8	57	1.4	21	6	2	T4212	T4219	2176AR.150608
1.5	0.75	1.25	10	57	1.4	21	6	2	T4214	-	2176AR.150610
2	1	1.5	12	57	1.9	21	6	2	T4213	-	2176AR.200612

3

## Carbide ball-nose end mills 2184LR

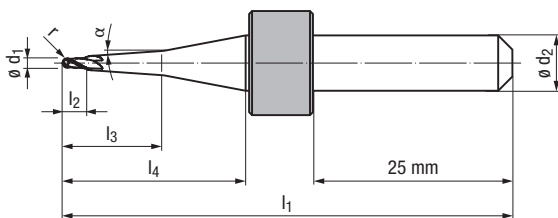
- For finishing and machining residual material in cobalt-chrome.
- ALCR coating for high wear protection and very long tool life.
- High accuracy radius tolerance of  $\pm 5\mu\text{m}$  for precise machining results and maximum repeat accuracy.

Cobalt-chrome



2184LR

4



Machining data: P. 19

$\phi d_1$	$r_1$	$l_2$	$l_3$	$l_1$	$l_4$	$\phi d_2$	Neck angle $\alpha$	Flutes	T-number		Article number
$\pm 0.01$	$\pm 0.005$					<b>h5</b>					
0.3	0.15	0.5	10	57	20	6	4°	2	T4203	T5203	2184LR.030610

5

### Carbide ball-nose end mills 2179AR

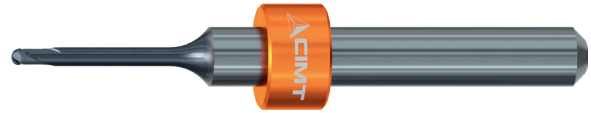
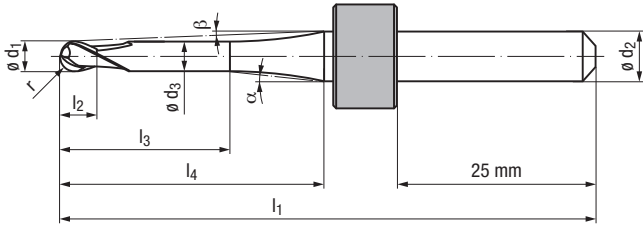
1

- For roughing, pre-finishing, finishing and machining residual material in cobalt-chrome.
- TIALN coating for longer tool life.
- High accuracy radius tolerance of  $\pm 5\mu\text{m}$  for precise machining results and maximum repeat accuracy.



2179AR

2



Machining data: P. 19

$\phi d_1$	$r_1$	$l_2$	$l_3$	$l_1$	$\phi d_3$	$l_4$	$\phi d_2$	Neck angle $\alpha / \beta$	Flutes	T-number	Article number	
$\pm 0.01$	$\pm 0.005$						<b>h5</b>					
0.5	0.25	0.5	2.5	57	0.45	9.5	6	22.5° / 17°	2	T4205	-	2179AR.050603

3

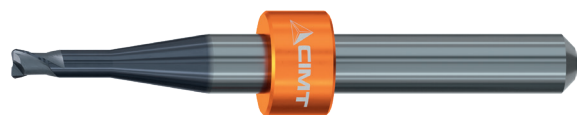
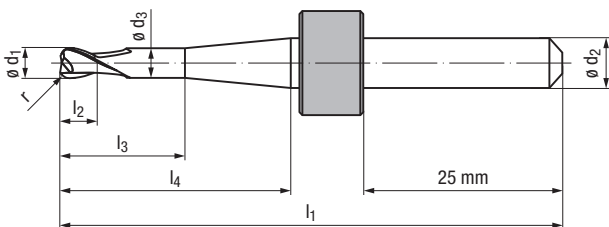
### Carbide torus end mills 2175AR

- For roughing, pre-finishing and machining residual material in cobalt-chrome.
- TIALN coating for longer tool life.
- High accuracy radius tolerance of  $\pm 5\mu\text{m}$  for precise machining results and maximum repeat accuracy.



2175AR

4



Machining data: P. 19

5

$\phi d_1$	$r_1$	$l_2$	$l_3$	$l_1$	$\phi d_3$	$l_4$	$\phi d_2$	Flutes	T-number	Article number	
$\pm 0.01$	$\pm 0.005$						<b>h5</b>				
1	0.25	2	4	57	0.95	20	6	2	T4325	-	2175AR.100604



## Carbide ball-nose end mills 2173TR

- For roughing, finishing and machining residual material in titanium.
- TIN / TIALN coating for longer tool life.
- High accuracy radius tolerance of  $\pm 5\mu\text{m}$  for precise machining results and maximum repeat accuracy.

