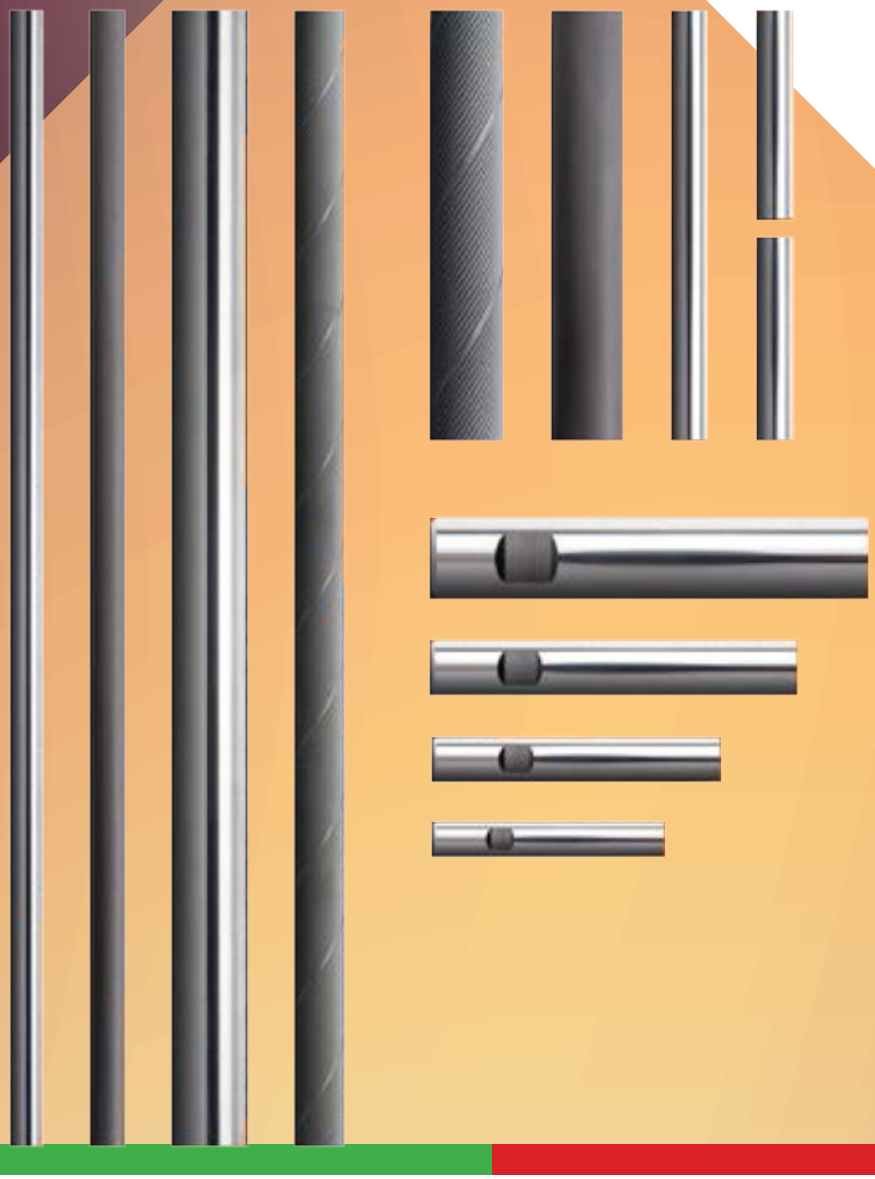
ADD engineering

HARD METALS FOR PRECISION TOOLS



Germany | India | Russia

Germany | India | Russia

TABLE OF CONTENTS

ADD engineering

COMPOSITION AND PHYSICAL DATA

Grade	ISO Group	Structure	Grain size µm	Co ±0,5%	Hardness HV30	Hardness HRA	Density g/ cm³	TRS N/ mm²	Fracture toughness K_{IC} (MPam$^{1/2}$)
F06	K05-K10	ultrafine	≤ 0,6	7,0	1800	93,2	14,60	3600	9,5
F06D	K05-K10	ultrafine	≤ 0,6	6,0	1840	93,4	14,80	3500	9,0
F10	K20-K30	fine	0,7	10,0	1580	92,0	14,35	3800	10,7
F10S	K20-K40	fine	0,7	10,0	1510	91,3	14,40	4000	10,9
U12	K40	ultrafine	≤ 0,6	12,0	1640	92,2	14,15	3800	9,8
U12S	K40	ultrafine	≤ 0,6	11,0	1660	92,3	14,15	3800	10,0
U08	K01-K05	ultrafine	≤ 0,6	8,0	2010	94,4	14,50	3800	8,6

