



ZHUZHOU CEMENTED CARBIDE WORKS USA INC.

ZCC America

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2023 VERSION

CARBIDE ROLLS



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ABOUT ZCC



Zhuzhou Cemented Carbide Group Co., LTD (ZCC), hailed as "the cradle of China's cemented carbide industry", is one of the 156 key projects constructed during the First Five-Year Plan. ZCC is a key enterprise of China Minmetals Corporation, one of the Fortune Global 500 companies. ZCC specializes in cemented carbides, which are known as "the teeth of industry" and are widely applied to military industry, aerospace, mechanical processing, metallurgy, petroleum drilling, mining tools, electronic communication, construction, among other fields.

ZCC is a leading enterprise in the cemented carbide industry with the largest production and sales scale in China. It is also a "world-class professional leading demonstration enterprise" awarded by China's State-owned Assets Supervision and Administration Commission of the State Council (SASAC). It is also a national manufacturing champion demonstration enterprise, a national technological innovation demonstration enterprise, a high-tech enterprise, and a national green factory. On March 21, 2023, Chinese Premier Li Qiang, also a member of the Standing Committee of the Political Bureau of the Communist Party of China Central Committee, fully approved ZCC's work in sci-tech innovation and product development during his visit.

1954

FOUNDATION

One of the 156 major projects that China constructed in 1954 in its "First Five-Year Plan"

1970s

THE FIRST ROLL RING

China's first cemented carbide roll ring was born in ZCC

1980s

**STRENGTH
RECOGNITION**

Provided a series of cemented carbide rolls for the first high line introduced in China

1997

ALLOY PLANT

Covering two processes of pressing and sintering

2007

MACHINING PLANT

Covering 6 main processes: plane grinding, internal grinding, external grinding, turning, grooving and notching, and composite assembly

PRODUCTION CAPACITY

Under ZCC, there are 8 professional production units: Profile Products Branch, Big Products Division, Drill Business Division, Special Products Division, Drilling and Tunneling Division, Powder Division, RTP Plant, and Mold Manufacturing Plant; as well as 4 wholly owned and holding subsidiaries: ZCC Cutting Tools Co., Ltd. (ZCC.CT), Jinzhou Cemented Carbide Co., Ltd. (Jinzhou), Zhuzhou Changjiang Carbide Tools Co., Ltd., and ZCC Works Imp.& Exp.Co., Ltd.

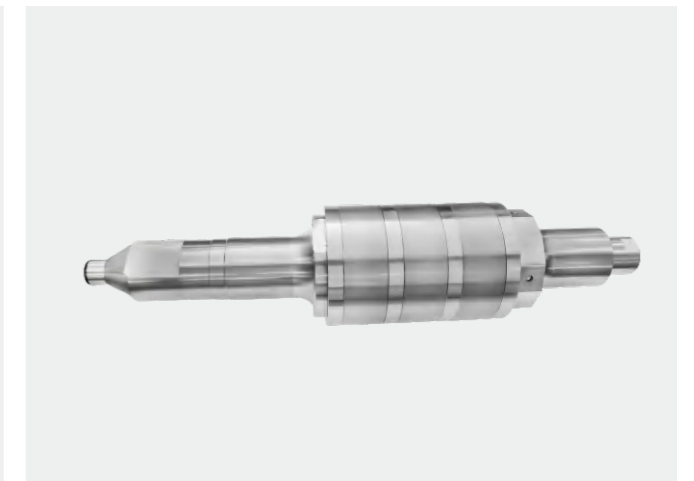
Among them, ZCC.CT is a leading enterprise in domestic cemented carbide cutting tools, and has been rated as high-tech enterprise of Hunan Province, key high-tech enterprise under the National Torch Plan, innovative enterprise of Hunan Province, and national innovative enterprise. Jinzhou is a global leading player of micro cutting tools, and a manufacturing champion demonstration enterprise.

8 PROFESSIONAL PRODUCT DIVISIONS

3 R&D CENTERS

1 ANALYSIS AND TESTING CENTER

4 HOLDING SUBSIDIARIES



R&D



ZCC is in possession of the only national key laboratory of cemented carbide industry, one of the first batch of certified state-level enterprise technology centers, state-level analysis and testing center, and quality-control and technology-evaluation laboratory of industrial products (cemented carbides and other tungsten products). ZCC undertakes many of the the national "863" and "973" programs, national innovation capacity building programs, the national key technology R&D program, and national strategic innovative products and key new products project. The company has won the first and second prizes of national sci-tech progress, and the second prize of national invention.



Products of ZCC have been widely applied to the forefront of "Made in China 2025" and "the Belt and Road Initiative". Some typical achievements have solved the bottleneck problems of national industrial development. High-end cemented carbide products can be produced domestically, thus holistically promoting related industries.

The production technology of spiral tools for deep-hole drilling has led to the emergence of independent high-end cemented carbide processing tools in China's automotive industry. The development of cemented carbide roller rings for low-temperature rolling has enabled domestic rollers to be the preferred choice of steel enterprises. The industrial application enables PDC cemented carbide matrix to be a key material for energy extraction in deep/ultra deep wells with a depth of more than 3000 meters. Thanks to the production of ultra-fine diameter cemented carbides for micro drilling and milling, China's PCB processing is taking the lead globally.

QUALITY ASSURANCE

ZCC always adheres to the quality policy of "laying emphasis on technology, being strict with management, and placing quality on top priority to meet customers' requirements with the Diamond brand". ZCC has acquired certificate of QHSE management system (quality, health and safety, and environment). ZCC has been adhering to the concept of "all for the customers" by respecting customers' requirements, and constantly improving technical and market services.





BIG PRODUCTS BUSINESS DIVISION

Zhuzhou Cemented Carbide Group Co., Ltd. successfully developed China's first cemented carbide rolls ring in the 1970s, and provided a series of cemented carbide rolls for the first high line introduced in our country in the 1980s. After more than 40 years of development, we have continuously updated our technology and equipment to improve product quality. At present, our company has become a professional manufacturer of high-end cemented carbide rolls in China, producing various specifications of cemented carbide flat rolls, grooved rolls, rebar rolls, special-shaped rolls, composite rolls, Kocks rolls, large-shaped products, etc., which can meet the processing needs of various materials and working conditions. Through continuous technological updates and provide product quality that the product market share has taken the lead in the domestic and foreign markets.

Adhered to technology leadership as the guide of product development, on the basis of the hard material research and development center and the national analysis and testing center, it has established a State Key Laboratory, focusing on the basic theoretical research of cemented carbide, and the basic application research of new cemented carbide technologies and new materials. Relying on the technology platform of the State Key Laboratory, research group of the large carbide products has developed 6 series of roll rings, such as R series, H series, FHL series, PA series, YGA series, PC series. The project results have been highly recognized, and have declared 48 patents and 32 technical secrets.

The cemented carbide roll ring developed based on the national “973” plan project “Tungsten Carbide Intermetallic Compound New cemented carbide Preparation and Organization Control Foundation” can two-way improve hardness and strength, adapting to the market’s trend of adopting low-temperature rolling to improve steel quality. In terms of special steel rolling, it has reached or exceeded the international level, and its service life has increased by more than 20%. In addition, another project “Cemented carbide roll rings for finished stands of high-wire rolling mills and their preparation Methods”, won the gold medal of the 12th China Invention Exhibition.

At present, Big Products Business Division is now divided into two factories—the alloy plant and the machining plant. The alloy plant started construction in 1996 and was fully put into use in 1997, covering two processes of pressing and sintering. The processing plant of the started construction in 2006 and was fully put into use in 2007. It covers 6 main processes: plane grinding, internal grinding, external grinding, turning, grooving and notching, and composite assembly. The main product categories are rolls, anvils and large special-shaped. The current comprehensive production capacity has reached 1,800 tons.



HIGH-SPEED WIRE ROLL RINGS & HIGH-SPEED BAR ROLL RINGS

HIGH-SPEED WIRE ROLL RINGS

BRIEF INTRODUCTION OF HIGH WIRE ROLL RINGS OF CEMENTED CARBIDE

Compared with steel rolls, cemented carbide roll rings have the characteristics of longer service life, higher cost-effectiveness, higher dimension precision and better surface finish owing to its high hardness, good wear resistance and high modulus of elasticity, thus greatly reduce labor intensity and improve productivity.

With the development of iron and steel industry, cemented carbide roll rings and rolls are widely used in the production of a variety of products such as wire, bar, steel tube, small strip and so on.