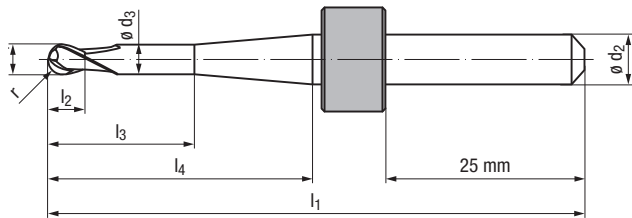
Titanium



1-3°



2173TR



Machining data: P. 21

$\phi d_1$	$r_1$	$l_2$	$l_3$	$l_1$	$\phi d_3$	$l_4$	$\phi d_2$	Flutes	T-number	Article number
$\pm 0.01$	$\pm 0.005$						<b>h6</b>			
2	1	1.5	8	57	1.8	21	6	2	T5211 -	2173TR.200608
3	1.5	2	10	57	2.8	21	6	2	T5216 -	2173TR.300610

## Carbide end mill 2187TR

- With corner radius for roughing titanium.
- TIN / TIALN coating for longer tool life.

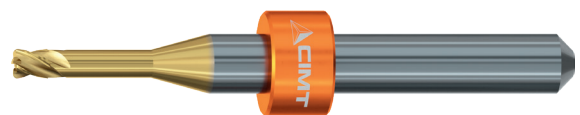
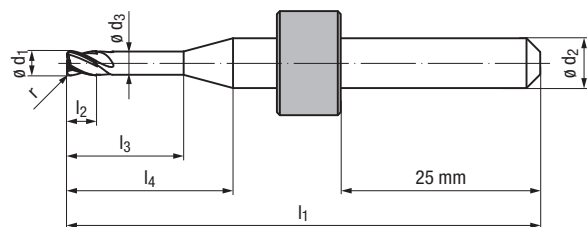
Titanium



1-3°



2187TR



Machining data: P. 21

$\phi d_1$	$r_1$	$l_2$	$l_3$	$l_1$	$\phi d_3$	$l_4$	$\phi d_2$	Flutes	T-number	Article number
<b>h10</b>	$\pm 0.01$						<b>h6</b>			
3	0.5	8	14	57	2.9	20	6	4	T5299 -	2187TR.300614

### Carbide end mills “Duplex” 2181AR

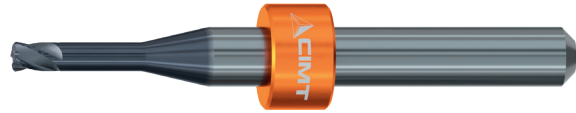
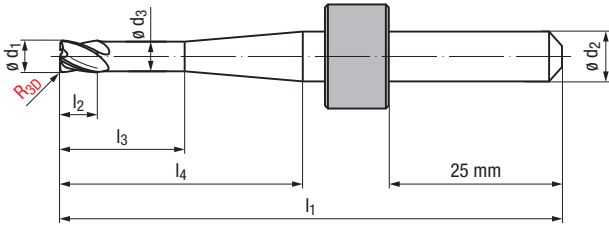
1

- Duplex for roughing in cobalt-chrome.
- The duplex geometry combines HPC and HFC geometry and enables 2D and 3D machining with just one tool.
- TiAlN coating for longer tool life.

Cobalt-chrome
Titanium
R<sub>3D</sub>
3-5°


2181AR

2



Machining data: P. 20

$\varnothing d_1$	$r_1$	$r_2$	$R_{3D}$	$l_2$	$l_3$	$l_1$	$\varnothing d_3$	$l_4$	$\varnothing d_2$	Flutes	T-number	Article number
-0.02									h6			
3	1.5	0.3	0.4	3	14	57	2.9	20	6	4	T4035 T5035	2181AR.300614

3

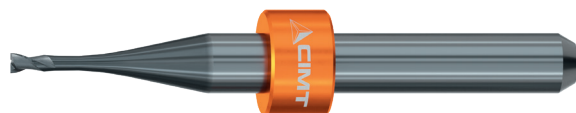
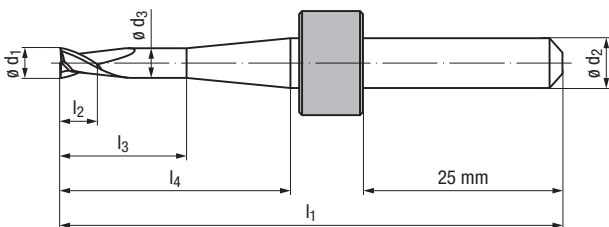
### Carbide end mills 2172LR

- For finishing and machining residual material in cobalt-chrome and titanium.
- ALCR coating for longer tool life.

