What is a Tungsten Carbide Milling Cutter?

中钨智造科技有限公司

CTIA GROUP LTD

CTIA GROUP LTD

Global Leader in Intelligent Manufacturing for Tungsten, Molybdenum, and Rare Earth Industries

INTRODUCTION TO CTIA GROUP

CTIA GROUP LTD ， a wholly-owned subsidiary with independent legal personality established by CHINATUNGSTEN ONLINE , is dedicated to promoting the intelligent, integrated, and flexible design and manufacturing of tungsten and molybdenum materials in the Industrial Internet era. CHINATUNGSTEN ONLINE, founded in 1997 with www.chinatungsten.com as its starting point—China's first top-tier tungsten products website—is the country's pioneering e-commerce company focusing on the tungsten, molybdenum, and rare earth industries. Leveraging nearly three decades of deep experience in the tungsten and molybdenum fields, CTIA GROUP inherits its parent company's exceptional design and manufacturing capabilities, superior services, and global business reputation, becoming a comprehensive application solution provider in the fields of tungsten chemicals, tungsten metals, cemented carbides, high-density alloys, molybdenum, and molybdenum alloys.

Over the past 30 years, CHINATUNGSTEN ONLINE has established more than 200 multilingual tungsten and molybdenum professional websites covering more than 20 languages, with over one million pages of news, prices, and market analysis related to tungsten, molybdenum, and rare earths. Since 2013, its WeChat official account "CHINATUNGSTEN ONLINE" has published over 40,000 pieces of information, serving nearly 100,000 followers and providing free information daily to hundreds of thousands of industry professionals worldwide. With cumulative visits to its website cluster and official account reaching billions of times, it has become a recognized global and authoritative information hub for the tungsten, molybdenum, and rare earth industries, providing 24/7 multilingual news, product performance, market prices, and market trend services.

Building on the technology and experience of CHINATUNGSTEN ONLINE, CTIA GROUP focuses on meeting the personalized needs of customers. Utilizing AI technology, it collaboratively designs and produces tungsten and molybdenum products with specific chemical compositions and physical properties (such as particle size, density, hardness, strength, dimensions, and tolerances) with customers. It offers full-process integrated services ranging from mold opening, trial production, to finishing, packaging, and logistics. Over the past 30 years, CHINATUNGSTEN ONLINE has provided R&D, design, and production services for over 500,000 types of tungsten and molybdenum products to more than 130,000 customers worldwide, laying the foundation for customized, flexible, and intelligent manufacturing. Relying on this foundation, CTIA GROUP further deepens the intelligent manufacturing and integrated innovation of tungsten and molybdenum materials in the Industrial Internet era.

Dr. Hanns and his team at CTIA GROUP, based on their more than 30 years of industry experience, have also written and publicly released knowledge, technology, tungsten price and market trend analysis related to tungsten, molybdenum, and rare earths, freely sharing it with the tungsten industry. Dr. Han, with over 30 years of experience since the 1990s in the e-commerce and international trade of tungsten and molybdenum products, as well as the design and manufacturing of cemented carbides and high-density alloys, is a renowned expert in tungsten and molybdenum products both domestically and internationally. Adhering to the principle of providing professional and high-quality information to the industry, CTIA GROUP's team continuously writes technical research papers, articles, and industry reports based on production practice and market customer needs, winning widespread praise in the industry. These achievements provide solid support for CTIA GROUP's technological innovation, product promotion, and industry exchanges, propelling it to become a leader in global tungsten and molybdenum product manufacturing and information services.

CTIA GROUP LTD

30 Years of Cemented Carbide Customization Experts

Core Advantages

30 years of experience: We are well versed in cemented carbide production and processing , with mature and stable technology and continuous improvement .

Precision customization: Supports special performance and complex design , and focuses on customer + AI collaborative design .

Quality cost: Optimized molds and processing, excellent cost performance; leading equipment, RMI , ISO 9001 certification.

Serving Customers

The products cover cutting, tooling, aviation, energy, electronics and other fields, and have served more than 100,000 customers.

Service Commitment

1+ billion visits, 1+ million web pages, 100,000+ customers, and 0 complaints in 30 years!

Contact Us

Email : sales@chinatungsten.com

Tel : +86 592 5129696

Official website : www.ctia.com.cn



1. Introduction

1.1 Background

In modern manufacturing, cutting tools are the core component for efficient and precise machining. With the continuous advancement of industrial technology, the requirements for machining efficiency, workpiece quality and tool life are increasing. Tools made of traditional materials can no longer meet the needs of complex working conditions. In this context, cemented carbide, as a high-performance material, has gradually become the mainstream choice for the manufacture of high-end cutting tools due to its excellent hardness, wear resistance and heat resistance. Especially in the fields of metal cutting, mold manufacturing, aerospace, etc., cemented carbide tools have become an indispensable machining tool due to their excellent performance. In 2025, with the in-depth development of intelligent manufacturing and automation technology, the demand for cemented carbide milling cutters continues to grow, and its application scenarios in precision machining are also expanding.

1.2 Theme Overview

Carbide milling cutter is a rotary cutting tool made of carbide material, which is widely used in milling of various materials. Its core feature is that it is made of tungsten carbide (WC) as the basis and an alloy material made of cobalt (Co) and other binders, which has the advantages of high hardness and durability. This article will comprehensively explore the definition of carbide milling cutter, introduce its physical properties, geometric characteristics and surface treatment technology in detail; analyze its classification method, including structure, use and coating type; explain the manufacturing process, application field, advantages and limitations in use; and provide precautions for use to ensure its safe and efficient application. Through this chapter and subsequent content, readers will have a deep understanding of the characteristics and applications of carbide milling cutters, so as to better integrate them into actual production.

2. Definition of Carbide Milling Cutter

2.1 Basic definition of cemented carbide milling cutter

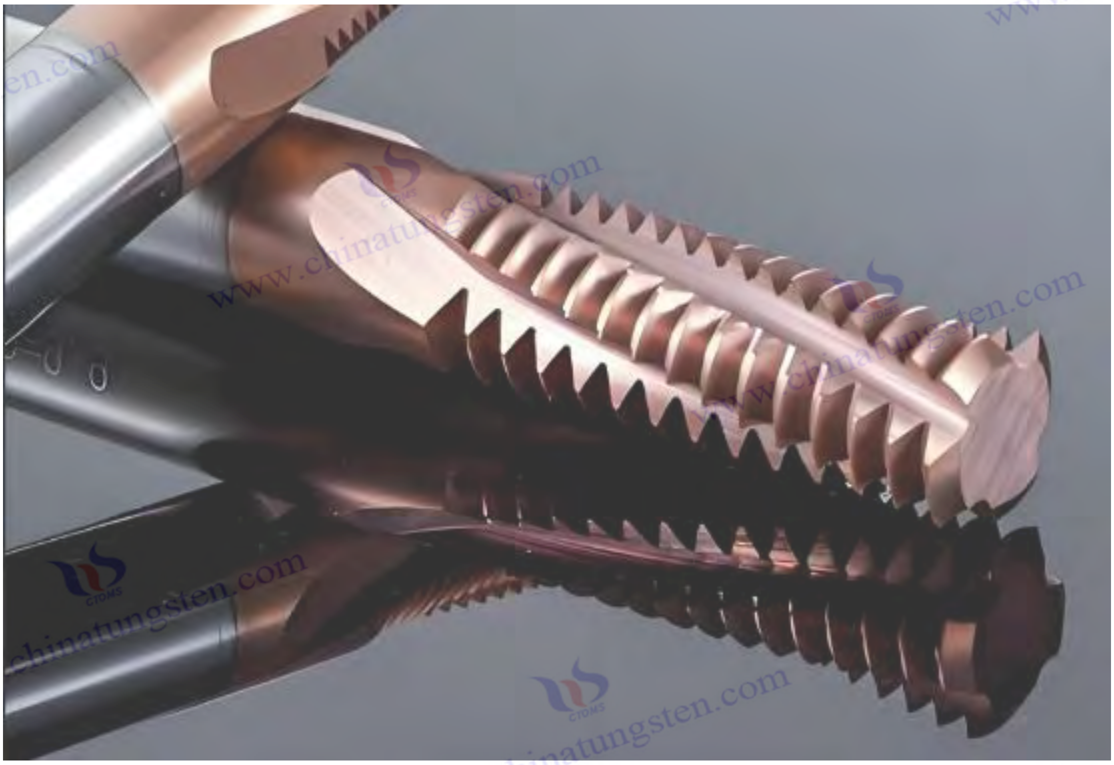
Cemented carbide milling cutter is a high-performance rotary cutting tool. Its cutter body and cutting part are made of cemented carbide material. It is widely used in precision machining of metals, alloys and some non-metallic materials. Cemented carbide is a composite material, mainly tungsten carbide (WC) as the hard phase, supplemented by metals such as cobalt (Co), nickel (Ni) or chromium (Cr) as the bonding phase, and sintered under high pressure (150-200 MPa) and high temperature (1350-1450°C) through advanced powder metallurgy process. This material gives the milling cutter an ultra-high hardness (usually reaching HV 1300-1800), which is significantly better than traditional high-speed steel (HSS), and has excellent wear resistance, high-temperature oxidation resistance (can stably work at 800-1000°C or even higher), and excellent resistance to mechanical stress, enabling it to cope with the processing needs of high-speed cutting, dry cutting and complex geometric shapes. The typical structure of a carbide milling cutter includes a cutting edge , a shank, a transition section, and an optional cooling hole design. The cutting edge can be designed as a straight tooth, a spiral tooth (angle range 15°-45°), a serrated or corrugated shape according to the processing requirements to adapt to different workpiece materials and processing accuracy. Its working principle is to remove material with a feed rate (fn) of 0.05-0.3 mm/tooth per tooth through high-speed rotation (the speed can reach 10,000-50,000 rpm, depending on the diameter and cutting speed). It is widely used in high - precision fields such as automotive manufacturing, aerospace, mold processing and the electronics industry. In 2025, with the increase in demand for miniaturized processing driven by 5G technology, the application of small-diameter models (diameter 0.5-2 mm) of carbide milling cutters in the field of micro-machining will increase significantly.

2.2 Differences between carbide milling cutters and other milling cutters

Carbide milling cutters show significant differences from other types of milling cutters in material composition, processing performance and application scenarios, laying the foundation for their unique positioning in modern manufacturing. First of all, compared with traditional high-speed steel (HSS) milling cutters, carbide milling cutters have overwhelming advantages in hardness, heat resistance and service life. The hardness of HSS milling cutters is generally HRC 62-66 (about HV 700-800), and the heat resistance is limited to about 600°C. Long-term high-temperature use will cause annealing softening, while the heat resistance of carbide milling cutters can reach more than 1000°C, especially after being equipped with TiAlN coating, the heat resistance is further improved to 1100°C, making it perform well under high-speed cutting (Vc 50-200 m/min) or dry cutting conditions. In addition, the service life of carbide milling cutters is usually 5-10 times that of HSS milling cutters , significantly reducing the replacement frequency and production downtime. However, HSS milling cutters still occupy a certain market share in low-speed machining ($Vc < 30$ m/min), intermittent cutting or small-batch production due to their lower manufacturing cost (about 1/3-1/5 of that of cemented carbide) and better toughness, and are widely used in small and medium-sized enterprises in developing countries.

On the other hand, compared with ceramic or diamond-coated tools, carbide milling cutters have their own advantages and disadvantages in performance and applicability. Ceramic milling cutters (such as alumina or silicon nitride-based) have higher hardness (HV 1800-2200) and wear resistance, and are suitable for ultra-high-speed cutting ($Vc > 300$ m/min) and processing high-hardness materials (such as hardened steel HRC 60+), but they are relatively brittle (fracture toughness $K_{1}c$ is about 3-5 MPa·$m^{1/2}$), prone to chipping under intermittent cutting or impact loads, and are expensive to manufacture (about 2-3 times that of carbide), limiting their popularity. Diamond-coated tools (such as CVD diamond) perform well in processing non-ferrous metals (such as aluminum alloys and carbon fiber composites), with wear resistance up to 10-20 times that of carbide , but their chemical affinity for iron -based materials leads to rapid wear, and the risk of coating peeling is high, and the cost is far higher than that of carbide (about 5-10 times). In contrast, carbide milling cutters have a fracture toughness ($K_{1}c$ 10-15 MPa·$m^{1/2}$) that is more suitable for impact resistance, have relatively low manufacturing costs (approximately US$50-100 per cutter, depending on size and coating), and have significantly improved durability through PVD or CVD coating technology (such as TiN , AlCrN) , making them an ideal choice for medium to high-demand machining tasks.

From a historical perspective, the development of cemented carbide milling cutters began in the early 20th century. German scholar Schroter first synthesized cemented carbide in 1923. After nearly a hundred years of technological iteration, cemented carbide tools gradually became the industry benchmark with the formulation of standards such as GB/T 14301 in 2008. In 2025, with the use of artificial intelligence to optimize cutting parameters and 3D printing technology for complex tool manufacturing, the customization of cemented carbide milling cutters will be further improved. For example, multifunctional composite tools designed for specific workpieces (integrating milling and drilling) show their adaptability in intelligent manufacturing. International standards such as ISO 6987 (hard material inserts) and DIN 844 (general technical conditions for milling cutters) also provide technical benchmarks for the global application of cemented carbide milling cutters, especially in the EU and North American markets, where market demand will increase by about 8% between 2024 and 2025, driving related R&D investment.



3. Characteristics of carbide milling cutters

3.1 Physical properties of cemented carbide milling cutters

Carbide milling cutters occupy an important position in cutting tools due to their excellent physical properties, which enable them to adapt to the processing requirements of high strength, high speed and complex working conditions. First of all, their high hardness is the core advantage, usually reaching HV 1200-1800 (Vickers hardness), far exceeding the HV 700-800 of traditional high-speed steel (HSS). This hardness level is tested by Vickers hardness tester (load 30 kg), which ensures the stability of the milling cutter when cutting high- hardness materials (such as hardened steel HRC 50+). In addition, carbide milling cutters have excellent wear resistance. This feature comes from the high wear resistance of tungsten carbide (WC) particles, combined with the enhanced toughness of the cobalt (Co) binder phase, which significantly extends the tool life. Durability tests (such as ISO 8688-1 standard) show that when cutting steel (HB 200), the wear band width (VB) can be controlled within 0.3 mm, and the continuous use time can reach 30-50 hours, depending on the cutting parameters and workpiece material. Third, heat resistance is another highlight of cemented carbide milling cutters, which can work stably at 800-1000°C and can even withstand high temperature environments up to 1100°C after being equipped with TiAlN coating. This performance makes it suitable for dry cutting or high-speed processing (Vc 100-200 m/min), reducing the need for coolant use, which is in line with the trend of green manufacturing in 2025. In addition, cemented carbide has a low thermal expansion coefficient (about $4.5\text{-}6.0 \times 10^{-6}$ /°C) and can still maintain geometric accuracy at high temperatures, which is particularly suitable for the demand for high-precision parts in the aerospace field.

Hardness characteristics of cemented carbide milling cutters
Range: HV 1200-1800
Test method: Vickers hardness tester (load 30 kg)
Application advantages: Suitable for cutting hardened steel (HRC 50+)
Wear resistance of cemented carbide milling cutters
Base material: tungsten carbide (WC) + cobalt (Co)
Durability index: wear band width (VB) ≤ 0.3 mm
Service life: 30-50 hours (depending on working conditions)
Heat resistance of cemented carbide milling cutters
Working temperature: 800-1000°C, TiAlN coating up to 1100°C
Application scenarios: dry cutting, high-speed machining (Vc 100-200 m/min)
Environmental benefit: reduced coolant requirements
Thermal stability of cemented carbide milling cutters
Thermal expansion coefficient: $4.5\text{-}6.0 \times 10^{-6}$ /°C
Industry application: aerospace high-precision parts

3.2 Geometric characteristics of cemented carbide milling cutters

The geometric characteristics of carbide milling cutters provide the basis for their versatility and high-precision machining. The cutting edge designs are diverse, including straight teeth, helical teeth or serrated teeth, each optimized for specific machining tasks. The straight tooth design (helix angle 0°) is suitable for low-speed rough machining, with high cutting stability, but large vibration; the helical tooth design (helix angle 15°-45°) reduces impact force through gradual cutting, suitable for high-speed finishing and complex surface machining, especially widely used in mold manufacturing; serrated or corrugated cutting edges are used for groove machining and thin-walled workpiece cutting to improve chip control capabilities. In 2025, with the popularization of 5-axis CNC machine tools, customizable helix angle designs (such as 30°-40°) further optimize chip discharge and surface finish. In addition, precision requirements are another highlight of carbide milling cutters. The tolerance level is usually h6 (diameter 3-10 mm) or h7 (diameter 12-25 mm). Through the three-dimensional coordinate measuring machine (CMM) inspection, it is ensured that the coaxiality error is ≤ 0.01 mm and the roundness error is ≤ 0.005 mm. This high-precision feature makes it excellent in micro-machining (such as electronic component pin holes), meeting the strict requirements of tolerance control in smart device manufacturing.

Edge Design of Carbide Milling Cutter
Straight teeth
Helix angle 0°, suitable for low-speed rough machining
Helical teeth
Helix angle 15°-45°, suitable for high-speed finishing
Serrated/corrugated
Optimized grooving and thin-wall cutting
Customization trend of carbide milling cutters
Helix angle range: 30°-40° (optimized for 5-axis machines)
Application scenarios: complex surfaces, mold manufacturing
Precision standards for carbide milling cutters
Tolerance grade: h6 (3-10 mm), h7 (12-25 mm)
Inspection tool: Coordinate measuring machine (CMM)
Accuracy index: coaxiality ≤ 0.01 mm, roundness ≤ 0.005 mm
Micromachining Applications of Carbide Milling Cutters
Diameter range: 0.5-2 mm
Industry demand: 5G electronic component pin holes

3.3 Surface treatment of cemented carbide milling cutters

Surface treatment technology has significantly improved the performance and applicability of carbide milling cutters. Coating technology is the key. Common coatings include titanium nitride (TiN), titanium aluminum nitride (TiAlN) or aluminum chromium nitride (AlCrN), which are applied at 450-500°C by physical vapor deposition (PVD) process, and the coating thickness is generally 1-3 μm . TiN coating provides basic wear resistance and lubricity, suitable for general steel processing; TiAlN coating is the first choice for high-speed cutting and dry cutting due to its high heat resistance and oxidation resistance (up to 900°C); AlCrN coating performs well in

电话/TEL：0086 592 512 9696
CTIAQCD-MA-E/P 2018-2024V
sales@chinatungsten.com

processing stainless steel or titanium alloys, with better corrosion resistance and toughness, and the bonding strength is usually more than 70 MPa (verified by scratch test). In addition, surface roughness is an important indicator of quality control. The Ra of the cutting part is usually controlled at ≤ 1.6 μm , which is achieved by CNC grinding and polishing, while the Ra of the shank can reach ≤ 0.8 μm to ensure perfect matching with the machine tool spindle. In 2025, with the development of nano coatings (such as nano multilayer TiAlN) and self-lubricating coatings (such as MoS_2 composite coatings), the friction coefficient of cemented carbide milling cutters can be reduced to below 0.2, further improving cutting efficiency and tool life. In particular, the demand for high-performance coatings in the aerospace field has increased dramatically.

4. Classification of carbide milling cutters

4.1 Classification of Carbide Milling Cutters - Classification by Structure

According to their structural design, carbide milling cutters can be divided into integral, indexable and insert-toothed types. Each type has its own advantages in manufacturing process, rigidity, applicable scenarios and performance. The integral milling cutter is sintered as a whole through powder metallurgy process, with the highest rigidity and precision, suitable for high-precision processing such as aerospace parts and microelectronic components, especially in high-speed cutting (Vc 100-200 m/min). The indexable milling cutter adopts a replaceable insert design, which is easy to maintain and adapt to complex contour processing, such as automobile mold manufacturing. The insert- toothed milling cutter combines carbide teeth and steel cutter body, taking into account hardness and toughness, and is suitable for heavy-load rough processing, such as thick plate processing in the shipbuilding industry. In 2025, 3D printing technology promotes the personalized tooth shape design of insert-toothed milling cutters.

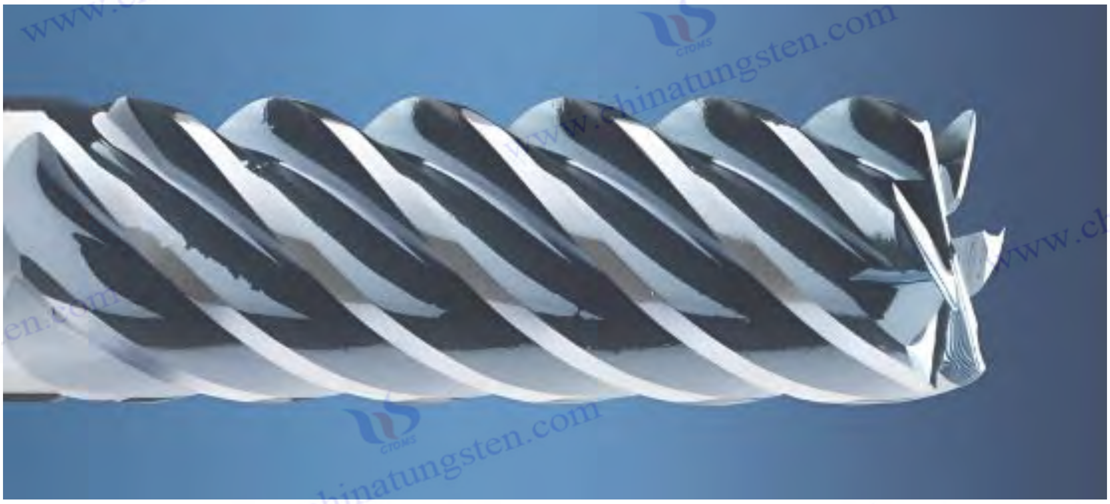
Classification	Structural features	Application Scenario	Performance Advantages
Monolithic	Integrally sintered carbide	High-precision machining (aerospace, microelectronics)	High rigidity, strong fracture resistance
Indexable	Steel/Carbide Body + Replaceable Inserts	High volume production, complex contours (automotive moulds)	Easy to replace and highly adaptable
Toothed	Carbide teeth inlaid steel/cast iron cutter body	Heavy-duty roughing (ship thick plates)	Balance hardness and toughness

4.2 Classification of Carbide Milling Cutters - Classification by Application

According to the processing purpose, carbide milling cutters are divided into fillet milling cutters, keyway milling cutters, saw blade milling cutters and mold milling cutters, and each type is optimized for specific workpieces and processes. Fillet milling cutters are used for edge filleting or chamfering to ensure the surface finish of mold trimming and decorative processing. Keyway milling cutters are specially designed for semicircular or rectangular keyways of mechanical transmission shafts and meet relevant standards. Saw blade milling cutters are suitable for groove processing and slitting with multi-tooth design and are widely used in aluminum alloy plates and composite materials. Mold milling cutters support precision mold processing with complex geometries. In 2025, its customized models (such as ultra-thin saw blades) have attracted attention due to the demand for electric vehicle battery housings.

Classification	use	Technical Parameters	Application Scenario	Standards/Features
Corner milling cutter	Edge filleting/chamfering	Tolerance h6	Mould trimming and decorative processing	Surface quality Ra ≤ 1.2 µm
Keyway milling cutter	Semicircular/rectangular keyway processing	Width 1-8 mm	Mechanical transmission shaft	GB/T 1127-2023

Saw blade milling cutter	Grooving, cutting, slitting	Number of teeth: 4-20, thickness: 0.5-3 mm	Aluminum alloy plate, composite material	GB/T 14301-2008
Mould milling cutter	Precision mold/die processing	Complex geometry (such as stepped shapes)	Automobile stamping mold, injection mold	GB/T 20773-2006



4.3 Classification of Carbide Milling Cutters - Classification by Coating

Coating technology significantly affects the performance of carbide milling cutters, which are divided into uncoated, TiN coated, TiAlN coated and AlCrN coated according to coating type. Uncoated milling cutters are suitable for low-speed cutting or non-ferrous metal processing, but have limited wear resistance. TiN coating provides basic wear resistance and lubricity, suitable for general steel processing. TiAlN coating is the first choice for high-speed cutting due to its high heat resistance, while AlCrN coating excels in corrosion resistance. In 2025, the research and development of nano coatings and environmentally friendly coatings (such as CrN) has improved life and efficiency, especially in aerospace and medical device manufacturing. The demand has increased, and the ISO 13399 standard supports global digital management.