HIGH-SPEED WIRE ROLL RINGS

General Roll Rings Series Grades

Grade	Chemical Composition, Wt%		Physical & Mechanical Properties					
	WC (%)	Co+Ni+Cr (%)	Density g/cm ³	Hardness HRA	TRS N/mm ²	Compressive Strength N/mm ²	Young's modulus KN/mm ²	Thermal Conductivity W/(m·K)
YGR20	90	10	14.45	86.2	3100	3900	560	100
YGR25	87	13	14.2	85.5	2900	3600	550	98
YGR30	85	15	14.03	84.5	2800	3400	540	95
YGR40	82	18	13.73	83	2700	3300	500	92
YGR45	80	20	13.54	82	2650	3200	500	88
YGR50	78	22	13.37	81.5	2630	3100	480	76
YGR55	75	25	13.03	79.5	2600	3100	446	66
YGR60	70	30	12.73	79	2600	3000	425	57

Note: 1. Typical physical & mechanical properties are listed with the variation range in accordance with the relevant national and industry standards.

2. Relevant parameters are for reference only.

General roll rings series: Co-Ni-Cr is used as the bonding phase, with high wear resistance, corrosion resistance and versatility.	
Grade	Applications
YGR20	High wear resistance and corrosion resistance, used in the last 1-2 stands of finishing mills.
YGR25	High wear resistance and corrosion resistance, used in the last 1-3 stands of finishing mills.
YGR30	Good toughness, wear resistance, corrosion resistance and hot cracking resistance, used in the intermediate stands of finishing mills.
YGR40	Good toughness and hot cracking resistance, high versatility, used in most stands of the finishing mills and in the rear stands of common mills.
YGR45	Good toughness and hot cracking resistance, used in the front stands of finishing mills.
YGR50	Good toughness and hot cracking resistance, used in the front stands of finishing mills.
YGR55	Good impact resistance, used in the stands of pre-finishing rolling mills for hot rolling rebars and they can be machined by turning and milling.
YGR60	Good impact resistance, used for hot rolling rebars and in the first and second stands of Pre-finishing rolling mills.

HIGH-SPEED WIRE ROLL RINGS

High-performance Roll Rings Series Grades

Grade	Chemical Composition, Wt%		Physical & Mechanical Properties					
	WC (%)	Co+Ni+Cr (%)	Density g/cm ³	Hardness HRA	Transverse Rupture Strength Mpa	Compressive Strength N/mm ²	Young's modulus KN/mm ²	Thermal Conductivity W/(m·K)
YGH05	94	6	14.92	88.5	2620	4200	585	110
YGH10	92	8	14.71	88	2870	4000	580	108
YGH20	90	10	14.48	87	3120	3500	560	105
YGH25	87	13	14.25	86	2950	3400	550	102
YGH30	85	15	14.03	85	2870	3300	540	100
YGH40	82	18	13.75	83.5	2720	3200	500	98
YGH45	80	20	13.55	82.8	2680	3100	480	95
YGH55	74	26	13.05	81.5	2660	3100	450	92
YGH60	70	30	12.75	80.0	2700	3000	400	90

Note: 1. Typical physical & mechanical properties are listed with the variation range in accordance with the relevant national and industry standards.

2. Relevant parameters are for reference only.

High-performance roll rings series: pure Co is used as the bonding phase. Compared with the general roll rings series, the high-performance roll rings have better strength, toughness and wear resistance, but it has certain requirements for working conditions on the site and cooling water quality.	
Grade	Applications
YGH05	High hardness and wear resistance, used in the last 1-2 stands of finishing mills.
YGH10	High hardness and wear resistance, used in the last 1-2 stands of finishing mills.
YGH20	High hardness and wear resistance, used in the last 1-2 stands of finishing mills.
YGH25	High strength, toughness and wear resistance, used in the last 1-3 stands of finishing mills.
YGH30	Good toughness, wear resistance and hot cracking resistance, used in the middle stands of finishing mills.
YGH40	Good toughness and hot cracking resistance, used in most stands of the finishing mills and in the rear stands of common mills.
YGH45	Good toughness and hot cracking resistance, used in the front stands of finishing mills.
YGH55	Good impact resistance, used in the stands of pre-finishing rolling mills for hot rolling rebar and they can be machined by turning and milling.
YGH60	Good impact resistance, used for hot rolling rebar and in the first and second stands of pre-finishing rolling mills.

HIGH-SPEED WIRE ROLL RINGS

Special Roll Rings Series For Special Steel Rolling

Grade	Physical & mechanical properties					
	Density g/cm ³	Hardness HRA	Transverse Rupture Strength Mpa	Compressive Strength N/mm ²	Young's modulus KN/mm ²	Thermal Conductivity W/(m·K)
LS05	14.9	88.5	2600	4200	580	110
LS10	14.5	87.5	2800	3800	560	105
PA05	14.42	89	2600	2600	580	108
PA10	14.55	86	2750	3800	560	105
PA20	13.95	84.5	2700	3400	540	95
PA30	13.5	82.5	2500	3200	540	90

Note: 1. Typical physical & mechanical properties are listed with the variation range in accordance with the relevant national and industry standards.

2. Relevant parameters are for reference only.

Special roll rings series for special steel rolling: adopt coarse grain WC, with high hot cracking resistance and toughness. Suitable for rolling all types of high quality steel.

Grade	Applications
LS05	With excellent abrasion resistance and thermal fatigue resistance, used in finished stands. Especially suitable for stainless steel rolling.
LS10	With excellent abrasion resistance and thermal fatigue resistance, used in finished stands. Especially suitable for stainless steel rolling.
PA05	Good wear resistance, toughness, and hot cracking resistance, used in the last 1-2 stands of finishing mills.
PA10	Good wear resistance, toughness, and hot cracking resistance, used in the last 1-2 stands of finishing mills.
PA20	Good toughness and hot cracking resistance, used in the intermediate stands of finishing mills.
PA30	Good toughness and hot cracking resistance, used in the front stands of finishing mills.

HIGH-SPEED WIRE ROLL RINGS

"Hot Wheels" Roll Rings Series

Grade	Physical & mechanical properties					
	Density g/cm ³	Hardness HRA	Transverse Rupture Strength Mpa	Compressive Strength N/mm ²	Young's modulus KN/mm ²	Thermal Conductivity W/(m·K)
FHL-011	14.9	89	2600	4200	580	110
FHL-012	14.48	87.5	2800	3800	560	100
FHL-013	14	85	2700	3400	540	95
FHL-014	13.53	83	2700	2700	540	95
FHL-015	13.58	82	2700	2700	500	88

Note: 1. Typical physical & mechanical properties are listed with the variation range in accordance with the relevant national and industry standards.

2. Relevant parameters are for reference only.

With the improved wear resistance and fracture toughness through optimizing micro structure, "Hot Wheels" roll rings series are mainly used for the finished product stands of high speed wire mills and before the finished product stands of finishing mills, and post rod, wire metal products processing, suitable for rolling automobile industry cord steel and spring steel. The steel rolling capacity of single pass is 1.5~2 times that of the common grades.

Grade	Applications
FHL-011	Excellent wear resistance and fracture toughness, used in finished stands.
FHL-012	Excellent wear resistance and fracture toughness, used in the last 1-2 stands of finishing mills.
FHL-013	Good toughness, corrosion resistance, and creep resistance, used in the intermediate stands of finishing mills.
FHL-014	Good impact resistance, used in the stands of pre-finishing rolling mills for hot rolling rebars and they can be machined by turning and milling.
FHL-015	Good impact resistance, used in the stands of pre-finishing rolling mills for hot rolling rebars and they can be machined by turning and milling.

HIGH-SPEED BAR ROLL RINGS

Special Roll Rings Series For Low-temperature High Bar Line Rolling

Grade	Physical & mechanical properties					
	Density g/cm ³	Hardness HRA	Transverse Rupture Strength Mpa	Compressive Strength N/mm ²	Young's modulus KN/mm ²	Thermal Conductivity W/(m·K)
YGA06	14.7	89	3100	4200	585	105
YGA10	14.3	87.5	3000	3900	580	100
YGA20	13.85	85.5	3100	3500	540	95
YGA30	13.3	84.5	3000	3400	500	90
YGA40	12.8	82.5	3000	3100	480	88
YGA50	12.4	81	2900	3000	400	85
YGD05	12.1	81	2750	2700	380	82

Note: 1. Typical physical & mechanical properties are listed with the variation range in accordance with the relevant national and industry standards.