Cobalt-chrome
Titanium
1-3°


2172LR

4



Machining data: P. 20

5

$\varnothing d_1$		$l_2$	$l_3$	$l_1$	$\varnothing d_3$	$l_4$	$\varnothing d_2$	Flutes	T-number	Article number
0.5	-0.025	0.5	2.5	57	0.4	13	h5	2	T4003 T5003	2172LR.050603
0.5	-0.025	0.5	5	57	0.4	20	6	2	T4004 T5004	2172LR.050605
1	-0.04	1	5	57	0.8	15.5	6	2	T4005 T5005	2172LR.100605
1.5	-0.04	1.5	7.5	57	1.2	17.5	6	2	T4008 T5008	2172LR.150608
2	-0.04	2	10	57	1.6	19.5	6	2	T4020 T5020	2172LR.200610

## Carbide end mills 2186LR

- For finishing and machining residual material in cobalt-chrome and titanium.
- ALCR coating for longer tool life.
- High accuracy radius tolerance of  $\pm 5\mu\text{m}$  for precise machining results and maximum repeat accuracy.

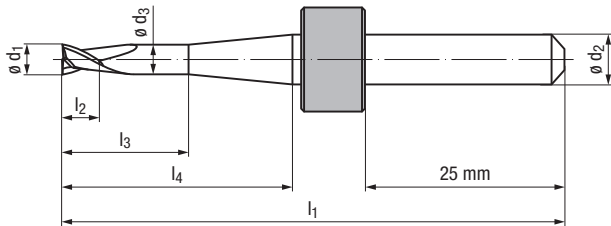
Cobalt-chrome

Titanium



2186LR

1



Machining data: P. 20

2

$\varnothing d_1$	$l_2$	$l_3$	$l_1$	$\varnothing d_3$	$l_4$	$\varnothing d_2$	Flutes	T-number	Article number
<b>h10</b>						<b>h5</b>			
2	2	16	57	1.6	20	6	2	T4040 T5040	2186LR.200616

## Carbide ball-nose end mills 2174TR

- For roughing, pre-finishing, finishing and machining residual material in cobalt-chrome and titanium.
- TIN / TIALN coating for longer tool life.
- High accuracy radius tolerance of  $\pm 5\mu\text{m}$  for precise machining results and maximum repeat accuracy.

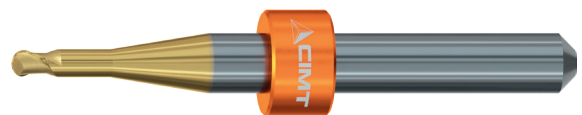
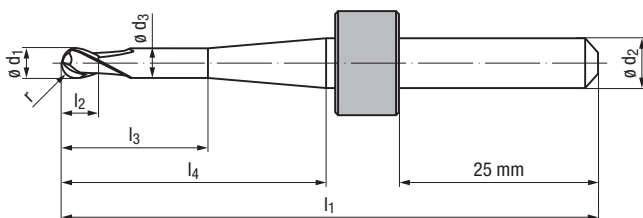
Cobalt-chrome

Titanium



2174TR

3



Machining data: P. 20

4

$\varnothing d_1$	$r_1$	$l_2$	$l_3$	$l_1$	$\varnothing d_3$	$l_4$	$\varnothing d_2$	Flutes	T-number	Article number	
<b><math>\pm 0.01</math></b>	<b><math>\pm 0.005</math></b>						<b>h6</b>				
1	0.5	0.85	8	57	0.87	21	6	2	T5215	-	2174TR.100608
1.5	0.75	1.275	8	57	1.3	21	6	2	T5212	T5219	2174TR.150608
2	1	1.7	12	57	1.74	21	6	2	T5213	-	2174TR.200612

5



### Carbide torus end mills 2189AR

1

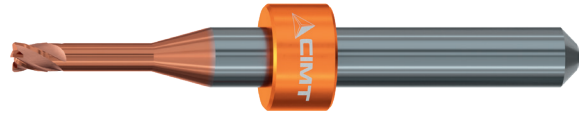
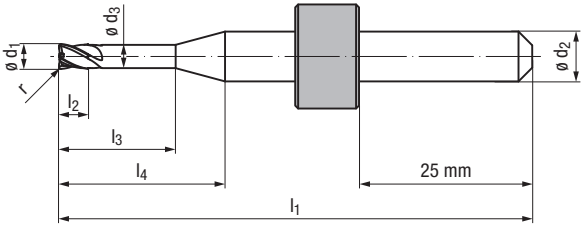
- Long version for roughing and finishing in titanium and cobalt-chrome.
- TIALN coating for best possible wear protection and long tool life.

