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# Grade specification

## Composition and physical data

	ISO Group	Structure	Grain size $\mu\text{m}$	Co $\pm 0,5\%$	Hardness HV30	Hardness HRA	Density $\text{g}/\text{cm}^3$	TRS $\text{N}/\text{mm}^2$	Fracture toughness $K_{IC}$ ( $\text{MPam}^{1/2}$ )
F06	K05-K10	ultrafine	$\leq 0,6$	7,0	1800	93,2	14,60	3600	9,5
F06D	K05-K10	ultrafine	$\leq 0,6$	6,0	1840	93,4	14,80	3500	9,0
F10	K20-K30	submicron	0,7	10,0	1580	92,0	14,35	3800	10,7
F10S	K20-K40	submicron	0,7	10,0	1510	91,3	14,40	4000	10,9
U12	K40	ultrafine	$\leq 0,6$	12,0	1640	92,2	14,15	3800	9,8
U12S	K40	ultrafine	$\leq 0,6$	11,0	1660	92,3	14,15	3800	10,0
U08	K01-K05	ultrafine	$\leq 0,6$	8,0	2010	94,4	14,50	3800	8,6

## Grade recommendation & Application areas

### Application area

F06	<b>K05 / K10 grade for HSC application drilling, milling and reaming</b> Steel, cast iron, non-ferrous metal, graphite and plastics Hard machining until 60 HRC
F06D	<b>K05 / K10- standard grade for HSC application drilling, milling, reaming</b> Steel, cast iron, non-ferrous metal, graphite, plastics, fiber-reinforced too Hard machining until 60 HRC Especially suitable for diamond coating
F10	<b>K20/K30 - standard multiple application grade for HPC application drilling and milling</b> Steel, cast iron, stainless steel, special alloys Main grade for central and helical coolant bores ( twice /triple, $30^\circ / 40^\circ$ )
F10S	<b>K20/K40 - grade for HPC application drilling and milling with very good toughness</b> Steel, cast iron, stainless steel and special alloy (titanium / nickel) High feeds, also suitable for unstable machine conditions
U12	<b>K40- standard grade for HPC application especially milling</b> Low and high-alloyed steel, cast iron, cast steel, stainless steel and special alloys Hard machining until 42 HRC
U12S	<b>K40- grade for HPC application especailly milling</b> High-alloyed steel, cast iron, cast steel, stainless steel, Ti / Ni / Co- base alloys Hard machining until 50 HRC
U08	<b>K01 / K05- grade for HSC application drilling and milling with very high wear resistance</b> Especially suitable for glass / carbon fiber- reinforced plastics, graphite, Al- alloys $> 6\%$ Si Hard machining $> 60$ HRC and analogous reaming applications

# Classification WC-crystallites after sintering

## Grain sizes and definitions

Grain size	Definition	Grain size	Definition
< 0,2 µm	Nano	1,3 - 2,5 µm	Medium
0,2 - 0,5 µm	Ultrafine	2,5 - 6,0 µm	Coarse
0,5 - 0,8 µm	Submicron	> 6,0 µm	Extracoarse
0,8 - 1,3 µm	Fine		

## Work Material - Grade recommendation

ISO Norm	Work Material Group	Material Selection	F06	F06D	F10	F10S	U12	U12S	U08
<b>P</b>	Steel	Non Alloy Steel	●	●	●	●	○	○	
		Low / Medium Alloy Steel	●	●	●	●	○	○	
		High Alloy Steel	○	○	●	○	●	●	
		Tool Steel	○	○	●	●	●	●	
		Cast Steel	○	○	●	●	○	○	
<b>M</b>	Stainless Steel	Austenitic, Ferritic, Martensitic			○	●	●	●	
		Cast Steel			○	○	●	●	
		Duplex Steel			○	○	○	●	
<b>K</b>	Cast iron	Gray Cast Iron	●	●	●	●	○	○	
		Malleable Cast Iron	●	●	●	●	○	○	
		Ductil Graphite Iron	●	●	●	●	○	○	
		Nodular Graphite Iron	○	○	●	●	○	○	
<b>N</b>	Nonferrous Metals	Aluminium < 6% Si	●	●	○	○	○	○	
		Copper	●	●	○	○	○	○	
		Brass	●	●	○	○	○	○	
		Plastics, fiber-reinforced	○	●					●
		Composite, Aluminium > 6% Si	○	●					●
<b>S</b>	Super Alloy	Ni- Base Alloy			○	○	●	●	
		Co-Base Alloy			○	○	●	●	
		Titanium and Ti-Base Alloy			○	●	○	●	
<b>H</b>	Hard Materials	Steel 45-65 HRC	○	●	○	○	○	●	●
		Chilled Cast Iron 400-600 HB	○	○	○	○	○	●	
		Manganese Steel	○	○	○	○	●	●	

● optimal ○ suitable

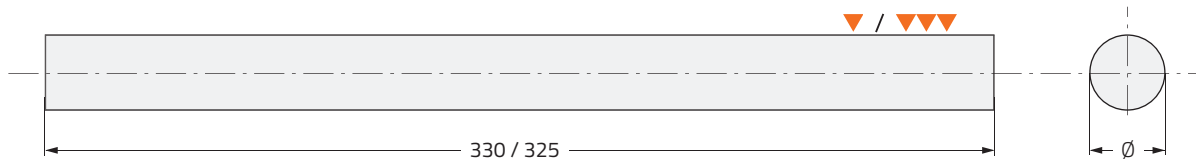
**i** Grade recommendation is a preselection only. Performance of cutting is dependent on cutting edge geometry, coating and specific machine operations additionally.

## Solid rods / 330 and 325 mm

Article group **0110** / Sintered plus grinding stock

Article group **0111** / Ground h6

<b>F06</b>	<b>K10</b>	<b>F06D</b>	<b>K10</b>	<b>F10</b>	<b>K30</b>	<b>U12</b>	<b>K40</b>
Cobalt	7%	Cobalt	6%	Cobalt	10%	Cobalt	12%
Ultrafine		Ultrafine		Submicron		Ultrafine	
HV30	1800	HV30	1840	HV30	1580	HV30	1640
3600	N/mm <sup>2</sup>	3500	N/mm <sup>2</sup>	3800	N/mm <sup>2</sup>	3800	N/mm <sup>2</sup>
325 mm		325 mm		330 mm		330 mm	