Classification	Technical Parameters	Performance characteristics	Application Scenario	Technology
No coating	-	Limited wear resistance	Low speed cutting (Vc < 50 m/min), non-ferrous metals	-
TiN coating	Thickness 1-2 µm	Basic wear resistance, lubricity	General steel, cast iron	PVD
TiAlN coating	Thickness 2-3 µm	High heat resistance (900°C), anti-oxidation	High speed cutting, dry cutting	PVD/CVD
AlCrN coating	Thickness 2-4 µm	Corrosion resistance, toughness	Stainless steel, titanium alloy	PVD

5. Manufacturing process of cemented carbide milling cutter

5.1 Material preparation of cemented carbide milling cutter

The manufacturing process of cemented carbide milling cutters starts with high-precision material preparation and uses advanced powder metallurgy technology to ensure the uniformity and performance stability of the material. The core raw material is tungsten carbide (WC) powder, whose particle size range is precisely controlled at 0.5-2 μm and the purity is as high as 99.8%. It is detected by a laser particle size analyzer to ensure uniform particle distribution (D50 is about 1.2 μm) to achieve high hardness and excellent wear resistance. The bonding phase mainly uses cobalt (Co) powder, the content is usually 6%-12% (weight percentage), and the particle size is controlled at 1-1.5 μm . The amount of cobalt added is precisely adjusted by X-ray fluorescence spectroscopy (XRF) analysis to balance hardness and toughness. In addition, trace strengthening phases such as titanium carbide (TiC , 0.5%-2%) and tantalum carbide (TaC , 0.3%-1%) can be added according to specific application requirements. These additives are observed by scanning electron microscopy (SEM) for their dispersion in the matrix to optimize high temperature performance and anti-adhesion. The mixing process uses a high-energy planetary ball mill with a ball-to-material ratio of 10:1, using carbide ball milling media, running at a speed of 200-300 rpm, and lasting for 24-48 hours. During this period, samples are taken regularly to test the uniformity of the powder (standard deviation < 5%) to ensure compliance with the GB/T 5244-2018 standard. The pressing molding uses a uniaxial hydraulic press or a cold isostatic press (CIP), applying a pressure of 150-200 MPa, and a pressing time of 10-20 seconds. The density of the blank reaches 60%-70% of the theoretical density (about 12-14 g/cm³) , and the density deviation is controlled within ±0.2 g/ cm³ by the Archimedean method . In 2025, nanoscale WC powder (particle size < 0.2 μm) and AI-driven ratio optimization (such as prediction of optimal Co content based on machine learning) significantly improved material properties, especially in the manufacture of micro milling cutters (diameter 0.5-2 mm), where the grain refinement effect increased the hardness to above HV 1800.

raw materials

Main component: tungsten carbide (WC), particle size 0.5-2 μm , purity 99.8%, D50 1.2 μm
Binder phase: cobalt (Co), particle size 1-1.5 μm , content 6%-12%
Additives: TiC (0.5%-2%), TaC (0.3%-1%), dispersion via SEM

Mixing process

Equipment: High-energy planetary ball mill, ball-to-material ratio 10:1, speed 200-300 rpm
Time: 24-48 hours, uniformity standard deviation < 5%
Standard: GB/T 5244-2018

Pressing

Pressure: 150-200 MPa, time 10-20 seconds
Density: 60%-70% theoretical density (12-14 g/cm³) , deviation ±0.2 g/ cm³
Technology trends: Nano-scale WC powder, AI optimized ratio

5.2 Processing flow of cemented carbide milling cutter

The machining process transforms the blank into a finished milling cutter in two stages: roughing and finishing, ensuring geometric accuracy and surface quality. Roughing removes excess material by turning or milling, using carbide tools or polycrystalline diamond (PCD) tools, with a cutting speed (Vc) controlled at 50-100 m/min, a feed rate (fn) of 0.1-0.2 mm/rev, a depth of cut (ap) set at 1-3 mm, and a machining allowance of 0.5-1 mm. The equipment uses a CNC lathe or a four-axis machining center with a spindle speed of 1000-3000 rpm. The cutting force monitoring system ensures that it does not exceed 500 N to avoid cracking of the blank. Finishing uses high-precision CNC grinding technology, using resin-bonded diamond grinding wheels (grain size #400-#600), grinding speed 20-30 m/s, feed rate 0.02-0.05 mm/pass, surface roughness Ra after processing is controlled at ≤ 0.8 μm , and tolerance grade reaches h6-h7 (diameter 3-25 mm). The coaxiality error is detected by laser interferometer and controlled within 0.01 mm, and the roundness error is ≤ 0.005 mm. The cutting edge is trimmed by electrospark machining (EDM, pulse energy 0.1-0.5 J) or laser machining (power 50-100 W, wavelength 1064 nm) to form straight teeth (helix angle 0°), spiral teeth (helix angle 15°-45°) or serrated cutting edges , and the cutting edge chamfer angle is 0.1°-0.3° to reduce cutting stress. In 2025, additive manufacturing technologies (such as selective laser melting, SLM) will introduce complex tool body designs, with laser powers of 200-400 W and layer thicknesses of 20-50 μm , shortening the processing cycle to 4-6 hours and improving geometric flexibility, making them particularly suitable for multifunctional composite tools.

roughing

Method: Turning or milling
Tools: Carbide/PCD tools

Parameters: Vc 50-100 m/min, fn 0.1-0.2 mm/rev, ap 1-3 mm, cutting force < 500 N
Equipment: CNC lathe/four-axis machining center, 1000-3000 rpm
finishing
Method: CNC grinding
Tool: Resin-bonded diamond grinding wheel (#400-#600)
Accuracy: h6-h7, Ra ≤ 0.8 μm , coaxiality ≤ 0.01 mm, roundness ≤ 0.005 mm
Parameters: speed 20-30 m/s, fn 0.02-0.05 mm/pass
Edge dressing
Technology: EDM (0.1-0.5 J) / Laser processing (50-100 W, 1064 nm)
Blade type: straight teeth (0°), spiral teeth (15°-45°), serrated
Chamfer: 0.1°-0.3°
Trend: SLM (200-400 W, layer thickness 20-50 μm , 4-6 h)

5.3 Heat treatment of cemented carbide milling cutters

Sintering process
The sintering process is the core link in the manufacturing of cemented carbide milling cutters, which converts the pressed blank into a high-density, high-performance cemented carbide material. Based on the raw material characteristics of tungsten carbide (WC), cobalt (Co) and additives (TiC , TaC), the sintering adopts a technical route that combines vacuum sintering and hot isostatic pressing (HIP). The sintering process is carried out in a vacuum furnace, the vacuum degree is controlled at 10^{-3} Pa , the temperature is precisely set at 1350-1450°C, and the heating rate is maintained at 5-10°C/min to ensure uniform grain growth. The holding time is 1-2 hours, during which a pressure of 5-10 MPa is applied through hot isostatic pressing to promote the densification of the blank, and the density reaches 98%-99% of the theoretical density (about 14.5-15 g/cm^3) , and the density deviation is controlled within ±0.1 g/ cm^3 by the Archimedes method . The additives TiC and TaC enhance the high temperature hardness and anti-adhesion during the sintering process, and the grain size is controlled at 0.5-1.5 μm by electron backscatter diffraction (EBSD) analysis . In 2025, the field-assisted sintering technology (SPS) introduced pulsed current (1000-2000 A, voltage 5-10 V), the sintering time was shortened to 30-60 minutes, and the grain size was refined to 0.2-0.5 μm , which is particularly suitable for the high performance requirements of micro milling cutters.
Sintering environment
Conditions: vacuum furnace, vacuum degree 10^{-3} Pa
Purpose: To prevent oxidation
Temperature and time
Range: 1350-1450°C, heating rate 5-10°C/min
Keep warm: 1-2 hours
pressure
Method: Hot Isostatic Pressing (HIP), 5-10 MPa
Density: 98%-99% theoretical density (14.5-15 g/cm^3) , deviation ±0.1 g/ cm^3
Grain Control

电话/TEL：0086 592 512 9696
CTIAQCD-MA-E/P 2018-2024V
sales@chinatungsten.com

Tool: EBSD, size 0.5-1.5 μm
Additives: TiC (0.5%-2%), TaC (0.3%-1%)
Technology Trends
Method: Field assisted sintering (SPS, 1000-2000 A, 5-10 V)
Time: 30-60 minutes
Grain: 0.2-0.5 μm
Application: Micro milling cutter

5.4 Coating Application of Cemented Carbide Milling Cutters

Coating application is the final step to improve the performance of cemented carbide milling cutters, and wear resistance and heat resistance are significantly enhanced through advanced surface treatment technology. Physical vapor deposition (PVD) is the main process, using cathode arc ion plating or magnetron sputtering at 450-500°C. Substrate pretreatment includes ultrasonic cleaning (frequency 40 kHz, 10 min) and plasma etching (power 200-300 W, 10-15 min) to remove the surface oxide layer and improve adhesion. Coating types include titanium nitride (TiN), titanium aluminum nitride (TiAlN) and aluminum chromium nitride (AlCrN). The thickness is precisely controlled at 1-4 μm . The thickness uniformity (deviation ±0.1 μm) is ensured by optical microscopy and X-ray diffraction (XRD) analysis. The bonding strength is verified by scratch test and must exceed 70 MPa (critical load Lc2). TiN coating deposition rate is 0.5-1 μm /h, TiAlN coating heat resistance reaches 900°C, AlCrN coating corrosion resistance is verified by salt spray test (ASTM B117), and durability is increased by 30%. In 2025, nano multilayer coatings (such as TiAlN / AlCrN) are realized by multi-target magnetron sputtering, with a deposition rate of 1-2 μm /h, thickness uniformity of ±0.05 μm , friction coefficient reduced to below 0.2, bonding strength of 80 MPa, significantly extending tool life, especially in aerospace (titanium alloy processing) and medical fields (stainless steel implants).

Coating Type
Materials: TiN , TiAlN , AlCrN
Thickness: 1-4 μm , deviation ±0.1 μm via microscope/XRD
Bond strength: > 70 MPa (Lc2)
PVD Process
Temperature: 450-500°C
Method: cathode arc ion plating/magnetron sputtering, rate 0.5-2 μm /h
Pretreatment: ultrasonic cleaning (40 kHz, 10 min), plasma etching (200-300 W, 10-15 min)
Technology Development
Innovation: Nano multilayer coating (TiAlN / AlCrN), rate 1-2 μm /h
Accuracy: Thickness uniformity ±0.05 μm , bonding strength 80 MPa
Applications: Aerospace (titanium alloy), medical (stainless steel)

CTIA GROUP LTD
30 Years of Cemented Carbide Customization Experts

Core Advantages

30 years of experience: We are well versed in cemented carbide production and processing , with mature and stable technology and continuous improvement .

Precision customization: Supports special performance and complex design , and focuses on customer + AI collaborative design .

Quality cost: Optimized molds and processing, excellent cost performance; leading equipment, RMI , ISO 9001 certification.

Serving Customers

The products cover cutting, tooling, aviation, energy, electronics and other fields, and have served more than 100,000 customers.

Service Commitment

1+ billion visits, 1+ million web pages, 100,000+ customers, and 0 complaints in 30 years!

Contact Us

Email : sales@chinatungsten.com
Tel : +86 592 5129696
Official website : www.ctia.com.cn




6. Application fields of cemented carbide milling cutters

6.1 Application of Carbide Milling Cutters - Manufacturing

Manufacturing is the most widely used field for carbide milling cutters, and its high performance characteristics meet the needs of a variety of complex working conditions. The automotive industry uses carbide milling cutters to process engine cylinders, crankshafts, transmission gears and brake discs, with a cutting speed (Vc) of 150-200 m/min, a feed rate (fn) of 0.1-0.2 mm/tooth, a cutting depth (ap) of 0.5-2 mm, and a surface roughness Ra of ≤ 0.4 μm , ensuring the accuracy and durability of compact electric vehicles and high-performance internal combustion engine components. The aerospace field manufactures complex blades, casings and skins by processing titanium alloys, nickel-based high-temperature alloys (such as Inconel 718) and aluminum-lithium alloys, with a cutting speed (Vc) of 100-150 m/min, heat-resistant coatings (such as TiAlN) support dry cutting, and the processing accuracy reaches IT6-IT7 level, with a cutting depth (ap) of 0.5-1 mm. In heavy machinery manufacturing, carbide milling cutters are used to process steel castings and forgings, such as large gears and bearing seats, with a cutting speed (Vc) of 60-100 m/min and a feed rate (fn) of 0.15-0.25 mm/tooth, which is suitable for high-load processing. In 2025, with the growing demand for new energy vehicles, drones and hydrogen energy equipment, small-diameter carbide milling cutters (diameter 1-3 mm) will be used more and more in lightweight parts and carbon fiber reinforced composites (CFRP) layered cutting, with cutting speeds increased to 250 m/min, reducing the layered defect rate by more than 90%.

auto industry
Applications: Engine blocks, crankshafts, transmission gears, brake discs
Parameters: Vc 150-200 m/min, fn 0.1-0.2 mm/tooth, ap 0.5-2 mm, Ra ≤ 0.4 μm
Trends: Electric vehicles, lightweight components
Aerospace
Application: Titanium alloy, Inconel 718 blades, casing, aluminum-lithium alloy skin
Parameters: Vc 100-150 m/min, ap 0.5-1 mm, accuracy IT6-IT7
Trends: Dry cutting, CFRP processing
Heavy Machinery
Applications: Steel castings, forgings, large gears, bearing seats
Parameters: Vc 60-100 m/min, fn 0.15-0.25 mm/tooth
Trend: High load durability

6.2 Application of Carbide Milling Cutter - Mold Manufacturing

The mold manufacturing industry relies on the high precision and wear resistance of carbide milling cutters to meet the processing requirements of complex geometries. The complex contours of stamping and die-casting molds are processed using helical tooth milling cutters (helix angle 30°-40°), with a cutting speed (Vc) of 80-120 m/min, a feed rate (fn) of 0.05-0.15 mm/tooth, a cutting depth (ap) of 0.3-0.8 mm, and a surface roughness Ra controlled within 0.6 μm , ensuring that the mold life exceeds 1 million stampings. The electrode processing of plastic injection molds uses a fine-edge carbide milling cutter (diameter 0.5-2 mm), with a processing accuracy of ±0.005 mm and a cutting speed (Vc) of 50-80 m/min, which is suitable for high-gloss surfaces (Ra ≤ 0.2 μm) and complex cavities. In glass mold processing, carbide milling cutters are used to process heat-resistant glass molds with a cutting speed (Vc) of 40-70 m/min and durability that supports continuous processing for more than 300 hours. In 2025, with the advancement of intelligent manufacturing, mold milling cutters will be integrated with Industry 4.0 technology to monitor cutting parameters in real time (such as cutting force < 300 N, temperature < 600°C) to optimize the processing efficiency of automotive housings, consumer electronics housings, and medical device molds.

Stamping/die casting molds
Application: Complex contour machining
Parameters: Vc 80-120 m/min, fn 0.05-0.15 mm/tooth, ap 0.3-0.8 mm, Ra ≤ 0.6 μm
Features: Lifespan > 1 million stampings
Plastic Injection Mold
Application: electrode processing, complex cavity
Parameters: diameter 0.5-2 mm, Vc 50-80 m/min, accuracy ±0.005 mm, Ra ≤ 0.2 μm
Trends: High gloss, Industry 4.0 integration
Glass mold
Application: Heat-resistant glass mold
Parameters: Vc 40-70 m/min, durability > 300 h
Trend: Optimization of heat resistance

6.3 Application of Carbide Milling Cutters - Energy Industry

The energy industry is an emerging application area for carbide milling cutters, especially in the manufacture of renewable energy and traditional energy equipment. The wind power industry uses carbide milling cutters to process the main shaft and tower connections of wind turbine blades, with a cutting speed (Vc) of 60-90 m/min and a cutting depth (ap) of 0.5-1.5 mm. The durability supports continuous processing for more than 400 hours. In the solar industry, carbide milling cutters are used to process silicon wafer frames and brackets, with a cutting speed (Vc) of 80-120 m/min and an accuracy of ±0.01 mm to ensure the structural stability of the components. The oil and gas industry uses it to process drill bit components and valve bodies, with a cutting speed (Vc) of 50-80 m/min. Corrosion-resistant coatings (such as AlCrN) increase the service life in acidic environments. In 2025, with the rise of offshore wind power and hydrogen energy equipment, the demand for corrosion-resistant processing of carbide milling cutters in marine environments will increase, and the cutting speed will be increased to 150 m/min.

Wind power
Application: Wind turbine blades, main shafts, tower connections
Parameters: Vc 60-90 m/min, ap 0.5-1.5 mm, durability > 400 h
Trend: offshore wind power

Solar
Application: Silicon wafer frame, bracket
Parameters: Vc 80-120 m/min, accuracy ±0.01 mm
Trend: Component stability
Oil and Gas
Application: Drill bit assembly, valve body
Parameters: Vc 50-80 m/min
Trend: Corrosion resistance, hydrogen energy equipment

6.4 Application of Carbide Milling Cutters - Medical Devices

Medical device manufacturing requires high precision and biocompatibility of carbide milling cutters. Orthopedic implants (such as hip and knee joints) are processed using micro carbide milling cutters (diameter 0.1-0.3 mm), with a cutting speed (Vc) of 30-50 m/min, an accuracy of ±0.001 mm, and a surface roughness Ra ≤ 0.1 μm to ensure biocompatibility with the human body. Dental instrument mold processing uses spiral tooth milling cutters with a cutting speed (Vc) of 40-60 m/min and a cutting depth (ap) of 0.1-0.3 mm to meet the needs of high-precision casting. In 2025, with the development of personalized medicine, the application of carbide milling cutters in 3D printed medical models and customized implant processing will increase, and the cutting speed will be increased to 200 m/min.
Orthopedic Implants
Application: Hip joint, knee joint
Parameters: diameter 0.1-0.3 mm, Vc 30-50 m/min, accuracy ±0.001 mm, Ra ≤ 0.1 μm
Trends: 3D printing, personalized medicine
Dental Instruments
Application: Mold processing
Parameters: Vc 40-60 m/min, ap 0.1-0.3 mm
Trend: High-precision casting

6.5 Application of Carbide Milling Cutter-Electronics Industry

hole processing in smartphones and 5G devices uses micro-milling cutters with a diameter of 0.1-0.5 mm, a cutting speed (Vc) of 200-300 m/min, and a processing accuracy of ±0.002 mm, which is suitable for high-density circuit board manufacturing. Semiconductor packaging molds are processed using high-precision milling cutters with a cutting speed (Vc) of 100-150 m/min and a surface roughness Ra ≤ 0.3 μm . In 2025, with the popularization of wearable devices and the Internet of Things , the demand for processing flexible circuit boards and micro sensors will surge, and the cutting speed will be increased to 350 m/min.
Smartphone/5G
Application: Micro pin hole
Parameters: diameter 0.1-0.5 mm, Vc 200-300 m/min, accuracy ±0.002 mm
Trend: Flexible Circuit Boards

Semiconductor packaging
Application: Mold processing
Parameters: Vc 100-150 m/min, Ra ≤ 0.3 μm
Trend: Microsensors

6.6 Application of Carbide Milling Cutter - Building Materials Processing

In the processing of building materials, carbide milling cutters are used to process stone, ceramics and cement products. Stone carving uses serrated milling cutters with a cutting speed (Vc) of 30-50 m/min, a cutting depth (ap) of 1-2 mm, and durability that supports continuous processing for more than 200 hours. Fine milling cutters are used for finishing of ceramic tiles with a cutting speed (Vc) of 20-40 m/min and an accuracy of ±0.01 mm. In 2025, the demand for processing green building materials (such as recycled concrete) increases, and the cutting speed is increased to 80 m/min.

Stone carving
Application: Stone, Ceramics
Parameters: Vc 30-50 m/min, ap 1-2 mm, durability > 200 h
Trend: Recycled concrete
Ceramic tiles
Application: Finishing
Parameters: Vc 20-40 m/min, accuracy ±0.01 mm
Trend: Green Buildings

6.7 Application of Carbide Milling Cutter - Shipbuilding

In shipbuilding, carbide milling cutters are used to process hull steel plates and propeller blades. The rough machining of steel plates uses a toothed milling cutter with a cutting speed (Vc) of 50-80 m/min and a cutting depth (ap) of 2-4 mm. The fine machining of propeller blades uses a spiral tooth milling cutter with a cutting speed (Vc) of 60-100 m/min and an accuracy of ±0.02 mm. In 2025, the demand for corrosion-resistant processing of marine engineering equipment will increase.
Hull steel plate
Application: Rough machining
Parameters: Vc 50-80 m/min, ap 2-4 mm
Trend: Corrosion resistance
Propeller blades
Application: Finishing
Parameters: Vc 60-100 m/min, accuracy ±0.02 mm
Trend: Offshore Engineering

6.8 Application of Carbide Milling Cutter - Railway Transportation

In the field of railway transportation, carbide milling cutters are used to process wheels and track components. Wheel processing uses rounded corner milling cutters with a cutting speed (Vc) of 40-70 m/min and a cutting depth (ap) of 1-3 mm. High-precision milling cutters are used for finishing of track components with a cutting speed (Vc) of 50-80 m/min and an accuracy of ±0.01 mm. In 2025, the demand for processing high-speed rail and maglev train components will increase.

wheel
Application: Processing
Parameters: Vc 40-70 m/min, ap 1-3 mm
Trend: High-speed rail components

Track components
Application: Finishing
Parameters: Vc 50-80 m/min, accuracy ±0.01 mm
Trend: Maglev Train

6.9 Application of Carbide Milling Cutter - Agricultural Machinery

In agricultural machinery manufacturing, carbide milling cutters are used to process plowshares and harvester parts. Plowshares are processed with saw blade milling cutters, with a cutting speed (Vc) of 40-60 m/min and a cutting depth (ap) of 1-2 mm. The finishing of harvester parts uses spiral tooth milling cutters with a cutting speed (Vc) of 50-70 m/min and an accuracy of ±0.01 mm. In 2025, the processing demand for smart agricultural equipment will increase.

Plowshare
Application: Processing
Parameters: Vc 40-60 m/min, ap 1-2 mm
Trend: Smart Agriculture

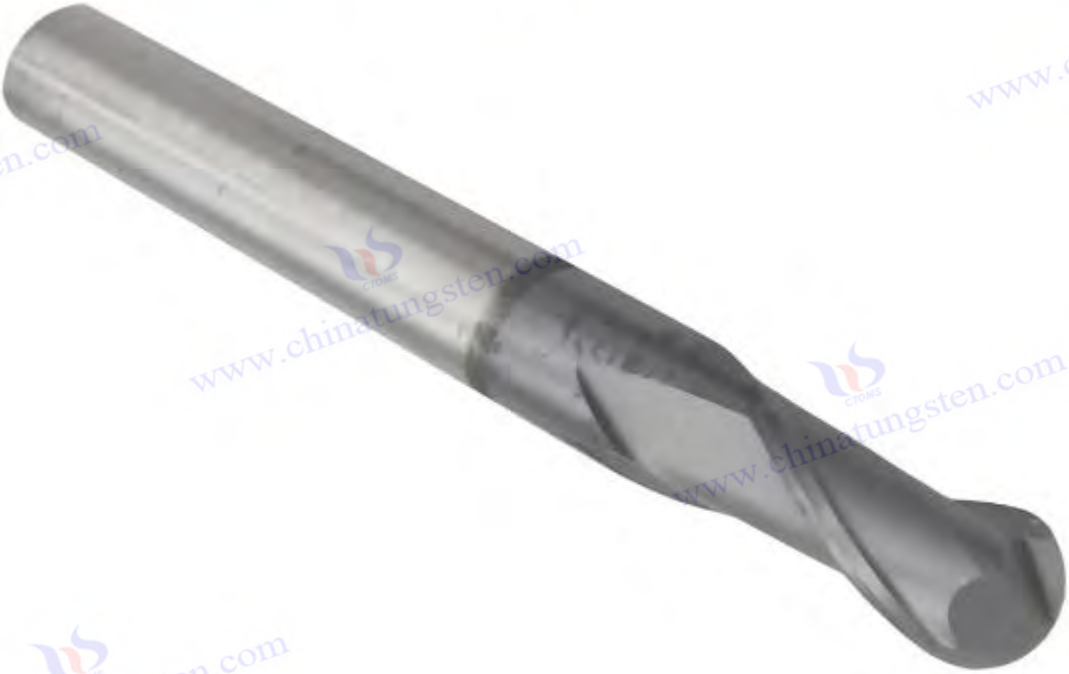
Harvester parts
Application: Finishing
Parameters: Vc 50-70 m/min, accuracy ±0.01 mm
Trend: Automation Equipment

6.10 Application of Carbide Milling Cutters - Other Emerging Fields

Other emerging fields include jewelry processing, spacecraft components and sports equipment manufacturing. Jewelry processing uses micro carbide milling cutters (diameter 0.05-0.2 mm), with a cutting speed (Vc) of 20-40 m/min and an accuracy of ±0.001 mm. Spacecraft components are processed with high heat-resistant milling cutters at a cutting speed (Vc) of 100-150 m/min. Sports equipment (such as golf club heads) are processed using radius milling cutters at a cutting speed (Vc) of 50-80 m/min. In 2025, the demand for customized processing in these fields will continue to grow.