Cobalt-chrome
Titanium


3-5°


2189AR

2



Machining data: P. 20

$\varnothing d_1$	$r_1$	$l_2$	$l_3$	$l_1$	$\varnothing d_3$	$l_4$	$\varnothing d_2$	Flutes	T-number	Article number	
<b>f8</b>	<b><math>\pm 0.01</math></b>						<b>h6</b>				
3	0.3	8	14	57	2.9	20	6	4	T5218	-	2189AR.300614

3

### Carbide torus end mills 2178TR

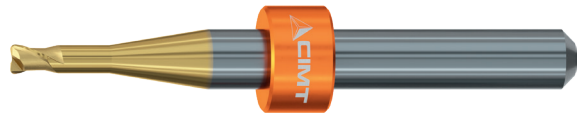
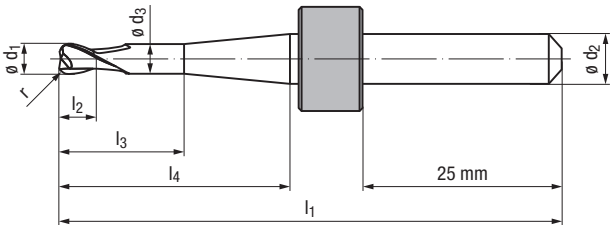
- For roughing, pre-finishing and machining residual material in cobalt-chrome and titanium.
- TIN / TIALN coating for longer tool life.
- High accuracy radius tolerance of  $\pm 5\mu\text{m}$  for precise machining results and maximum repeat accuracy.

Cobalt-chrome
Titanium


1-3°


2178TR

4



Machining data: P. 20

5

$\varnothing d_1$	$r_1$	$l_2$	$l_3$	$l_1$	$\varnothing d_3$	$l_4$	$\varnothing d_2$	Flutes	T-number	Article number	
<b><math>\pm 0.01</math></b>	<b><math>\pm 0.005</math></b>						<b>h6</b>				
1.5	0.1	2.5	8	57	1.4	20	6	2	T4308	-	2178TR.150608

## Carbide torus end mills 2185TR

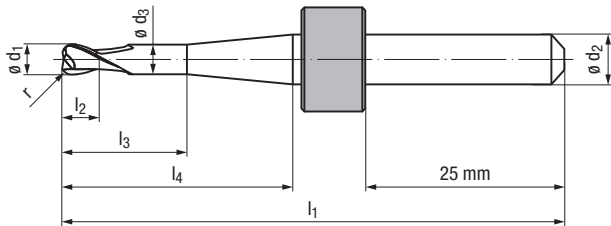
- For roughing, pre-finishing and machining residual material in cobalt-chrome and titanium.
- TIN /TIALN coating for longer tool life.
- High accuracy radius tolerance of  $\pm 5\mu\text{m}$  for precise machining results and maximum repeat accuracy.

Cobalt-chrome
Titanium


1-3°


2185TR

1



Machining data: P. 20

2

$\phi d_1$	$r_1$	$l_2$	$l_3$	$l_1$	$\phi d_3$	$l_4$	$\phi d_2$	Flutes	T-number	Article number
$\pm 0.01$	$\pm 0.005$						<b>h6</b>			
1.5	0.1	2.5	16	57	1.4	20	6	2	T4360 T5360	2185TR.150616

3

## Carbide torus end mills 2188TR

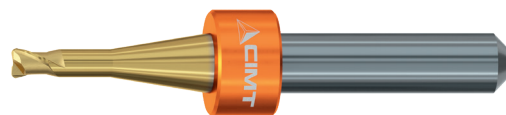
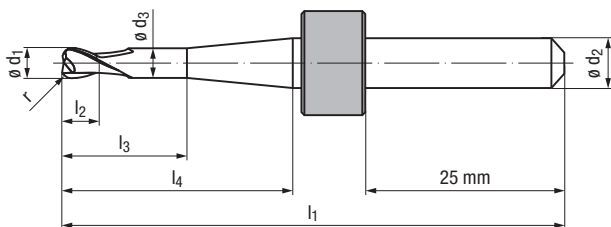
- For roughing, pre-finishing, finishing and machining residual material in cobalt-chrome and titanium.
- TIN /TIALN coating for longer tool life.
- High accuracy radius tolerance of  $\pm 5\mu\text{m}$  for precise machining results and maximum repeat accuracy.

Cobalt-chrome
Titanium


1-3°


2188TR

4



Machining data: P. 20

$\phi d_1$	$r_1$	$l_2$	$l_3$	$l_1$	$\phi d_3$	$l_4$	$\phi d_2$	Flutes	T-number	Article number
$\pm 0.01$	$\pm 0.005$						<b>h6</b>			
1	0.1	2	8	57	0.95	20	6	2	T5222 -	2188TR.100608

5

## Carbide twist drills 7456LR

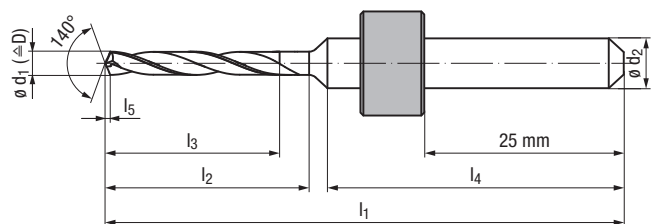
- 7 x D for drilling applications in titanium or cobalt-chrome.
- ALCR coating for high wear protection and very long tool life.
- Self-centering for highest precision.