▽	▽▽▽	▽	▽▽▽
Ø mm (sintered)	Ø mm (ground)	Ø mm (sintered)	Ø mm (ground)
Ø 2,2 +0,2	Ø 2,0 h6	Ø 16,2 +0,4	Ø 16,0 h6
Ø 2,7 +0,2	Ø 2,5 h6	Ø 16,7 +0,4	Ø 16,5 h6
Ø 3,2 +0,2	Ø 3,0 h6	Ø 17,2 +0,4	Ø 17,0 h6
Ø 3,7 +0,2	Ø 3,5 h6	Ø 17,7 +0,4	Ø 17,5 h6
Ø 4,2 +0,2	Ø 4,0 h6	Ø 18,2 +0,4	Ø 18,0 h6
Ø 4,7 +0,2	Ø 4,5 h6	Ø 18,7 +0,4	Ø 18,5 h6
Ø 5,2 +0,2	Ø 5,0 h6	Ø 19,2 +0,4	Ø 19,0 h6
Ø 5,7 +0,2	Ø 5,5 h6	Ø 19,7 +0,4	Ø 19,5 h6
Ø 6,2 +0,2	Ø 6,0 h6	Ø 20,2 +0,5	Ø 20,0 h6
Ø 6,7 +0,2	Ø 6,5 h6	Ø 20,7 +0,5	Ø 20,5 h6
Ø 7,2 +0,2	Ø 7,0 h6	Ø 21,2 +0,5	Ø 21,0 h6
Ø 7,7 +0,2	Ø 7,5 h6	Ø 21,7 +0,5	Ø 21,5 h6
Ø 8,2 +0,3	Ø 8,0 h6	Ø 22,2 +0,5	Ø 22,0 h6
Ø 8,7 +0,3	Ø 8,5 h6	Ø 22,7 +0,5	Ø 22,5 h6
Ø 9,2 +0,3	Ø 9,0 h6	Ø 23,2 +0,5	Ø 23,0 h6
Ø 9,7 +0,3	Ø 9,5 h6	Ø 23,7 +0,5	Ø 23,5 h6
Ø 10,2 +0,3	Ø 10,0 h6	Ø 24,2 +0,5	Ø 24,0 h6
Ø 10,7 +0,3	Ø 10,5 h6	Ø 25,2 +0,5	Ø 25,0 h6
Ø 11,2 +0,3	Ø 11,0 h6	Ø 25,7 +0,5	Ø 25,5 h6
Ø 11,7 +0,3	Ø 11,5 h6	Ø 26,2 +0,5	Ø 26,0 h6
Ø 12,2 +0,3	Ø 12,0 h6	Ø 27,2 +0,5	Ø 27,0 h6
Ø 12,7 +0,3	Ø 12,5 h6	Ø 28,2 +0,5	Ø 28,0 h6
Ø 13,2 +0,3	Ø 13,0 h6	Ø 29,2 +0,5	Ø 29,0 h6
Ø 13,7 +0,3	Ø 13,5 h6	Ø 30,2 +0,5	Ø 30,0 h6
Ø 14,2 +0,3	Ø 14,0 h6	Ø 31,2 +0,5	Ø 31,0 h6
Ø 14,7 +0,3	Ø 14,5 h6	Ø 32,2 +0,5	Ø 32,0 h6
Ø 15,2 +0,3	Ø 15,0 h6		
Ø 15,7 +0,3	Ø 15,5 h6		

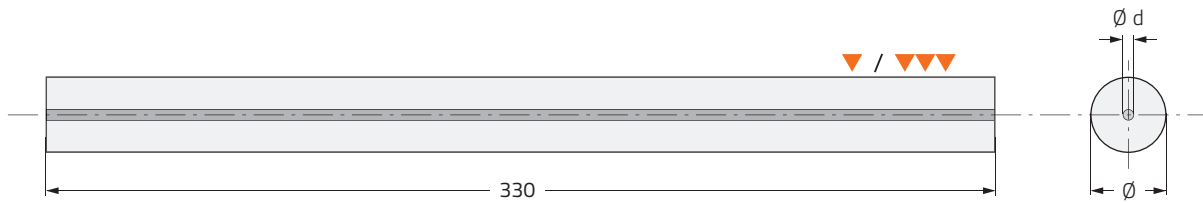
**i** Delivery from stock; Subject to prior sale!  
Other sizes and grades on request.

## Coolant hole rods / Single central hole / 330 mm

Article group **0120** / Sintered plus grinding stock

Article group **0121** / Ground h6

**F10** **K30**  
 Cobalt 10%  
 Submicron  
 HV30 1580  
 3800 N/mm<sup>2</sup>



▽ Ø mm (sintered)	▽▽▽ Ø mm (ground)	Ø d mm
Ø 4,2 +0,3	Ø 4,0 h6	1,0 ± 0,10
Ø 6,2 +0,3	Ø 6,0 h6	1,0 ± 0,10
Ø 8,2 +0,3	Ø 8,0 h6	1,5 ± 0,15
Ø 10,2 +0,3	Ø 10,0 h6	2,0 ± 0,25
Ø 12,2 +0,3	Ø 12,0 h6	2,5 ± 0,30
Ø 14,2 +0,3	Ø 14,0 h6	2,8 ± 0,30
Ø 16,2 +0,3	Ø 16,0 h6	4,0 ± 0,30
Ø 18,2 +0,3	Ø 18,0 h6	3,0 ± 0,30
Ø 20,2 +0,3	Ø 20,0 h6	4,0 ± 0,30
Ø 25,2 +0,3	Ø 25,0 h6	4,0 ± 0,30

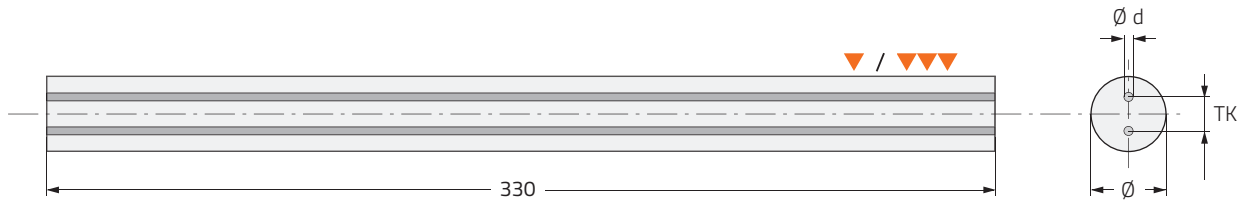
**i** Delivery from stock; Subject to prior sale!  
 Other sizes and grades on request.

## Coolant hole rods / Double parallel holes / 330 mm

Article group **0130** / Sintered plus grinding stock

Article group **0131** / Ground h6

<b>F06</b>	<b>K10</b>	<b>F06D</b>	<b>K10</b>
Cobalt	7%	Cobalt	6%
Ultrafine		Ultrafine	
HV30	1800	HV30	1840
3600 N/mm <sup>2</sup>		3500 N/mm <sup>2</sup>	