2. Relevant parameters are for reference only.

Special roll rings series for low-temperature high bar line rolling: excellent corrosion resistance and thermal fatigue resistance owing to the reinforced bonding phase and improved creep resistance of the alloy. Used in low temperature (700~850°C) special steel rolling.	
Grade	Applications
YGA06	High wear resistance, corrosion resistance and creep resistance, used in the last 1-2 stands of finishing mills.
YGA10	High wear resistance, corrosion resistance and creep resistance, used in the last 1-3 stands of finishing mills.
YGA20	Good toughness, corrosion resistance, and creep resistance, used in the intermediate stands of finishing mills.
YGA30	Good toughness, corrosion resistance and creep resistance, used in most stands of the finishing mills and in the rear stands of common mills.
YGA40	Good impact resistance, used in the stands of pre-finishing rolling mills for hot rolling rebar and they can be machined by turning and milling.
YGA50	Good impact resistance, used for hot rolling rebar and in the first and second stands of pre-finishing rolling mills.
YGD05	Good impact resistance, used for hot rolling rebar and in the first and second stands of pre-finishing rolling mills.

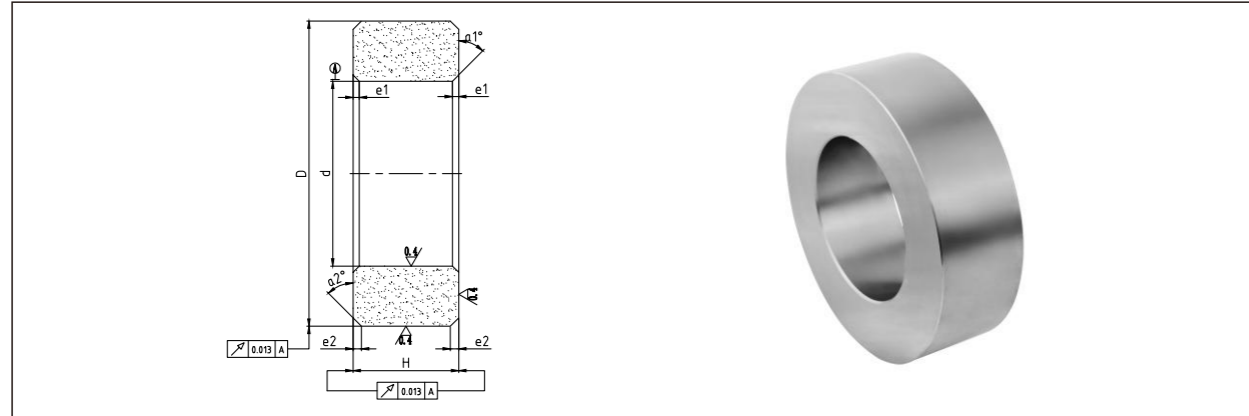
TABLE OF GRADES RECOMMENDED FOR USE IN DIFFERENT STANDS

Mills Stands			A	B	C	A	B	C	A	B	C	
Stands of Pre-finishing Mills	1	○	○	YGH55	YGR60	YGR60	YGR60 (PB60)					
	2	○	○	YGH55	YGH55	YGH55	YGR60 (PB60)	YGR60 (PB60)	YGR60 (PB60)			
	3	○	○	YGH50	YGH55	YGH55	YGR55 (PB55)	YGR55 (PB55)	YGR60 (PB60)			
	4	○	○	YGH50	YGH55	YGH55	YGR50	YGR55 (PB55)	YGR55 (PB55)			
Stands of Finishing Mills	1	○	○	YGH45	YGH50	YGH50	YGR40	YGR45	YGR45 (YGR55)	YGA30 PA30		
	2	○	○	YGH45	YGH50	YGH50	YGR40	YGR45	YGR45 (YGR55)	YGA30 PA30		
	3	○	○	YGH40	YGH45	YGH50	YGR40	YGR45	YGR45	YGA30 PA30	YGA30 PA30	
	4	○	○	YGH40	YGH45	YGH50	YGR40	YGR45	YGR45	YGA30 PA30	YGA30 PA30	
	5	○	○	YGH30	YGH40	YGH45	YGR30	YGR40	YGR45	YGA30 FA30 (YGA20) (RA20)	YGA30 DA30	
	6	○	○	YGH30	YGH40	YGH45	YGR30	YGR40	YGR45	YGA30 FA30 (YGA20) (RA20)	YGA30 PA30	
	7	○	○	YGH30	YGH40	YGH45	YGR30	YGR40	YGR40	Pa20 YGA20 (YGA30)	Pa20 YGA20 (YGA30)	YGA30 PA20
	8	○	○	YGH30	YGH40	YGH45	YGR30	YGR40	YGR40	PA20 YGA20 (YGA30)	Pa20 YGA20 (YGA30)	YGA30 PA20
	9	○	○	YGH20 (YGH25)	YGH25 (YGH30)	YGH40	YGR20 (YGR25)	YGR25 (YGR30)	YGR40	PA20 YGA20 (YGA30)	BA20 YGA2 (YGA30)	YGA30 PA20
	10	○	○	YGH20 (YGH25)	YGH25 (YGH30)	YGH40	YGR20 (YGR25)	YGR25 (YGR30)	YGR40	PA20 YGA20 (YGA30)	PA20Y GA20 (YGA30)	YGA30 PA20
Stands for Reducing and Sizing Mills	1	○	○	YGH40	YGH45 (YGH40)	YGH45	YGH40	YGR45 (YGR40)	YGR45	YGA20 PA20 (YGA30) (PA30)	YGA30 PA30 (YGA20) (PA20)	YGA30 PA30
	2	○	○	YGH40	YGH45 (YGH40)	YGH45	YGH40	YGR45 (YGR40)	YGR45	YGA20 PA20 (YGA30) (PA30)	YGA30 PA30 (YGA20) (PA20)	YGA30 PA30
	3	○	○	YGH10 YGH20 (YGH25)	YGH30 (YGH25)	YGH40 (YGH30)	YGR20 (YGR25)	YGR30 (YGR25)	YGR40 (YGR30)	YGA10 PA10 (YGA20) (PA20)	YGA20 PA20 (YGA10) (PA10)	YGA20 PA20
	4	○	○	YGH05 YGH10 YGH20 (YGH25)	YGH30 (YGH25)	YGH40 (YGH30)	YGR20 (YGR25)	YGR30 (YGR25)	YGR40 (YGR30)	YGA10 PA10 (YGA20) (PA20)	YGA20 PA20 (YGA10) (PA10)	YGA20 PA20

Note: Classes A, B, C stand for excellent, good, poor working condition of rolling mills respectively. () is the alternate choice.

PICTURE OF CARBIDE ROLL RINGS

Carbide Roll Rings Without Grooves



Rang of O.D. (D)	Rang of I.D. (d)	Rang of Height (H)
120~470	70~310	40~250

Unit:mm

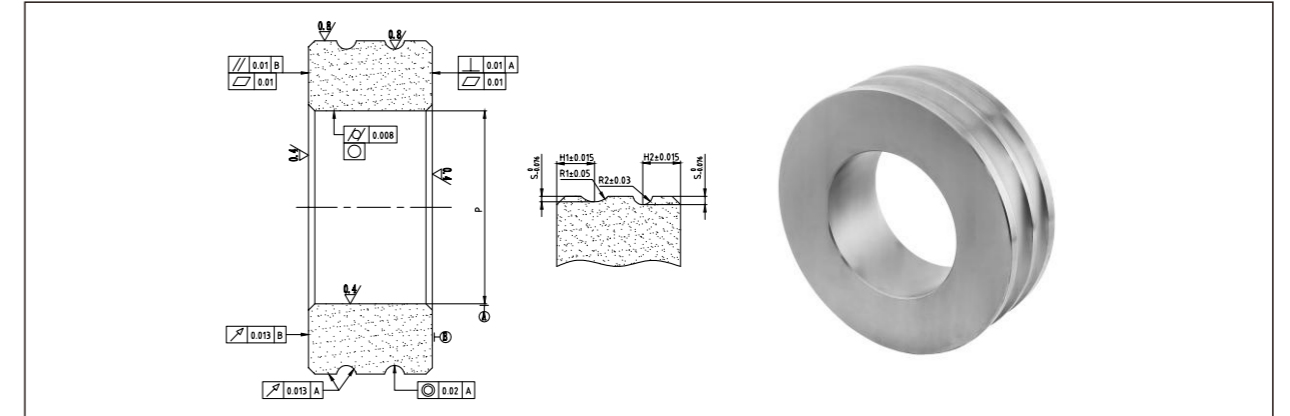
The Allowable Deviation in outsider diameter, inner diameter and Height of Roll Rings