Cobalt-chrome

Titanium



7456LR



Machining data: P. 21

$\phi d_1$	$l_1$	$l_2$	$l_3$	$l_4$	$l_5$	$\phi d_2$	Flutes	T-number		Article number
<b>h5</b>	<b>+2</b>					<b>h6</b>				
1.5	57	13.2	10.5	41.05	0.27	6	2	T4115	T5115	7456LR.0015
2	57	16.7	14	37.8	0.36	6	2	T4120	T5120	7456LR.002



## Carbide ball-nose end mills 2191\_R

- For roughing, finishing and machining residual material in PMMA / PEEK and wax.
- Uncoated version.

PMMA / PEEK

Wax

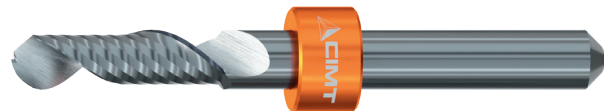
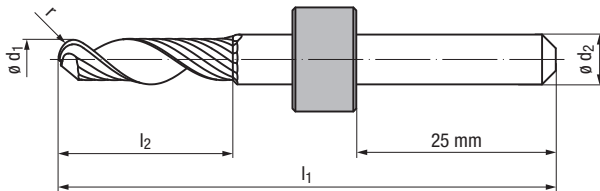


1-3°



2191\_R

1



Machining data: P. 21

2

$\varnothing d_1$	$r_1$	$l_2$	$l_1$	$\varnothing d_2$	Flutes	T-number	Article number
$\pm 0.04$	$\pm 0.02$		+2	h6			
6	3	20	60	6	1	T1061 -	2191_R.600620

3

## Carbide ball-nose end mills 2171\_R

- For roughing, finishing and machining residual material in PMMA / PEEK and wax.
- Highly accurate radius tolerance for precise machining results and highest repeat accuracy.

PMMA / PEEK

Wax

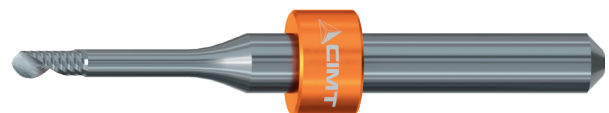
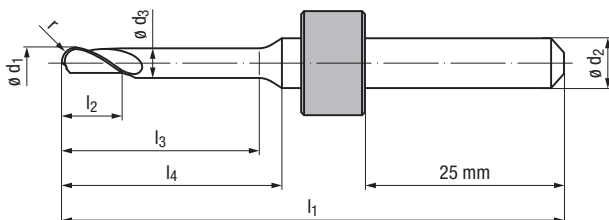


1-3°



2171\_R

4



Machining data: P. 21

5

$\varnothing d_1$	$r_1$	$l_2$	$l_3$	$l_1$	$\varnothing d_3$	$l_4$	$\varnothing d_2$	Flutes	T-number	Article number
$\pm 0.04$	$\pm 0.02$						h6			
0.6	0.3	0.8	6	60	0.5	15	6	1	T1040 -	2171_R.060606
1	0.5	2	18	60	0.92	25.5	6	1	T1010 -	2171_R.100618
2	1	4	18	60	1.8	25	6	1	T1020 -	2171_R.200618
3	1.5	6	18	60	2.8	24	6	1	T1030 -	2171_R.300618

### Carbide ball-nose end mills 2180ER

1

- For roughing, finishing and machining residual material in zirconium oxide.
- Smooth diamond coating for very long tool life.
- High accuracy radius tolerance of  $\pm 5\mu\text{m}$  for precise machining results and maximum repeat accuracy.

Zirkonium oxide

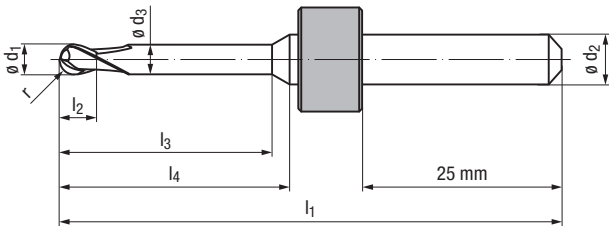



1-3°



2180ER

2



Machining data: P. 22

$\phi d_1$	$r_1$	$l_2$	$l_3$	$l_1$	$\phi d_3$	$l_4$	$\phi d_2$	Flutes	T-number	Article number	
$\pm 0.01$	$\pm 0.005$						<b>h6</b>				
0.6	0.3	0.6	10	57	0.55	21	6	2	T3236	-	2180ER.060610
1	0.5	0.85	16	57	0.95	21	6	2	T3231	-	2180ER.100616
2	1	1.7	20	57	1.8	24	6	2	T3232	-	2180ER.200620
2.5	1.25	2.125	20	57	2.3	24	6	2	T3225	-	2180ER.250620

3

### Carbide ball-nose end mills 2183LR

- For finishing and machining residual material of the fissures in zirconium oxide.
- ALCR coating for high wear protection and very long tool life.
- High accuracy radius tolerance of  $\pm 5\mu\text{m}$  for precise machining results and maximum repeat accuracy.