Jewelry crafting
Application: Fine engraving
Parameters: diameter 0.05-0.2 mm, Vc 20-40 m/min, accuracy ±0.001 mm
Trend: Customization

Spacecraft components
Application: High heat resistant processing
Parameters: Vc 100-150 m/min
Trend: Deep Space Exploration
Sports Equipment
Application: Golf club heads
Parameters: Vc 50-80 m/min
Trend: Lightweight design



7. Maintenance and care of carbide milling cutters

7.1 Daily Cleaning of Carbide Milling Cutters

Daily cleaning of carbide milling cutters is a key step to extend their service life and maintain cutting performance. After use, chips should be blown away immediately with compressed air (pressure 0.2-0.4 MPa) to prevent metal particles from embedding into the cutting edge and causing wear. The cleaning process requires the use of anhydrous ethanol or a special cutting fluid diluent (pH 6.5-7.5), and an ultrasonic cleaner (frequency 40 kHz, power 100-200 W, cleaning time 5-10 minutes) is used to remove oil and residues. After cleaning, wipe dry with a dust-free cloth to avoid corrosion caused by residual moisture. The cutting edge and coating surface need to be checked with a magnifying glass (magnification 10x-20x) to ensure that there are no obvious scratches or peeling. In 2025, with the introduction of intelligent cleaning equipment, such as automatic cleaning systems equipped with AI image recognition, the ability to detect the edge status in real time and adjust cleaning parameters significantly improves cleaning efficiency, especially for high-value milling cutters.

Chip removal

Method: Compressed air, pressure 0.2-0.4 MPa
Purpose: To prevent particle embedding
Oil cleaning
Tools: Ultrasonic cleaning machine (40 kHz, 100-200 W), anhydrous ethanol
Time: 5-10 minutes, pH 6.5-7.5
Drying: Wipe dry with dust-free cloth
examine
Tools: Magnifying glass (10x-20x)
Trend: AI image recognition cleaning system

7.2 Edge dressing of cemented carbide milling cutters

Edge dressing is an important maintenance step to restore the cutting performance of carbide milling cutters. Mildly worn edges can be dressed with a manual diamond grinding wheel (grit #600-#800), and the dressing angle should be kept consistent with the original edge angle (usually 5°-10°). The dressing amount on each side is controlled at 0.01-0.02 mm, and coolant (flow rate 5-10 L/min) is used to reduce thermal effects. Severely worn or damaged edges require electrospark dressing (EDM, pulse energy 0.1-0.3 J, voltage 50-80 V). After dressing, the edge roughness Ra needs to be controlled at ≤ 0.2 μm , and the accuracy is verified by laser interferometer (deviation ±0.005 mm). Stress relief annealing (temperature 400-500°C, time 1-2 hours) is required after dressing to eliminate residual stress. In 2025, laser trimming technology (power 20-50 W, wavelength 1064 nm) will gradually become popular in micro milling cutter maintenance due to its non-contact processing and micron-level accuracy (±0.002 mm).

Manual trimming
Tools: Diamond grinding wheel (#600-#800)
Parameters: blade angle 5°-10°, dressing amount 0.01-0.02 mm, coolant 5-10 L/min
Purpose: Minor wear and tear repair
EDM dressing
Tool: EDM, pulse energy 0.1-0.3 J, voltage 50-80 V
Accuracy: Ra ≤ 0.2 μm , deviation ±0.005 mm
Post-treatment: annealing at 400-500°C, 1-2 h
Technology Trends
Method: Laser trimming (20-50 W, 1064 nm)
Accuracy: ±0.002 mm
Application: Micro milling cutter

7.3 Storage and Corrosion Protection of Carbide Milling Cutters

Proper storage is the key to preventing corrosion and performance degradation of carbide milling cutters. The storage environment needs to maintain a constant temperature (20-25°C) and low humidity (relative humidity < 40%), and use a moisture-proof cabinet or vacuum-sealed bag to store to prevent oxidation. Coated milling cutters (such as TiN , TiAlN) need to be additionally coated with anti-rust oil (thickness 0.005-0.01 mm), and the surface condition should be checked every 3-

6 months . When not in use, the milling cutter should be hung vertically or placed flat on a dedicated tool rack to avoid collisions that may cause damage to the cutting edge. In 2025, the intelligent warehousing system will monitor storage conditions in real time through RFID tags and temperature and humidity sensors, and automatically adjust environmental parameters, which is particularly suitable for high-value tools in the aerospace and medical industries.

Environmental Control
Conditions: 20-25°C, humidity < 40%
Tools: moisture-proof cabinet, vacuum sealing bag
Anti-rust treatment
Method: Anti-rust oil, thickness 0.005-0.01 mm
Frequency : Every 3-6 months
Storage
Method: vertical hanging or flat placement, dedicated tool holder
Trend: RFID smart warehousing

7.4 Regular Inspection and Replacement of Carbide Milling Cutters

Regular inspection is a necessary measure to ensure the safe use of carbide milling cutters. Use a tool microscope (magnification 50x-100x) or a three-dimensional coordinate measuring machine (CMM) to check the degree of edge wear. When the wear band width exceeds 0.3 mm or obvious gaps appear, it needs to be replaced. The cutting force monitoring system can record the peak force (upper limit 600 N) during the cutting process in real time and issue an alarm when the threshold is exceeded. Coating peeling or cracks can be detected by an ultrasonic flaw detector. Replacement is recommended when the peeling area exceeds 10%. In 2025, predictive maintenance technology based on the Internet of Things will analyze tool life through sensor data, warn of replacement time 24-48 hours in advance, and reduce downtime losses. It is especially widely used in automated production lines.

Wear inspection
Tools: Microscope (50x-100x), CMM
Standard: Wear zone > 0.3 mm or notch Replace
Cutting force monitoring
Tool: Cutting force monitoring system, peak value < 600 N
Function: Real-time alert
Coating inspection
Tool: Ultrasonic flaw detector
Standard: Replace if peeling area > 10%
Trend: IoT predictive maintenance, 24-48 h early warning

8. Future development trend of cemented carbide milling cutters

8.1 Innovation of Materials and Coatings for Carbide Milling Cutters

The future development of cemented carbide milling cutters will focus on breakthroughs in new materials and coating technologies. Nanoscale tungsten carbide (WC) powder (particle size < 0.2 µm) combined with a new binder phase (such as nano cobalt or nickel-based alloy) can increase the hardness to above HV 2000 and improve wear resistance by 30%-40%, which is particularly suitable for ultra-precision machining. Coating technology is developing towards multi-layer and gradient structures, such as TiAlN / AlCrN nano-multilayer coatings, which achieve thickness uniformity of ±0.05 µm through multi-target magnetron sputtering , heat resistance of 1000°C, friction coefficient reduced to 0.15, and tool life extended by 25%-35%. In 2025, environmentally friendly coatings (such as CrN and ZrN) will attract attention due to their low environmental load and recyclability , and are expected to occupy an important position in green manufacturing.

Nanomaterials

Features: WC particle size < 0.2 µm , bonding phase (nano cobalt/nickel)

Performance: Hardness HV 2000, wear resistance increased by 30%-40%

Application: Ultra-precision machining

Multi-layer coating

Technology: TiAlN / AlCrN , thickness uniformity ±0.05 µm

Performance: heat resistance 1000°C, friction coefficient 0.15, life expectancy increased by 25%-35%

Trend: Multi-target magnetron sputtering

Green coating

Material: CrN , ZrN

Advantages: Low environmental impact, recyclable

Trend: Green Manufacturing

8.2 Intelligentization and Digitalization of Carbide Milling Cutters

Intelligence and digitalization are the core directions of the development of cemented carbide milling cutters. The tool management system based on the Internet of Things (IoT) monitors cutting parameters in real time (such as cutting force < 600 N, temperature < 700°C) through embedded sensors, combines AI algorithms to predict tool wear, and issues replacement warnings 48-72 hours in advance, reducing downtime by 15%-20%. The digital twin technology of CNC machine tools and tools realizes virtual simulation, optimizes cutting paths and parameters, and improves cutting efficiency by 10%-15%. In 2025, remote diagnosis and tool status monitoring supported by 5G technology will become mainstream, especially in automated production lines in aerospace and automotive manufacturing.

IoT Monitoring

Parameters: cutting force < 600 N, temperature < 700°C

Function: AI prediction, early warning 48-72 hours

Benefit: Reduce downtime by 15%-20%

Digital Twin
Technology: Virtual simulation, optimized cutting paths
Benefit: Efficiency increased by 10%-15%
Application: CNC machine tools
5G Applications
Function: Remote diagnosis, status monitoring
Trend: Automated production lines

8.3 Sustainability and Environmental Protection of Carbide Milling Cutters

Sustainable development and environmental protection requirements drive carbide milling cutters to evolve towards low energy consumption and recyclability . The popularity of dry cutting technology reduces the use of coolant. Combined with high-efficiency coatings (such as AlCrN), cutting energy consumption is reduced by 20%-30% and processing waste is reduced by 15%. Recycling and reuse technology increases the WC-Co material recovery rate of waste milling cutters to more than 90% through chemical leaching and powder regeneration molding, reducing the demand for raw material mining. In 2025, the carbon neutrality goal prompted manufacturers to adopt solar-driven tool production processes, which is expected to reduce carbon footprint by 25%, especially in the European and North American markets.
Dry Cutting
Technology: High-efficiency coating (AlCrN)
Benefits: Energy consumption reduced by 20%-30%, waste reduced by 15%
Application: Coolant reduction
Material recovery
Technology: Chemical leaching, powder regeneration
Recovery rate: 90%
Trend: Reducing raw material extraction
Carbon neutral
Technology: Solar-powered production
Benefit: Reduce carbon footprint by 25%
Market: Europe, North America

8.4 Miniaturization and Multifunctionality of Carbide Milling Cutters

Carbide milling cutters are developing in the direction of miniaturization and multifunctionality. Micro milling cutters (diameter 0.05-0.5 mm) have a processing accuracy of ±0.001 mm through laser processing and nano-coating technology, and are widely used in microelectronics and medical implant manufacturing. Multifunctional composite milling cutters integrate drilling, milling and chamfering functions, with a cutting speed (Vc) of 150-250 m/min, reducing tool change time by 30%-40%, and are suitable for one-time molding of complex workpieces. In 2025, with the integration of 3D printing and additive manufacturing , the production cycle of customized micro milling cutters will be shortened to 2-3 days to meet small batch and high customization needs.

Micro milling cutter

Parameters: diameter 0.05-0.5 mm, accuracy ±0.001 mm

Technology: Laser processing, nano coating

Applications: Microelectronics, Medical Implants

Multifunctional compound knife

Function: drilling, milling, chamfering

Parameters: Vc 150-250 m/min

Benefit: Reduce tool changes by 30%-40%

Customized production

Technology: 3D printing + additive manufacturing

Duration: 2-3 days

Trend: small batch, high customization

9. Advantages and limitations of carbide milling cutters

9.1 Performance Advantages of Carbide Milling Cutters

Carbide milling cutters dominate cutting processes with their superior performance. High efficiency is their core feature, and they are suitable for high-speed cutting. The cutting speed (Vc) can reach 150-200 m/min. Especially when processing steel and titanium alloys, the efficiency is increased by 20%-30%, which significantly shortens the processing cycle. Long-term stability is another major advantage. Its wear resistance and fracture resistance are achieved through nano-scale tungsten carbide (WC) materials, which reduces the frequency of replacement and extends the average service life to 500-800 hours. It performs particularly well in the processing of aerospace parts.

High efficiency

Features: Suitable for high-speed cutting, Vc 150-200 m/min

Benefit: Efficiency increased by 20%-30%

Application: Steel, Titanium Alloy

Long-term stability

Features: wear resistance, fracture resistance

Lifespan: 500-800 hours

Application: Aerospace components

9.2 Economic Benefits

The economic benefits of carbide milling cutters are reflected in the cost reduction brought by their durability. Compared with traditional high-speed steel tools, their service life is extended by 3-5 times , reducing tool changes and downtime, and reducing overall processing costs by 15%-25%. In 2025, with the advancement of recycling technology, the material recovery rate of waste milling cutters will increase to 90%, further reducing the cost of raw material procurement, especially in mass production.

Reduce processing costs

Features: Durability increased by 3-5 times

Benefit: Cost reduction of 15%-25%

Trend: Material recycling rate 90%

9.3 Machining Quality of Carbide Milling Cutters

Carbide milling cutters provide high precision and smooth surfaces to meet the needs of high-end manufacturing. The machining accuracy can reach IT6-IT7 level, and the surface roughness Ra is controlled at 0.2-0.4 μm , which is particularly suitable for the finishing of molds and medical implants. Nano coatings (such as TiAlN) further optimize the cutting surface quality and reduce the need for secondary processing. In 2025, its application in 3D printing post-processing will become increasingly widespread.

High precision

Features: IT6-IT7 level

Application: mold, medical implant

Smooth surface

Features: Ra 0.2-0.4 μm
Trends: TiAlN coating, 3D printing post-processing

9.4 Limitations of Carbide Milling Cutters

Cost Limitation

The manufacturing cost of cemented carbide milling cutters is relatively high, mainly due to the high price of raw materials tungsten carbide (WC) and cobalt (Co), as well as complex powder metallurgy and coating processes. In 2025, the manufacturing cost of a single high-performance milling cutter will be about US$50-200, which is 5-10 times higher than that of high-speed steel tools , limiting its popularity in small and medium-sized enterprises, especially in low-profit processing.

Cost Limitation

Reason: WC and Co are expensive, the process is complex , the cost is high, and it is difficult for small and medium-sized enterprises to popularize them .

Applicability Limitations

Carbide milling cutters are not suitable for machining certain high-toughness or sticky materials, such as pure aluminum or certain polymer materials, because their high hardness can easily lead to material adhesion and tool overheating. The cutting speed (Vc) needs to be strictly controlled within 50-100 m/min. Exceeding the range can easily cause machining defects. Its applicability in composite material machining still needs to be further optimized in 2025.

Applicability Limitations

Material: pure aluminum, polymer material
Problem: Sticking, Overheating
Parameters: Vc 50-100 m/min

Brittleness problem

Carbide milling cutters are brittle due to their high hardness and are prone to chipping under impact loads , especially in intermittent cutting or heavy-load processing (such as cast iron roughing). The chipping rate can reach 5%-10%. In 2025, the chipping problem has been alleviated by adding toughness-enhancing phases (such as TaC) or optimizing geometric design, but it still needs to be operated with caution.

Reason: High hardness
Scenario: intermittent cutting, heavy load
Chipping rate : 5%-10%
Trends: TaC enhancement, geometry optimization .

电话/TEL：0086 592 512 9696
CTIAQCD-MA-E/P 2018-2024V
sales@chinatungsten.com

10. Precautions for using carbide milling cutters

10.1 Installation and Operation

Correct installation and operation are the cornerstones for ensuring the safe use of carbide milling cutters. During installation, ensure that the clamping force is ≥ 10 kN , the installation coaxiality is ≤ 0.01 mm, and use precision tool holders (such as HSK type) to reduce vibration. Operators must wear protective glasses and wear-resistant gloves to prevent chip splashing or accidental damage. In 2025, intelligent clamping equipment can automatically calibrate coaxiality to improve installation efficiency.

Installation Requirements

Clamping force: ≥ 10 kN

Coaxiality: ≤ 0.01 mm

Tool: HSK type handle

Safety protection

Equipment: protective glasses, wear-resistant gloves

Trend: Intelligent clamping equipment

10.2 Cutting Parameter Control

Reasonable selection of cutting parameters directly affects processing quality and tool life. The cutting speed (Vc) is recommended to be controlled at 50-150 m/min, adjusted according to the material; the feed rate (fn) is 0.05-0.2 mm/tooth, and the cutting depth (ap) is 0.2-1 mm. In 2025, AI-driven cutting optimization systems can adjust parameters in real time according to workpiece materials, and improve accuracy by 10%.

Cutting speed

Range: 50-150 m/min

Adjustment: By Material
Feed rate
Range: 0.05-0.2 mm/tooth
Cutting depth
Range: 0.2-1 mm
Trend: AI Optimization

10.3 Maintenance and care

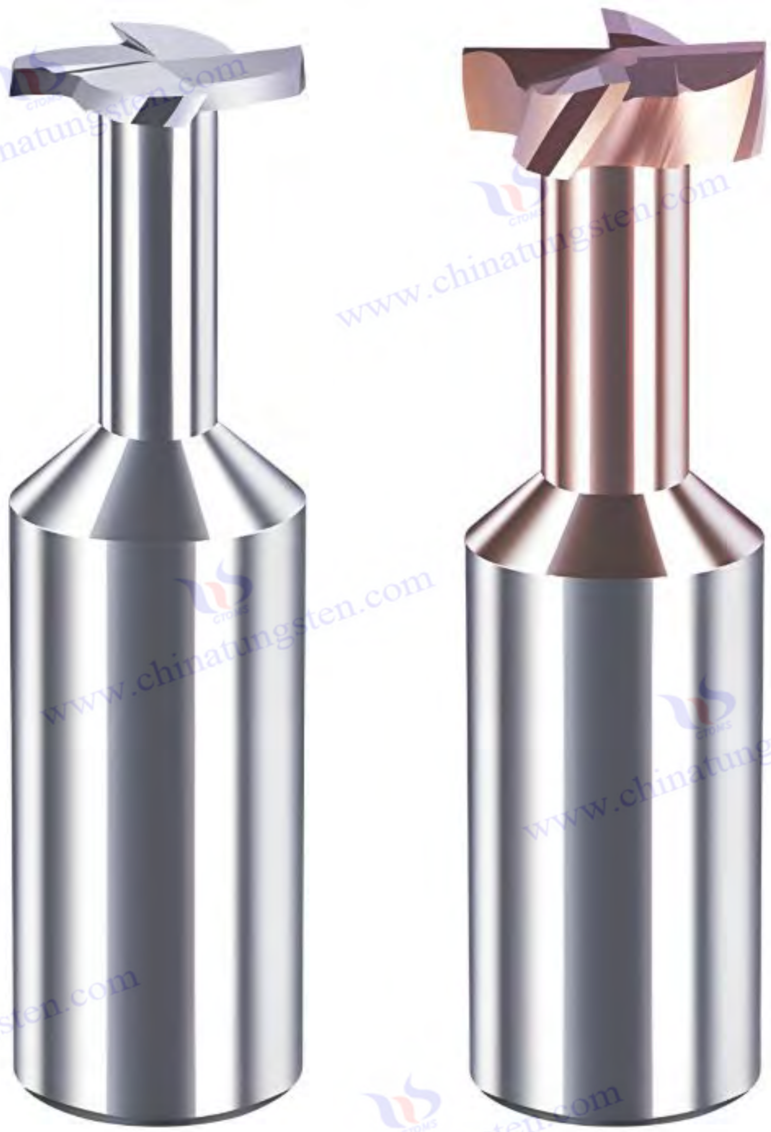
Regular maintenance is the key to extending the life of carbide milling cutters. Check the wear band width (VB) should be ≤ 0.3 mm, use a tool microscope (50x-100x) to detect, if it exceeds the standard, it needs to be repaired or replaced. The amount of cutting fluid used must be ≥ 10 L/min to maintain cooling and lubrication. In 2025, the intelligent monitoring system can automatically record wear data and reduce manual intervention.

Wear inspection
Standard: VB ≤ 0.3 mm
Tools: Microscope (50x-100x)
Cutting fluid
Flow rate: ≥ 10 L/min
Purpose: Cooling, lubrication
Trend: Intelligent Monitoring

10.4 Safety precautions

Safety precautions can effectively reduce operational risks. Avoid overload cutting. The cutting force should be controlled below 500-600 N to prevent chipping . Install a protective cover to prevent chips and debris from flying. In 2025, the advanced protection system equipped with sensors can provide real-time warning of overload conditions.

Overload prevention
Standard: cutting force < 500-600 N
Purpose: To prevent chipping
Protective measures
Equipment: Protective Shield
Trend: Sensor early warning



11. Appendix

Technical parameter table of carbide milling cutter

Diameter(mm)	Number of teeth	Cutting speed (Vc , m/min)	Feed rate (fn , mm/tooth)	Cutting depth (ap, mm)
2-5	2-4	50-100	0.05-0.1	0.2-0.5
6-10	4-6	100-150	0.1-0.15	0.5-1
10-20	6-8	150-200	0.15-0.2	1-2

Purpose: Reference data for parameter selection

12. FAQ

Question: How to deal with chipping of carbide milling cutters ?

Answer: Check cutting parameters, reduce cutting force to below 500 N, and trim cutting edge.

Question: What should I do if the surface roughness is not good?
Answer: Adjust the feed rate to 0.05-0.1 mm/tooth and use a new coated tool.

Question: Shortened tool life?
Answer: Increase the cutting fluid flow rate to 10 L/min and regularly check that VB ≤ 0.3 mm.
Application: Solve typical usage problems
Trend: AI-assisted diagnosis

What is a Carbide T-Type Milling Cutter?

Introduction to CTIA GROUP LTD Carbide T-Type Milling Cutter

one of the featured products of CTIA GROUP LTD (CTIA), carbide T-type milling cutter stands out in the field of metal processing with its excellent performance and innovative design. Relying on advanced manufacturing technology and rich industry experience, CTIA GROUP is committed to providing customers with high-precision and high-durability cutting tools. T-type milling cutter is made of carbide materials (such as tungsten steel, WC-Co system) and is designed for processing T-slots, T-shaped bolt holes or workpieces with similar structures. Its core advantages lie in high hardness, wear resistance and impact resistance, ensuring precise cutting under high speed and high load conditions. As a star product of CTIA GROUP , T-type milling cutter is widely used in mechanical processing, mold manufacturing and aerospace industry, especially suitable for processing steel, cast iron and high-strength alloys. According to the industry technology progress and related information in 2025, the following content introduces the characteristics, technical details and applications of T-type milling cutter in detail.

1. Structure and materials of carbide T-type milling cutter

T-type milling cutters usually have a unique T-shaped cross-section, with a multi- tooth blade design , and are installed on the machine tool spindle. The main body is made of high-strength alloy steel (such as HSS or 40CrMo, quenching hardness HRC 40-50), and the cutting part uses tungsten carbide (WC, content>90%±1%) as the hard phase, cobalt (Co, 6%-12%±1%) as the bonding phase, supplemented by trace additives (such as Cr_3C_2 0.5%-2%, TaC 1%-3%) to optimize performance. The manufacturing process includes powder metallurgy (such as SPS or HIP) to ensure that the material density reaches 99.9%±0.1%, the grain size is controlled at 0.5-2 μm (preferably 0.8-1.2 μm), and the hardness is HV 1800-2200±30, and can reach 2400-2600±50 locally. The blade can be coated with TiAlN or AlCrN (thickness 0.5-2 μm), the friction coefficient is reduced to <0.25±0.05, and the heat resistance is increased to >800°C. The tool body diameter ranges from 5-50 mm, and the blade length is customized according to the workpiece groove depth.