▽			▽ / ▽		
Ø mm (sintered)	TK mm	Ø d mm	Ø mm (ground)	TK mm	Ø d mm
Ø 6,3 +0,3	1,5 ±0,20	0,8 ±0,15	Ø 6,0 h6	1,5 ±0,20	0,8 ±0,10
Ø 6,3 +0,3	2,2 ±0,20	1,0 ±0,15	Ø 6,0 h6	2,2 ±0,30	1,0 ±0,10
Ø 8,3 +0,3	1,5 ±0,20	0,8 ±0,15	Ø 8,0 h6	1,5 ±0,20	0,8 ±0,10
Ø 8,3 +0,3	2,2 ±0,20	1,0 ±0,15	Ø 8,0 h6	2,2 ±0,30	1,0 ±0,10
Ø 8,3 +0,3	3,5 ±0,20	1,2 ±0,15	Ø 8,0 h6	3,5 ±0,30	1,2 ±0,15
Ø 10,3 +0,3	2,6 ±0,30	1,0 ±0,15	Ø 10,0 h6	2,6 ±0,30	1,0 ±0,15
Ø 10,3 +0,3	3,5 ±0,30	1,2 ±0,15	Ø 10,0 h6	3,5 ±0,30	1,2 ±0,15
Ø 10,3 +0,3	4,3 ±0,30	1,6 ±0,15	Ø 10,0 h6	4,3 ±0,40	1,6 ±0,15
Ø 12,3 +0,3	3,5 ±0,30	1,2 ±0,15	Ø 12,0 h6	3,5 ±0,30	1,2 ±0,15
Ø 12,3 +0,3	5,0 ±0,40	1,8 ±0,15	Ø 12,0 h6	5,0 ±0,40	1,8 ±0,15
Ø 14,3 +0,3	5,0 ±0,40	2,0 ±0,20	Ø 14,0 h6	5,0 ±0,50	2,0 ±0,25
Ø 16,3 +0,3	5,0 ±0,40	2,0 ±0,20	Ø 16,0 h6	5,0 ±0,50	2,0 ±0,25
Ø 18,3 +0,3	6,0 ±0,40	2,0 ±0,25	Ø 18,0 h6	6,0 ±0,50	2,0 ±0,25
Ø 18,3 +0,3	9,15 ±0,40	2,0 ±0,25	Ø 20,0 h6	6,0 ±0,50	2,0 ±0,25
Ø 20,3 +0,3	6,0 ±0,50	2,0 ±0,25	Ø 20,0 h6	9,9 ±0,50	1,75 ±0,30
Ø 20,3 +0,3	9,9 ±0,50	2,0 ±0,25	Ø 22,0 h6	6,0 ±0,50	2,0 ±0,25
Ø 20,3 +0,3	10,0 ±0,50	2,5 ±0,25	Ø 24,0 h6	7,5 ±0,50	2,0 ±0,25
Ø 25,3 +0,3	7,5 ±0,50	2,0 ±0,25	Ø 25,0 h6	7,5 ±0,50	2,0 ±0,25
Ø 25,3 +0,3	10,5 ±0,50	2,8 ±0,25	Ø 26,0 h6	10,5 ±0,50	2,8 ±0,30

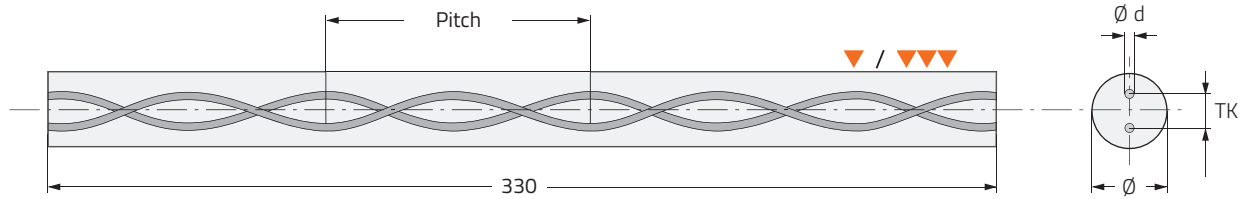
**i** Delivery from stock; Subject to prior sale!  
Other sizes and grades on request.

## Coolant hole rods / Double helical 30° / 330 mm

Article group **0140** / Sintered plus grinding stock

Article group **0141** / Ground h6

**F10** **H30**  
Cobalt 10%  
Submicron  
HV30 1580  
3800 N/mm<sup>2</sup>



▽ Ø mm (sintered)	▽▽▽ Ø mm (ground)	TK mm	Ø d mm	Pitch mm
Ø 3,3 +0,3	Ø 3,0 h6	1,6 ±0,15	0,4 ±0,10	16,32 -0,64/+0,21
Ø 4,3 +0,3	Ø 4,0 h6	1,6 ±0,15	0,4 ±0,15	21,77 -0,85/+0,29
Ø 5,3 +0,3	Ø 5,0 h6	2,4 ±0,20	0,7 ±0,15	27,21 -1,06/+0,37
Ø 6,3 +0,3	Ø 6,0 h6	1,8 ±0,20	0,5 ±0,15	32,65 -1,28/+0,43
Ø 6,3 +0,3	Ø 6,0 h6	2,4 ±0,20	0,7 ±0,15	32,65 -1,28/+0,43
Ø 8,3 +0,3	Ø 8,0 h6	2,8 ±0,20	0,6 ±0,15	43,53 -1,70/+0,57
Ø 8,3 +0,3	Ø 8,0 h6	3,8 ±0,20	1,0 ±0,15	43,53 -1,70/+0,57
Ø 10,3 +0,3	Ø 10,0 h6	4,5 ±0,30	1,4 ±0,15	54,41 -2,13/+0,71
Ø 12,3 +0,3	Ø 12,0 h6	5,85 ±0,40	1,4 ±0,15	65,30 -2,55/+0,85
Ø 14,3 +0,3	Ø 14,0 h6	6,7 ±0,40	1,75 ±0,20	76,18 -2,98/+1,00
Ø 16,3 +0,3	Ø 16,0 h6	7,9 ±0,40	1,75 ±0,25	87,06 -3,40/+1,14
Ø 18,3 +0,3	Ø 18,0 h6	9,15 ±0,40	2,0 ±0,25	97,95 -3,83/+1,28
Ø 20,3 +0,3	Ø 20,0 h6	9,9 ±0,50	2,0 ±0,25	108,83 -4,25/+1,42
Ø 25,3 +0,3	Ø 25,0 h6	12,8 ±0,50	2,0 ±0,25	136,03 -5,32/+1,78

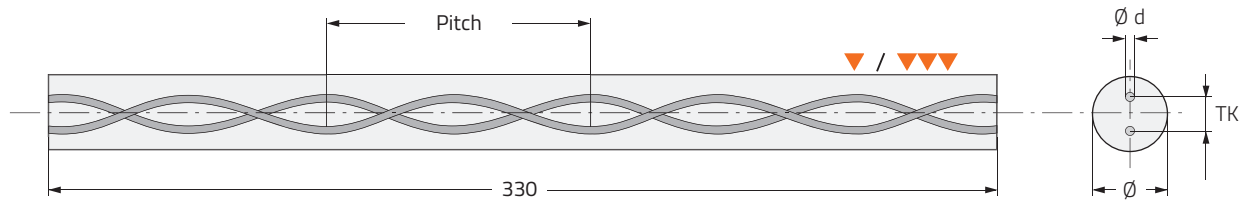
**i** Delivery from stock; Subject to prior sale!  
Other sizes and grades on request.