GRADE RECOMMENDATION & APPLICATION AREAS

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

GRAIN SIZES AND DEFINITIONS

Grain size	Definition
< 0,2 µm	Nano
0,2 - 0,5 µm	Ultrafine
0,5 - 0,8 µm	Submicron
0,8 - 1,3 µm	Fine

Grain size	Definition
1,3 - 2,5 µm	Medium
2,5 - 6,0 µm	Coarse
> 6,0 µm	Extracoarse

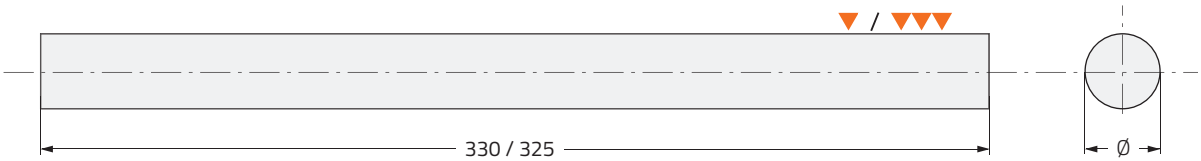
WORK MATERIAL - GRADE RECOMMENDATION

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

● Optimal ○ suitable

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

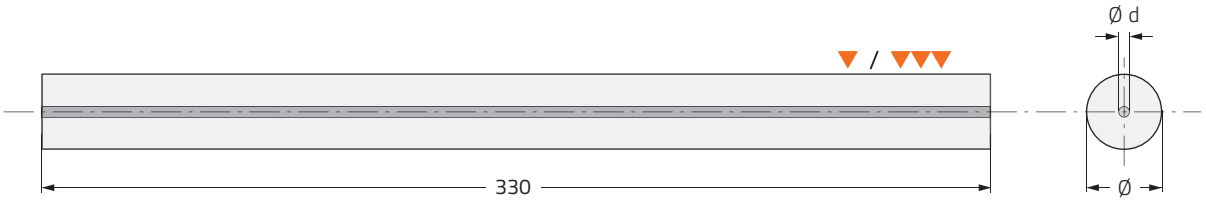
ARTICLE GROUP 0110 / SINTERED PLUS GRINDING STOCK
ARTICLE GROUP 0111 / GROUND H6



▼ 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		

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

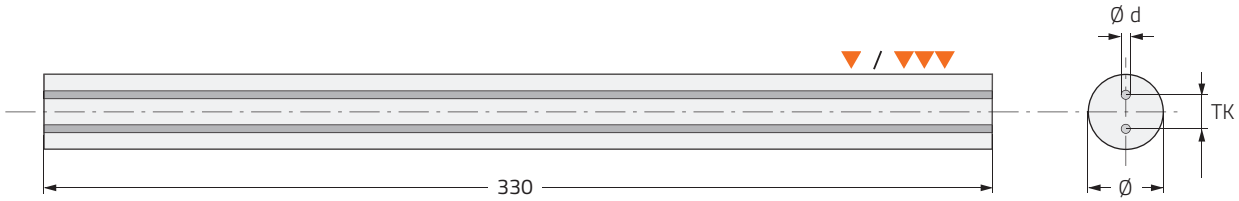
ARTICLE GROUP 0120 / SINTERED PLUS GRINDING STOCK
ARTICLE GROUP 0121 / GROUND H6