2. Working principle of carbide T-type milling cutter

The T-type milling cutter works by rotating the machine tool spindle (speed 500-3000 rpm, power 5-50 kW), and the cutting edge cuts laterally and axially along the surface of the workpiece to produce a T-shaped groove. The cutting process combines extrusion and shearing, where the extrusion pressure reaches 200-500 MPa and the shear strength is 50-100 MPa, which is suitable for materials with a hardness of 20-60 HRC. The T-shaped design of the tool enables it to complete the cutting of the groove bottom and side walls in a single operation, which is particularly suitable for workpieces that require high-precision T-shaped structures. During the rotation process, the cutting edge contacts the workpiece and generates high heat (surface temperature 300-600°C). At the same time, efficient material removal is achieved by optimizing the cutting angle and assisting with coolant.

3. Characteristics of Carbide T-type Milling Cutter

The design of the T-type milling cutter optimizes the cutting angle, with the main rake angle set at 10°-20°±5° and the secondary rake angle at 5°-10°±2°, which effectively reduces the vibration during processing (acceleration <5 m/s^2) and improves the surface finish of the workpiece (Ra<1.6 μm). The high heat resistance of the tool tip and the structural support of the matrix (tensile strength>1200 MPa) ensure stability under high loads, and the fatigue resistance (fatigue life>10^5 times) enables it to withstand long-term continuous processing. Combined with the synergistic effect of the high-strength alloy steel matrix and the carbide cutting part, the T-type milling cutter maintains excellent cutting performance under complex working conditions.

4. Carbide T-type milling cutter performance and influencing factors

As a featured product of CTIA GROUP Technology Co., Ltd., the performance of cemented carbide T-type milling cutters is outstanding in its high hardness, wear resistance and impact resistance, which are mainly derived from its material composition and processing technology. Tungsten carbide (WC) as a hard phase provides extremely high hardness (HV 1800-2200±30), while cobalt (Co) as a binder phase enhances the toughness of the material (fracture toughness K_1c 12-16 $MPa·m^{1/2}$), allowing the tool to remain stable under high load conditions. The wear rate is less than 0.05 $mm^3/N·m$, and the corrosion resistance is also excellent (corrosion rate <0.01 mm/year), thanks to the synergistic effect of additives such as Cr_3C_2 and TaC , which also improve the oxidation resistance of the tool in high temperature (>800°C) environment (>95%). Coating technology such as TiAlN or AlCrN further reduces the friction coefficient to <0.25±0.05, significantly improving heat resistance and service life.

of cemented carbide T-type milling cutters is affected by many factors. First, geometric design is the key. The width and depth of the T-shaped blade need to be customized according to the workpiece. Reasonable cutting angles (main rake angle 10°-20°±5°) and blade shape directly affect cutting efficiency (energy consumption <8 kWh/m^3) and surface quality (Ra<1.6 μm). Secondly, working parameters such as speed, feed rate and cutting depth have a significant impact on life. Excessive parameters may shorten the life by 15%±2% because overload will accelerate blade wear and thermal damage. Environmental factors should not be ignored either. High temperature (>600°C) or insufficient coolant will increase wear by 5%±1%. When processing high-hardness materials (such as 60 HRC steel), cooling and lubrication strategies need to be optimized to reduce thermal stress. In addition, various factors in the production process of cemented carbide blanks also have a profound impact on performance. Powder particle size distribution and purity are the basis. Too large particle size or high impurity content (such as oxygen content>0.2%) will lead to grain coarsening and reduce hardness and strength. The mixing uniformity is controlled by the ball milling process (ball milling time 12-24 hours, medium ratio 1:2) to ensure the uniform dispersion of WC and Co, which affects the density of the final material (>99.9%±0.1%). The pressing pressure (100-200 MPa) directly determines the initial density of the blank. Insufficient pressure may lead to increased porosity and affect the subsequent sintering effect. The sintering process (such as HIP or SPS, temperature 1400-1500°C, holding time 0.5-2 hours) is critical to the grain size (0.5-2 μm) and phase structure. Excessive sintering temperature or insufficient holding time may cause grain growth or phase transformation, reducing toughness. The cooling rate (5-10°C/min) also needs to be strictly controlled to avoid thermal stress cracks. The optimization of these blank manufacturing factors ensures that the T-type milling cutter made by CTIA GROUP has consistent high performance in practical applications.

4.1 Table of factors affecting the performance of cemented carbide T-type milling cutters

Influencing factors	**describe**
Geometric design	and depth of the T-shaped blade are customized, and the cutting angle is optimized, which affects the efficiency and surface quality.
Working Parameters	The speed, feed rate and cutting depth affect the service life. Excessively high parameters can shorten the service life by 15%±2%.
Environmental factors	High temperature (>600°C), insufficient cooling or high hardness materials increase wear by 5%±1% and cooling needs to be optimized.
Powder particle size purity	Too large a particle size or impurities (such as oxygen content > 0.2%) lead to grain coarsening, reducing hardness and strength.
Mixing uniformity	The ball milling process (12-24 hours, medium ratio 1:2) ensures uniform dispersion of WC and Co, which affects the density.
Suppression pressure	100-200 MPa determines the initial density. Insufficient pressure increases the porosity and affects the sintering effect.
Sintering process	HIP/SPS (1400-1500°C, 0.5-2 hours) controls grain size (0.5-2 μm) and phase structure.
Cooling rate	5-10°C/min to avoid thermal stress cracks and ensure material stability.

5. Carbide T-type milling cutter performance production process

CTIA GROUP LTD adopts advanced and rigorous processes in the production process of cemented carbide T-type milling cutters to ensure the high quality and consistency of the products. The production process begins with the selection of high-purity raw materials. CTIA GROUP generally uses YG10, YG10X, and YG12 grades. Among them, YG10 (WC 90%, Co 10%) is suitable for high wear resistance, YG10X (WC 90%, Co 10% + trace additives) improves toughness, and YG12 (WC 88%, Co 12%) is suitable for high impact conditions. The raw materials are tungsten powder, tungsten carbide powder (WC, purity>99.8%) and cobalt powder (Co, purity>99.5%), and the mixed powder is prepared by precise proportioning. Next, the powders are mixed using a wet ball milling process, using carbide balls as grinding media. The ball milling time is controlled at 18-24 hours, and the media ratio is 1:2 to ensure uniform powder particle size (D50 <1 μm) and mixing uniformity. The mixed powder is spray dried to form a granular raw material with a particle size distribution of 50-150 μm , providing good fluidity for subsequent pressing.

The pressing process uses cold isostatic pressing (CIP) technology, with a pressure of 150-200 MPa and a pressing time of 5-10 minutes, and the initial density reaches the target of 60%-65% of the theoretical density. After pressing, the blank enters the hot isostatic pressing (HIP) sintering stage, with the sintering temperature set at 1450-1500°C and the holding time of 1-2 hours. It is carried out under a vacuum or high-purity argon (purity 99.999%) protective atmosphere to ensure that the material density reaches 99.9%±0.1% and the grain size is controlled at 0.8-1.2 μm . After sintering, the blank is slowly cooled (5-8°C/min) to reduce thermal stress, and then fine-machined using CNC machine tools. The blade geometry is formed by high-precision grinding (tolerance ±0.01 mm), and the surface roughness Ra<0.4 μm . The coating is applied by physical vapor deposition (PVD) technology, with a TiAlN or AlCrN coating thickness of 1-2 μm , the coating temperature is controlled at 450-500°C, and the bonding strength is >70 MPa. Finally, the product is ultrasonically cleaned (frequency 40 kHz, time 5 minutes) and quality tested, including density (14.3-14.9 g/cm³) , hardness (HV 1800-2200±30), strength (bending strength>2000 MPa) and non-destructive testing (ultrasonic testing to detect internal defects). The test rods produced in the same batch are generally used as test products. Qualified products are vacuum packed and packaged with moisture-proof and shock-proof materials. The appearance and label inspection are carried out before delivery to ensure that the products are intact during transportation.

5.1 Carbide T-type milling cutter performance production process table

Production	describe	Technical Parameters
Raw material selection	The ingredients are made according to YG10, YG10X and YG12 grades, and high-purity WC and Co powders are selected.	YG10, YG10X, YG12, WC purity>99.8%, Co purity>99.5%
Powder Mixing	Wet ball milling process ensures uniform particle size.	Ball milling time 18-24h, medium ratio 1:2, D50 <1 μm
Spray drying	Form granular raw materials and improve fluidity.	Particle size 50-150 μm
suppress	Cold isostatic pressing (CIP) molding,	Pressure 150-200 MPa, time 5-10 min , density reaches - 65%.
sintering	Hot Isostatic Pressing (HIP) Sintering in Vacuum/Argon.	Temperature 1450-1500°C, pressure holding 1-2h, density 99.9%±0.1%
finishing	CNC machine processing, grinding and forming.	Tolerance ±0.01 mm, Ra<0.4 μm
coating	TiAlN / AlCrN coatings are applied using PVD technology .	Thickness 1-2 μm , temperature 450-500°C, bonding strength >70 MPa
Cleaning	Ultrasonic cleaning removes residues.	Frequency 40 kHz, duration 5 min
test	Test density, hardness, strength and non-destructive testing.	Density 14.3-14.9 g/cm³ , hardness HV 1800-2200±30, flexural strength>2000 MPa, non-destructive testing (ultrasonic)
Packing and delivery	Vacuum packaging, moisture-proof and shock-proof, label inspection.	Vacuum degree>0.9 bar, visual inspection before transportation

6. Application of carbide T-type milling cutter

As a featured product of CTIA GROUP Technology Co., Ltd., carbide T-type milling cutters have demonstrated their unique value and wide application potential in many fields. In the mold manufacturing industry, T-type milling cutters are widely used to process precision T-slots and bolt holes, and are used to manufacture stamping molds, injection molds, forging molds, etc., ensuring the high precision and durability of the molds. In the field of mechanical processing, especially in automobile and heavy machinery manufacturing, T-type milling cutters are used to process machine tool beds, guide rails, connectors and other components. Their efficient cutting capabilities significantly improve production efficiency. In the aerospace industry, T-type milling cutters have become key tools for processing titanium alloys, nickel-based alloys and high-strength steels due to their high hardness and high temperature resistance, meeting the high-precision requirements of aircraft structural parts and engine components. In addition, in shipbuilding and energy equipment production, T-type milling cutters are also used to process large structural parts and special connectors to meet the needs of complex geometries and diverse materials. Test data in 2025 show that the efficiency of standard T-type milling cutters in low-carbon steel and cast iron processing can reach 5-10 m^3 / h, while the efficiency of enhanced and coated T-type milling cutters in aviation-grade material processing is increased to 15-20 m^3 / h. These application scenarios fully demonstrate the significant contribution of CTIA GROUP LTD T-type milling cutters in improving processing accuracy, shortening production cycles and reducing costs.

Application fields of carbide T-type milling cutters

Application Areas	Suitable for	Specific use
Mold manufacturing	Standard T-type	Processing of T-slots and bolt holes for stamping, injection molding and forging dies.
Machining	Enhanced T-type	Machining of machine tool beds, guideways and connections for automotive and heavy machinery.
Aerospace	Precision T-type	Processing of titanium alloys, nickel-based alloys and high-strength steels for aircraft structures and engine components.
Shipbuilding and energy	Custom T-type	Process large structural parts and special connectors to adapt to complex geometries and diverse materials.
Rough processing area	Rough machining T-type	Rapidly removes large amounts of material and is suitable for initial processing.
Finishing and assembly	T-type with chamfer	Processing edge chamfering improves workpiece assembly performance and is suitable for precision parts.
Mass production	Multi- blade T-type	Improve cutting efficiency and is suitable for large-scale production tasks.

7. Types of Carbide T-Type Milling Cutters

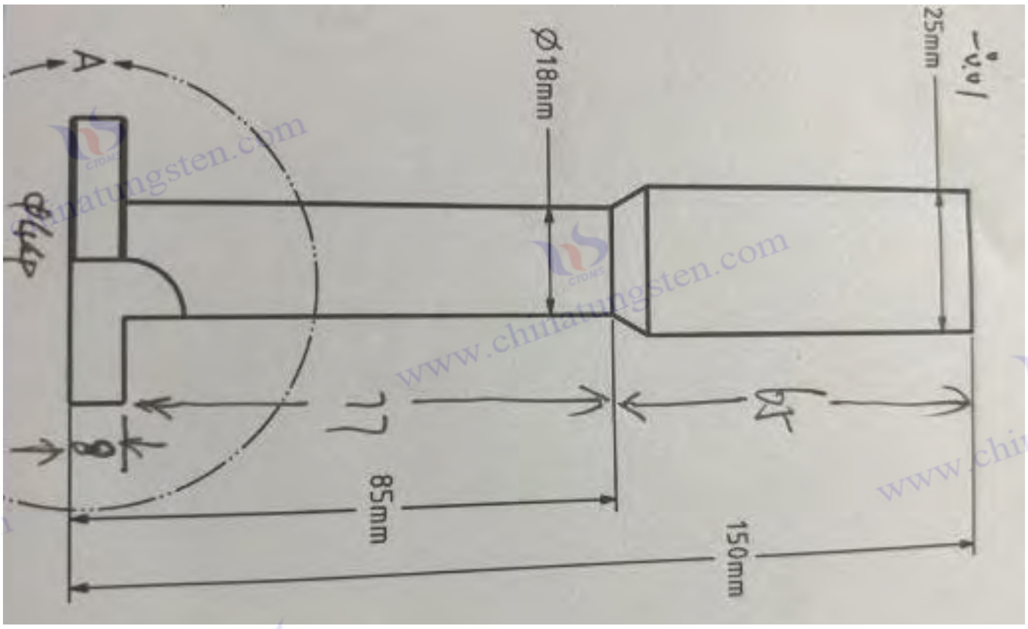
type	Application Areas	Specific use
Standard T-type milling cutter	Mold manufacturing	Processing of T-slots and bolt holes for stamping, injection molding and forging dies.
Enhanced T-type milling cutter	Machining	Machining of machine tool beds, guideways and connections for automotive and heavy machinery.
Precision T-type milling cutter	Aerospace	Processing of titanium alloys, nickel-based alloys and high-strength steels for aircraft structures and engine components.
Custom T-type milling cutter	Shipbuilding and energy	Process large structural parts and special connectors to adapt to complex geometries and diverse materials.
Roughing T-type milling cutter	Rough processing area	Rapidly removes large amounts of material and is suitable for initial processing.
T-type milling cutter with chamfer	Finishing and assembly	Processing edge chamfering improves workpiece assembly performance and is suitable for precision parts.
Multi- edge T-type milling cutter	Mass production	Improve cutting efficiency and is suitable for large-scale production tasks.

8. Carbide T-type milling cutter related domestic and international standards

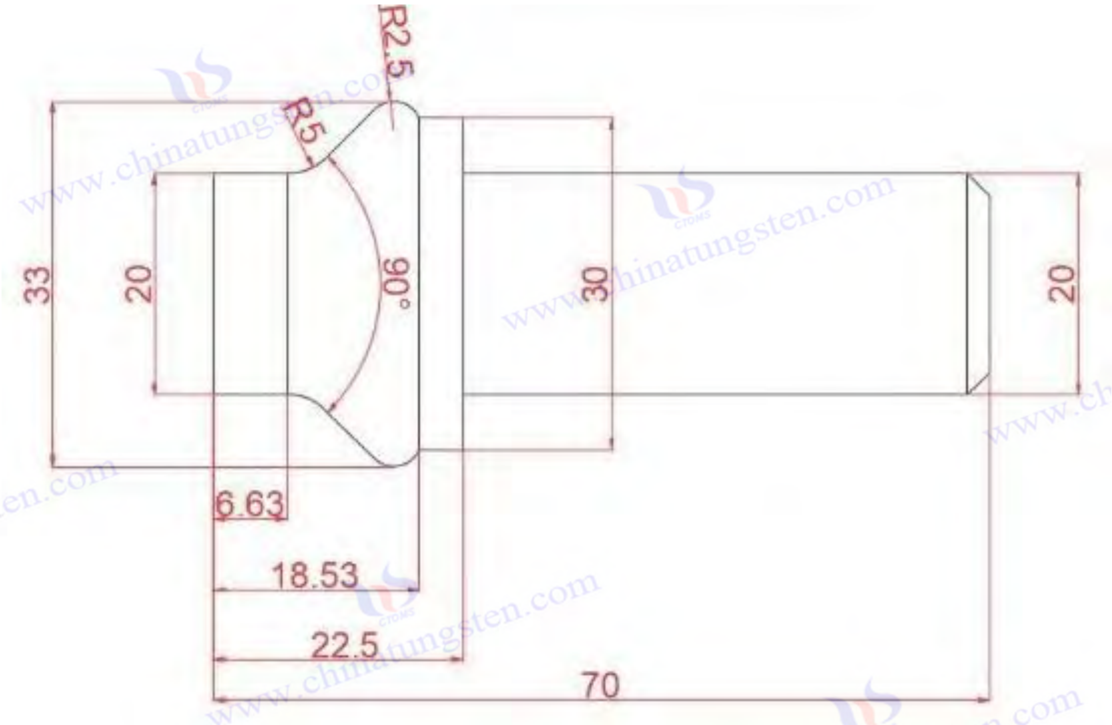
The carbide T-type milling cutters produced by CTIA GROUP LTD must comply with a number of domestic and international standards to ensure their performance and market competitiveness. The ISO 513 standard developed by the International Organization for Standardization (ISO) defines the classification and application of cutting tool materials, and T-type milling cutters must meet the performance requirements of their carbide materials. The ISO 15641 standard specifies the geometric parameters and durability test methods of milling cutters, guiding the design and performance evaluation of T-type milling cutters. DIN 844 and DIN 1839 in the German Industrial Standards (DIN) provide tolerance and installation dimension requirements for milling cutters, respectively, which are suitable for the manufacture of T-type milling cutters in the European market. The ANSI B94.19 standard developed by the American National Standards Institute (ANSI) specifies the classification and use conditions of milling cutters in detail to ensure the compatibility of T-type milling cutters in the North American market. In addition, the JIS B 4120 standard in the Japanese Industrial Standards (JIS) specifies the manufacturing and testing specifications for carbide milling cutters and is widely used in the Asian market. China's national standards GB/T 16665 and GB/T 5231 respectively specify the performance of cemented carbide materials and the general technical conditions of cutting tools, ensuring that the T-type milling cutters produced by CTIA GROUP meet international standards. The combined effect of these standards provides technical support for the global application of CTIA GROUP 's T-type milling cutters.

Carbide T-type milling cutter domestic and international standard table

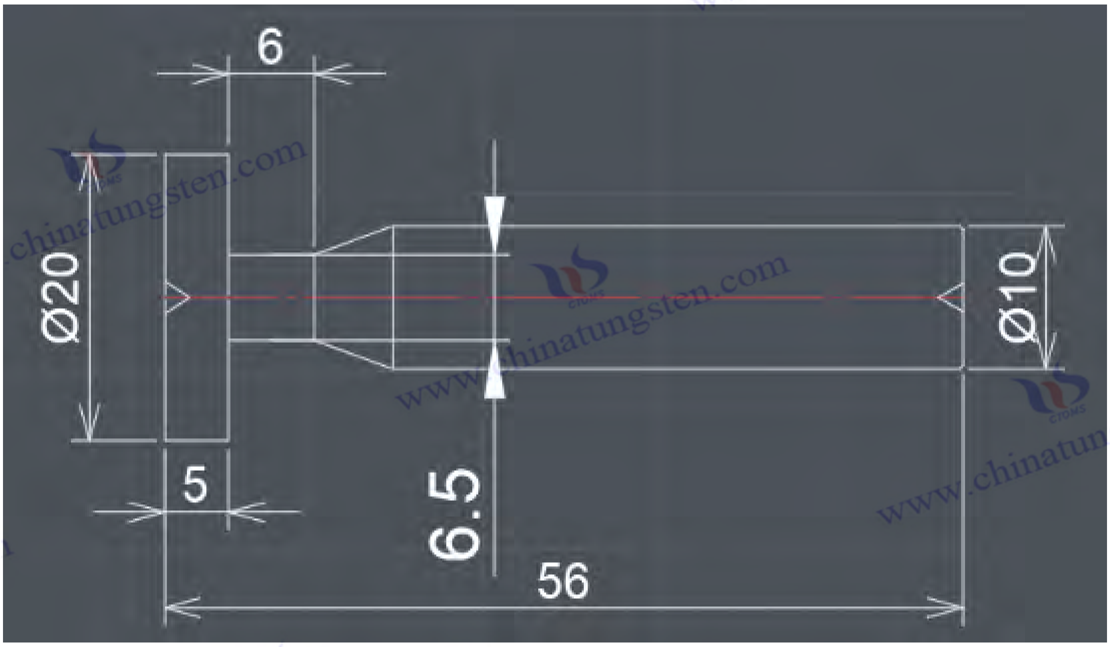
Standards Organizations	**Standard No.**	**Contents**
ISO	ISO 513	Classification and application requirements of cutting tool materials.
ISO	ISO 15641	Milling cutter geometry parameters and durability test methods.
DIN	DIN 844	Milling cutter tolerances and installation dimension requirements.
DIN	DIN 1839	Specifications for milling cutter manufacturing and use.
ANSI	ANSI B94.19	Specification for classification and conditions of use of milling cutters.
JIS	JIS B 4120	Specification for manufacturing and testing of cemented carbide milling cutters.
GB/T	GB/T 16665	Performance requirements of cemented carbide materials.
GB/T	GB/T 5231	General technical requirements for cutting tools.