Precision Classes	1	2	3	4	Special Requirements
O.D. (±)	0.02	0.05	0.10	0.15	
I.D. (+)	IT5	IT6	IT7	IT8	
Height(-)	0.03	0.1	0.20	0.5	

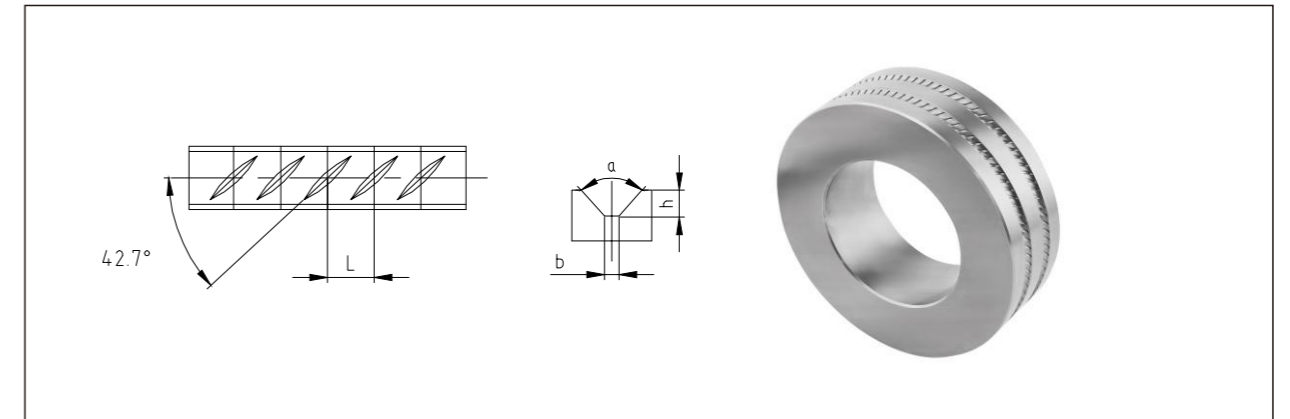
Unit:mm

PICTURE OF CARBIDE ROLL RINGS

Grooved Carbide Roll Rings



Notched Carbide Roll Rings



The Geometrical tolerance of Carbide Roll Rings

Radial run-out of groove	Radial run-out of periphery	End face run-out	End face flatness	End face parallelism	Inner hole cylindricity
≤0.013	≤0.02	≤0.01			

Unit:mm

Roughness of carbide rolls

Inner hole roughness	Outer roughness	End face roughness
0.4~0.8	0.8~1.6	0.4~0.8

The allowable deviation in outer diameter, inner diameter and height is to be determined based on customer's needs. Unit:μm

COMPOSITE ROLLS

CEMENTED CARBIDE COMPOSITE ROLLS

INTRODUCTION OF CEMENTED CARBIDE COMPOSITE ROLLS

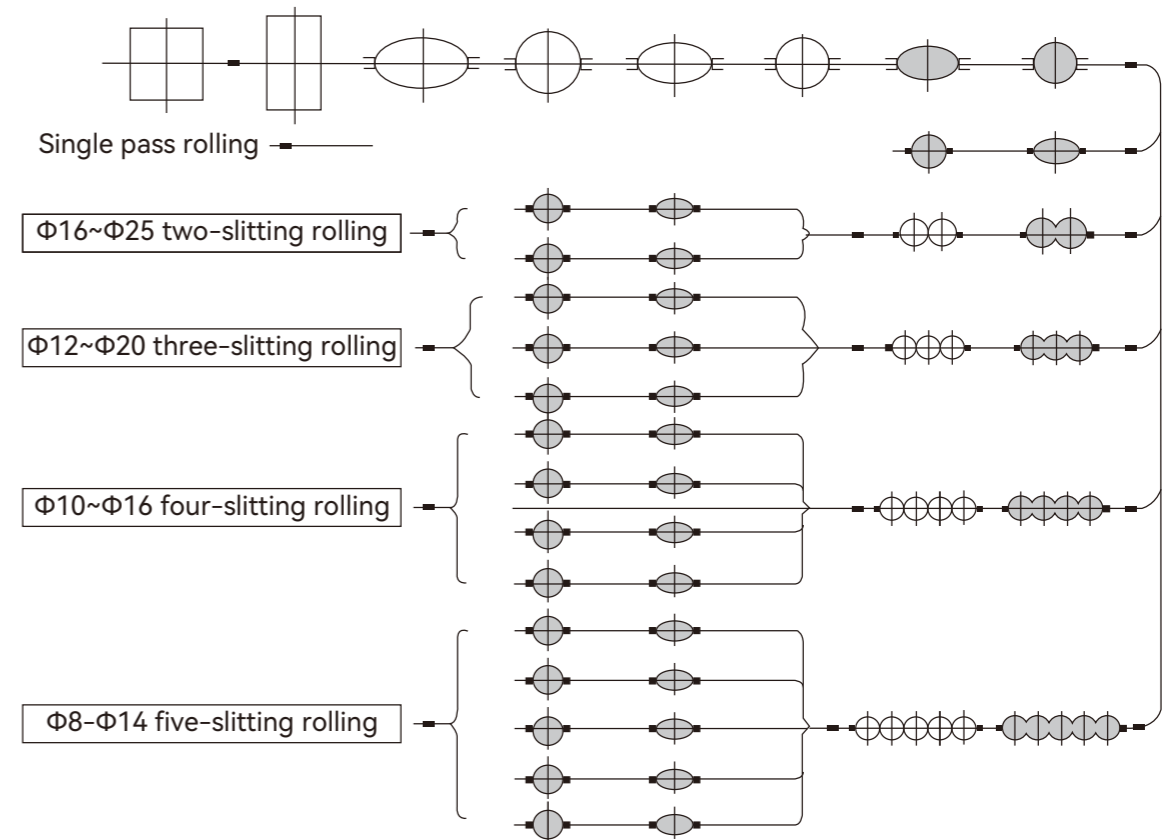
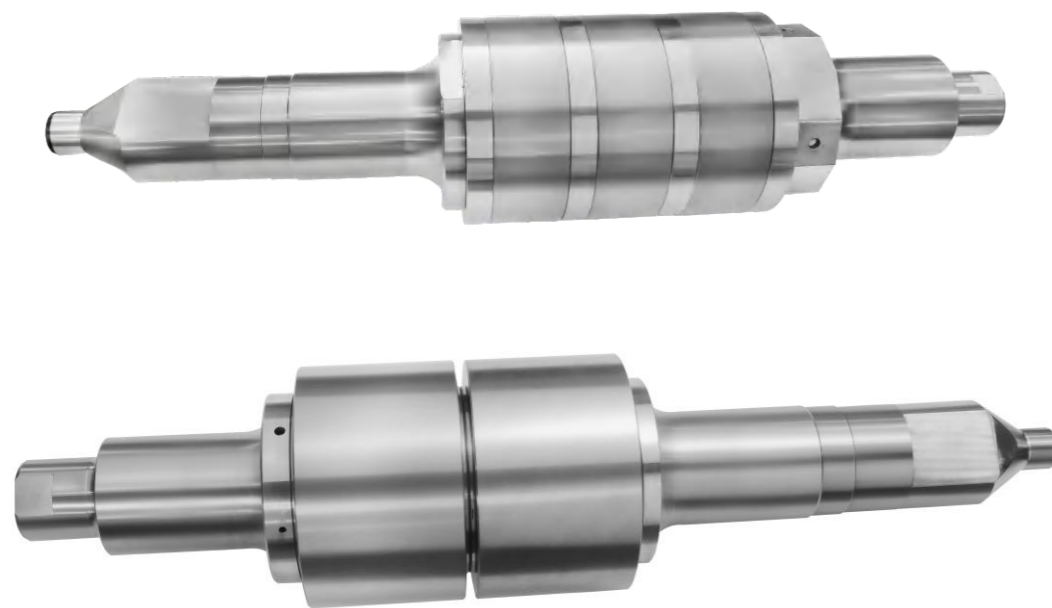
Definition of Cemented Carbide Composite Rolls

Composite roll is specially made by combining the cemented carbide roll rings with steel shaft, which is used for rolling round steel, ribbed steel, square steel, flat steel, angle steel and other profiles.