▼ 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

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

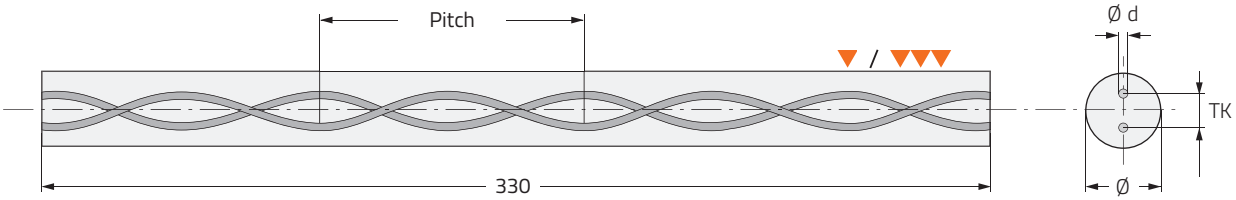
ARTICLE GROUP 0130 / SINTERED PLUS GRINDING STOCK
ARTICLE GROUP 0131 / GROUND H6



▼ 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

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

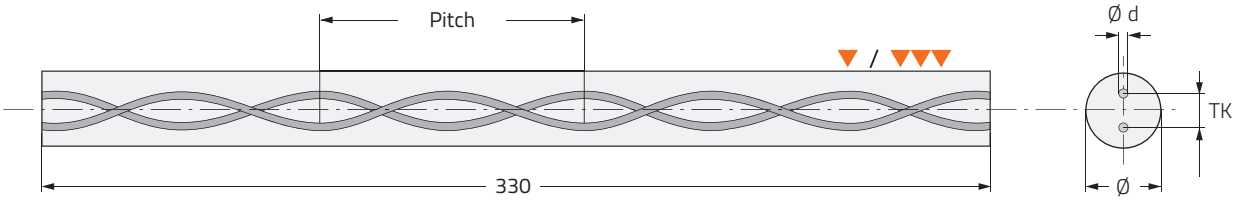
ARTICLE GROUP 0140 / SINTERED PLUS GRINDING STOCK
ARTICLE GROUP 0141 / GROUND H6



▼ 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

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

ARTICLE GROUP 0160 / SINTERED PLUS GRINDING STOCK
ARTICLE GROUP 0161 / GROUND H6



▼ 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

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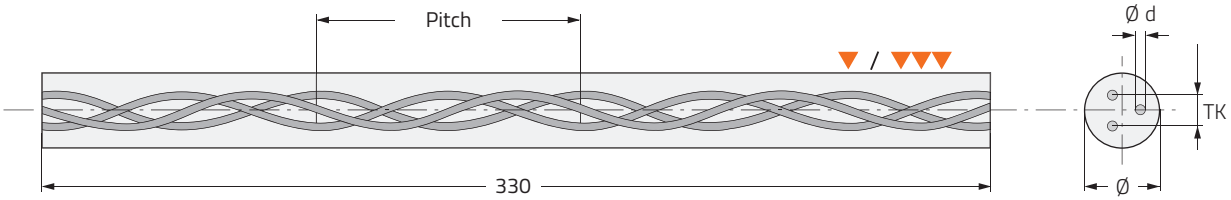
Other sizes and grades on request.

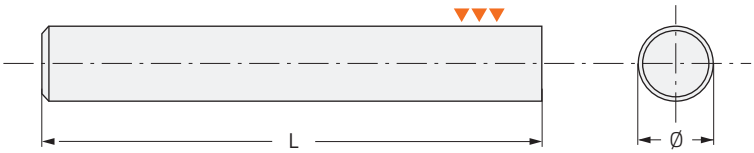
ARTICLE GROUP 0150 / SINTERED PLUS GRINDING STOCK
ARTICLE GROUP 0151 / GROUND H6