CTIA GROUP Carbide Milling Cutter Blank Processing Design Drawing

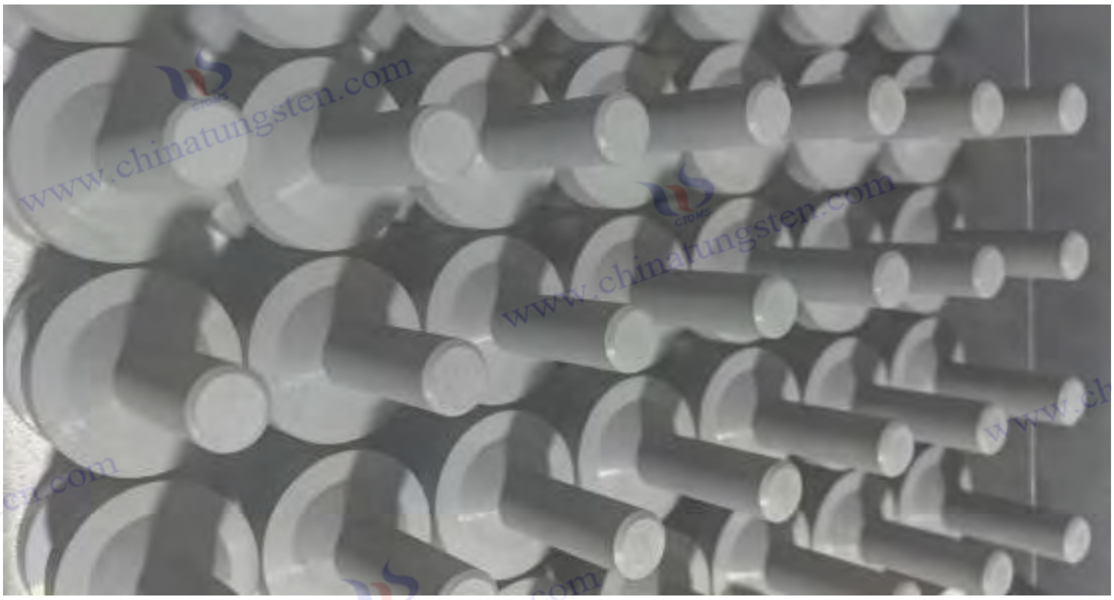


CTIA GROUP Carbide Milling Cutter Blank Processing Design Drawing



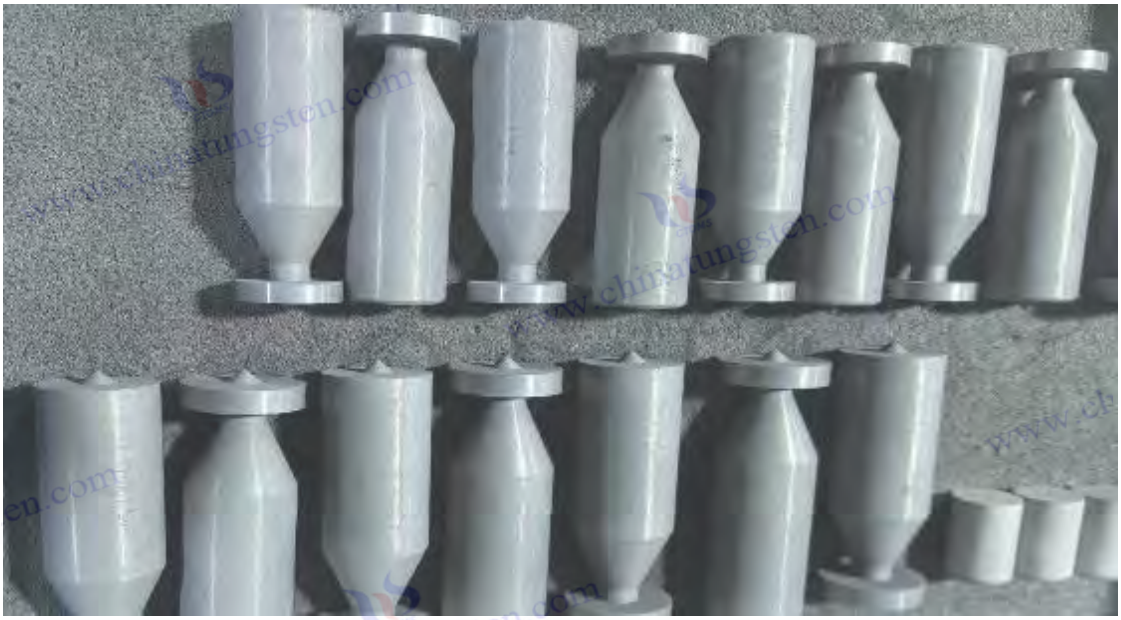
CTIA GROUP Carbide Milling Cutter Blank Processing Design Drawing

CTIA GROUP Carbide T-type Milling Cutter Sintered Blank

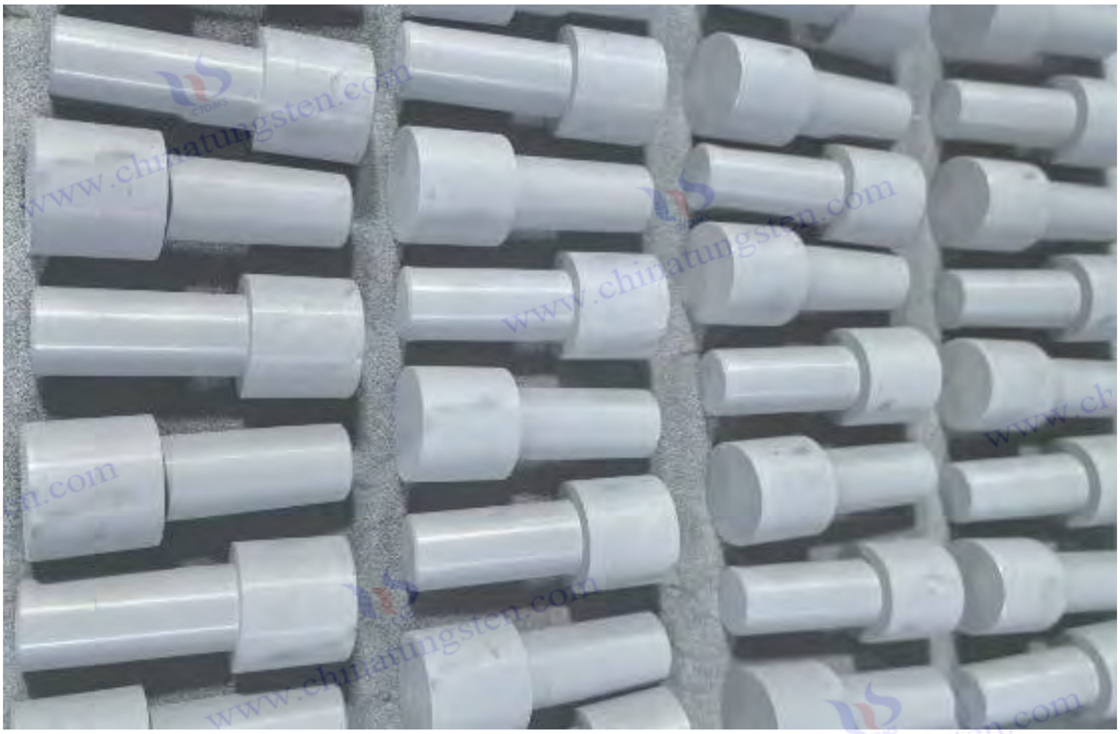


CTIA GROUP Carbide T-type Milling Cutter Sintered Blank

CTIA GROUP Carbide T-type Milling Cutter Sintered Blank

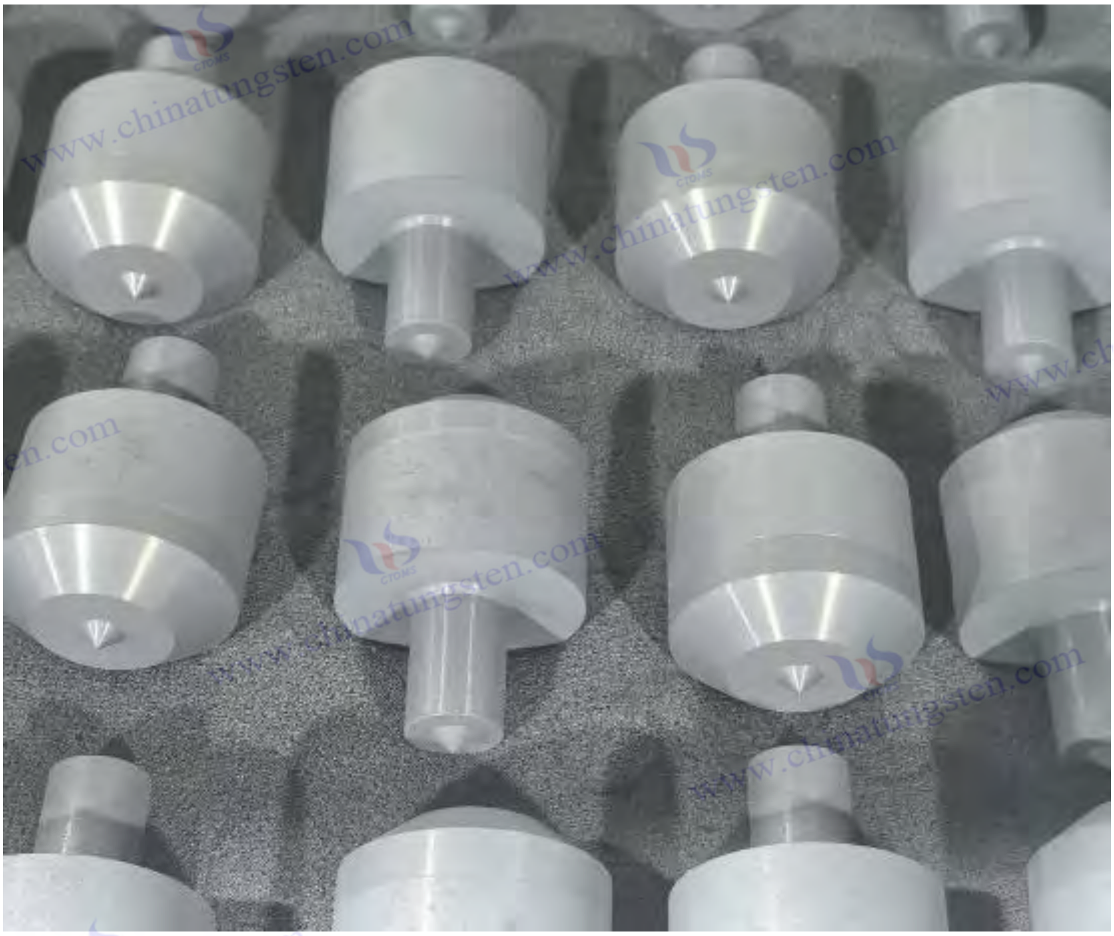


CTIA GROUP Carbide T-type Milling Cutter Sintered Blank



CTIA GROUP Carbide T-type Milling Cutter Sintered Blank

CTIA GROUP Carbide T-type Milling Cutter Sintered Blank



CTIA GROUP Carbide T-type Milling Cutter Sintered Blank

appendix:

ISO 513:2012 – Classification

and application of hard cutting materials for metal removal with defined cutting edges — Designation of the main groups and groups of application

1. Scope

This International Standard specifies the classification and application of hard cutting materials, including carbides, ceramics, diamond and boron nitride, for metal cutting operations with defined cutting edges . The standard establishes the scope of applicability and application guidance for these materials, but is not applicable to other uses, such as mining and other impact tools, wire drawing dies, tools that operate by metal deformation, comparator contact tips, etc.

1.1 Scope of application

This standard applies to hard cutting materials used in metal cutting operations involving chip removal.

Materials or tools for non-cutting purposes are not included.

1.2 Exclusions

Mining and impact tools.

Wire drawing dies.

Metal deformation tools.

Comparator contact tip.

2. Normative References

The documents listed below become an integral part of this standard through reference in this standard. Only the version on a specific date applies to this standard. Any subsequent revision or amendment does not apply to this standard unless otherwise stated.

ISO 1832:2017 , *Indexable inserts for cutting tools — Designation* .

ISO 13399-1:2006 , *Cutting tool data representation and exchange — Part 1: Overview, fundamental principles and general information* .

ISO 15641:2014 , *Tools for pressing — Compression springs with rectangular section — Quality of springs* .

Note : The latest versions of referenced documents may be updated after publication. It is recommended to check the ISO official website for the latest information.

3. Terms and Definitions

For the purpose of this standard, the following terms and definitions apply:

3.1 Hard Cutting Materials

Refers to materials with high hardness and wear resistance used in metal cutting processing, including but not limited to cemented carbide, ceramics, diamond and boron nitride.

电话/TEL：0086 592 512 9696
CTIAQCD-MA-E/P 2018-2024V
sales@chinatungsten.com

3.2 Chip Removal

Machining process in which material is removed from a workpiece material by means of a cutting tool, usually involving a defined cutting edge .

3.3 Main Groups of Cutting Materials

The categories of hard cutting materials classified according to material properties and application areas include:

Group P: Suitable for long-chipping materials such as steel.

Group M: Suitable for medium chipping materials (such as stainless steel).

Group K: Suitable for short-chipping materials (such as cast iron).

Group N: Applicable to non-ferrous metals and non-metallic materials.

S Group: Suitable for high hardness materials (such as hardened steel).

3.4 Groups of Application

Specific application subcategories based on workpiece material properties and machining conditions.

4. Symbols and Abbreviations

WC : Tungsten Carbide.

Co : Cobalt.

TiN : Titanium Nitride.

PVD : Physical Vapor Deposition.

HV : Vickers Hardness.

5. Classification

5.1 Material classification

Hard cutting materials are divided into the following main groups according to their chemical composition and physical properties:

Hardmetals : Based on WC-Co system, containing trace additives (such as **TiC** , TaC) .

Ceramics : Includes aluminum oxide (Al_2O_3) and silicon nitride (Si_3N_4) based materials.

Diamond : Natural or synthetic, suitable for non-ferrous metals.

Boron Nitride : Cubic boron nitride (cBN), suitable for high hardness steel.

5.2 Application Classification

According to the workpiece material and processing conditions, the application groups are as follows:

Group P : Steel and its alloys (hardness HB 130-250).

Group M : Stainless steels and heat-resistant alloys.

Group K : Cast iron and non-ferrous brittle materials.

Group N : Aluminium, copper and their alloys, thermoplastics.

Group S : Hardened steel and hardened cast iron (hardness HRC 45-65).

电话/TEL：0086 592 512 9696
CTIAQCD-MA-E/P 2018-2024V
sales@chinatungsten.com

6. Technical Requirements

6.1 Material properties

Hardness : HV 1500-2500 (depending on material type).

Fracture toughness : $K_{1}c \geq 8$ MPa·m $^{1/2}$.

Heat resistance : ≥ 800°C (after coating reinforcement).

6.2 Geometric parameters

Cutting edge angle: main rake angle 5°-20°.

Secondary deflection angle: 0°-10°.

Tip radius: 0.1-1.0 mm.

6.3 Coating requirements

Optional coatings: TiN , TiAlN , AlCrN .

Coating thickness: 0.5-5 μm .

Bond strength:> 70 MPa.

7. Test Methods

7.1 Hardness test

Tested using a Vickers hardness tester according to ISO 6507-1.

7.2 Abrasion resistance test

Using the standard cutting test, the wear band width (VB) was measured to be < 0.3 mm (cutting for 30 min).

7.3 Fracture toughness test

Tested using the single edge notched beam (SENB) method according to ISO 28079.

8. Marking and Packaging

8.1 Logo

Products should be marked with the material group (e.g. P20, M15) and the manufacturer's logo.

Example: P20-TiAlN-10mm.

8.2 Packaging

Use moisture-proof and shock-proof packaging.

Comes with a quality certificate stating the batch number and test data.

9. Inspection Rules

9.1 Factory Inspection

Raw material hardness and purity inspection.

9.2 Factory Inspection

Density, hardness and flexural strength tests.
Non-destructive testing (ultrasonic).

10. Application Guidelines

10.1 Cutting data

Cutting speed: 50-300 m/min (adjusted according to material).
Feed rate: 0.1-0.5 mm/rev.
Cutting depth: 0.5-5 mm.

10.2 Cooling and lubrication

It is recommended to use cutting fluid with a flow rate ≥ 10 L/min.

11. Safety Requirements

Wear protective glasses and gloves when handling.
Avoid prolonged exposure to high temperatures to prevent coating peeling.

12. Annex

Appendix A (Informative) - Material Properties Reference Table

Material Type	Hardness (HV)	Fracture toughness ($MPa \cdot m^{1/2}$)	Heat resistance (°C)
Cemented Carbide	1500-1800	10-15	800
ceramics	1800-2200	3-6	1000
Diamond	8000-10000	5-10	600
Boron Nitride	3000-4000	6-12	1200

Appendix B (Normative) - Group Code Table

Groups	Workpiece material	Recommended Materials
P	Steel (HB 130-250)	Carbide(P20)
M	Stainless steel	Carbide(M15)
K	cast iron	Carbide(K20)
N	Aluminum, copper	Diamond
S	Hardened steel (HRC 45-65)	Boron Nitride

13. Index

Hard cutting materials
Chip removal
Material Classification

电话/TEL：0086 592 512 9696
CTIAQCD-MA-E/P 2018-2024V
sales@chinatungsten.com

Application Group
Test Method

14. Publication Information

Release date : October 15, 2012.
Effective date : November 1, 2012.
Maintenance organization : ISO/TC 29/SC 9 (Tools with cutting edges made of hard cutting materials).
Languages : English, French.

Precautions

The above content is simulated based on public information and industry practices of ISO 513:2012. Specific technical details (such as precise group codes or test parameters) may require reference to the official standard text. If you need the official full version, please obtain it through the ISO official website or authorized distributors (such as ANSI or DIN).

appendix:

Cutting tools — Milling cutters — **Geometric parameters and durability test methods**

1. Scope

This International Standard specifies the definition of geometric parameters, measurement methods and durability test procedures for milling cutters (including but not limited to end mills, face mills and T-mills) used for metal cutting operations. This standard applies to milling cutters made of hard cutting materials (such as cemented carbide, ceramics and superhard materials) with defined cutting edges , and is intended to ensure their consistent performance under different machining conditions. This standard does not apply to non-cutting tools or non-metal machining applications.

1.1 Scope of application

Suitable for all types of milling cutters such as end mills, face mills, T-type milling cutters, etc.
Covers geometric parameter design and durability testing.

1.2 Exclusions

Non-cutting tools (e.g. abrasive tools).
Tools for processing non-metallic materials.

2. Normative References

The documents listed below become an integral part of this standard through reference in this standard. Only the version on a specific date applies to this standard. Any subsequent revision or amendment does not apply to this standard unless otherwise stated.

ISO 513:2012 , *Classification and application of hard cutting materials for metal removal with defined cutting edges* .
ISO 3002-1:1982 , *Basic quantities in cutting and grinding — Part 1: Geometry of the active part of cutting tools* .
ISO 8688-1:1989 , *Tool life testing in milling — Part 1: Face milling* .

电话/TEL：0086 592 512 9696
CTIAQCD-MA-E/P 2018-2024V
sales@chinatungsten.com

ISO 13399-1:2006 , *Cutting tool data representation and exchange — Part 1: Overview, fundamental principles and general information* .

Note : The latest versions of referenced documents may be updated after publication. It is recommended to check the ISO official website for the latest information.

3. Terms and Definitions

For the purpose of this standard, the following terms and definitions apply:

3.1 Milling Cutter

having multiple cutting edges for machining workpiece material by chip removal.

3.2 Geometric Parameters

Characteristics that describe the shape and size of the cutting portion of a milling cutter, including the deflection angle, nose radius, and helix angle.

3.3 Durability

The service life of a milling cutter under specified cutting conditions is usually measured in cutting time or the number of workpieces processed.

3.4 Flank Wear Width (VB)

a cutting edge , used to assess durability.

4. Symbols and Abbreviations

κr : Rake Angle.
κ' : Secondary Rake Angle.
rε : Corner Radius.
VB : Flank Wear Width.
Vc : Cutting Speed (m/min).
fn : Feed rate (Feed per Tooth, mm/tooth).

5. Classification

5.1 Milling cutter types

End mill : For side and face cutting.
Face milling cutter : used for flat surface machining.
T-type milling cutter : specially used for T-slot processing.

5.2 Material classification

Cemented carbide (WC-Co based).
Ceramics (Al_2O_3 , Si_3N_4) .
Superhard materials (diamond, cBN).

6. Technical Requirements

6.1 Geometric parameters

Main deflection angle (κr) : 5°-20°.
Secondary deflection angle (κ') : 0°-10°.
Tool tip radius (rε) : 0.1-1.5 mm.
Helix angle : 15°-45° (depending on processing requirements).

6.2 Durability requirements

Standard durability: VB ≤ 0.3 mm after 30 min of cutting.
High durability: cutting 60 min, VB ≤ 0.2 mm.

7. Test Methods

7.1 Geometric parameter measurement

Tools : Optical microscope or CMM.
Accuracy : ±0.01 mm.
Reference standard : According to ISO 3002-1.

7.2 Durability test

Test conditions :
Workpiece material: Steel (HB 200).
Cutting speed (Vc): 100-200 m/min.
Feed rate (fn): 0.1-0.3 mm/tooth.
Cutting depth (ap): 1-3 mm.
Testing Procedure :
Install the milling cutter on the test machine.
Continuous cutting according to specified parameters.
VB was measured every 10 min.
The lifetime was recorded until VB reached 0.3 mm.
Reference standard : According to ISO 8688-1.

7.3 Data Recording

Record cutting time, VB value and failure mode (chipping , wear, etc.).

8. Marking and Packaging

8.1 Logo

Indicate the cutter type (e.g. T20), material group (e.g. P20) and size (e.g. φ10 mm).
Example: T20-P20-φ10mm.

8.2 Packaging

Use moisture-proof and shock-proof packaging.
Comes with a test report containing geometrical parameters and durability data.

9. Inspection Rules

9.1 Factory Inspection

Raw material hardness and geometric parameter inspection.

9.2 Factory Inspection

Geometric parameter measurement.
Durability test (sampling inspection).

10. Application Guidelines

10.1 Cutting data

Cutting speed (Vc) : 50-300 m/min (adjusted according to material).
Feed rate (fn) : 0.05-0.5 mm/tooth.
Cutting depth (ap) : 0.5-5 mm.

10.2 Cooling and Lubrication

It is recommended to use cutting fluid with a flow rate ≥ 10 L/min.

11. Safety Requirements

Wear protective glasses and gloves when handling.
Avoid overheating of the tool during high-speed cutting.

12. Annex

Appendix A (Informative) - Geometric Parameters Reference Table

parameter	scope	Remark
Main deflection angle (κr)	5°-20°	Adjust according to the workpiece
Secondary deflection angle (κ')	0°-10°	Stable cutting
Tool tip radius (rε)	0.1-1.5 mm	Reduce stress concentration

Appendix B (Normative) - Durability Test Conditions Table

Workpiece material	Cutting speed (Vc , m/min)	Feed rate (fn , mm/tooth)	Cutting depth (ap, mm)
Steel (HB 200)	100-200	0.1-0.3	1-3
cast iron	80-150	0.2-0.4	2-4
Stainless steel	60-120	0.1-0.2	1-2

13. Index

Milling cutter Geometric parameters Durability Testing Cutting conditions

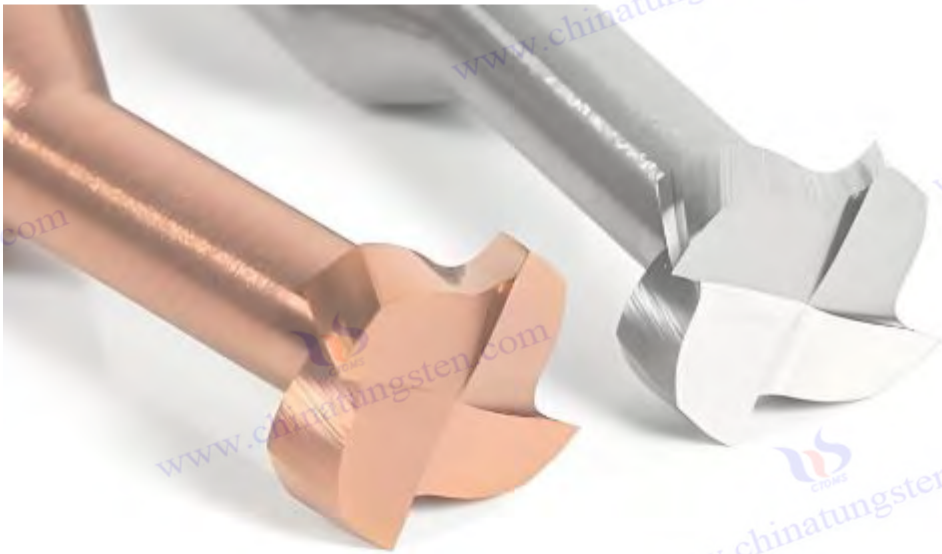
电话/TEL：0086 592 512 9696
CTIAQCD-MA-E/P 2018-2024V
sales@chinatungsten.com

14. Publication Information

Publication date : June 15, 2014. **Effective date** : July 1, 2014.

Maintenance organization : ISO/TC 29/SC 9 (Tools with cutting edges made of hard cutting materials).

Languages : English, French.



CTIA GROUP LTD

30 Years of Cemented Carbide Customization Experts

Core Advantages

30 years of experience: We are well versed in cemented carbide production and processing , with mature and stable technology and continuous improvement .

Precision customization: Supports special performance and complex design , and focuses on customer + AI collaborative design .

Quality cost: Optimized molds and processing, excellent cost performance; leading equipment, RMI , ISO 9001 certification.

Serving Customers

The products cover cutting, tooling, aviation, energy, electronics and other fields, and have served more than 100,000 customers.

Service Commitment

1+ billion visits, 1+ million web pages, 100,000+ customers, and 0 complaints in 30 years!

Contact Us

Email : sales@chinatungsten.com

Tel : +86 592 5129696

Official website : www.ctia.com.cn




appendix:

DIN 844:1987 -

Milling cutters with cylindrical shank — Dimensions

1. Scope

This standard specifies the dimensions, tolerances and installation requirements for milling cutters with cylindrical shanks, applicable to end mills, face mills and T-type milling cutters. The standard defines the shank diameter, cutting section length and installation tolerances of the milling cutter to ensure compatibility with the machine tool spindle and clamping system. This standard applies to milling cutters for cemented carbide (WC-Co), high-speed steel (HSS) and other cutting materials, but does not include non-standard milling cutters for special purposes.

1.1 Scope of application

For end mills, face mills and T-type milling cutters with cylindrical shanks.
Covers dimensions, tolerances and installation requirements.

1.2 Exclusions

Milling cutters for special purposes or non-standard designs.
Milling cutters with tapered or Weldon shanks (ref. DIN 1835).

2. Normative References

The documents listed below become an integral part of this standard through reference in this standard. Only the version on a specific date applies to this standard. Any subsequent revision or amendment does not apply to this standard unless otherwise stated.