## Coolant hole rods / Double helical 40° / 330 mm

Article group **0160** / Sintered plus grinding stock

Article group **0161** / Ground h6

**F10** K30  
Cobalt 10%  
Submicron  
HV30 1580  
3800 N/mm<sup>2</sup>



▽ Ø mm (sintered)	▽▽▽ Ø mm (ground)	TK mm	Ø d mm	Pitch mm
Ø 6,3 +0,3	Ø 6,0 h6	2,0 ±0,20	0,5 ±0,15	22,46 -0,78/+0,26
Ø 8,3 +0,3	Ø 8,0 h6	2,4 ±0,20	0,65 ±0,15	29,95 -1,04/+0,34
Ø 10,3 +0,3	Ø 10,0 h6	3,2 ±0,30	1,0 ±0,15	37,44 -1,30/+0,43
Ø 12,3 +0,3	Ø 12,0 h6	3,8 ±0,40	1,2 ±0,15	44,92 -1,56/+0,51
Ø 14,3 +0,3	Ø 14,0 h6	4,3 ±0,40	1,2 ±0,20	52,41 -1,82/+0,60
Ø 16,3 +0,3	Ø 16,0 h6	5,1 ±0,40	1,3 ±0,20	59,90 -2,08/+0,69
Ø 18,3 +0,3	Ø 18,0 h6	5,9 ±0,40	1,4 ±0,25	67,39 -2,34/+0,77
Ø 20,3 +0,3	Ø 20,0 h6	6,6 ±0,50	1,5 ±0,25	74,88 -2,60/+0,86
Ø 25,3 +0,3	Ø 25,0 h6	7,6 ±0,50	1,75 ±0,25	93,60 -3,25/+1,07

**i** Delivery from stock; Subject to prior sale!  
Other sizes and grades on request.

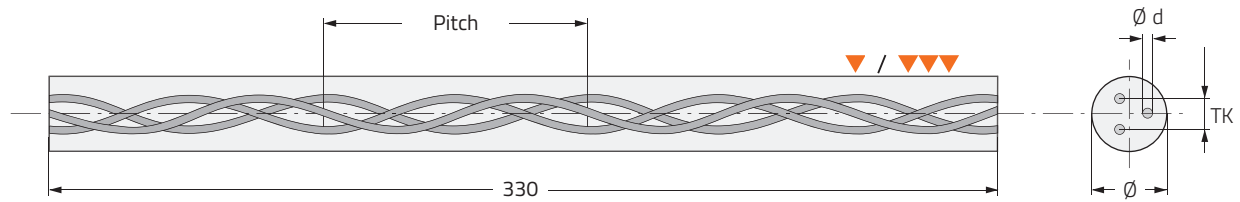


## Coolant hole rods / Triple helical 30° / 330 mm

Article group **0150** / Sintered plus grinding stock

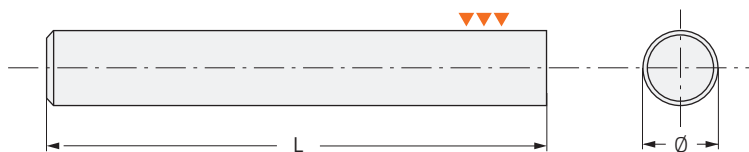
Article group **0151** / Ground h6

**F10** **K30**  
Cobalt 10%  
Submicron  
HV30 1580  
3800 N/mm<sup>2</sup>



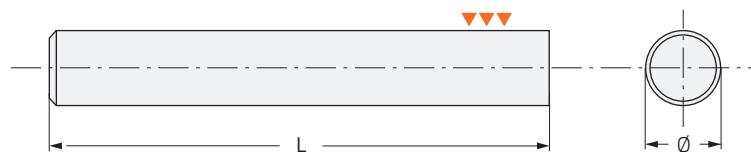
$\nabla$ Ø mm (sintered)	$\nabla\nabla\nabla$ Ø mm (ground)	TK mm	Ø d mm	Pitch mm
Ø 6,3 +0,3	Ø 6,0 h6	3,0 ±0,20	0,6 ±0,15	32,65 -1,28/+0,43
Ø 8,3 +0,3	Ø 8,0 h6	4,0 ±0,20	0,7 ±0,15	43,53 -1,70/+0,57
Ø 10,3 +0,3	Ø 10,0 h6	4,9 ±0,30	1,0 ±0,15	54,41 -2,13/+0,71
Ø 12,3 +0,3	Ø 12,0 h6	6,0 ±0,40	1,1 ±0,15	65,30 -2,55/+0,85
Ø 14,3 +0,3	Ø 14,0 h6	7,1 ±0,40	1,3 ±0,20	76,18 -2,98/+1,00
Ø 16,3 +0,3	Ø 16,0 h6	8,3 ±0,40	1,5 ±0,20	87,06 -3,40/+1,14
Ø 18,3 +0,3	Ø 18,0 h6	9,7 ±0,40	1,7 ±0,25	97,95 -3,83/+1,28
Ø 20,3 +0,3	Ø 20,0 h6	10,4 ±0,50	2,0 ±0,25	108,83 -5,32/+1,78

**i** Delivery from stock; Subject to prior sale!  
Other sizes and grades on request.



Ø mm	L +0,8 / +0,5 mm	Chamfer ± 0,1 mm	Ø mm	L +0,8 / +0,5 mm	Chamfer ± 0,1 mm
Ø 2,0 h6	33	0,2 x 45°	Ø 8,0 h6	63	0,8 x 45°
Ø 3,0 h6	32	0,3 x 45°	Ø 8,0 h6	68	0,8 x 45°
Ø 3,0 h6	39	0,3 x 45°	Ø 8,0 h6	70	0,8 x 45°
Ø 3,0 h6	50	0,3 x 45°	Ø 8,0 h6	75	0,8 x 45°
Ø 3,0 h6	55	0,3 x 45°	Ø 8,0 h6	80	0,8 x 45°
Ø 3,0 h6	60	0,3 x 45°	Ø 8,0 h6	100	0,8 x 45°
Ø 3,0 h6	100	0,3 x 45°	Ø 10,0 h6	60	1,0 x 45°
Ø 4,0 h6	40	0,4 x 45°	Ø 10,0 h6	66	1,0 x 45°
Ø 4,0 h6	50	0,4 x 45°	Ø 10,0 h6	70	1,0 x 45°
Ø 4,0 h6	54	0,4 x 45°	Ø 10,0 h6	72	1,0 x 45°
Ø 5,0 h6	50	0,5 x 45°	Ø 10,0 h6	90	1,0 x 45°
Ø 5,0 h6	60	0,5 x 45°	Ø 10,0 h6	100	1,0 x 45°
Ø 6,0 h6	38	0,6 x 45°	Ø 10,0 h6	110	1,0 x 45°
Ø 6,0 h6	40	0,6 x 45°	Ø 10,0 h6	120	1,0 x 45°
Ø 6,0 h6	50	0,6 x 45°	Ø 10,0 h6	150	1,0 x 45°
Ø 6,0 h6	54	0,6 x 45°	Ø 12,0 h6	55	1,0 x 45°
Ø 6,0 h6	57	0,6 x 45°	Ø 12,0 h6	58	1,0 x 45°
Ø 6,0 h6	60	0,6 x 45°	Ø 12,0 h6	70	1,0 x 45°
Ø 6,0 h6	63	0,6 x 45°	Ø 12,0 h6	73	1,0 x 45°
Ø 6,0 h6	68	0,6 x 45°	Ø 12,0 h6	83	1,0 x 45°
Ø 6,0 h6	75	0,6 x 45°	Ø 12,0 h6	90	1,0 x 45°
Ø 6,0 h6	80	0,6 x 45°	Ø 12,0 h6	93	1,0 x 45°
Ø 6,0 h6	100	0,6 x 45°	Ø 12,0 h6	100	1,0 x 45°
Ø 8,0 h6	43	0,8 x 45°	Ø 12,0 h6	110	1,0 x 45°
Ø 8,0 h6	58	0,8 x 45°	Ø 12,0 h6	120	1,0 x 45°
Ø 8,0 h6	60	0,8 x 45°	Ø 12,0 h6	150	1,0 x 45°