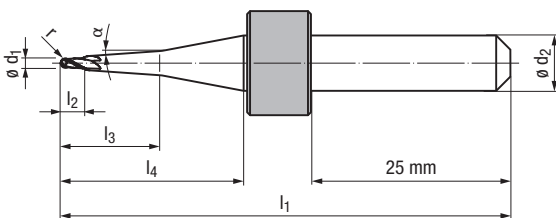
Zirkonium oxide





2183LR

4

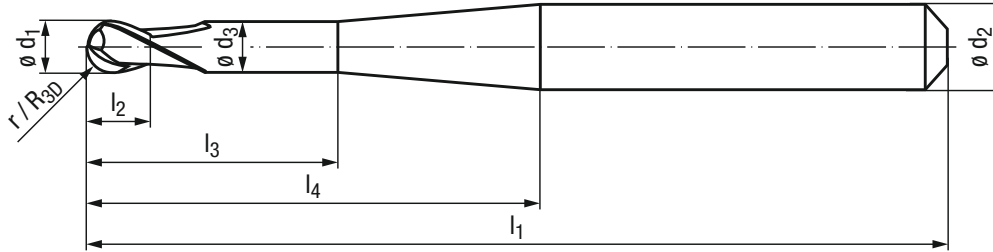


Machining data: P. 22

5

$\phi d_1$	$r_1$	$l_2$	$l_3$	$l_1$	$l_4$	$\phi d_2$	Neck angle $\alpha$	Flutes	T-number	Article number	
$\pm 0.01$	$\pm 0.005$					<b>h5</b>					
0.3	0.15	0.5	10	57	20	6	4°	4	T3233	-	2183LR.030610

## Dimensions abbreviations



$\varnothing d_1$	Cutting diameter
$\varnothing d_2$	Shank diameter
$\varnothing d_3$	Neck diameter
r	Tool radius (corner radius)
$R_{3D}$	Radius to be programmed in CAM
$l_1$	Overall length
$l_2$	Cutting length
$l_3$	Clear neck length
$l_4$	Length of shank connection
Z	Number of flutes

## Machining and application data

### Cobalt-chrome

Cutting diameter	Tool radius	Number of flutes	Roughing	Machining of residual material	Pre-finishing	Finishing	Equidistant infeed	Axial depth of cut	Radial depth of cut	Speed / rpm	Feed speed	Machining allowance	Article number	T-number
$\varnothing d_1$	r	Z	Type of machining				3D Step [mm]	$a_p$ [mm]	$a_e$ [mm]	n [min <sup>-1</sup> ]	$V_f$ [mm/min]	[mm]		

### Carbide ball-nose end mills

0.5	0.25	2	-	-	-	■	0.02	-	-	57,300	576	0	2179AR.050603	T4205	-
0.3	0.15	2	-	■	-	■	0.01	-	-	50,000	250	0	2184LR.030610	T4203	T5203
3	1.5	4	■	-	-	-	-	0.15	1	12,500	2,500	0.05	2182AR.300610	T1016	-
			-	-	-	■	0.12	-	-	14,000	2,800	0			
2	1	4	■	■	■	-	-	0.1	0.6	14,500	2,000	0.05	2182AR.200608	T1011	-
			-	-	-	■	0.1	-	-	19,000	2,000	0			
3	1.5	4	■	-	-	-	-	0.15	1	12,500	2,500	0.05	2177AR.300614	T4218	-
			-	-	-	■	0.12	-	-	14,000	2,800	0			
3	1.5	4	■	-	-	-	-	0.15	1	12,500	2,500	0.05	2177AR.300610	T4216	-
			-	-	-	■	0.12	-	-	14,000	2,800	0			
2	1	4	■	■	■	-	-	0.1	0.6	14,500	2,000	0.05	2177AR.200608	T4211	-
			-	-	-	■	0.1	-	-	19,000	2,000	0			
2	1	2	■	■	■	-	-	0.1	0.6	14,500	1,500	0.05	2176AR.200612	T4213	-
			-	-	-	■	0.1	-	-	19,000	2,000	0			
1.5	0.75	2	■	■	■	-	-	0.05	0.45	19,000	1,500	0.05	2176AR.150610	T4214	-
			-	-	-	■	0.07	-	-	25,000	2,000	0			
1.5	0.75	2	■	■	■	-	-	0.05	0.45	19,000	1,500	0.05	2176AR.150608	T4212	T4219
			-	-	-	■	0.07	-	-	25,000	2,000	0			
1	0.5	2	-	■	■	-	-	0.02	0.1	28,500	1,150	0	2176AR.100610	T4215	-
			-	-	-	■	0.04	-	-	38,000	1,500	0			
1	0.5	2	-	■	■	-	-	0.02	0.1	28,500	1,150	0	2176AR.100608	T4220	-
			-	-	-	■	0.04	-	-	38,000	1,500	0			
0.6	0.3	2	-	-	■	■	0.02	-	-	63,500	635	0	2176AR.060603	T4217	T5217