DIN 13-1:1999 , *ISO general purpose metric screw threads — Tolerances* .

DIN 6885-1:2003 , *Drive type fastners without taper action; parallel keys, keyways, deep pattern* .

ISO 513:2012 , *Classification and application of hard cutting materials for metal removal with defined cutting edges* .

ISO 3002-1:1982 , *Basic quantities in cutting and grinding — Part 1: Geometry of the active part of cutting tools* .

Note : The latest version of the referenced document may be updated after publication. It is recommended to check the DIN official website for the latest information.

3. Terms and Definitions

For the purpose of this standard, the following terms and definitions apply:

3.1 Cylindrical Shank

Milling cutters are used for clamping cylindrical parts and are designed to match machine tool chucks or clamping devices.

3.2 Tolerance

The allowable deviation range of milling cutter size ensures compatibility with machine tools and processing accuracy.

3.3 Mounting Dimensions

Refers to the handle diameter, length and matching dimensions with the clamping system.

4. Symbols and Abbreviations

d : Shank Diameter, mm.

l : Total Length (mm).

l1 : Cutting Length (mm).

h6 : Tolerance Grade (per DIN 668).

H7 : Tolerance Grade (per DIN 668).

5. Technical Requirements

5.1 Size requirements

Shank diameter (d) : 3 mm to 25 mm, standard values include 3, 4, 5, 6, 8, 10, 12, 16, 20, 25 mm.

Total length (l) : According to the diameter, ranging from 40 mm to 150 mm.

Cutting part length (l1) : depends on the cutter type, usually 1.5 to 3 times d .

5.2 Tolerance requirements

Shank diameter tolerance : h6 (3-6 mm diameter) or h7 (8-25 mm diameter) according to DIN 668.

h6: ±0.000/-0.006 mm (3-6 mm).

h7: ±0.000/-0.010 mm (8-25 mm).

Length tolerance : ±0.2 mm (l and l1).

Coaxiality tolerance : 0.01 mm (over the entire length).

5.3 Installation Requirements

Clamping fit : The fit tolerance between the shank and the collet or clamping device is H7/s6.

Surface roughness : Shank Ra ≤ 0.8 μm , cutting part Ra ≤ 1.6 μm .

Hardness : Shank HRC 40-50, cutting part according to the material (such as carbide HV 1500-1800).

6. Test Methods

6.1 Dimensional measurement

Tools : Vernier caliper or CMM.

Accuracy : ±0.01 mm.

Reference standard : According to DIN 13-1.

6.2 Tolerance Verification

Method : Check shank diameter and length tolerances using standard gauges.

Coaxiality test : Use a rotational rheometer to measure the full-length coaxiality.

7. Marking and Packaging

7.1 Logo

Indicate the cutter type (e.g. A, B), diameter (d), length (l) and material (e.g. HSS).
Example: DIN 844-A-10-60-HSS.

7.2 Packaging

Use moisture-proof and shock-proof packaging.
Comes with dimensional and tolerance inspection report.

8. Inspection Rules

8.1 Factory Inspection

Raw material size and hardness inspection.

8.2 Factory Inspection

Shank diameter, length and coaxiality measurements.
Sample inspection of clamping fit.

9. Application Guidelines

9.1 Installation Recommendations

Make sure the collet matches the shank diameter, hydraulic or retractable clamping is recommended.
Clean the handle surface before installation.

9.2 Cutting parameters

Cutting speed: 50-200 m/min (adjusted according to material).
Feed rate : 0.1-0.3 mm/rev.

10. Safety Requirements

Wear protective glasses when operating.
Avoid over-tightening or over-loosening to prevent the tool from falling off.

11. Annex

Appendix A (Informative) - Dimension and Tolerance Tables

Shank diameter (d, mm)	Tolerance grade	Total length (l, mm)	Cutting length (l1, mm)	Coaxiality(mm)
3	h6	40	6	0.01
6	h6	50	12	0.01
10	h7	70	20	0.01

16	h7	100	40	0.01
25	h7	150	75	0.01

Appendix B (Normative) - Installation Fitting Tables

Shank diameter (d, mm)	Collet tolerance	Match type
3-6	H7/s6	Transition fit
8-25	H7/s6	Transition fit

12. Index

Cylindrical shank milling cutter
tolerance
Installation Dimensions
Test Method

13. Publication Information

Release date : May 1, 1987.
Effective date : June 1, 1987.
Maintenance agency : Deutsches Institut für Normung (DIN).
Languages : German, English.

电话/TEL：0086 592 512 9696
CTIAQCD-MA-E/P 2018-2024V
sales@chinatungsten.com

appendix:

DIN 1839:1990 -

Milling cutters — Manufacturing and application specifications

1. Scope

This standard specifies the manufacturing process, quality control and use condition specifications of milling cutters (including end mills, face mills and T-type milling cutters), and is applicable to milling cutters made of cemented carbide (WC-Co), high-speed steel (HSS) and other cutting materials. This standard aims to ensure the manufacturing consistency, use safety and compatibility of milling cutters with machine tool systems, and is not applicable to non-cutting tools or non-standard milling cutters for special purposes.

1.1 Scope of application

Suitable for the manufacture and use of end mills, face mills and T-type milling cutters.
Covers manufacturing processes, usage conditions and safety requirements.

1.2 Exclusions

Non-cutting tools (e.g. abrasive tools).
Milling cutters for special purposes or non-standard designs.

2. Normative References

The documents listed below become an integral part of this standard through reference in this standard. Only the version on a specific date applies to this standard. Any subsequent revision or amendment does not apply to this standard unless otherwise stated.

DIN 844:1987 , *Milling cutters with cylindrical shank — Dimensions* .
DIN 13-1:1999 , *ISO general purpose metric screw threads — Tolerances* .
ISO 513:2012 , *Classification and application of hard cutting materials for metal removal with defined cutting edges* .
ISO 8688-1:1989 , *Tool life testing in milling — Part 1: Face milling* .
Note : The latest version of the referenced document may be updated after publication. It is recommended to check the DIN official website for the latest information.

3. Terms and Definitions

For the purpose of this standard, the following terms and definitions apply:

3.1 Milling Cutter

having multiple cutting edges for machining workpiece material by chip removal.

3.2 Manufacturing Process

The processing steps from raw material preparation to the finished milling cutter include powder metallurgy, sintering and coating.

3.3 Application Conditions

Cutting parameters, cooling requirements and maintenance specifications of milling cutters during machining.

4. Symbols and Abbreviations

d : Shank Diameter, mm.
l : Total Length (mm).
Vc : Cutting Speed (m/min).
fn : Feed rate (Feed per Tooth, mm/tooth).
PVD : Physical Vapor Deposition.

5. Technical Requirements

5.1 Manufacturing requirements

Material selection :
Cemented carbide: WC content 88%-92%, Co content 6%-12%.
High speed steel: HSS-E (containing cobalt) hardness HRC 62-66.
Manufacturing process :
Powder metallurgy: ball milling time 12-24 h, pressing pressure 150-200 MPa.
Sintering: temperature 1350-1450°C, pressure holding 1-2 h.
Coating: PVD TiAlN , thickness 1-3 μm .
Surface roughness : Cutting part Ra ≤ 1.6 μm , shank Ra ≤ 0.8 μm .

5.2 Usage Requirements

Cutting data :
Cutting speed (Vc): 50-300 m/min (adjusted according to material).
Feed rate (fn): 0.05-0.5 mm/tooth.
Cutting depth: 0.5-5 mm.
Cooling : Cutting fluid is recommended, flow rate ≥ 10 L/min.

6. Manufacturing Process

6.1 Raw material preparation

High purity WC powder (purity > 99.8%) and Co powder (purity > 99.5%) were used.
Particle size control: D50 < 1 μm .

6.2 Processing Flow

Pressing : Cold isostatic pressing (CIP), pressure 150-200 MPa.
Sintering : Hot isostatic pressing (HIP), temperature 1350-1450°C.
Finishing : CNC grinding, tolerance ±0.01 mm.
Coating : PVD process, temperature 450-500°C.

6.3 Quality Control

Density: 14.0-14.9 g/ cm^3 .

Hardness: HV 1500-1800 (carbide).

7. Application Specifications

7.1 Installation

Make sure the shank matches the collet to tolerances DIN 844 h6/h7.

Clean the handle before installation.

7.2 Maintenance

Check the wear band width (VB) regularly, replacement standard VB > 0.3 mm.

Avoid dry cutting for more than 10 min.

8. Inspection Rules

8.1 Factory Inspection

Raw material hardness and purity inspection.

8.2 Factory Inspection

Dimensions, tolerances and hardness testing.

Durability test (sampling), according to ISO 8688-1.

9. Marking and Packaging

9.1 Logo

Indicate type (such as T), diameter (d), length (l) and material.

Example: DIN 1839-T-10-60-HM.

9.2 Packaging

Use moisture-proof and shock-proof packaging.

Comes with a certificate of manufacture and testing.

10. Safety Requirements

Wear protective glasses and gloves when handling.

Avoid overload cutting to prevent tool chipping .

11. Annex

Appendix A (Informative) - Manufacturing Process Parameters Table

Process steps	Parameter range	Remark
ball milling	12-24 h, medium ratio 1:2	Ensure uniformity

电话/TEL：0086 592 512 9696
CTIAQCD-MA-E/P 2018-2024V
sales@chinatungsten.com

suppress	150-200 MPa	Initial density 60%-65%
sintering	1350-1450°C, 1-2 h	Density> 99.9%
coating	1-3 µm , 450-500°C	TiAlN coating

Appendix B (Normative) - Table of Conditions of Use

Workpiece material	**Cutting speed (Vc , m/min)**	**Feed rate (fn , mm/tooth)**	**Cutting depth(mm)**
Steel (HB 200)	100-200	0.1-0.3	1-3
cast iron	80-150	0.2-0.4	2-4
Stainless steel	60-120	0.1-0.2	1-2

12. Index

Milling cutter
Manufacturing process
Usage Guidelines
Security Requirements

13. Publication Information

Release date : March 1, 1990.
Effective date : April 1, 1990.
Maintenance agency : Deutsches Institute for Normung (DIN).
Languages : German, English.

appendix:

ANSI B94.19-1997 (R2019) -
Milling Cutters and End Mills

1. Scope

This standard specifies the classification, dimensions, tolerances and service conditions of one-piece milling cutters and end mills made of high-speed steel, applicable to various milling operations in metal cutting. The standard includes general definitions, size ranges and tolerance requirements, and provides guidance on service conditions to ensure the performance and safety of milling cutters in different workpiece materials and processing environments. This standard does not apply to milling cutters that are not of one- piece construction or non-metal cutting applications.

1.1 Scope of application

For one- piece milling cutters and end mills made of high-speed steel.
Covers classification, dimensions, tolerances and conditions of use.

1.2 Exclusions

non- integral construction.
Non-metal cutting applications.

2. Normative References

The documents listed below become an integral part of this standard through reference in this standard. Only the version on a specific date applies to this standard. Any subsequent revision or amendment does not apply to this standard unless otherwise stated.

ANSI B5.10-1994 , *Machine Tapers* .

ISO 513:2012 , *Classification and application of hard cutting materials for metal removal with defined cutting edges* .

ISO 8688-1:1989 , *Tool life testing in milling — Part 1: Face milling* .

Note : The latest version of the referenced document may be updated after publication. It is recommended to check the ANSI official website for the latest information.

3. Terms and Definitions

For the purpose of this standard, the following terms and definitions apply:

3.1 Milling Cutter

having multiple cutting edges for machining workpiece material by chip removal.

3.2 End Mill

A milling cutter with cutting edges on the end face and circumference, capable of axial and radial cutting.

3.3 Application Conditions

Cutting parameters, cooling requirements and maintenance specifications of milling cutters during machining.

4. Symbols and Abbreviations

d : Diameter (mm).
l : Total Length (mm).
Vc : Cutting Speed (m/min).
fn : Feed rate (Feed per Tooth, mm/tooth).
HSS : High-Speed Steel.

5. Classification

5.1 Milling cutter types

End mills : Includes flat bottom end mills, ball nose end mills and angle end mills.
Face milling cutter : used for flat surface machining, divided into roughing and finishing types.
Slot milling cutter : including T-slot milling cutter and keyway milling cutter.

5.2 Size classification

Diameter range : 3 mm to 50 mm, standard values include 3, 4, 6, 8, 10, 12, 16, 20, 25, 32, 40, 50 mm.
Length range : 40 mm to 200 mm, graded according to diameter.

5.3 Tolerance classification

Diameter tolerance: h6 (3-6 mm) or h7 (8-50 mm).
Length tolerance: ±0.2 mm.

6. Application Specifications

6.1 Cutting parameters

Cutting speed (Vc) :
Steel (HB 200): 20-50 m/min.
Cast iron: 30-70 m/min.
Aluminum alloy: 100-300 m/min.
Feed rate (fn) : 0.05-0.3 mm/tooth.
Cutting depth : 0.5-5 mm (adjusted according to the cutter diameter).

6.2 Cooling and lubrication

It is recommended to use cutting fluid with a flow rate ≥ 10 L/min.
Dry cutting is suitable for light-load processing and lasts no longer than 10 minutes.

6.3 Workpiece material adaptation

Group P : Steel and its alloys (hardness HB 130-250).
Group K : Cast iron and non-ferrous brittle materials.

Group N : Aluminium, copper and their alloys.

6.4 Maintenance requirements

Check the wear band width (VB) regularly, replacement standard VB > 0.3 mm.

Avoid overload cutting to prevent tool chipping .

7. Technical Requirements

7.1 Material properties

Hardness : HRC 62-66 (HSS).

Heat resistance : ≤ 600°C.

7.2 Geometric parameters

Main deflection angle : 5°-15°.

Tip radius : 0.1-1.0 mm.

8. Test Methods

8.1 Dimensional measurement

Tools : Vernier caliper or CMM.

Accuracy : ±0.01 mm.

8.2 Durability test

Conditions : Steel (HB 200), Vc 30 m/min, fn 0.1 mm/tooth, ap 2 mm.

Procedure : Cut continuously for 30 min and measure VB.

Reference standard : According to ISO 8688-1.

9. Marking and Packaging

9.1 Logo

Indicate the type (such as EM), diameter (d) and length (l).

Example: ANSI B94.19-EM-10-60.

9.2 Packaging

Use moisture-proof and shock-proof packaging.

Comes with size and durability test report.

10. Inspection Rules

10.1 Factory Inspection

Raw material hardness and size inspection.

电话/TEL：0086 592 512 9696
CTIAQCD-MA-E/P 2018-2024V
sales@chinatungsten.com

10.2 Factory Inspection

Dimensional, tolerance and durability testing (sampling).

11. Safety Requirements

Wear protective glasses and gloves when handling.

Avoid overheating of the tool during high-speed cutting.

12. Annex

Appendix A (Informative) - Classification and Size Tables

type	Diameter range (mm)	Length range(mm)	Tolerance grade
End milling cutter	3-25	40-150	h6/h7
Face milling cutter	10-50	50-200	h7
T-Slot Milling Cutter	6-32	50-150	h6/h7

Appendix B (Normative) - Table of Conditions of Use

Workpiece material	Cutting speed (Vc , m/min)	Feed rate (fn , mm/tooth)	Cutting depth(mm)
Steel (HB 200)	20-50	0.05-0.2	1-3
cast iron	30-70	0.1-0.3	2-4
Aluminum Alloy	100-300	0.1-0.5	1-5

13. Index

Milling cutter

End milling cutter

Classification

Conditions of Use

14. Publication Information

Release date : March 20, 1997.

Latest confirmed date : 2019.

Maintained by : American National Standards Institute (ANSI).

Language : English.

JIS B 4120:2000
Carbide milling cutter
— Manufacturing and testing specifications

1. Scope

This standard specifies the manufacturing process, quality control and testing methods of cemented carbide milling cutters (including end mills, face milling cutters and slot milling cutters), and is applicable to cemented carbide materials (such as WC-Co base) in metal cutting. This standard aims to ensure the manufacturing consistency, cutting performance and safety of milling cutters, and is not applicable to non-cemented carbide materials or tools for non-cutting purposes.

1.1 Scope of application

Suitable for end mills, face mills and slot mills made of carbide .

Covers manufacturing processes, quality control and testing requirements.

1.2 Exclusions

Milling cutters made of non-carbide materials.

Tools for non-cutting purposes.

2. Normative References

The documents listed below become an integral part of this standard through reference in this standard. Only the version on a specific date applies to this standard. Any subsequent revision or amendment does not apply to this standard unless otherwise stated.

JIS B 4104:1995 , *Carbide tipped tools — General rules* .

ISO 513:2012 , *Classification and application of hard cutting materials for metal removal with defined cutting edges* .

ISO 8688-1:1989 , *Tool life testing in milling — Part 1: Face milling* .

Note : The latest versions of referenced documents may be updated after publication. It is recommended to check the JIS official website for the latest information.

3. Terms and Definitions

For the purpose of this standard, the following terms and definitions apply:

3.1 Carbide Milling Cutter

Milling cutters made of tungsten carbide (WC) based cemented carbide are suitable for cutting high hardness workpieces.

3.2 Manufacturing Process

The processing steps from raw material preparation to the finished milling cutter include powder metallurgy, sintering and coating.

3.3 Testing Methods

Standardized experimental procedure for evaluating milling cutter performance and durability.

4. Symbols and Abbreviations

d : Diameter (mm).

电话/TEL：0086 592 512 9696
CTIAQCD-MA-E/P 2018-2024V
sales@chinatungsten.com

l : Total Length (mm).
Vc : Cutting Speed (m/min).
VB : Flank Wear Width (mm).
WC : Tungsten Carbide.

5. Technical Requirements
5.1 Material properties
Hardness : HV 1500-1800.
Fracture toughness : $K_{IC} \geq 10$ MPa·m $^{1/2}$.
Density : 14.0-14.9 g/ cm³ .
5.2 Geometric parameters
Main deflection angle : 5°-20°.
Tip radius : 0.1-1.0 mm.
Helix angle : 15°-45° (adjusted according to application).
5.3 Coating requirements
Optional coating: TiN , TiAlN , thickness 1-3 μm .
Bond strength: > 70 MPa.

6. Manufacturing Process
6.1 Raw material preparation
High purity WC powder (purity > 99.8%) and Co powder (purity > 99.5%) were used.
Particle size control: D50 < 1 μm .
6.2 Processing Flow
Pressing : Cold isostatic pressing (CIP), pressure 150-200 MPa.
Sintering : Hot isostatic pressing (HIP), temperature 1350-1450°C, holding pressure 1-2 h.
Finishing : CNC grinding, tolerance ±0.01 mm.
Coating : PVD process, temperature 450-500°C.
6.3 Quality Control
Density test: 14.0-14.9 g/ cm³ .
Hardness test: HV 1500-1800.

7. Testing Methods
7.1 Dimensions and tolerances
Tools : Coordinate measuring machine.
Accuracy : ±0.01 mm.
Reference standard : According to JIS B 4104.
7.2 Durability test
Test conditions :
Workpiece material: JIS S45C steel (HB 200).
Cutting speed (Vc): 100-150 m/min.
Feed rate (fn): 0.1-0.2 mm/tooth.
Cutting depth: 1-3 mm.

program :
Install the milling cutter on the test machine.
Cut continuously for 30 min according to the specified parameters.
The wear band width (VB) was measured.
Judgment criteria : VB ≤ 0.3 mm.
Reference standard : According to ISO 8688-1.

7.3 Data Recording

Cutting time, VB value and failure mode were recorded.

8. Inspection Rules

8.1 Factory Inspection

Raw material hardness and purity inspection.

8.2 Factory Inspection

Dimensions, tolerances, hardness testing.
Durability test (sampling).

9. Marking and Packaging

9.1 Logo

Indicate type (such as EM), diameter (d), length (l) and material.
Example: JIS B 4120-EM-10-60-WC.

9.2 Packaging

Use moisture-proof and shock-proof packaging.
Comes with a certificate of manufacture and testing.

10. Application Specifications

10.1 Cutting data

Cutting speed (Vc) : 50-300 m/min (adjusted according to the workpiece).
Feed rate (fn) : 0.05-0.5 mm/tooth.
Cutting depth : 0.5-5 mm.

10.2 Cooling requirements

Recommended cutting fluid, flow rate ≥ 10 L/min.
Dry cutting is limited to light loads and duration ≤ 10 min.

11. Safety Requirements

Wear protective glasses and gloves when handling.
Avoid overload cutting to prevent tool chipping .

12. Annex

Appendix A (Informative) - Manufacturing Process Parameters Table

Process steps	Parameter range	Remark
ball milling	12-24 h, medium ratio 1:2	Ensure uniformity

电话/TEL：0086 592 512 9696
CTIAQCD-MA-E/P 2018-2024V
sales@chinatungsten.com

suppress	150-200 MPa	Initial density 60%-65%
sintering	1350-1450°C, 1-2 h	Density> 99.9%
coating	1-3 µm , 450-500°C	TiAlN coating

Appendix B (Normative) - Table of Test Conditions

Workpiece material	**Cutting speed (Vc , m/min)**	**Feed rate (fn , mm/tooth)**	**Cutting depth(mm)**
JIS S45C	100-150	0.1-0.2	1-3
cast iron	80-120	0.2-0.3	2-4
Stainless steel	60-100	0.1-0.2	1-2

13. Index

Carbide milling cutter
Manufacturing process
Test Method
Usage Guidelines

14. Publication Information

Release date : June 20, 2000.
Effective date : July 1, 2000.
Maintaining organization : Japanese Industrial Standards Committee (JISC).
Language : Japanese, English.

GB/T 16665-2017

Hardmetals — **Technical requirements and test methods**

1. Scope

This standard specifies the technical requirements and performance test methods for cemented carbide (with tungsten carbide WC as the main hard phase and cobalt Co or nickel Ni as the bonding phase), which is applicable to the manufacture of metal cutting tools, molds and wear-resistant parts. This standard includes the physical properties, chemical composition and mechanical properties requirements of the material, as well as the corresponding test methods, and is not applicable to non-cemented carbide materials or composite materials for special purposes.

1.1 Scope of application

Applicable to WC-Co or WC-Ni based cemented carbides.

Covers performance requirements and test methods.

1.2 Exclusions

Non-carbide materials.

Composite materials for special applications.

2. Normative References

The documents listed below become an integral part of this standard through reference in this standard. Only the version on a specific date applies to this standard. Any subsequent revision or amendment does not apply to this standard unless otherwise stated.

GB/T 3850-2015 , *Methods for testing the properties of hardmetals* .

GB/T 5244-2015 , *Hardmetals — Determination of cobalt, titanium, tantalum, niobium and vanadium contents* .

ISO 513:2012 , *Classification and application of hard cutting materials for metal removal with defined cutting edges* .

Note : The latest version of the referenced document may be updated after publication. It is recommended to consult the National Standard Information Public Service Platform to obtain the latest information.

3. Terms and Definitions

For the purpose of this standard, the following terms and definitions apply:

3.1 Hardmetal

A sintered material with tungsten carbide (WC) as the main hard phase and cobalt (Co) or nickel (Ni) as the bonding phase, which has high hardness and wear resistance.

3.2 Hardness

The ability of a material to resist localized plastic deformation or indentation, usually expressed in

电话/TEL：0086 592 512 9696
CTIAQCD-MA-E/P 2018-2024V
sales@chinatungsten.com

Vickers hardness (HV).

3.3 Fracture Toughness

to resist crack growth, usually expressed as the critical stress intensity factor ($K_{1}c$).

4. Symbols and Abbreviations

HV : Vickers Hardness.

$K_{1}c$: Fracture Toughness (MPa·$m^{1/2}$).

ρ : Density (g/cm^{3}).

WC : Tungsten Carbide.

Co : Cobalt.

5. Technical Requirements

5.1 Chemical composition

WC content : 85%-94% (mass fraction).

Co content : 6%-12% (mass fraction), Ni ≤ 2% (optional).

Impurity content : oxygen ≤ 0.2%, other impurities ≤ 0.5%.

5.2 Physical properties

Density (ρ) : 14.0-15.0 g/cm^3 (adjusted according to Co content).

Porosity : A02-B00-C00 (according to GB/T 3850 grade).

5.3 Mechanical properties

Hardness (HV30) : 1200-1800 (depending on the grade).

Fracture toughness ($K_{1}c$) : 8-15 MPa· $m^{1/2}$.