Scope Applications of Cemented Carbide Composite Rolls

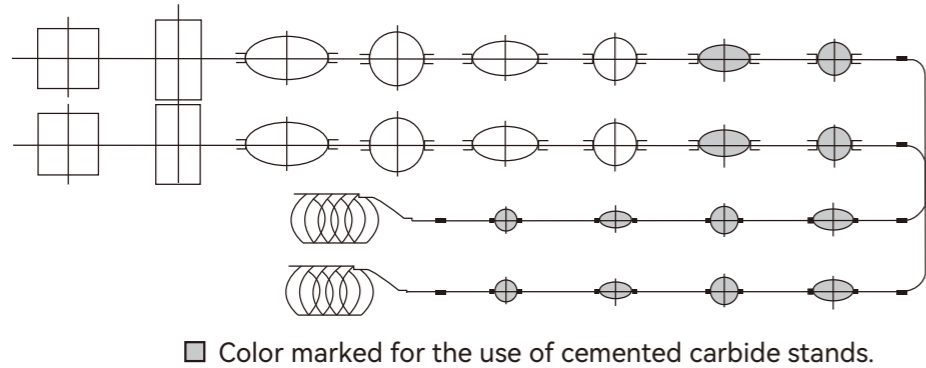
The cemented carbide composite roll is suitable for the intermediate stands of the traditional rod mills, rod and wire mills and high-speed wire mills with rolling speed is 2-50m/s.

(1) Traditional rod mills: It is used for product stands, pre-slitting stands and intermediate stands of traditional rod mills.



■ Color marked for the use of cemented carbide stands.

(2) Wire & Rod mills: used for the stands of finishing mills and intermediate rolling stands of rod and wire mills.

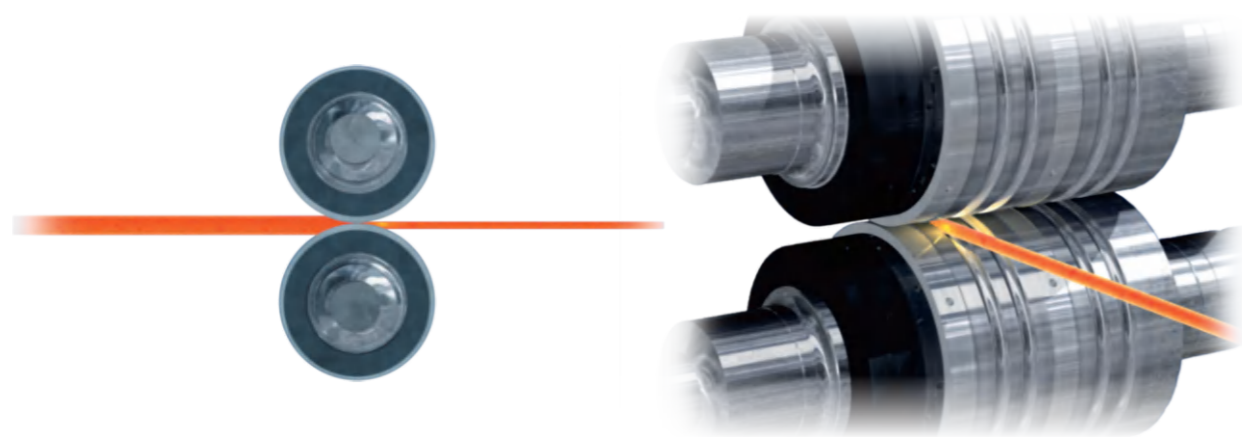
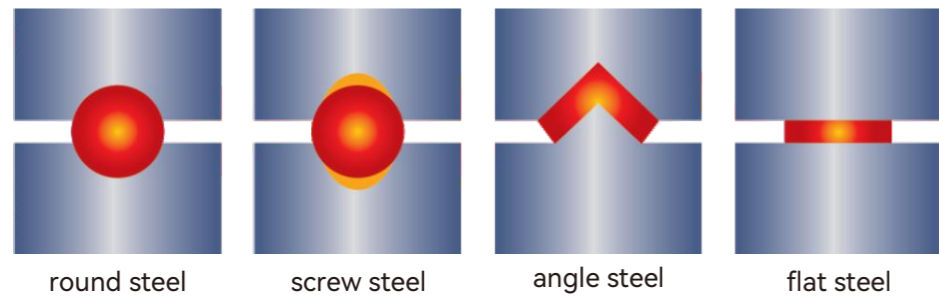


(3) High speed wire rolling mills

Used in Intermediate stands for high speed wire rolling mills.

(4) Small profile mills

Used for Angle steel, square steel, flat steel of pre-finished product and finished product stands.



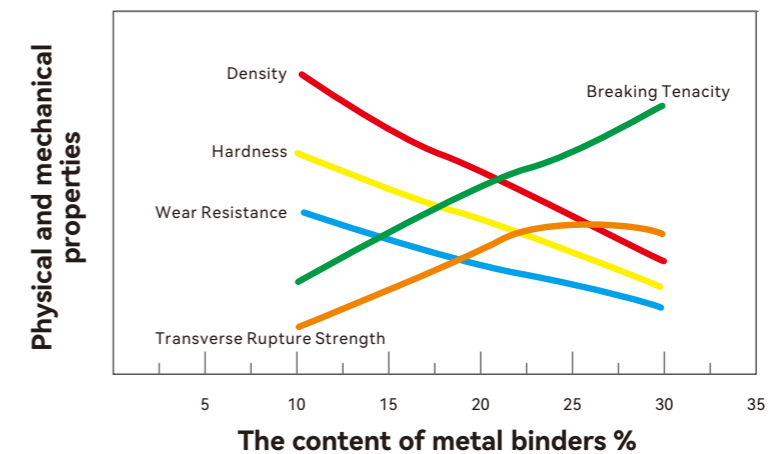
Advantages of Cemented Carbide Composite Rolls

- (1) The quality of steel products is improved, and the surface quality and tolerance of rolled materials improved thoroughly. The negative deviation can be controlled more precisely.
- (2) The change frequency of groove and roll, the downtime and the labor intensity can be reduced in rolling workshop. Increasing productivity and output can create greater economic benefit at the same time.
- (3) Improve the yield of products.
- (4) Greatly reducing the steel rolling cost per ton is an effective way for enterprise to reduce cost and increase benefit.

Composition and Characteristics of Grades for Cemented Carbide Composite Roll Rings

Cemented carbide is mainly made of tungsten carbide particles and metal binder (often cobalt), When needed, nickel, chromium, etc., is added in order to improve its hot cracking resistance and corrosion resistance. Different binder content and corresponding WC particle size can yield different cemented carbide grades. ZCC has a series of cemented carbide roll rings grades to apply different rolling mills and stands.

The relationship between the physical and mechanical properties of cemented carbide grades and the content of metal binders:



COMPOSITE ROLLS

Special Cemented Carbide Roll Rings Series

Grade	Chemical Composition, Wt%		Physical & Mechanical Properties					
	WC (%)	Co+Ni+Cr (%)	Density g/cm ³	Hardness HRA	Transverse Rupture Strength N/mm ²	Compressive Strength N/mm ²	Young's modulus KN/mm ²	Thermal Conductivity W/(m·K)
Pc20	77	23	13.25	83	2950	3100	450	77
PC30	74	26	13	81.6	2920	2900	450	69
PC40	70	30	12.65	80.9	2871	2700	400	61
Pc50	68	32	12.48	79.2	2700	2320	400	60

Note: 1. Typical physical & mechanical properties are listed with the variation range in accordance with the relevant national and industry standards.

2. Relevant parameters are for reference only.

Special cemented carbide roll rings series: with optimized structure of WC, good hot cracking resistance and impact resistance, used in the stands of finishing rolling mills for rebar, rods and wire, which can greatly increase the amount of single pass rolling tonnage, reduce the labor intensity, so as to improve the production efficiency and obtain better economic benefits.

Grade	Applications
PC20	Good impact resistance and hot cracking resistance, used in the front stands of the finishing mills stand.
PC30	Good impact resistance and hot cracking resistance, used in the stands of pre-finishing rolling mills for hot rolling rebar.
PC40	Good impact resistance and hot cracking resistance, used in round bar finished products and rebar stands.
PC50	Good impact resistance and hot cracking resistance, used in round bar finished products and rebar stands.