▼ Ø mm (sintered)	▼▼▼ 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

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

ARTICLE GROUP 0113 / ONE SIDE CHAMFERED

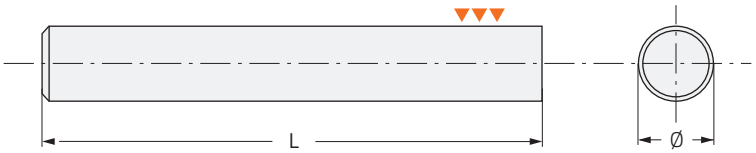


Ø mm	L +0,8 / +0,5 mm	Chamfer ± 0,1 mm
Ø 2,0 h6	33	0,2 x 45°
Ø 3,0 h6	32	0,3 x 45°
Ø 3,0 h6	39	0,3 x 45°
Ø 3,0 h6	50	0,3 x 45°
Ø 3,0 h6	55	0,3 x 45°
Ø 3,0 h6	60	0,3 x 45°
Ø 3,0 h6	100	0,3 x 45°
Ø 4,0 h6	40	0,4 x 45°
Ø 4,0 h6	50	0,4 x 45°
Ø 4,0 h6	54	0,4 x 45°
Ø 5,0 h6	50	0,5 x 45°
Ø 5,0 h6	60	0,5 x 45°
Ø 6,0 h6	38	0,6 x 45°
Ø 6,0 h6	40	0,6 x 45°
Ø 6,0 h6	50	0,6 x 45°
Ø 6,0 h6	54	0,6 x 45°
Ø 6,0 h6	57	0,6 x 45°
Ø 6,0 h6	60	0,6 x 45°
Ø 6,0 h6	63	0,6 x 45°
Ø 6,0 h6	68	0,6 x 45°
Ø 6,0 h6	75	0,6 x 45°
Ø 6,0 h6	80	0,6 x 45°
Ø 6,0 h6	100	0,6 x 45°
Ø 8,0 h6	43	0,8 x 45°
Ø 8,0 h6	58	0,8 x 45°
Ø 8,0 h6	60	0,8 x 45°

Ø mm	L +0,8 / +0,5 mm	Chamfer ± 0,1 mm
Ø 8,0 h6	63	0,8 x 45°
Ø 8,0 h6	68	0,8 x 45°
Ø 8,0 h6	70	0,8 x 45°
Ø 8,0 h6	75	0,8 x 45°
Ø 8,0 h6	80	0,8 x 45°
Ø 8,0 h6	100	0,8 x 45°
Ø 10,0 h6	60	1,0 x 45°
Ø 10,0 h6	66	1,0 x 45°
Ø 10,0 h6	70	1,0 x 45°
Ø 10,0 h6	72	1,0 x 45°
Ø 10,0 h6	90	1,0 x 45°
Ø 10,0 h6	100	1,0 x 45°
Ø 10,0 h6	110	1,0 x 45°
Ø 10,0 h6	120	1,0 x 45°
Ø 10,0 h6	150	1,0 x 45°
Ø 12,0 h6	55	1,0 x 45°
Ø 12,0 h6	58	1,0 x 45°
Ø 12,0 h6	70	1,0 x 45°
Ø 12,0 h6	73	1,0 x 45°
Ø 12,0 h6	83	1,0 x 45°
Ø 12,0 h6	90	1,0 x 45°
Ø 12,0 h6	93	1,0 x 45°
Ø 12,0 h6	100	1,0 x 45°
Ø 12,0 h6	110	1,0 x 45°
Ø 12,0 h6	120	1,0 x 45°
Ø 12,0 h6	150	1,0 x 45°

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

ARTICLE GROUP 0113 / ONE SIDE CHAMFERED



Ø mm	L +0,8 / +0,5 mm	Chamfer ± 0,1 mm
Ø 14,0 h6	58	1,0 x 45°
Ø 14,0 h6	75	1,0 x 45°
Ø 14,0 h6	83	1,0 x 45°
Ø 14,0 h6	100	1,0 x 45°
Ø 16,0 h6	82	1,0 x 45°
Ø 16,0 h6	92	1,0 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°

Ø mm	L +0,8 / +0,5 mm	Chamfer ± 0,1 mm
Ø 25,0 h6	100	1,5 x 45°
Ø 25,0 h6	121	1,5 x 45°
Ø 25,0 h6	125	1,5 x 45°
Ø 25,0 h6	150	1,5 x 45°
Ø 32,0 h6	110	2,0 x 45°
Ø 32,0 h6	151	2,0 x 45°

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

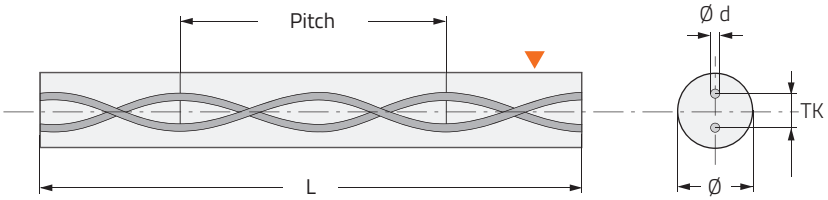
FIXLENGHTS / SOLID / ONE SIDE CHAMFERED / GROUND H6