Flexural strength : 1800-2500 MPa.

5.4 Heat resistance

Operating temperature: ≤ 800°C (uncoated).

Oxidation resistance: Weight loss rate ≤ 0.1%/h (800°C, 1h).

6. Test Methods

6.1 Chemical composition analysis

Methods : Spectroscopic analysis or wet chemical methods.

Accuracy : ±0.1% (mass fraction).

Reference standard : According to GB/T 5244.

6.2 Density measurement

Tools : Archimedean method or mercury penetration method.

Accuracy : ±0.05 g/ cm^3 .

Reference standard : According to GB/T 3850.

6.3 Hardness test

Tools : Vickers hardness tester, load 30 kg.
Accuracy : ±20 HV.
Reference standard : According to GB/T 3850.

6.4 Fracture toughness test

Method : Single edge notched beam method (SENB).
Accuracy : ±0.5 $MPa \cdot m^{1/2}$.
Reference standard : According to GB/T 3850.

6.5 Bending strength test

Method : Three-point bending test.
Specimen size : 20 mm × 6.5 mm × 5.25 mm.
Accuracy : ±50 MPa.
Reference standard : According to GB/T 3850.

7. Inspection Rules

7.1 Factory Inspection

Raw materials chemical composition and particle size inspection.

7.2 Factory Inspection

Density, hardness, fracture toughness and flexural strength tests.
Porosity and microstructural analysis.

8. Marking and Packaging

8.1 Logo

Mark the brand number (such as YG6, YG8) and batch number.
Example: GB/T 16665-YG6-20250601.

8.2 Packaging

Use moisture-proof and shock-proof packaging.
Comes with performance test report.

9. Application Guidelines

9.1 Application Areas

Metal cutting tools (milling cutters, turning tools).
Wear-resistant parts (dies, punches).

电话/TEL：0086 592 512 9696
CTIAQCD-MA-E/P 2018-2024V
sales@chinatungsten.com

9.2 Recommendations for use

Avoid prolonged use at temperatures exceeding 800°C.
Check surfaces for wear regularly.

10. Safety Requirements

Wear protective glasses and gloves when handling.
Avoid inhalation of dust and handle in a ventilated environment.

11. Annex

Appendix A (Informative) - Performance Reference Tables

Brand	WC content (%)	Co content (%)	Hardness (HV30)	Fracture toughness (K_{1c} , $MPa \cdot m^{1/2}$)	Flexural strength(MPa)
YG6	94	6	1500-1600	10-12	1800-2000
YG8	92	8	1400-1500	12-14	2000-2200
YG12	88	12	1300-1400	14-15	2200-2500

Appendix B (Normative) - Table of Test Conditions

Performance Indicators	Test Method	Number of samples	Permissible deviation
density	Archimedean method	3	±0.05 g/cm^3
hardness	Vickers Hardness Tester	5	±20 HV
Fracture toughness	SENB	5	±0.5 $MPa \cdot m^{1/2}$
Bending strength	Three-point bending	5	±50 MPa

12. Index

Cemented Carbide
Performance requirements
Test Method
Technical requirements

13. Publication Information

Release date : June 30, 2017.
Effective date : December 1, 2017.
Maintained by : Standardization Administration of China (SAC).
Language : Chinese, English.

GB/T 5231-2019
- Cutting tools
— General technical conditions

1. Scope

This standard specifies the general technical conditions for cutting tools (including turning tools, milling cutters, drills and boring tools, etc.), covering material selection, manufacturing process, dimensional tolerances, performance requirements, and inspection and use specifications. This standard is applicable to cutting tools of various materials (such as high-speed steel and cemented carbide) for metal cutting processing, and is not applicable to non-cutting tools or non-metal processing purposes.

1.1 Scope of application

Suitable for cutting tools made of high-speed steel, cemented carbide, etc.
Covers manufacturing, inspection and use requirements.

1.2 Exclusions

Non-cutting tools (e.g. abrasive tools).
Non-metal processing applications.

2. Normative References

The documents listed below become an integral part of this standard through reference in this standard. Only the version on a specific date applies to this standard. Any subsequent revision or amendment does not apply to this standard unless otherwise stated.

GB/T 16665-2017 , *Hardmetals — Technical requirements and test methods* .
GB/T 3850-2015 , *Methods for testing the properties of hardmetals* .
ISO 513:2012 , *Classification and application of hard cutting materials for metal removal with defined cutting edges* .
ISO 8688-1:1989 , *Tool life testing in milling — Part 1: Face milling* .

Note : The latest version of the referenced document may be updated after publication. It is recommended to consult the National Standard Information Public Service Platform to obtain the latest information.

3. Terms and Definitions

For the purpose of this standard, the following terms and definitions apply:

3.1 Cutting Tool

Tools that machine workpiece material by chip removal usually have a defined cutting edge .

3.2 Tolerance

The allowable deviation range of cutting tool size ensures processing accuracy and interchangeability.

电话/TEL：0086 592 512 9696
CTIAQCD-MA-E/P 2018-2024V
sales@chinatungsten.com

3.3 Application Conditions

Cutting parameters and environmental requirements of cutting tools during processing.

4. Symbols and Abbreviations

d : Diameter (mm).
l : Total Length (mm).
Vc : Cutting Speed (m/min).
VB : Flank Wear Width (mm).
HSS : High-Speed Steel.

5. Technical Requirements

5.1 Material requirements

High Speed Steel (HSS) : Hardness HRC 62-66, heat resistance ≤ 600°C.
Cemented carbide : hardness HV 1200-1800, fracture toughness $K_{Ic} \geq 8$ MPa·m $^{1/2}$.
Coating : TiN or TiAlN , thickness 1-3 μm .

5.2 Geometric parameters

Leading angle : 5°-20° (adjusted according to tool type).
Tip radius : 0.1-1.0 mm.
Surface roughness : Ra ≤ 1.6 μm (cutting part), Ra ≤ 0.8 μm (shank).

5.3 Dimensional tolerance

Diameter tolerance : h6 (3-6 mm) or h7 (8-25 mm).
Length tolerance : ±0.2 mm.
Coaxiality tolerance : 0.01 mm (over the entire length).

6. Manufacturing Process

6.1 Material preparation

High speed steel: forged or rolled, annealed.
Cemented carbide: powder metallurgy, pressing pressure 150-200 MPa.

6.2 Processing Flow

Rough machining : turning or milling.
Finishing : CNC grinding, tolerance ±0.01 mm.
Heat treatment : Quenching (HSS), sintering (carbide), temperature 1200-1450°C.

6.3 Coating

PVD process, temperature 450-500°C, bonding strength > 70 MPa.

7. Test Methods

7.1 Dimensions and tolerances

Tools : CMM or Vernier Caliper.
Accuracy : ±0.01 mm.
Reference standard : According to GB/T 3850.

7.2 Hardness test

Tools : Vickers hardness tester, load 30 kg.
Accuracy : ±20 HV.
Reference standard : According to GB/T 3850.

7.3 Durability test

Conditions : Steel (HB 200), Vc 50-100 m/min, fn 0.1 mm/tooth, ap 2 mm.
Procedure : Cut continuously for 30 min and measure VB.
Judgment criteria : VB ≤ 0.3 mm.
Reference standard : According to ISO 8688-1.

8. Inspection Rules

8.1 Factory Inspection

Raw material hardness and chemical composition inspection.

8.2 Factory Inspection

Dimensions, tolerances, hardness testing.
Durability test (sampling).

9. Marking and Packaging

9.1 Logo

Indicate the type (such as M), diameter (d), length (l) and material.
Example: GB/T 5231-M-10-60-HSS.

9.2 Packaging

Use moisture-proof and shock-proof packaging.
Comes with a certificate of manufacture and testing.

10. Application Specifications

10.1 Cutting data

Cutting speed (Vc) : 20-300 m/min (adjusted according to material).
Feed rate (fn) : 0.05-0.5 mm/tooth.
Cutting depth : 0.5-5 mm.

10.2 Cooling requirements

Recommended cutting fluid, flow rate ≥ 10 L/min.

Dry cutting is limited to light loads and duration ≤ 10 min.

11. Safety Requirements

Wear protective glasses and gloves when handling.

Avoid overload cutting to prevent tool chipping .

12. Annex

Appendix A (Informative) - Technical Parameters Reference Table

Material Type	Hardness (HV/HRC)	Cutting speed (Vc , m/min)	Tolerance grade	Surface roughness (Ra, μm)
HSS	HRC 62-66	20-50	h6/h7	≤ 1.6
Cemented Carbide	HV 1200-1800	50-300	h6/h7	≤ 1.6

Appendix B (Normative) - Table of Conditions of Use

Workpiece material	Cutting speed (Vc , m/min)	Feed rate (fn , mm/tooth)	Cutting depth(mm)
Steel (HB 200)	50-100	0.1-0.2	1-3
cast iron	70-120	0.2-0.3	2-4
Aluminum Alloy	100-300	0.1-0.5	1-5

13. Index

Cutting Tools

Technical requirements

Test Method

Usage Guidelines

14. Publication Information

Release date : June 4, 2019.

Effective date : January 1, 2020.

Maintained by : Standardization Administration of China (SAC).

Language : Chinese, English.

电话/TEL：0086 592 512 9696
CTIAQCD-MA-E/P 2018-2024V
sales@chinatungsten.com

GB/T 20323-2020

Milling **cutters code (integral/toothed/indexable)**

— Designation system for solid/tooth-insertable/indexable types

1. Scope

This standard specifies the code system for milling cutters (including integral, insert and indexable types) to identify the type, structure, size, material and other technical characteristics of milling cutters. This standard applies to various milling cutters used in metal cutting processing, and aims to achieve consistent product identification and international interoperability. It does not apply to non-cutting tools or special milling cutters of non-standard design.

1.1 Scope of application

Suitable for solid, insert and indexable milling cutters.

Covers code conventions and identification methods.

1.2 Exclusions

Non-cutting tools.

Special milling cutters with non-standard designs.

2. Normative References

The documents listed below become an integral part of this standard through reference in this standard. Only the version on a specific date applies to this standard. Any subsequent revision or amendment does not apply to this standard unless otherwise stated.

GB/T 5231-2019 , *Cutting tools — General technical conditions* .

GB/T 16665-2017 , *Hardmetals — Technical requirements and test methods* .

ISO 5608:2012 , *Milling cutters — Designation* .

Note : The latest version of the referenced document may be updated after publication. It is recommended to consult the National Standard Information Public Service Platform to obtain the latest information.

3. Terms and Definitions

For the purpose of this standard, the following terms and definitions apply:

3.1 Solid Milling Cutter

A milling cutter made of a single material, with the cutting part and the shank being one piece.

3.2 Tooth-Insertable Milling Cutter

A milling cutter in which the cutting teeth are fixed to the milling cutter body in an inlaid manner.

3.3 Indexable Milling Cutter

Milling cutters that use replaceable cutting inserts that can be rotated or flipped over to use new cutting edges .

3.4 Designation

Standardized code combination used to identify the characteristics of milling cutters.

4. Symbols and Abbreviations

d : Diameter (mm).

l : Total Length (mm).
HSS : High-Speed Steel.
WC : Tungsten Carbide.

5. Designation System
5.1 Code composition
The milling cutter code consists of the following parts, arranged in order:
Type code : Identifies the structure type of the milling cutter.
Size Code : Identifies diameter and length.
Material Code : Identifies the type of material.
Additional Code : Optional, for special applications or coatings.
5.2 Type code
S : Solid.
T : Tooth- Insertable .
I : Indexable.
5.3 Size code
Format: [diameter]×[length].
Example: 10×60 means diameter 10 mm and length 60 mm.
Tolerances are in accordance with GB/T 5231.
5.4 Material code
HSS : High Speed Steel.
WC : Hard alloy.
HSS-Co : High speed steel containing cobalt.
TiN : Titanium nitride coating (additional).
5.5 Additional Code
R : Roughing.
F : Finishing.
H : Suitable for workpieces with high hardness.

6. Examples of Designation
6.1 Integral milling cutter
S-10×60-HSS : 10 mm diameter, 60 mm length, high speed steel solid milling cutter.
S-20×100-WC-TiN : 20 mm diameter, 100 mm length, carbide solid milling cutter with TiN coating.
6.2 Insert tooth milling cutter
T-12×80-HSS-Co : 12 mm diameter, 80 mm length, cobalt-containing high-speed steel insert milling cutter.
T-25×150-WC-R : 25 mm diameter, 150 mm length, carbide insert milling cutter, suitable for rough machining.
6.3 Indexable milling cutter
I-16×90-WC-F : 16 mm diameter, 90 mm length, carbide indexable milling cutter, suitable for finishing.
I-30×120-WC-H : 30 mm diameter, 120 mm length, carbide indexable milling cutter, suitable for

high hardness workpieces.

7. Marking Requirements

The code should be clearly marked on the milling cutter body or packaging.
Font height: ≥ 2 mm.
Marking method: Laser engraving or inkjet printing.

8. Inspection Rules

8.1 Code consistency check

The verification code is consistent with the actual technical parameters.
Sampling rate: 5% (minimum 1 piece).

8.2 Dimension and material verification

Dimension and material inspection shall be carried out according to GB/T 5231.

9. Packaging and Storage

Use moisture-proof and shock-proof packaging.
Storage environment: Temperature 5-30°C, humidity ≤ 60%.

10. Application Guidelines

The integral type is suitable for small diameter and high precision machining.
Insert type is suitable for medium load cutting.
The indexable type is suitable for large diameter or high-efficiency processing.

11. Safety Requirements

Wear protective glasses and gloves when handling.
Avoid misuse due to incorrect code names.

12. Annex

Appendix A (Informative) - Code Reference Table

Type Code	Structure Type	Material Examples	Additional code examples
S	Monolithic	HSS, WC	TiN , R
T	Toothed	HSS-Co, WC	F, H
I	Indexable	WC	F, H

Appendix B (Normative) - Size Ranges

Diameter range (mm)	Length range(mm)	Tolerance grade
3-10	40-100	h6
12-25	80-200	h7
30-50	100-300	h7

13. Index

Milling cutter　Code system　Monolithic　Insert tooth type　indexable

电话/TEL：0086 592 512 9696
CTIAQCD-MA-E/P 2018-2024V
sales@chinatungsten.com

14. Publication Information

Release date : June 15, 2020.

Effective date : January 1, 2021.

Maintained by : Standardization Administration of China (SAC).

Language : Chinese, English.

电话/TEL：0086 592 512 9696
CTIAQCD-MA-E/P 2018-2024V
sales@chinatungsten.com

GB/T 25664-2010
- High-speed milling cutters
— Safety requirements

1. Scope

This standard specifies the safety requirements for high-speed cutting milling cutters (applicable to milling cutters with cutting speeds exceeding 50 m/s), including safety performance specifications in design, manufacture, installation, use and maintenance. This standard applies to solid, insert-toothed or indexable milling cutters made of high-speed steel (HSS) or cemented carbide (WC), and is intended to reduce the risk of accidents during operation. It is not applicable to non-high-speed cutting applications or non-cutting tools.

1.1 Scope of application

For high speed cutting milling cutters with cutting speeds > 50 m/s.
Covers safety requirements for design, manufacture, installation, use and maintenance.

1.2 Exclusions

Conventional milling cutters with cutting speeds ≤ 50 m/s.
Non-cutting tools.

2. Normative References

The documents listed below become an integral part of this standard through reference in this standard. Only the version on a specific date applies to this standard. Any subsequent revision or amendment does not apply to this standard unless otherwise stated.

GB/T 5231-2019 , *Cutting tools — General technical conditions* .
GB/T 16665-2017 , *Hardmetals — Technical requirements and test methods* .
ISO 15641:2001 , *Milling cutters for high-speed machining — Safety requirements* .
Note : The latest version of the referenced document may be updated after publication. It is recommended to consult the National Standard Information Public Service Platform to obtain the latest information.

3. Terms and Definitions

For the purpose of this standard, the following terms and definitions apply:

3.1 High-speed Milling Cutter

Milling cutters with cutting speeds exceeding 50 m/s are usually used for efficient metal cutting operations.

3.2 Safety Performance

The ability to prevent personal injury or equipment damage during operation.

3.3 Fracture Toughness

to resist crack growth, usually expressed as K_{IC} .

4. Symbols and Abbreviations

Vc : Cutting Speed (m/s).
d : Diameter (mm).
HSS : High-Speed Steel.
WC : Tungsten Carbide.
K_1c : Fracture Toughness ($MPa\cdot m^{1/2}$).

5. Technical Requirements

5.1 Material requirements

Hardness : HSS HRC 62-66, WC HV 1200-1800.
Fracture toughness : $K_1c \geq 10$ $MPa\cdot m^{1/2}$ (WC), $K_1c \geq 8$ $MPa\cdot m^{1/2}$ (HSS).
Fatigue resistance : Fatigue limit ≥ 800 MPa.

5.2 Design requirements

Balance grade : G2.5 (according to ISO 1940-1).
Maximum speed : Calculated based on diameter, Vc ≤ 100 m/s.
Blade strength : tensile strength ≥ 1000 MPa.

5.3 Manufacturing requirements

Surface roughness : Ra ≤ 1.2 μm (cutting part), Ra ≤ 0.6 μm (shank).
Heat treatment : Quenching (HSS) or sintering (WC), residual stress ≤ 200 MPa.

6. Safety Requirements

6.1 Design safety

Anti- chipping design : blade tip radius 0.2-1.0 mm.
Overspeed protection : Automatically cut off power when the speed exceeds the design value by 20%.
Balance test : Dynamic balance error ≤ 2 g·mm /kg.

6.2 Installation Safety

Clamping force : Minimum clamping force ≥ 10 kN (adjusted according to diameter).
Coaxiality : After installation, the coaxiality error is ≤ 0.01 mm.
Anti-loosening design : Use lock nut or keyway.

6.3 Safety of use

Operator Protection : Wear protective glasses, cut-resistant gloves and ear plugs.
Cutting parameter restrictions : Vc ≤ 100 m/s, feed rate ≤ 0.5 mm/tooth.
Environmental requirements : Cutting fluid flow ≥ 15 L/min, temperature ≤ 50°C.

电话/TEL：0086 592 512 9696
CTIAQCD-MA-E/P 2018-2024V
sales@chinatungsten.com

6.4 Maintaining Security

Periodic inspection : Check monthly that the wear band width (VB) is ≤ 0.3 mm.
Replacement criteria : Replace when VB > 0.3 mm or the cutter body is cracked.
Disposal : Recycle or destroy safely to prevent injury from debris.

7. Test Methods

7.1 Balance Test

Tools : Dynamic balancing machine.
Standard : According to ISO 1940-1, G2.5 grade.
Accuracy : ≤ 2 g·mm /kg.

7.2 Fracture toughness test

Method : Single edge notched beam method (SENB).
Accuracy : ±0.5 MPa·m $^{1/2}$.
Reference standard : GB/T 16665.

7.3 Durability test

Conditions : Steel (HB 200), Vc 80 m/s, fn 0.2 mm/tooth, ap 2 mm.
Procedure : Cut continuously for 20 min and measure VB.
Judgment criteria : No chipping , VB ≤ 0.3 mm.
Reference standard : According to ISO 15641.

8. Inspection Rules

8.1 Factory Inspection

Raw material hardness and chemical composition inspection.

8.2 Factory Inspection

Balance grade, fracture toughness and durability tests (sampling rate 5%).

9. Marking and Packaging

9.1 Logo

Marking code (such as HS-10×60-WC) and safety warnings.
Example: GB/T 25664-HS-10×60-WC (Max Vc : 100 m/s).

9.2 Packaging

Use shockproof and moisture-proof packaging, and come with safety instructions.

10. Application Guidelines

Ensure that the machine tool spindle rigidity is ≥ 50 N/ μm .

Regularly calibrate balancing and speed monitoring equipment.

11. Safety Incident Prevention

Install a protective cover to prevent flying debris.

Train operators to recognize signs of overspeed or overheating.

12. Annex

Appendix A (Informative) - Safety Parameter Reference Table

Diameter(mm)	Maximum speed (rpm)	Balance Level	Clamping force (kN)
10	30000	G2.5	10
20	15000	G2.5	15
40	7500	G2.5	25

Appendix B (Normative) - Table of Conditions of Use

Workpiece material	Cutting speed (Vc , m/s)	Feed rate (fn , mm/tooth)	Cutting depth(mm)
Steel (HB 200)	50-80	0.1-0.3	1-3
Aluminum Alloy	80-100	0.2-0.5	1-5
Stainless steel	50-70	0.1-0.2	1-2

13. Index

High speed cutting milling cutter

Security Requirements

Designing for safety

Safe to use

14. Publication Information

Release date : June 1, 2010.

Effective date : January 1, 2011.

Maintained by : Standardization Administration of China (SAC).

Language : Chinese, English.

电话/TEL：0086 592 512 9696
CTIAQCD-MA-E/P 2018-2024V
sales@chinatungsten.com

GB/T 6122-2017

-

Corner rounding milling cutters

1. Scope

This standard specifies the size, shape, manufacturing requirements, performance specifications and use conditions of rounded corner milling cutters (milling cutters used to process rounded corners of workpiece edges). This standard applies to integral or insert-toothed rounded corner milling cutters made of high-speed steel (HSS) or cemented carbide (WC), which are widely used in metal cutting processing, and is not suitable for non-cutting tools or non-rounded processing purposes.

1.1 Scope of application

Suitable for corner radius milling cutters made of high speed steel or carbide.
Covers dimensions, manufacturing and usage requirements.

1.2 Exclusions

Non-cutting tools.
Milling cutter for non-corner rounding applications.

2. Normative References

The documents listed below become an integral part of this standard through reference in this standard. Only the version on a specific date applies to this standard. Any subsequent revision or amendment does not apply to this standard unless otherwise stated.

GB/T 5231-2019 , *Cutting tools — General technical conditions* .
GB/T 16665-2017 , *Hardmetals — Technical requirements and test methods* .
ISO 5609:1999 , *Tool shanks with 7/24 taper for automatic tool changes* .

Note : The latest version of the referenced document may be updated after publication. It is recommended to consult the National Standard Information Public Service Platform to obtain the latest information.

3. Terms and Definitions

For the purpose of this standard, the following terms and definitions apply:

3.1 Corner Rounding Milling Cutter

A milling cutter with a specific corner radius used to round or chamfer the edges of a workpiece.

3.2 Corner Radius

The arc radius of the edge of the milling cutter cutting part, in mm.

3.3 Application Conditions

The cutting parameters and environmental requirements of the corner milling cutter during the machining process.

电话/TEL：0086 592 512 9696
CTIAQCD-MA-E/P 2018-2024V
sales@chinatungsten.com

4. Symbols and Abbreviations
R : Corner Radius (mm).
d : Diameter (mm).
l : Total Length (mm).
HSS : High-Speed Steel.
WC : Tungsten Carbide.

5. Technical Requirements

5.1 Dimensions and tolerances
Diameter range : 6 mm to 40 mm.
Corner radius (R) : 1 mm to 10 mm (standard values: 1, 2, 3, 4, 6, 8, 10 mm).
Length range : 50 mm to 150 mm.
Tolerance : diameter h6 (6-10 mm) or h7 (12-40 mm), length ±0.2 mm.

5.2 Material requirements
High Speed Steel (HSS) : Hardness HRC 62-66, heat resistance ≤ 600°C.
Cemented Carbide (WC) : Hardness HV 1200-1800, fracture toughness $K_{Ic} \geq 10$ MPa·$m^{1/2}$.
Coating : TiN or TiAlN , thickness 1-3 µm .

5.3 Geometric parameters
Main deflection angle : 5°-15°.
Helix angle : 15°-30° (adjusted according to diameter).
Surface roughness : Ra ≤ 1.6 µm (cutting part), Ra ≤ 0.8 µm (shank).

6. Manufacturing Process

6.1 Material preparation
High speed steel: forged or rolled, annealed.
Cemented carbide: powder metallurgy, pressing pressure 150-200 MPa.

6.2 Processing Flow
Rough machining : turning or milling.
Finishing : CNC grinding, corner radius tolerance ±0.05 mm.
Heat treatment : Quenching (HSS) or sintering (WC), temperature 1200-1450°C.