**i** Delivery from stock; Subject to prior sale!  
Other sizes and grades on request.



Ø mm	L +0,8 / +0,5 mm	Chamfer ± 0,1 mm	Ø mm	L +0,8 / +0,5 mm	Chamfer ± 0,1 mm
Ø 14,0 h6	58	1,0 x 45°	Ø 25,0 h6	100	1,5 x 45°
Ø 14,0 h6	75	1,0 x 45°	Ø 25,0 h6	121	1,5 x 45°
Ø 14,0 h6	83	1,0 x 45°	Ø 25,0 h6	125	1,5 x 45°
Ø 14,0 h6	100	1,0 x 45°	Ø 25,0 h6	150	1,5 x 45°
Ø 16,0 h6	82	1,0 x 45°	Ø 32,0 h6	110	2,0 x 45°
Ø 16,0 h6	92	1,0 x 45°	Ø 32,0 h6	151	2,0 x 45°
Ø 16,0 h6	100	1,0 x 45°			
Ø 16,0 h6	108	1,0 x 45°			
Ø 16,0 h6	114	1,0 x 45°			
Ø 16,0 h6	120	1,0 x 45°			
Ø 16,0 h6	123	1,0 x 45°			
Ø 16,0 h6	150	1,0 x 45°			
Ø 18,0 h6	84	1,5 x 45°			
Ø 18,0 h6	92	1,5 x 45°			
Ø 18,0 h6	100	1,5 x 45°			
Ø 20,0 h6	75	1,5 x 45°			
Ø 20,0 h6	92	1,5 x 45°			
Ø 20,0 h6	100	1,5 x 45°			
Ø 20,0 h6	104	1,5 x 45°			
Ø 20,0 h6	110	1,5 x 45°			
Ø 20,0 h6	115	1,5 x 45°			
Ø 20,0 h6	120	1,5 x 45°			
Ø 20,0 h6	126	1,5 x 45°			
Ø 20,0 h6	135	1,5 x 45°			
Ø 20,0 h6	141	1,5 x 45°			
Ø 20,0 h6	150	1,5 x 45°			

**i** Delivery from stock; Subject to prior sale!  
 Other sizes and grades on request.

Fixlengths / Solid / One side chamfered / Ground h6  
 Article group **0113** / With Weldon shank DIN 6535 HB

<b>F10</b>	<b>K30</b>	<b>U12</b>	<b>K40</b>
Cobalt 10%	Submicron	Cobalt 12%	Ultrafine
HV30 1580	3800 N/mm <sup>2</sup>	HV30 1640	3800 N/mm <sup>2</sup>



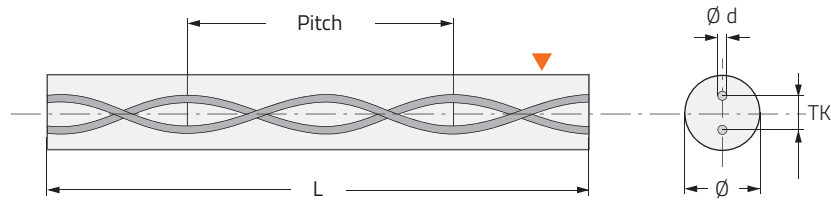
Ø mm	L +0,8 / +0,5 mm	Chamfer ± 0,1 mm
Ø 6,0 h6	57	0,6 x 45°
Ø 8,0 h6	63	0,8 x 45°
Ø 10,0 h6	72	1,0 x 45°
Ø 12,0 h6	83	1,0 x 45°
Ø 14,0 h6	83	1,0 x 45°
Ø 16,0 h6	92	1,0 x 45°
Ø 18,0 h6	92	1,5 x 45°
Ø 20,0 h6	104	1,5 x 45°

**i** Delivery from stock; Subject to prior sale!  
 Other sizes and grades on request.

# Fixlengths / Double helical 30°

Article group **0142** / Sintered plus grinding stock

**F10** **K30**  
 Cobalt 10%  
 Submicron  
 HV30 1580  
 3800 N/mm<sup>2</sup>



Ø mm (sintered)	L +0,8 / +0,5 mm	TK mm	Ø d mm	Pitch mm
Ø 6,3 +0,3	67	2,4 ±0,2	Ø0,7 ±0,15	32,65 -1,28/+0,43
Ø 6,3 +0,3	82	2,4 ±0,2	Ø0,7 ±0,15	32,65 -1,28/+0,43
Ø 8,3 +0,3	80	3,8 ±0,2	Ø1,0 ±0,15	43,53 -1,70/+0,57
Ø 8,3 +0,3	92	3,8 ±0,2	Ø1,0 ±0,15	43,53 -1,70/+0,57
Ø 10,3 +0,3	90	4,5 ±0,3	Ø1,4 ±0,15	54,41 -2,13/+0,71
Ø 10,3 +0,3	104	4,5 ±0,3	Ø1,4 ±0,15	54,41 -2,13/+0,71
Ø 12,3 +0,3	103	5,85 ±0,4	Ø1,4 ±0,20	65,30 -2,55/+0,85
Ø 12,3 +0,3	119	5,85 ±0,4	Ø1,4 ±0,20	65,30 -2,55/+0,85
Ø 14,3 +0,3	108	6,7 ±0,4	Ø2,0 ±0,20	76,18 -2,98/+1,00
Ø 14,3 +0,3	125	6,7 ±0,4	Ø2,0 ±0,20	76,18 -2,98/+1,00
Ø 16,3 +0,3	134	7,9 ±0,40	Ø2,0 ±0,25	87,06 -3,40/+1,14
Ø 16,3 +0,3	300	7,9 ±0,40	Ø2,0 ±0,25	87,06 -3,40/+1,14
Ø 18,3 +0,3	124	9,15 ±0,4	Ø2,5 ±0,25	97,95 -3,83/+1,28
Ø 18,3 +0,3	144	9,15 ±0,4	Ø2,5 ±0,25	97,95 -3,83/+1,28
Ø 20,3 +0,3	132	9,9 ±0,5	Ø2,5 ±0,25	108,83 -4,25/+1,42
Ø 20,3 +0,3	154	9,9 ±0,5	Ø2,5 ±0,25	108,83 -4,25/+1,42

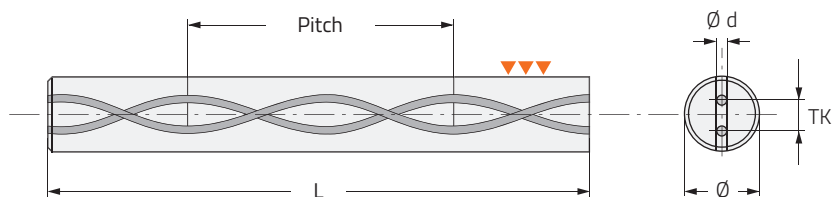
**i** Delivery from stock; Subject to prior sale!  
 Other sizes and grades on request.