COMPOSITE ROLLS

General Cemented Carbide Roll Rings Series

Grade	Chemical Composition, Wt%		Physical & Mechanical Properties					
	WC (%)	Co+Ni+Cr (%)	Density g/cm ³	Hardness HRA	Transverse Rupture Strength N/mm ²	Compressive Strength N/mm ²	Young's modulus KN/mm ²	Thermal Conductivity W/(m·K)
YGR55	75	25	13.03	79.5	2600	3100	446	66
YGR60	70	30	12.73	79	2600	3000	425	57

Note: 1. Typical physical & mechanical properties are listed with the variation range in accordance with the relevant national and industry standards.

2. Relevant parameters are for reference only.

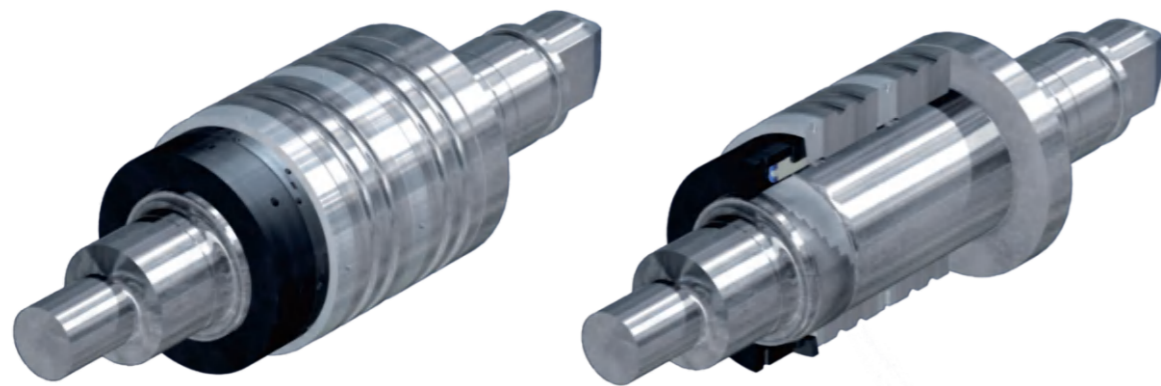
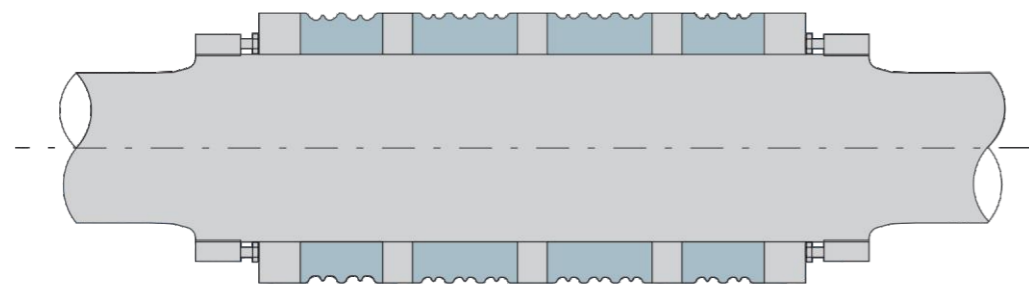
General cemented carbide roll rings series: utilize Co-Ni-Cr as the binder phase, with high wear resistance and corrosion resistance and versatility.

Grade	Applications
YGR55	Good impact resistance, used in round bar finished product and before the finished product stands.
YGR60	Good impact resistance, used in round bar finished products, before the finished product and the slitting stands.

KOCKS ROLL RINGS

Structure of Cemented Carbide Composite Rolls

The cemented carbide composite roll is assembled by hydraulic axial compression combination technology with ZCC's own intellectual property rights. Hydraulic axial compression combination technology is a method to combine the roll ring and the roll shaft by applying a certain compression force in the axial direction of the roll ring. With the screw thread of hydraulic nut, the force generated by the hydraulic system is transformed into the tension force on the roll shaft, which causes the elastic tensile deformation of the shaft and causes the roll ring on the roll shaft to be compressed, and ensure the cemented carbide roll is not loose. Meanwhile, the roll shaft can be reused.



Supporting Technical Services

1. Service is available for the design, groove and notches machining of cemented carbide composite rolls.
2. Various machining tools can be provided for machining cemented carbide composite rolls.
3. A variety of assembly methods of composite rolls can be offered according to customer requirements.
4. Various cemented carbide roll rings are available with diameters of $\phi 300-450\text{mm}$ and thicknesses of 30-250mm for RSB stands of bars and wires.



CEMENTED CARBIDE KOCKS ROLL RINGS

INTRODUCTION OF CEMENTED CARBIDE KOCKS ROLL RINGS

The Kocks roll ring is used in a rolling mill with three roll rings arranged at an angle of 120° to each other. It is also called as a Y-mill because of the center line of the ring pass is like the English letter Y. Its basic features:

- (1) The width margin of the grooving is large, and the rolled piece is not easy to be folded during rolling.
- (2) The rolled pieces are surrounded by pressure on three sides, the deformation is even, the splitting head is significantly reduced, and the accidents of continuous rolling pile caused by splitting head are eliminated.
- (3) The trace extension is even, and the wear of each groove is even.
- (4) A set of grooving drawing can be used in different kinds of steel rolling.
- (5) Compared with the common rolling mill under the condition of the same area, the cutting depth of the roll ring is small, so as to reduce the wear of the hole groove and improve the product quality.

KOCKS ROLL RINGS

Table of Grades and Recommended Applications

Grade	Chemical Composition, Wt%		Physical & Mechanical Properties					
	WC (%)	Co+Ni+Cr (%)	Density g/cm ³	Hardness HRA	Transverse Rupture Strength N/mm ²	Compressive Strength N/mm ²	Young's modulus KN/mm ²	Thermal Conductivity W/(m·K)
YGR50	78	22	13.37	81.5	2630	3100	480	76
YGR55	75	25	13.03	79.5	2600	3100	446	66
YGR60	70	30	12.73	79	2600	3000	425	57

Note: 1. Typical physical & mechanical properties are listed with the variation range in accordance with the relevant national and industry standards.

2. Relevant parameters are for reference only.

Grade	Applications
YGR50	Good toughness and hot cracking resistance, used in the front stands of finishing mills.
YGR55	Good impact resistance, used in round bar finished product and before the finished product stands.
YGR60	Good impact resistance, used in round bar finished product, before the finished product and slitting stands.

STEEL TUBE ROLL RINGS & STEEL ANGLE ROLL RINGS

INTRODUCTION OF CEMENTED CARBIDE ROLL RINGS FOR ROLLING STEEL TUBES AND STEEL ANGLE

The service life of cemented carbide roll rings is 50-80 times of that of conventional cast iron roll rings when they are used at tension tubes reducing machine for hot rolling of seamless steel tubes, and the surface quality and dimensional precision is substantially improved. Based on the condition of tension tube reducing machines (rolling force, speed, tube diameter), the use of either full carbide roll rings or composite roll rings can be recommended, achieving a high performance cost ratio. Optional cemented carbide grades: YGR55, YGR60.

STEEL TUBE ROLL RINGS & STEEL ANGLE ROLL RINGS

Table of Grades and Recommended Applications

Grade	Chemical Composition, Wt%		Physical & Mechanical Properties					
	WC (%)	Co+Ni+Cr (%)	Density g/cm ³	Hardness HRA	Transverse Rupture Strength N/mm ²	Compressive Strength N/mm ²	Young's modulus KN/mm ²	Thermal Conductivity W/(m·K)
YGR55	75	25	13.03	79.5	2600	3100	446	66
YGR60	70	30	12.73	79	2600	3000	425	57

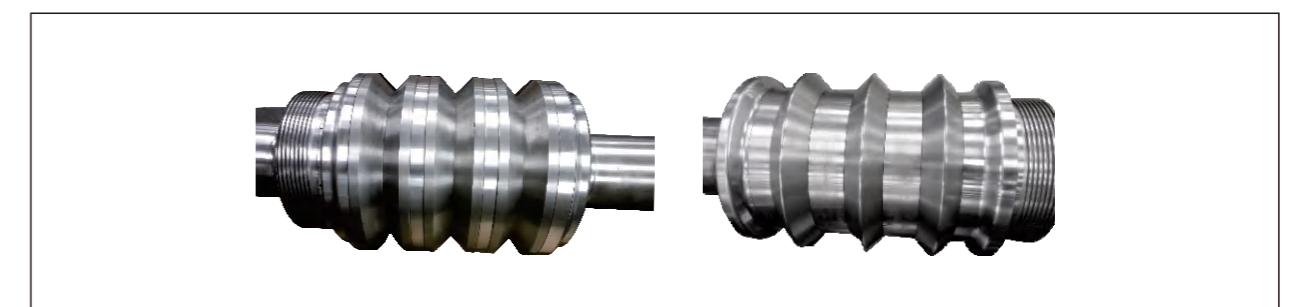
Note: 1. Typical physical & mechanical properties are listed with the variation range in accordance with the relevant national and industry standards.