ARTICLE GROUP 0113 / WITH WELDON SHANK DIN 6535 HB

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°

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

ARTICLE GROUP 0142 / SINTERED PLUS GRINDING STOCK



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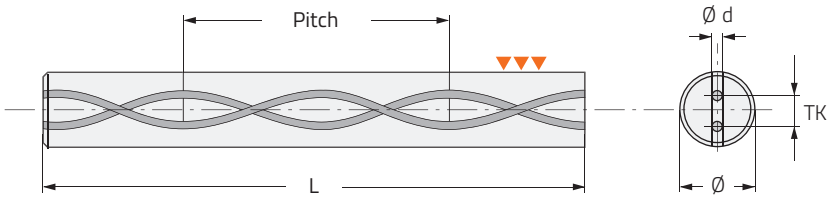
Ø mm (sintered)	L +0,8 / +0,5 mm	TK mm	Ø d mm	Pitch mm
Ø 6,3 +0,3	67	2,4 ±0,2	Ø0,7 ±0,15	32,65 +1,28/-0,43
Ø 6,3 +0,3	82	2,4 ±0,2	Ø0,7 ±0,15	32,65 +1,28/-0,43
Ø 8,3 +0,3	80	3,8 ±0,2	Ø1,0 ±0,15	43,53 +1,70/-0,57
Ø 8,3 +0,3	92	3,8 ±0,2	Ø1,0 ±0,15	43,53 +1,70/-0,57
Ø 10,3 +0,3	90	4,5 ±0,3	Ø1,4 ±0,15	54,41 +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

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

ARTICLE GROUP 0143 / GROUND H6 / 30⁰
ARTICLE GROUP 0163 / GROUND H6 / 40⁰



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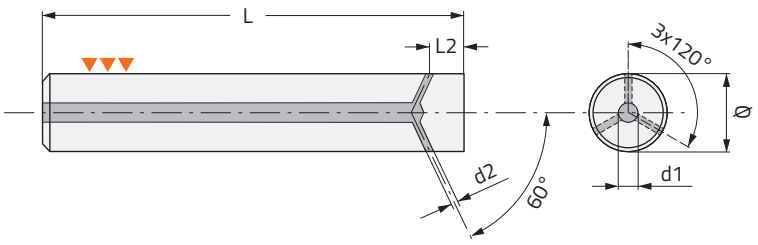
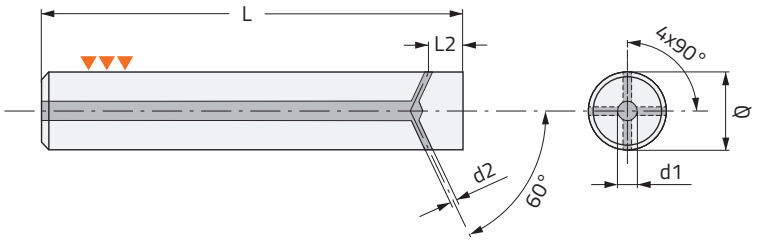
Ø mm (ground)	L +0,8 / +0,5 mm	TK mm	Ø d mm	Pitch mm
Ø 6,0 h6	67	1,7 ±0,2	Ø 0,55 ±0,15	23,00 +0,80/-0,27
Ø 6,0 h6	67	2,4 ±0,2	Ø 0,7 ±0,15	32,65 +1,28/-0,43
Ø 6,0 h6	75	2,4 ±0,2	Ø 0,7 ±0,15	29,00 +1,08/-0,37
Ø 6,0 h6	82	2,4 ±0,2	Ø 0,7 ±0,15	32,65 +1,28/-0,43
Ø 6,0 h6	95	2,4 ±0,2	Ø 0,7 ±0,15	32,65 +1,28/-0,43
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