# Fixlengths / Double helical 30° and 40° / One side chamfered / Connection slot

Article group **0143** / Ground h6 / 30°

Article group **0163** / Ground h6 / 40°

**F10** K30  
Cobalt 10%  
Submicron  
HV30 1580  
3800 N/mm<sup>2</sup>



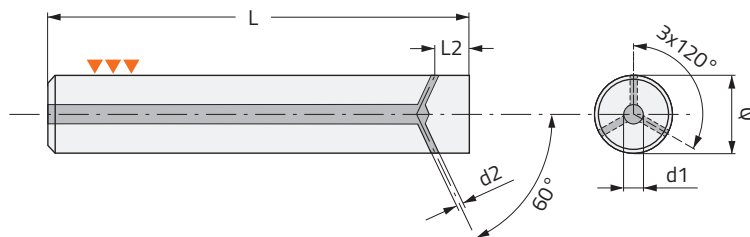
Ø mm (ground)	L +0,8 / +0,5 mm	TK mm	Ø d mm	Pitch mm
Ø 6,0 h6	67	1,7 ±0,2	Ø 0,55 ±0,15	23,00 -0,80/+0,27
Ø 6,0 h6	67	2,4 ±0,2	Ø 0,7 ±0,15	32,65 -1,28/+0,43
Ø 6,0 h6	75	2,4 ±0,2	Ø 0,7 ±0,15	29,00 -1,08/+0,37
Ø 6,0 h6	82	2,4 ±0,2	Ø 0,7 ±0,15	32,65 -1,28/+0,43
Ø 6,0 h6	95	2,4 ±0,2	Ø 0,7 ±0,15	32,65 -1,28/+0,43
Ø 6,0 h6	116	2,4 ±0,2	Ø 0,7 ±0,15	32,65 -1,28/+0,43
Ø 8,0 h6	80	3,8 ±0,2	Ø 1,0 ±0,15	43,53 -1,70/+0,57
Ø 8,0 h6	92	3,8 ±0,2	Ø 1,0 ±0,15	43,53 -1,70/+0,57
Ø 8,0 h6	114	3,8 ±0,2	Ø 1,0 ±0,15	43,53 -1,70/+0,57
Ø 8,0 h6	146	3,8 ±0,2	Ø 1,0 ±0,15	43,53 -1,70/+0,57
Ø 10,0 h6	90	4,5 ±0,3	Ø 1,4 ±0,15	54,41 -2,13/+0,71
Ø 10,0 h6	104	4,5 ±0,3	Ø 1,4 ±0,15	54,41 -2,13/+0,71
Ø 10,0 h6	142	4,5 ±0,3	Ø 1,4 ±0,15	54,41 -2,13/+0,71
Ø 10,0 h6	162	4,5 ±0,3	Ø 1,4 ±0,15	54,41 -2,13/+0,71
Ø 12,0 h6	103	5,85 ±0,4	Ø 1,4 ±0,20	65,30 -2,55/+0,85
Ø 12,0 h6	119	5,85 ±0,4	Ø 1,4 ±0,20	65,30 -2,55/+0,85
Ø 12,0 h6	162	5,85 ±0,4	Ø 1,4 ±0,20	65,30 -2,55/+0,85
Ø 12,0 h6	204	5,85 ±0,4	Ø 1,4 ±0,20	65,30 -2,55/+0,85
Ø 14,0 h6	108	6,7 ±0,4	Ø 2,0 ±0,20	76,18 -2,98/+1,00
Ø 14,0 h6	125	6,7 ±0,4	Ø 2,0 ±0,20	76,18 -2,98/+1,00
Ø 14,0 h6	178	6,7 ±0,4	Ø 2,0 ±0,20	76,18 -2,98/+1,00
Ø 14,0 h6	230	6,7 ±0,4	Ø 2,0 ±0,20	76,18 -2,98/+1,00
Ø 16,0 h6	116	7,9 ±0,40	Ø 2,0 ±0,25	87,06 -3,40/+1,14
Ø 16,0 h6	134	7,9 ±0,40	Ø 2,0 ±0,25	87,06 -3,40/+1,14
Ø 16,0 h6	203	7,9 ±0,40	Ø 2,0 ±0,25	87,06 -3,40/+1,14
Ø 16,0 h6	260	7,9 ±0,40	Ø 2,0 ±0,25	87,06 -3,40/+1,14
Ø 18,0 h6	124	9,15 ±0,4	Ø 2,5 ±0,25	97,95 -3,83/+1,28
Ø 18,0 h6	144	9,15 ±0,4	Ø 2,5 ±0,25	97,95 -3,83/+1,28
Ø 18,0 h6	222	9,15 ±0,4	Ø 2,5 ±0,25	97,95 -3,83/+1,28
Ø 20,0 h6	132	9,9 ±0,5	Ø 2,5 ±0,25	108,83 -4,25/+1,42
Ø 20,0 h6	154	9,9 ±0,5	Ø 2,5 ±0,25	108,83 -4,25/+1,42
Ø 20,0 h6	243	9,9 ±0,5	Ø 2,5 ±0,25	108,83 -4,25/+1,42

**i** Delivery from stock; Subject to prior sale!  
Other sizes and grades on request.

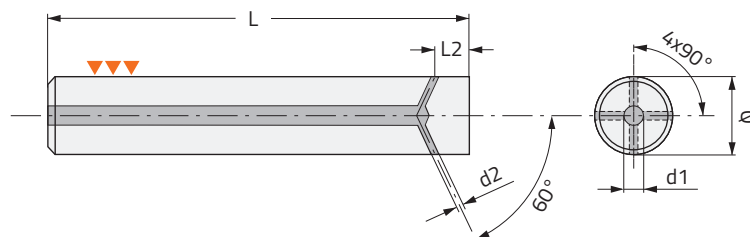
# Fixlengths / Radial Y-exit / 60° / Ground h6

Article group **0311** / 3 and 4 Y-exits

**F10** K30  
 Cobalt 10%  
 Submicron  
 HV30 1580  
 3800 N/mm<sup>2</sup>



Ø mm (ground)	L mm	d1 mm	d2 mm	L2 mm
6,0 h6	58	1,2	0,7	3
8,0 h6	64	1,6	0,9	4
10,0 h6	73	2,0	1,2	5
12,0 h6	84	2,2	1,3	6
14,0 h6	84	2,4	1,4	7
16,0 h6	93	2,6	1,5	8
18,0 h6	93	2,8	1,6	9
20,0 h6	105	3,0	1,7	10