2. Relevant parameters are for reference only.

Grade	Applications
YGR55	Good impact resistance, used in rolling steel tubes and steel angle A25~75.
YGR60	Good impact resistance, used in rolling steel tubes and steel angle A25~75.



Picture of Steel Tube Roll Rings



Picture of Steel Angle Roll Rings

CARBIDE ROLLS FOR COLD ROLLING REBARS & TITANIUM CARBIDE GUIDE ROLLERS

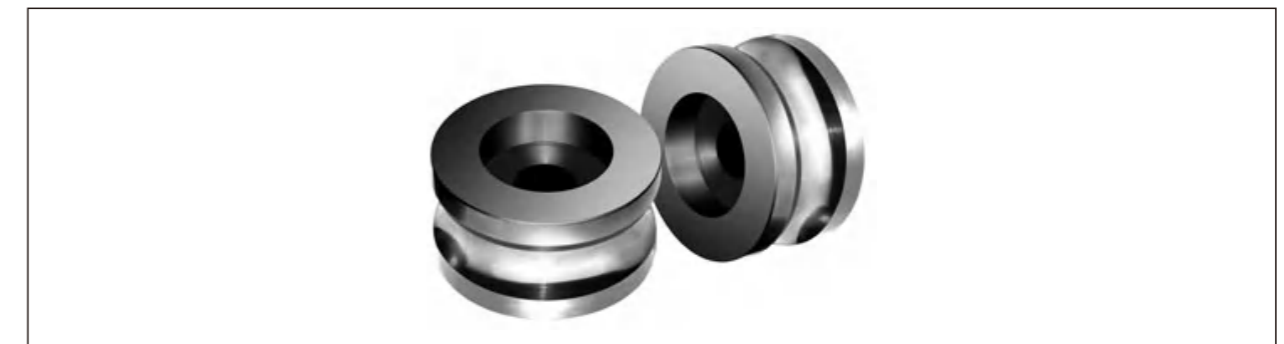
CARBIDE ROLLS FOR COLD ROLLING REBARS



Grade	Chemical Composition, Wt%		Physical & Mechanical Properties					
	WC (%)	Co+Ni+Cr (%)	Density g/cm ³	Hardness HRA	Transverse Rupture Strength N/mm ²	Compressive Strength N/mm ²	Young's modulus KN/mm ²	Thermal Conductivity W/(m·K)
YGH30	85	15	14.03	85	2870	3300	540	100



TITANIUM CARBIDE GUIDE ROLLERS



Grade	Chemical Composition, Wt%		Physical & Mechanical Properties		
	WC (%)		Density g/cm ³	Hardness HRA	Transverse Rupture Strength Mpa
GT35	Fe+TiC		6.43	86.5	1450

APPLICATION AND MAINTENANCE OF CEMENTED CARBIDE ROLL RINGS

Cemented carbide roll ring is a tool material which consists of tungsten carbide and cobalt with high hardness and wear resistance. To take advantage of high wear resistance, long life and high efficiency of cemented carbide roll rings during the high speed rolling, attention should be paid as follows when purchasing and using cemented carbide roll rings.

Grade Selection

An overall understanding of the properties of cemented carbide grades is a basis for correctly selecting the grades for roll rings used in the stands of rolling mills and an optimal combination of grades for the various stands of rolling mills.

Cemented Carbide Roll Rings Installation

Sleeve mounting and assembly of roll rings should be strictly performed according to the precision required by the design process. Proper fitting is needed for the roll rings, shaft for stands and conical sleeves, which can not be over tight or loose. When it is too tight, the roll rings are in a tensile load and is susceptible to cracking upon large rolling force fluctuation. When it is too loose, it causes the roll rings, shaft and conical sleeve to slide relatively during rolling, which scratches conical sleeves and shaft resulting in cracks. Before running the mill, check if the roll ring meets the requirements, and the assembled faces of the conical sleeve and the shaft need to be cleaned. It is forbidden to knock at the roll rings with hammer or other hard materials when mounting, and to impact each other during the transportation and installation to prevent roll rings from damage.

The installation reference specification is as follows:

- (1) The installation pressure is suggested to be 300-500 bar.
- (2) The installation process temperature is about 28°C.

Cooling of Cemented Carbide Roll Rings

Cooling is intended to reduce the impact of thermal corrosion, fatigue and stress to roll rings during milling. It can prevent the roll rings from cracking and slow down the crack propagation, prolonging

the life time of groove. It plays an important role in optimizing the performances of roll rings. The reference specifications for cooling are as follows:

- (1) The temperature of cooling water shall be less than 35°C.
- (2) Sufficient pressure of cooling water is needed to take away heat quickly, wash away the black skin sticking to the surface of the roll rings and reduce roll rings wear, and ensure the rolling tonnage. The pressure of cooling water is requested in 0.4-0.6MPa.

(3) Water volume

- Common high speed wire rolling line

Content of binder metal, %	6	10	15	20	25	30
Water volume L/(Groove width mm × min)	56	48	40	32	24	16

- Cemented Carbide Composite Rolls

Volume of Cooling Water (m ³ /h)	12~15	15~17	17~19	18~20
Application Situation	Single slot for bars under Φ12mm	Single slot for bars under Φ14-Φ16mm	Single slot for bars under Φ18-Φ20mm	Single slot for bars under Φ22-Φ25mm

(4) The optimum arrangement of cooling water is from mill exit to about one third of the circle of roll ring. The amount of cooling water should decrease with the increasing distance to mill exit. The cooling of mill exit is very important. The water flow out of the nozzle near mill exit should be 30% of the total amount the water column from the nozzle should be as close to the roll rings as possible.

The water is jetted in a radial direction and the angle between the water jet and the rotating direction of roll rings is 15-30 degrees. The width of the water column is 2 times that of the groove and the water should be jetted directly into the grooves and the water should not be scattering or misty. By controlling the water pressure, water volume and nozzle angle, the final cooling effect should be subject to the temperature of the roll surface which should be controlled to less than 50°C.

(5) Water quality requirements

①The PH level of the water suitable for the cemented carbide roll rings: 7.5≤pH≤7.8.

In weak alkali environment of pH≥7.2, carbide roll rings with pure cobalt binder phase should be used, such as YGH series.

In the weak acid environment of pH<7.2, the corrosion to cobalt is intensified, and carbide roll rings containing cobalt NI-Cr binder phase should be adopted, such as YGR series and PA series.

②The content of solid particles in the cooling water should be less than 15 mg/L, and the largest particles should be less than 40μm.

③The chemical composition of cooling water is as follows:

Composition	Chloride	Calcium ions	Sulfate
Content, mg/L	≤40	≤200	≤75

The Rolled Tons of Cemented Carbide Roll Rings

During rolling, microcracks in groove can not be avoided, and they need to be reground when they are at a certain depth (normally controlled at 0.2mm). Excessive rolling causes the microcracks to grow rapidly and risks of crushed rolls increase, which should be prevented. For rolling common materials, the normal rolled tonnage after each regrinding is as follows:

Mill stands	Rolled tons
Stands of pre-finishing mill	6000~1000
1~2 stands of finishing mill	3000~4000
3~4 stands of finishing mill	3000~4000
5~6 stands of finishing mill	2500~3000
7~8 stands of finishing mill	1500~2500
9~10 stands of finishing mill	800~1500
Stands for reducing and sizing diameters mill	1000~2000

The Machining of Cemented Carbide Roll Rings

During rolling, microcracks in groove can not be avoided, and they need to be reground when they are at a certain depth (normally controlled at 0.2mm). Excessive rolling causes the microcracks to grow rapidly and risks of crushed rolls increase, which should be prevented. For rolling common materials, the normal rolled tonnage after each regrinding is as follows:

CNC machines can be used for the turning of cementer carbide with high binder phase	
Tool material	Cubic boron carbide (CBN), Polycrystalline diamond (PCD)
Rotating speed in turning	15~25rpm
Feed rate	0.2~0.4mm/r
Depth of turning	0.2~0.5mm
Cooling	cooling is required for turning with PCD. Coolant should be applied before turning operations.