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

ARTICLE GROUP 0311 / 3 AND 4 Y- EXITS



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



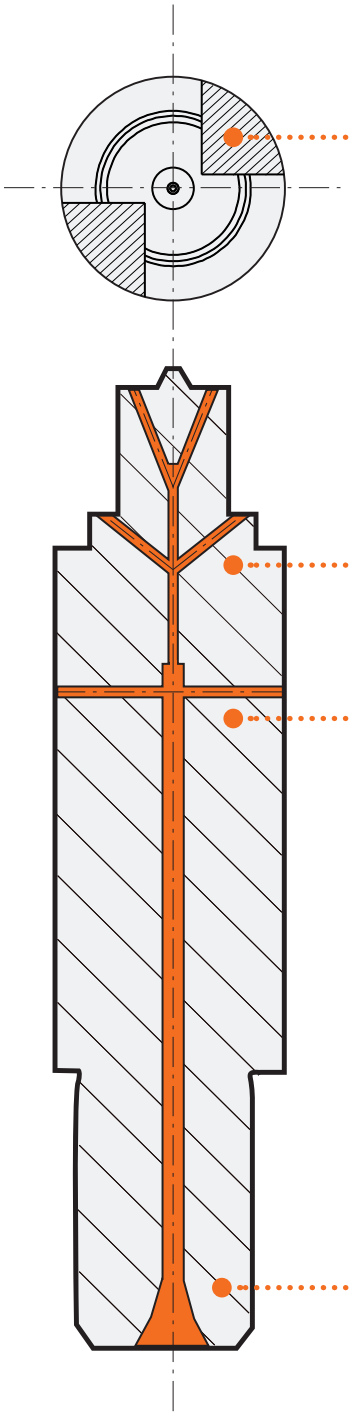
Ø mm (ground)	L mm	d1 mm	d2 mm	L2 mm
6,0 h6	58	1,2	0,6	3
8,0 h6	64	1,6	0,8	4
10,0 h6	73	2,0	1,0	5
12,0 h6	84	2,2	1,1	6
14,0 h6	84	2,4	1,2	7
16,0 h6	93	2,6	1,3	8
18,0 h6	93	2,8	1,4	9
20,0 h6	105	3,0	1,5	10

Other sizes, grades and additional Weldon shank on request.

ARTICLE GROUP 0320 / SINTERED PLUS GRINDING STOCK
ARTICLE GROUP 0321 / GROUND H6

For reduction of grinding time and production costs we offer a comprehensive selection of near-net shape preforms.

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



Straight and twisted chipping spaces

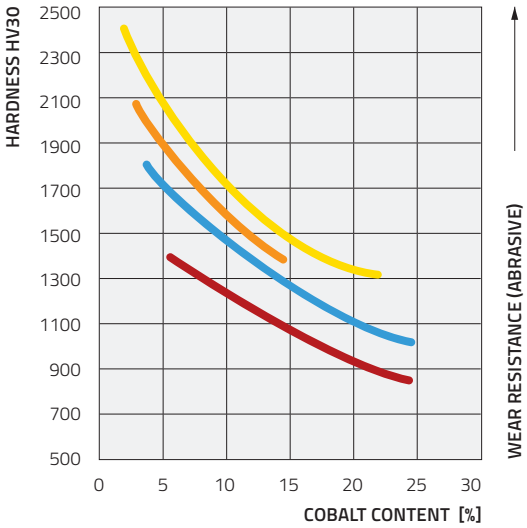
Multiple steps, chamfers and radiuses

Through or blind bores
Straight, helical or Y-Exit coolant holes
with different angles and lengths

Internal and external centerings

Other grades on request.

MECHANICAL PROPERTIES

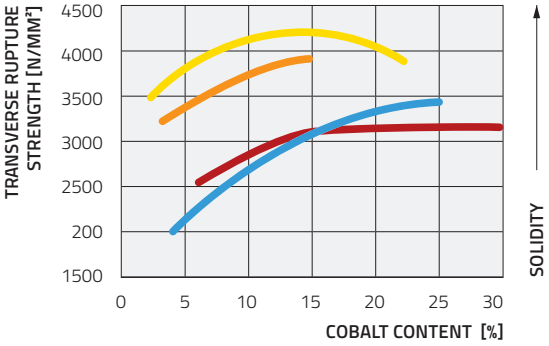


Hardness [HV / HRA]

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 auxillary 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.