Ø mm (ground)	L mm	d1 mm	d2 mm	L2 mm
6,0 h6	58	1,2	0,6	3
8,0 h6	64	1,6	0,8	4
10,0 h6	73	2,0	1,0	5
12,0 h6	84	2,2	1,1	6
14,0 h6	84	2,4	1,2	7
16,0 h6	93	2,6	1,3	8
18,0 h6	93	2,8	1,4	9
20,0 h6	105	3,0	1,5	10

**i** Other sizes, grades and additional Weldon shank on request.

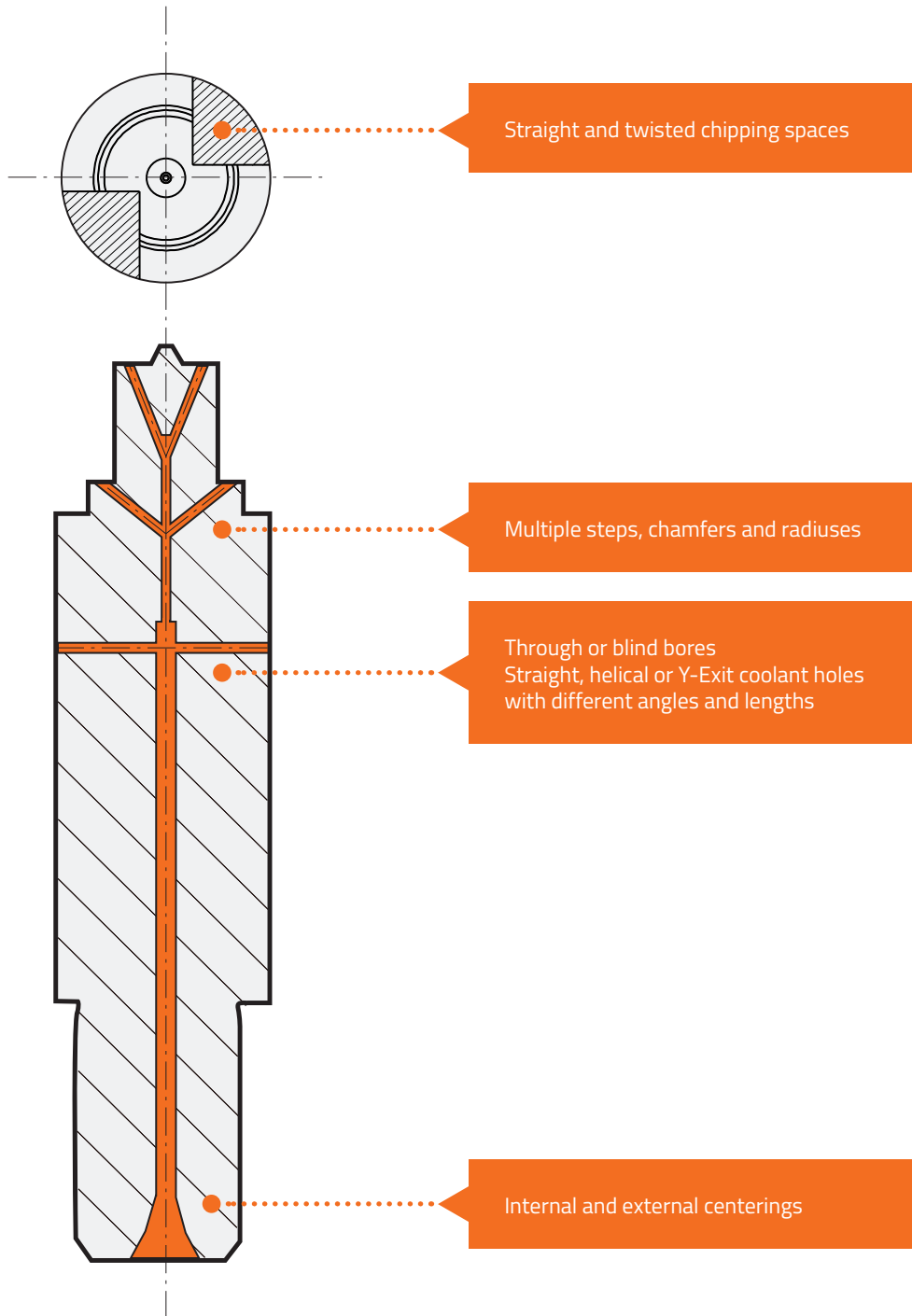
## Preforms

Article group **0320** / Sintered plus grinding stock

Article group **0321** / Ground h6

<b>F06</b>	<b>K10</b>	<b>F10</b>	<b>K30</b>	<b>U12</b>	<b>K40</b>
Cobalt	7%	Cobalt	10%	Cobalt	12%
Ultrafine		Submicron		Ultrafine	
HV30	1800	HV30	1580	HV30	1640
3600 N/mm <sup>2</sup>		3800 N/mm <sup>2</sup>		3800 N/mm <sup>2</sup>	

Based on our manufacturing process we are able to supply complex geometries corresponding to the customer's specifications.

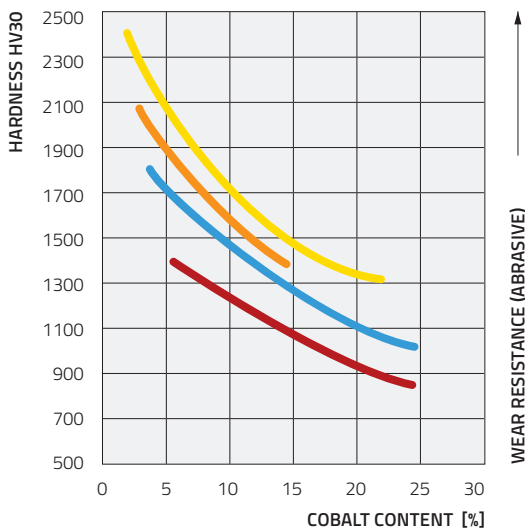


**i** Other grades on request.



# Technical information

## Mechanical properties

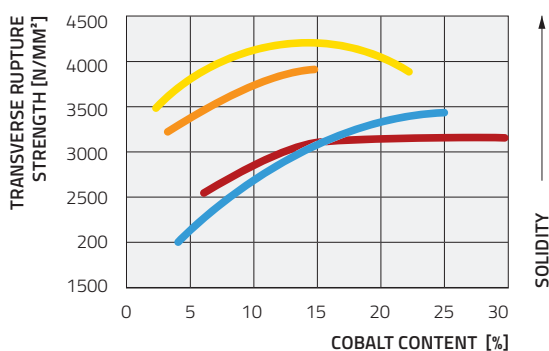


### Hardness [HV / HRA]

The hardness of cemented carbide is a very important characteristic. It is determined by the chemical consistence and the grain size of the hard components. Tungsten carbide (WC) as hard component and Cobalt (Co) as ductile auxiliary metal are preferably used. The hardness values of cemented carbide are measured by the methods of Vickers (HV30) or Rockwell (HRA), according to ISO 3738. The hardness is often used as reference of the wear resistance.