### Carbide torus end mills

1	0.25	2	-	■	-	■	-	0.05	0.4	32,000	650	0	2175AR.100604	T4325	-
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## Machining and application data

Cobalt-chrome

Titanium

Cutting diameter $\varnothing d_1$	Tool radius $r$	Number of flutes $Z$	Machining of residual material				Equidistant infeed 3D Step [mm]	Axial depth of cut $a_p$ [mm]	Radial depth of cut $a_e$ [mm]	Speed / rpm $n$ [min <sup>-1</sup> ]	Feed speed $V_f$ [mm/min]	Machining allowance [mm]	Article number	T-number
			Roughing	Pre-finishing	Finishing	Type of machining								

### Carbide end mills

2		2	-	■	-	■	-	0.06	0.6	16,000	850	0	2186LR.200616	T4040	T5040
2		2	-	■	-	■	-	0.06	0.6	16,000	850	0	2172LR.200610	T4020	T5020
1.5		2	-	■	-	■	-	0.045	0.45	21,000	760	0	2172LR.150608	T4008	T5008
1		2	-	■	-	■	-	0.03	0.3	32,000	620	0	2172LR.100605	T4005	T5005
0.5		2	-	■	-	■	-	0.015	0.15	64,000	450	0	2172LR.050603	T4003	T5003
0.5		2	-	■	-	■	-	0.015	0.15	64,000	450	0	2172LR.050605	T4004	T5004

### Carbide ball-nose end mills

2	1	2	■	■	■	-	-	0.1	0.6	11,000	1,050	0.05	2174TR.200612	T5213	-
			-	-	-	■	-	0.1	-	-	14,500	1,150			
1.5	0.75	2	■	■	■	-	-	0.05	0.45	15,000	1,050	0.05	2174TR.150608	T5212	T5219
			-	-	-	■	-	0.07	-	-	19,000	1,150			
1	0.5	2	-	■	■	-	-	0.02	0.1	22,000	900	0	2174TR.100608	T5215	-
			-	-	-	■	-	0.04	-	-	28,500	1,050			

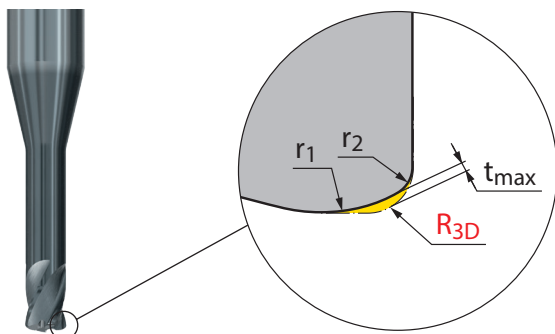
### Carbide torus end mills

3	0.3	4	■	-	-	-	-	4.5	0.6	7,275	2,000	0.05	2189AR.300614	T5218	-
1.5	0.1	2	-	■	■	■	-	0.05	0.6	19,000	760	0	2178TR.150608	T4308	-
1.5	0.1	2	-	■	■	■	-	0.05	0.6	19,000	760	0	2185TR.150616	T4360	T5360
1	0.1	2	-	■	-	-	-	0.03	0.4	28,000	570	0	2188TR.100608	T5222	-

### Carbide end mills "Duplex"

3	$R_{30}$ 0.4	4	■	-	-	-	-	0.2	1.3	11,500	3,100	0.05	2181AR.300614	T4035	T5035
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## "Duplex"-Geometry



$t_{max}$	Maximum residual material due to radius deviation from $R_{30}$
$R_{30}$	Radius to be programmed in CAM
$r_1$	Face radius
$r_2$	Tangential radius between face radius and circumferential cutting edge

## Machining and application data

Cutting diameter	Max. drilling depth	Cutting speed	Speed / rpm	Feed per revolution	Feed speed	Article number	T-number
$\varnothing d_1$	[mm]	$v_c$ [m/min]	$n$ [min <sup>-1</sup> ]	$f$ [mm/U]	$V_f$ [mm/min]		