The Regrinding of Cemented Carbide Roll Rings

Regrinding allowance of roll rings

Microcracks will occur after the rolling groove for some time and when the microcracks extend to 0.2mm, the roll ring has to be reground. Microcracks must be reground thoroughly when regrinding, otherwise the unground microcracks will make the microcracks extend more rapidly during the next rolling and probably bring the roll ring to crack. The recommended amount of regrinding after normal rolling is as follows:

Mill stands	Regrinding allowance of roll rings, mm
Pre-finishing	1.2~1.5
1-8 Stands of finishing rolling mill	0.6~1.2
9-10 Stands of finishing rolling mill	0.4~0.6

Selection of Grinding Wheel

Recommended grinding wheel for roll rings outer round

Process	Types of grinding wheel	Particle size	Concentration
Coarse grinding outer round	Resin wheel	120#	75%
Fine grinding outer round	Resin wheel	150#	75%

Recommended grinding wheel for roll rings grooving

Process	Types of grinding wheel	Particle size	Concentration
Coarse grinding outer round	Resin wheel	120#	75%
Fine grinding outer round	Resin wheel	150#	75%

Application and Maintenance of Cemented Carbide Roll Rings

(1) After the installation of the cemented carbide roll rings on line, the cooling water pipe and position of the roll rings should be carefully checked and then connected from the inlet hose to the special water pipe. The inlet must be fixed tightly after the hose is connected to prevent the inlet from falling off and causing serious consequences to the roll rings without being cooled (roll rings blast).

(2) Water cooling of cemented carbide rolls is a very important in the process of rolling, the better cooling condition will bring the higher rolling tonnage, otherwise the roll rings groove will tend to crack. Therefore, check whether the cooling water is normal before rolling test. In the rolling process, the production shift should stop every 4 hours to check whether the position of the special cooling water pipe is moved, whether the water pipe nozzle is blocked, and then start rolling.

(3) In order to ensure the roll rings cooling water volume, water quality and water pressure, it is recommended that the water pipe of the mills be connected from the control cooling water pipe, and

the water pressure gauge and water pressure alarm device be installed. In case of alarm, stop rolling immediately and start rolling after the water pressure is adjusted to normal range. Operators should ensure that the pressure of the special cooling water pipe for finished rolling mills is within the range of 0.4-0.6Mpa. If beyond the range, adjust the water pressure to the above range as required.

(4) During the rolling process, it is necessary to pay close attention to the running state of the bearing seat and stop rolling immediately if any abnormality is found.

(5) During the shift, the operator should carefully check the wear of the rolling rings groove to see whether there are microcracks. If so, report shall be made to the dispatcher and quality inspector, and then replace the rolling rings groove after confirmation.

(6) The adjustment of rolling rings gap shall not be seamless in the rolling process, that is, can not stick rolls rolling.

(7) Once abnormal rolling products are found in the sampling room, stop the rolling machine immediately to check it. If the screw is loose, the groove has microcracks and other phenomena, the groove and roll rings need to be replaced.

(8) When the rolling material surface is abnormal (such as the rolling material surface trace caused by microcracks in the rolling groove), the groove or roll rings shall be changed in time.

(9) During the rolling process, it is necessary to prevent the axial fracture of cemented carbide roll rings caused by bearing overheating.

(10) In the process of using the roll, if the water is stopped or the position of the water pipe is shifted, stop the rolling machine immediately to avoid burning out of the roll groove, cracking and dropping blocks, etc.

(11) The rolling tonnage of single groove is determined according to the actual situation (the reasonable rolling tonnage varies with the different rolling conditions), and it shall be strictly followed according to the rated tonnage. Excessive rolling is strictly prohibited to avoid cracking in the roll.

(12) In the case of stuck steel and piled steel, the roll rings should continue to be cooled and the upper roll shall be quickly lift. The water can not be cut off until the temperature of the rolled piece decreases.

(13) It must be stopped immediately to remove the roll and allow it to cool slowly (naturally) if the roll runs for a period of time without cooling water due to accidents, and it can be put into use after cooling or regrinding. Note that pouring cooling water directly onto the roll will cause the carbide roll rings to burst.

The Maintenance of Carbide Composite Roll

(1) Please carefully check the related contents of the Guidelines for the Use of Composite Rolls before use, and the relevant operators should be familiar with the requirements and matters needing

attention of the corresponding posts.

(2) The upper and lower rolls should be distinguished according to the Guidelines for the Use of Composite Rolls and marked conspicuously before the composite roll is installed to the rolling mill. (it is recommended to use sample punching to mark the shaft end or paint to mark conspicuously).

(3) It is necessary to check the cooling water pressure (recommended 0.4-0.6Mpa), water volume and arrangement of water pipes in accordance with the Guidelines for the Use of Composite Rolls before use, check whether the water pipes is aligned with the rolling groove and the water nozzle is not blocked, so that the machine rolling can only be started after meeting the requirements. It is recommended to check every 4 hours for pipe displacement or nozzle blockage.

(4) During the rolling process, it is necessary to pay close attention to the running state of the bearing seat and stop the rolling immediately if any abnormality is found.

(5) The rolling tons of single groove is carried out in strict accordance with the rolling system without excessive rolling. If the surface quality of the rolling rings groove is found to be abnormal (such as hair filaments), stop the rolling machine to check. If there are small short cracks in the rolling groove, the groove should be replaced in time or remove the composite rolls off the line.

(6) In the case of stuck steel and piled steel, the upper roll shall be lifted immediately, and the water shall be stopped only after the temperature of the rolled part is lowered (in the same way, after the last steel is rolled normally, keep cooling water for about 5 minutes and change the composite rolls after the composite roll shall be cooled).

(7) Product up (down) rolling mills, transfer process to avoid collision, storage needs to be fixed and protected.

(8) Every time up (down) rolling mills, it is necessary to check whether all parts are in good condition and tightened in place. If there is any abnormality, report needs to be made ensure safety before continuing use.

(9) Regularly (it is suggested that every month) Check the parts condition of bolts, threads, hydraulic nut oil inlet plug and other parts to ensure the fastening safety and the anti-rust surface treatment.

(10) It is recommended to protect the exposed bolts, threads, plugs and core holes with butter (or similar substances) if the product is not used for a long time.

(11) During the storage period, the overall appearance of the product is suggested to be protected by oil coating. Corrosive substances shall not be contacted to avoid damaging the product.

(12) If the bolts or spacers are seriously corroded due to long-term unused, it is necessary to check whether the parts are safe and reliable, and then use them after maintenance or replacement according to the actual situation.



SOCIAL RESPONSIBILITY

Focusing on the new development landscape featuring carbon peaking, carbon neutrality, and dual circulation, China Minmetals actively expands new standards, new technology, green energy, and digital intelligence, and continuously promotes intelligent, efficient, green and low-carbon development. It creates a more optimized lifestyle, and contributes to China's high-quality and sustainable development.

ZCC Group has been once again recognized as an environmental credit and integrity enterprise in Hunan Province. In accordance with people-orientated management philosophy, ZCC empowers the staff, provides quality service for customers and makes contributions to building a harmonious society. ZCC is dedicated to the development of staff, enterprise and society.

Aimed at becoming an environmental-friendly enterprise, ZCC implemented clean production and promoted environmental protection by eliminating its energy-intensive production lines and introducing new technologies, new processes and new energy resources. In May 2011, the natural gas boiler system went into operation, and the last two chimneys were removed.

WORLDWIDE SALES NETWORK



ZCC adopts international business strategy. Sales branches in Germany, the US, etc. were successively set up. Products of ZCC are exported to more than 70 countries and regions around the world. Adhering to the brand position of "first in China, first-class in the world", ZCC has become a reliable business partner of world-renowned enterprises, such as Schlumberger and Kennametal, through business cooperation and technology development. ZCC constantly strengthens itself by shaping brand, and fully integrates international resources including brand, technology, channels, and culture.

Looking ahead, ZCC is committed to the rejuvenation of China's tungsten industry. Bearing in mind the spirit of "pursuing excellence with relentless efforts", ZCC will create a cemented carbide group that is "first in China, first-class in the world" by constantly improving its technological innovation capacity and playing a leading role in the industry.

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