Ultrafine
Submicron
Fine / Medium
Coarse

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

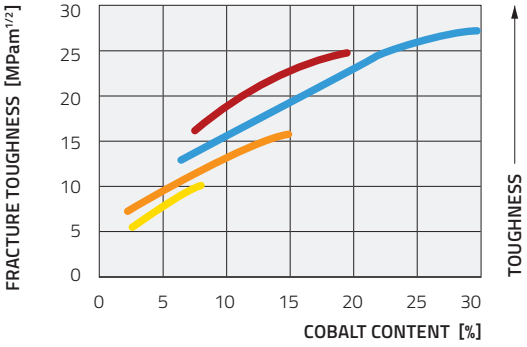


Transverse Rupture Strength [N/mm²]

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.

Ultrafine
Submicron
Fine / Medium
Coarse

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



Fracture toughness [MPam$^{1/2}$]

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.

Ultrafine
Submicron
Fine / Medium
Coarse

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

DEFINITIONS AND EXPLANATIONS

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 ø ≤ 3mm are measured also in the middle between two contact points but with distance of 100 mm!

Circular Run-Out

The tolerance range of the run-out is limited by two concentrical 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_{max} and A_{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° 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_{max} and A_{min} is made by dial gauge on one dimension line approx 2 mm from the other end of the fixlength.

Roundness

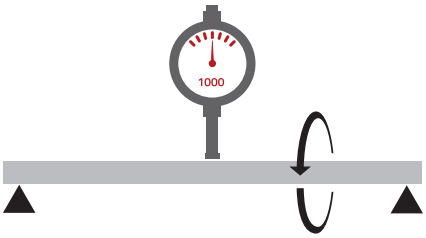
The tolerance range of the roundness is limited by two concentrical circles with constant distance. The measuring plane is vertical to the reference axis (ISO 1101).

Unlike to the run-out both concentrical 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_{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_{min} is done directly on one contact point. The test piece is completely rotated by 360° around its own axis. The value of the roundness is always significantly lower as the run-out.

GEOMETRICAL PRODUCT SPECIFICATION

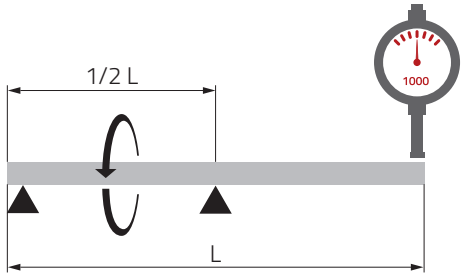
Straightness$_{max}$ of ground rods L= 330 mm

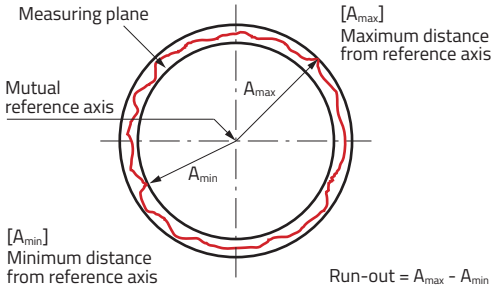
Ø mm	Straightness$_{max}$ (mm)
2,0 - 3,0	0,04*
4,0 - 7,0	0,06
7,0 - 18,0	0,05
18,0 - 32,0	0,04



Run-out$_{max}$ of ground fixlengths

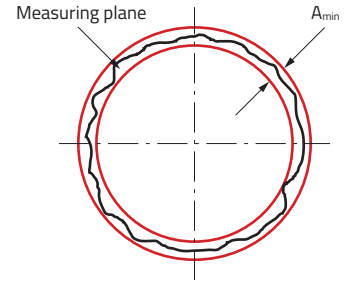
Ø mm	L (mm)			
	< 60	> 60 - 100	> 100 - 160	> 160 - 300
2,0 - 4,0	0,008	0,015	0,020	0,040
4,0 - 6,0	0,008	0,015	0,020	0,040
6,0 - 12,0	0,004	0,008	0,010	0,020
12,0 - 20,0	0,004	0,008	0,010	0,020
20,0 - 32,0	0,003	0,005	0,010	0,020





Roundness$_{max}$ of ground rods L = 330 mm

Ø mm	Roundness$_{max}$ (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



ADD engineering