### Carbide twist drills

2	14	25	3,979	0.096	382	7456LR.002	T4120	T5120
1.5	10.5	25	5,305	0.072	382	7456LR.0015	T4115	T5115

### Titanium

Cutting diameter	Tool radius	Number of flutes	Roughing	Machining of residual material	Pre-finishing	Finishing	Equidistant infeed	Axial depth of cut	Radial depth of cut	Speed / rpm	Feed speed	Machining allowance	Article number	T-number
$\varnothing d_1$	$r$	$Z$	Type of machining				3D Step [mm]	$a_p$ [mm]	$a_e$ [mm]	$n$ [min <sup>-1</sup> ]	$V_f$ [mm/min]	[mm]		

### Carbide ball-nose end mills

3	1.5	2	■	-	-	-	-	0.15	1	9,000	1,150	0.05	2173TR.300610	T5216	-
			-	-	-	■	0.12	-	-	10,500	1,300	0			

### Carbide end mills

3	0.5	4	■	-	-	-	-	0.2	1.3	16,000	1,050	0.05	2187TR.300614	T5299	-
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### Carbide ball-nose end mills

2	1	2	■	■	■	-	-	0.1	0.6	11,000	1,050	0.05	2173TR.200608	T5211	-
			-	-	-	■	0.1	-	-	14,500	1,150	0			

### PMMA / PEEK

### Wax

Cutting diameter	Tool radius	Number of flutes	Roughing	Machining of residual material	Pre-finishing	Finishing	Equidistant infeed	Axial depth of cut	Radial depth of cut	Speed / rpm	Feed speed	Machining allowance	Article number	T-number
$\varnothing d_1$	$r$	$Z$	Type of machining				3D Step [mm]	$a_p$ [mm]	$a_e$ [mm]	$n$ [min <sup>-1</sup> ]	$V_f$ [mm/min]	[mm]		

### Carbide ball-nose end mills

6	3	1	■	-	-	-	-	0.6	3	12,000	10,000	0.1	2191_R.600620	T1061	-
3	1.5	1	■	-	-	-	-	0.3	1.5	26,000	1,200	0.1	2171_R.300618	T1030	-
2	1	1	■	-	-	-	-	0.25	1	38,000	1,050	0.1	2171_R.200618	T1020	-
			-	-	-	■	0.15	-	-	38,000	1,050	0			
1	0.5	1	-	■	-	■	0.11	-	-	57,000	900	0	2171_R.100618	T1010	-
0.6	0.3	1	-	■	-	■	0.06	-	-	70,000	700	0	2171_R.060606	T1040	-

## Machining and application data

### Zirkonium oxide

Cutting diameter $\varnothing d_1$	Tool radius r	Number of flutes Z	Roughing Machining of residual material Pre-finishing Finishing Type of machining	Equidistant infeed	Axial depth of cut	Radial depth of cut	Speed / rpm	Feed speed	Machining allowance [mm]	Article number	T-number
				3D Step [mm]	$a_p$ [mm]	$a_e$ [mm]	n [min <sup>-1</sup> ]	$V_f$ [mm/min]			

### Carbide ball-nose end mills

2.5	1.5	2	■ - - -	-	0.3	1.25	28,000	1,200	0.1	2180ER.250620	T3225	-
			- - - ■	0.15	-	-	28,000	1,200	0			
2	1	2	■ - - -	-	0.3	1	35,000	1,200	0.1	2180ER.200620	T3232	-
			- - - ■	0.15	-	-	35,000	1,200	0			
1	0.5	2	- ■ - -	-	0.1	0.2	38,000	1,050	0	2180ER.100616	T3231	-
			- - - ■	0.1	-	-	38,000	1,050	0			
0.60	0.3	2	- ■ - ■	0.05	-	-	63,500	630	0	2180ER.060610	T3236	-
0.3	0.15	2	- ■ - ■	0.01	-	-	50,000	250	0	2183LR.030610	T3233	-



## Production tolerances

Ball-nose end mills		Torus end mills		End mills	
Radius tolerance	1 flute $r \pm 0.02 \text{ mm}$ 2-4 flutes $r \pm 0.005 \text{ mm}$	Radius tolerance	$r \pm 0.005 \text{ mm}$	Diameter tolerance	$d_1 \leq 0.5 \text{ mm}$ : - 0.025 mm
Diameter tolerance	1 flute $d_1 \pm 0.04 \text{ mm}$ 2-4 flutes $d_1 \pm 0.01 \text{ mm}$	Diameter tolerance	$d_1 \pm 0.01 \text{ mm}$		$d_1 > 0.5 \text{ mm}$ : - 0.040 mm

## Geometry designs

Ball-nose end mills		Torus end mills		End mills
without helix angle	with helix angle	without helix angle	with helix angle	with helix angle

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