Figure: Hardness as function of Co content and WC grain size

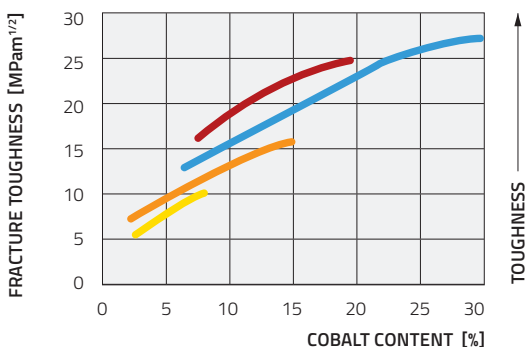


### Transverse Rupture Strength [N/mm<sup>2</sup>]

The T.R.S. testing is a method for identification of the solidity of cemented carbide. The test pieces with defined length are deposited on two prism and get certain stress in the middle up to crack. The examination of the T.R.S. are realised on precision ground cemented carbide rods contrary to the general test method.



Figure: T.R.S. as function of Co content and WC grain size



### Fracture toughness [MPam<sup>1/2</sup>]

The fracture toughness of cemented carbide is defined as resistance of materials against crack growth. This material parameter is the critical stress intensity factor  $K_{IC}$ . This factor selects the start of the unstable crack growth. The fracture toughness, also referred as to crack resistance, is an important value of the toughness of hard metal.



Figure: Fracture toughness as function of Co content and WC grain size

# Technical information

## Definitions and explanations

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### Straightness

The tolerance range of the straightness is limited by two parallel straight lines with constant distance in the measuring plane (ISO 1101). With cylindrical pieces the surface line is limited by two parallel lines with constant distance. The measurement of the cemented carbide rods is done between two contact points in the middle of test pieces by a dial gauge. The contact points are placed approx 10 mm from each end of the cylinders. The maximum peak (deviation) vertically to the centre line in one direction of rotation is the straightness or deflection.

\*Note: TC rods  $\varnothing \leq 3\text{mm}$  are measured also in the middle between two contact points but with distance of 100 mm!

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### Circular Run-Out

The tolerance range of the run-out is limited by two concentric circles with constant distance. Both circles have one combined centre on the centre line of the test piece. The measuring plane is vertical to the reference axis (ISO 1101).

The centre of both circles is fixed to the reference axis during the measurement of the circular run-out. The circular run-out of one rotational element equals the difference of the distances of the surface  $A_{\text{max}}$  and  $A_{\text{min}}$  from the reference axis. The measurement of the maximum and minimum distance is done especially for fixlength on special prisms or rolling equipments. During the measurement the cylinder is completely rotated by  $360^\circ$  around its own axis.

The measuring equipment consists of two contact points (A and B). Contact point A is placed approx 5 mm from one end. Contact point B is located in the middle of the fixlength. The measurement of  $A_{\text{max}}$  and  $A_{\text{min}}$  is made by dial gauge on one dimension line approx 2 mm from the other end of the fixlength.

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### Roundness

The tolerance range of the roundness is limited by two concentric circles with constant distance. The measuring plane is vertical to the reference axis (ISO 1101).

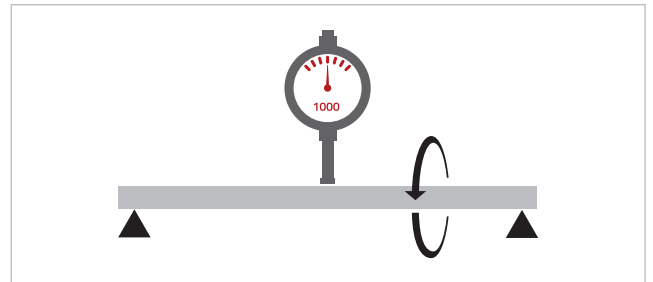
Unlike to the run-out both concentric circles do not have a reference to the reference axis. Both circles can be moved independently from each other to find the minimum distance  $A_{\text{min}}$  on the measuring plane. A simplified measuring equipment similar to the measurement of the straightness is used for the roundness too. Unlike to the measurement of the straightness the measurement of the minimum distance  $A_{\text{min}}$  is done directly on one contact point. The test piece is completely rotated by  $360^\circ$  around its own axis. The value of the roundness is always significantly lower as the run-out.

# Technical information

## Geometrical product specification

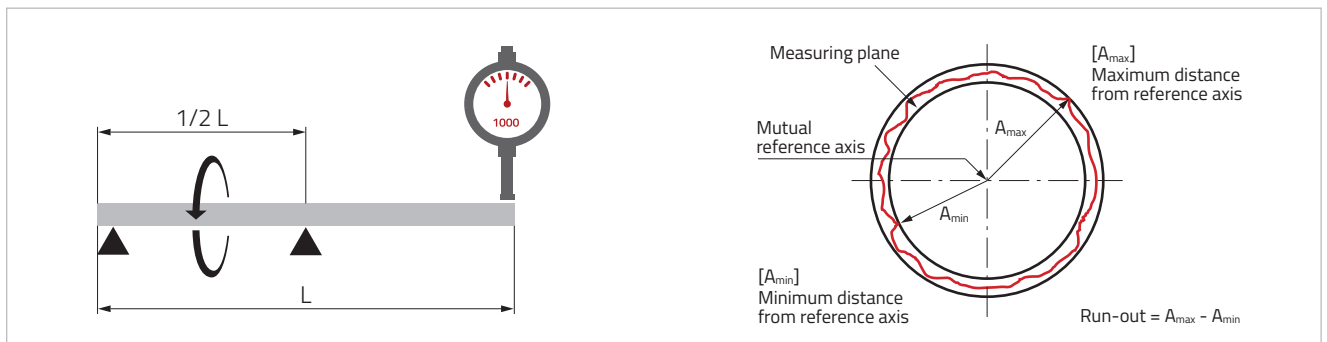
### Straightness<sub>max</sub> of ground rods L= 330 mm

∅ mm	Straightness <sub>max</sub> (mm)
2,0 - 3,0	0,04*
4,0 - 7,0	0,06
7,0 - 18,0	0,05
18,0 - 32,0	0,04



### Run-out<sub>max</sub> of ground fixlengths

∅ mm	L (mm)			
	< 60	> 60 - 100	> 100 - 160	> 160 - 300
2,0 - 4,0	0,008	0,015	0,020	0,040
4,0 - 6,0	0,008	0,015	0,020	0,040
6,0 - 12,0	0,004	0,008	0,010	0,020
12,0 - 20,0	0,004	0,008	0,010	0,020
20,0 - 32,0	0,003	0,005	0,010	0,020



### Roundness<sub>max</sub> of ground rods L = 330 mm

∅ mm	Roundness <sub>max</sub> (mm)
2,0 - 4,0	0,002
4,0 - 7,0	0,003
7,0 - 18,0	0,004
18,0 - 32,0	0,005