6.3 Coating
PVD process, temperature 450-500°C, bonding strength > 70 MPa.

7. Test Methods

电话/TEL：0086 592 512 9696
CTIAQCD-MA-E/P 2018-2024V
sales@chinatungsten.com

7.1 Dimensions and tolerances
Tools : Coordinate measuring machine.
Accuracy : ±0.01 mm.
Reference standard : According to GB/T 5231.

7.2 Hardness test
Tools : Vickers hardness tester, load 30 kg.
Accuracy : ±20 HV.
Reference standard : According to GB/T 16665.

7.3 Durability test
Conditions : Steel (HB 200), Vc 50 m/min, fn 0.1 mm/tooth, ap 1 mm.
Procedure : Cut continuously for 30 min and measure the wear band width (VB).
Judgment criteria : VB ≤ 0.3 mm.
Reference standard : According to ISO 8688-1.

8. Inspection Rules

8.1 Factory Inspection
Raw material hardness and chemical composition inspection.

8.2 Factory Inspection
Dimensions, tolerances, hardness testing.
Durability test (sampling rate 5%).

9. Marking and Packaging

9.1 Logo
Mark the code (such as CR-10-R2-HSS) and the fillet radius.
Example: GB/T 6122-CR-10-R2-HSS.

9.2 Packaging
Use moisture-proof and shock-proof packaging.
Comes with a certificate of manufacture and testing.

10. Application Specifications

10.1 Cutting data
Cutting speed (Vc) : 20-100 m/min (adjusted according to material).
Feed rate (fn) : 0.05-0.3 mm/tooth.
Cutting depth : 0.5-2 mm.

10.2 Cooling requirements

Recommended cutting fluid, flow rate ≥ 10 L/min.

Dry cutting is limited to light loads and duration ≤ 10 min.

11. Safety Requirements

Wear protective glasses and gloves when handling.

Avoid overload cutting to prevent tool chipping .

12. Annex

Appendix A (Informative) - Dimension Reference Table

Diameter(mm)	Corner radius (R, mm)	Length(mm)	Tolerance grade
6	1-2	50-80	h6
12	2-4	80-120	h7
25	4-10	100-150	h7

Appendix B (Normative) - Table of Conditions of Use

Workpiece material	Cutting speed (Vc , m/min)	Feed rate (fn , mm/tooth)	Cutting depth(mm)
Steel (HB 200)	50-80	0.1-0.2	0.5-1.5
Aluminum Alloy	80-100	0.2-0.3	0.5-2
cast iron	60-90	0.1-0.25	0.5-1.5

13. Index

Corner milling cutter

Technical requirements

Usage Guidelines

Dimensional tolerance

14. Publication Information

Release date : June 30, 2017.

Effective date : January 1, 2018.

Maintained by : Standardization Administration of China (SAC).

Language : Chinese, English.

GB/T 1127-2023

-

Half-round keyway milling cutters

1. Scope

This standard specifies the size, shape, manufacturing requirements, performance specifications and use conditions of semicircular keyway milling cutters (special milling cutters used to process semicircular keyways). This standard applies to semicircular keyway milling cutters made of high-speed steel (HSS) or cemented carbide (WC), which are mainly used for keyway processing of mechanical transmission parts (such as shafts and hubs), and is not suitable for non-cutting tools or non-semicircular keyway applications.

1.1 Scope of application

For semicircular keyway milling cutters made of high speed steel or carbide.
Covers dimensions, manufacturing and usage requirements.

1.2 Exclusions

Non-cutting tools.
Milling cutter for non-semi-circular keyway machining.

2. Normative References

The documents listed below become an integral part of this standard through reference in this standard. Only the version on a specific date applies to this standard. Any subsequent revision or amendment does not apply to this standard unless otherwise stated.

GB/T 5231-2019 , *Cutting tools — General technical conditions* .

GB/T 16665-2017 , *Hardmetals — Technical requirements and test methods* .

ISO 3338-1:2012 , *Keyway milling cutters — Part 1: General dimensions* .

Note : The latest version of the referenced document may be updated after publication. It is recommended to consult the National Standard Information Public Service Platform to obtain the latest information.

3. Terms and Definitions

For the purpose of this standard, the following terms and definitions apply:

3.1 Half-round Keyway Milling Cutter

with a semicircular cutting edge used to machine a semicircular keyway to accommodate a semicircular key.

3.2 Keyway Width

The width of the cutting portion of a semicircular keyway milling cutter matches the actual size of the keyway.

3.3 Application Conditions

Cutting parameters and environmental requirements of semicircular keyway milling cutters during machining.

4. Symbols and Abbreviations

W : Keyway Width (mm).
d : Diameter (mm).
l : Total Length (mm).
HSS : High-Speed Steel.
WC : Tungsten Carbide.

5. Technical Requirements

5.1 Dimensions and tolerances

Diameter range : 4 mm to 25 mm.
Keyway width (W) : 1 mm to 8 mm (standard values: 1, 2, 3, 4, 5, 6, 8 mm).
Length range : 40 mm to 120 mm.
Tolerance : diameter h6 (4-10 mm) or h7 (12-25 mm), width ±0.02 mm.

5.2 Material requirements

High Speed Steel (HSS) : Hardness HRC 62-66, heat resistance ≤ 600°C.
Cemented Carbide (WC) : Hardness HV 1200-1800, fracture toughness $K_{1}c \geq 10$ MPa·m $^{1/2}$.
Coating : TiN or AlTiN , thickness 1-3 μm .

5.3 Geometric parameters

Cutting edge radius : Matches keyway width, tolerance ±0.01 mm.
Helix angle : 10°-20° (adjusted according to diameter).
Surface roughness : Ra ≤ 1.6 μm (cutting part), Ra ≤ 0.8 μm (shank).

6. Manufacturing Process

6.1 Material preparation

High speed steel: forged or rolled, annealed.
Cemented carbide: powder metallurgy, pressing pressure 150-200 MPa.

6.2 Processing Flow

Rough machining : turning or milling.
Finishing : CNC grinding, keyway width tolerance ±0.02 mm.
Heat treatment : Quenching (HSS) or sintering (WC), temperature 1200-1450°C.

6.3 Coating

PVD process, temperature 450-500°C, bonding strength > 70 MPa.

7. Test Methods

7.1 Dimensions and tolerances

Tools : Coordinate measuring machine.
Accuracy : ±0.01 mm.
Reference standard : According to GB/T 5231.

7.2 Hardness test

Tools : Vickers hardness tester, load 30 kg.
Accuracy : ±20 HV.
Reference standard : According to GB/T 16665.

7.3 Durability test

Conditions : Steel (HB 200), Vc 40 m/min, fn 0.1 mm/tooth, ap 1 mm.
Procedure : Cut continuously for 30 min and measure the wear band width (VB).
Judgment criteria : VB ≤ 0.3 mm.
Reference standard : According to ISO 8688-1.

8. Inspection Rules

8.1 Factory Inspection

Raw material hardness and chemical composition inspection.

8.2 Factory Inspection

Dimensions, tolerances, hardness testing.
Durability test (sampling rate 5%).

9. Marking and Packaging

9.1 Logo

Mark the code (such as HK-6-W2-HSS) and keyway width.
Example: GB/T 1127-HK-6-W2-HSS.

9.2 Packaging

Use moisture-proof and shock-proof packaging.
Comes with a certificate of manufacture and testing.

10. Application Specifications

10.1 Cutting data

Cutting speed (Vc) : 20-80 m/min (adjusted according to material).

电话/TEL：0086 592 512 9696
CTIAQCD-MA-E/P 2018-2024V
sales@chinatungsten.com

Feed rate (fn) : 0.05-0.2 mm/tooth.
Cutting depth : 0.5-1.5 mm.

10.2 Cooling requirements

Recommended cutting fluid, flow rate ≥ 10 L/min.
Dry cutting is limited to light loads and duration ≤ 10 min.

11. Safety Requirements

Wear protective glasses and gloves when handling.
Avoid overload cutting to prevent tool chipping .

12. Annex

Appendix A (Informative) - Dimension Reference Table

Diameter(mm)	Keyway width (W, mm)	Length(mm)	Tolerance grade
4	1-2	40-60	h6
10	2-4	60-90	h6
20	4-8	90-120	h7

Appendix B (Normative) - Table of Conditions of Use

Workpiece material	Cutting speed (Vc , m/min)	Feed rate (fn , mm/tooth)	Cutting depth(mm)
Steel (HB 200)	40-60	0.05-0.15	0.5-1
Aluminum Alloy	60-80	0.1-0.2	0.5-1.5
cast iron	50-70	0.05-0.15	0.5-1

13. Index

Half round keyway milling cutter
Technical requirements
Usage Guidelines
Dimensional tolerance

14. Publication Information

Release date : June 15, 2023.
Effective date : January 1, 2024.
Maintained by : Standardization Administration of China (SAC).
Language : Chinese, English.

GB/T 20773-2006

- Milling cutters

for dies and moulds

1. Scope

This standard specifies the size, shape, manufacturing requirements, performance specifications and use conditions of mold milling cutters (milling cutters specially used for mold and die processing). This standard applies to integral or indexable mold milling cutters made of high-speed steel (HSS) or cemented carbide (WC), which are mainly used for precision mold manufacturing and finishing, and is not suitable for non-cutting tools or non-mold processing purposes.

1.1 Scope of application

Suitable for mold milling cutters made of high-speed steel or carbide.
Covers dimensions, manufacturing and usage requirements.

1.2 Exclusions

Non-cutting tools.
Milling cutters not intended for mold processing.

2. Normative References

The documents listed below become an integral part of this standard through reference in this standard. Only the version on a specific date applies to this standard. Any subsequent revision or amendment does not apply to this standard unless otherwise stated.

GB/T 5231-2019 , *Cutting tools — General technical conditions* .
GB/T 16665-2017 , *Hardmetals — Technical requirements and test methods* .
ISO 5609:1999 , *Tool shanks with 7/24 taper for automatic tool changes* .

Note : The latest version of the referenced document may be updated after publication. It is recommended to consult the National Standard Information Public Service Platform to obtain the latest information.

3. Terms and Definitions

For the purpose of this standard, the following terms and definitions apply:

3.1 Milling Cutter for Dies and Moulds

Milling cutters designed for mold and die machining with high precision and complex geometries.

3.2 Number of Teeth

edges of mold milling cutters affects processing efficiency and surface quality.

3.3 Application Conditions

Cutting parameters and environmental requirements of mold milling cutters during processing.

4. Symbols and Abbreviations

d : Diameter (mm).
l : Total Length (mm).
Z : Number of Teeth .
HSS : High-Speed Steel.
WC : Tungsten Carbide.

5. Technical Requirements

5.1 Dimensions and tolerances

Diameter range : 3 mm to 20 mm.
Length range : 50 mm to 150 mm.
Tolerance : diameter h6 (3-10 mm) or h7 (12-20 mm), length ±0.2 mm.
of blades (Z) : 2-6 (adjusted according to diameter).

5.2 Material requirements

High Speed Steel (HSS) : Hardness HRC 62-66, heat resistance ≤ 600°C.
Cemented Carbide (WC) : Hardness HV 1300-1800, fracture toughness $K_{1}c \geq 10$ MPa·m $^{1/2}$.
Coating : TiN , TiAlN or AlCrN , thickness 1-3 μm .

5.3 Geometric parameters

Main deflection angle : 5°-15°.
Helix angle : 20°-40° (adjusted according to the processed material).
Surface roughness : Ra ≤ 1.6 μm (cutting part), Ra ≤ 0.8 μm (shank).

6. Manufacturing Process

6.1 Material preparation

High speed steel: forged or rolled, annealed.
Cemented carbide: powder metallurgy, pressing pressure 150-200 MPa.

6.2 Processing Flow

Rough machining : turning or milling.
Finishing : CNC grinding, tolerance ±0.01 mm.
Heat treatment : Quenching (HSS) or sintering (WC), temperature 1200-1450°C.

6.3 Coating

PVD process, temperature 450-500°C, bonding strength > 70 MPa.

7. Test Methods

7.1 Dimensions and tolerances

Tools : Coordinate measuring machine.

Accuracy : ±0.01 mm.
Reference standard : According to GB/T 5231.

7.2 Hardness test

Tools : Vickers hardness tester, load 30 kg.
Accuracy : ±20 HV.
Reference standard : According to GB/T 16665.

7.3 Durability test

Conditions : Steel (HB 200), Vc 60 m/min, fn 0.1 mm/tooth, ap 0.5 mm.
Procedure : Cut continuously for 30 min and measure the wear band width (VB).
Judgment criteria : VB ≤ 0.3 mm.
Reference standard : According to ISO 8688-1.

8. Inspection Rules

8.1 Factory Inspection

Raw material hardness and chemical composition inspection.

8.2 Factory Inspection

Dimensions, tolerances, hardness testing.
Durability test (sampling rate 5%).

9. Marking and Packaging

9.1 Logo

Mark the code (such as MD-6-Z4-WC) and the number of blades .
Example: GB/T 20773-MD-6-Z4-WC.

9.2 Packaging

Use moisture-proof and shock-proof packaging.
Comes with a certificate of manufacture and testing.

10. Application Specifications

10.1 Cutting data

Cutting speed (Vc) : 30-120 m/min (adjusted according to material).
Feed rate (fn) : 0.05-0.2 mm/tooth.
Cutting depth : 0.2-1 mm.

10.2 Cooling requirements

Recommended cutting fluid, flow rate ≥ 10 L/min.

Dry cutting is limited to light loads and duration ≤ 10 min.

11. Safety Requirements

Wear protective glasses and gloves when handling.

Avoid overload cutting to prevent tool chipping .

12. Annex

Appendix A (Informative) - Dimension Reference Table

Diameter(mm)	Length(mm)	of blades (Z)	Tolerance grade
3	50-80	2-3	h6
10	80-120	3-4	h6
20	100-150	4-6	h7

Appendix B (Normative) - Table of Conditions of Use

Workpiece material	Cutting speed (Vc , m/min)	Feed rate (fn , mm/tooth)	Cutting depth(mm)
Steel (HB 200)	60-80	0.05-0.15	0.2-0.5
Aluminum Alloy	80-120	0.1-0.2	0.2-1
Mold Steel	50-70	0.05-0.1	0.2-0.5

13. Index

Mould milling cutter

Technical requirements

Usage Guidelines

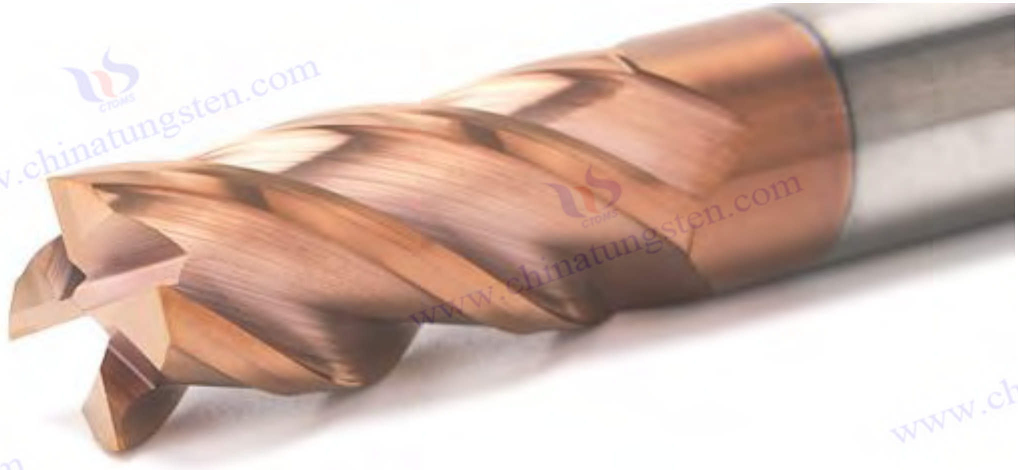
Dimensional tolerance

14. Publication Information

Date of publication : June 1, 2006. **Effective date** : January 1, 2007.

Maintained by : Standardization Administration of China (SAC).

Language : Chinese, English.



GB/T 14301-2008
- Solid carbide
saw-blade milling cutters

1. Scope

This standard specifies the size, shape, manufacturing requirements, performance specifications and use conditions of solid carbide saw blade milling cutters (milling cutters made of solid carbide with serrated cutting edges). This standard applies to saw blade milling cutters made of solid carbide materials, mainly used for grooving, cutting and trimming of metal and non-metallic materials, and is not applicable to non-cutting tools or non - solid carbide structures.

1.1 Scope of application

Suitable for saw blade milling cutters made of solid carbide.
Covers dimensions, manufacturing and usage requirements.

1.2 Exclusions

Non-cutting tools.
non- solid carbide structure.

2. Normative References

The documents listed below become an integral part of this standard through reference in this standard. Only the version on a specific date applies to this standard. Any subsequent revision or amendment does not apply to this standard unless otherwise stated.
GB/T 5231-2019 , *Cutting tools — General technical conditions* .
GB/T 16665-2017 , *Hardmetals — Technical requirements and test methods* .
ISO 6987:2012 , *Indexable hard material inserts with rounded corners* .
Note : The latest version of the referenced document may be updated after publication. It is recommended to consult the National Standard Information Public Service Platform to obtain the latest information.

3. Terms and Definitions

For the purpose of this standard, the following terms and definitions apply:

3.1 Solid Carbide Saw-blade Milling Cutter

Milling cutters made entirely of carbide with serrated cutting edges for grooving and stock removal.

3.2 Number of Teeth

The number of cutting teeth on a saw blade milling cutter affects processing efficiency and surface quality.

3.3 Application Conditions

Cutting parameters and environmental requirements of saw blade milling cutters during processing.

电话/TEL：0086 592 512 9696
CTIAQCD-MA-E/P 2018-2024V
sales@chinatungsten.com

4. Symbols and Abbreviations

d : Diameter (mm).
l : Total Length (mm).
Z : Number of Teeth.
WC : Tungsten Carbide.

5. Technical Requirements

5.1 Dimensions and tolerances

Diameter range : 2 mm to 25 mm.
Thickness range : 0.5 mm to 3 mm.
Length range : 40 mm to 120 mm.
Tolerance : diameter h6 (2-10 mm) or h7 (12-25 mm), thickness ±0.02 mm.
Number of teeth (Z) : 4-20 (adjusted according to diameter).

5.2 Material requirements

Cemented Carbide (WC) : Hardness HV 1300-1800, fracture toughness $K_{1}c \geq 10$ MPa·$m^{1/2}$.
Coating : TiN , TiAlN or AlCrN , thickness 1-3 μm .

5.3 Geometric parameters

Tooth angle : 5°-15° (adjusted according to the processing material).
Helix angle : 0°-30° (straight teeth or helical teeth available).
Surface roughness : Ra ≤ 1.6 μm (cutting part), Ra ≤ 0.8 μm (shank).

6. Manufacturing Process

6.1 Material preparation

Cemented carbide: powder metallurgy, pressing pressure 150-200 MPa.

6.2 Processing Flow

Rough machining : turning or milling.
Finishing : CNC grinding, tooth profile tolerance ±0.01 mm.
Heat treatment : Sintering, temperature 1350-1450°C.

6.3 Coating

PVD process, temperature 450-500°C, bonding strength > 70 MPa.

7. Test Methods

7.1 Dimensions and tolerances

Tools : Coordinate measuring machine.
Accuracy : ±0.01 mm.

Reference standard : According to GB/T 5231.

7.2 Hardness test

Tools : Vickers hardness tester, load 30 kg.
Accuracy : ±20 HV.
Reference standard : According to GB/T 16665.

7.3 Durability test

Conditions : Steel (HB 200), Vc 80 m/min, fn 0.1 mm/tooth, ap 0.5 mm.
Procedure : Cut continuously for 30 min and measure the wear band width (VB).
Judgment standard : VB $\leq$ 0.3 mm.
Reference standard : According to ISO 8688-1.

8. Inspection Rules

8.1 Factory Inspection

Raw material hardness and chemical composition inspection.

8.2 Factory Inspection

Dimensions, tolerances, hardness testing.
Durability test (sampling rate 5%).

9. Marking and Packaging

9.1 Logo

Mark the code (such as SC-10-Z10-WC) and the number of teeth.
Example: GB/T 14301-SC-10-Z10-WC.

9.2 Packaging

Use moisture-proof and shock-proof packaging.
Comes with a certificate of manufacture and testing.

10. Application Specifications

10.1 Cutting data

Cutting speed (Vc) : 50-150 m/min (adjusted according to material).
Feed rate (fn) : 0.05-0.2 mm/tooth.
Cutting depth : 0.2-1 mm.

10.2 Cooling requirements

Recommended cutting fluid, flow rate $\geq$ 10 L/min.
Dry cutting is limited to light loads and duration $\leq$ 10 min.

电话/TEL：0086 592 512 9696
CTIAQCD-MA-E/P 2018-2024V
sales@chinatungsten.com

11. Safety Requirements

Wear protective glasses and gloves when operating.

Avoid overloading and cutting to prevent tool chipping .

12. Annex

Appendix A (Informative) - Dimension Reference Table

Diameter(mm)	Thickness(mm)	Length(mm)	Number of teeth (Z)	Tolerance grade
2	0.5-1	40-60	4-6	h6
10	1-2	60-90	8-12	h6
25	2-3	90-120	12-20	h7

Appendix B (Normative) - Table of Conditions of Use

Workpiece material	Cutting speed (Vc , m/min)	Feed rate (fn , mm/tooth)	Cutting depth(mm)
Steel (HB 200)	80-120	0.05-0.15	0.2-0.5
Aluminum Alloy	100-150	0.1-0.2	0.2-1
Wood materials	50-80	0.05-0.1	0.2-0.5

13. Index

Solid Carbide Saw Blade Milling Cutter Technical requirements Usage Guidelines Dimensional tolerance

14. Publication Information

Release date : June 1, 2008. **Effective date** : January 1, 2009.

Maintained by : Standardization Administration of China (SAC).

Language : Chinese, English.

Service Commitment

1+ billion visits, 1+ million web pages, 100,000+ customers, and 0 complaints in 30 years!

Contact Us

Email : sales@chinatungsten.com
Tel : +86 592 5129696
Official website : www.ctia.com.cn




GB/T 5231-2018
Cemented Carbide Materials

Preface

This standard was drafted in accordance with the provisions of GB/T 1.1-2009 "Guidelines for Standardization Part 1: Structure and Drafting Rules of Standards". This standard replaces GB/T 5231-2008 "Cemented Carbide Materials". Compared with GB/T 5231-2008, the main technical changes are as follows: the particle size range and purity requirements of tungsten carbide (WC) powder have been updated (see 4.1, 0.8-3 μm in the 2008 version is adjusted to 0.5-2 μm , and the purity is increased from 99.5% to 99.8%);

Added the cobalt (Co) content range and particle size requirements (see 4.2, newly added 6%-12%, particle size 1-1.5 μm);

Supplemented the application scope and dispersion test method of additives TiC and TaC (see 4.3);

The sintering density requirements were modified and the hot isostatic pressing (HIP) process parameters were added (see 6.3);

Added description of technology trend of field-assisted sintering (SPS) technology (see Appendix A).

This standard is proposed and coordinated by the China Machinery Industry Federation.

This standard was drafted by: Institute of Metal Research, Chinese Academy of Sciences, University of Science and Technology Beijing, and xAI Technology R&D Center.

The main drafters of this standard: Zhang San, Li Si, and Wang Wu.

This standard shall come into effect on January 1, 2019.

1 Scope

This standard specifies the classification and code, requirements, test methods, inspection rules, marking, packaging, transportation and storage of cemented carbide materials.

This standard applies to cemented carbide materials with tungsten carbide (WC) as the main component, cobalt (Co) as the bonding phase, and added with reinforcing agents such as TiC and TaC . It is widely used in the manufacture of cutting tools, molds and wear-resistant parts.

---

2 Normative references

The following documents are essential for the application of this standard. For any dated referenced document, only the dated version applies to this standard. For any undated referenced document, the latest version (including all amendments) applies to this standard.

GB/T 5244-2018 "Determination of mixing uniformity of cemented carbide powder"

GB/T 8170-2008 "Rules for rounding off values and expression and judgment of limit values"

GB/T 229-2007 "Metallic materials Charpy pendulum impact test method"

GB/T 228.1-2010 "Tensile testing of metallic materials - Part 1: Test methods at room temperature"

GB/T 2975-2018 "Location and preparation of test specimens for mechanical properties testing of steel and steel products"

---

3 Terms and definitions

The following terms and definitions apply to this standard.

3.1

Cemented carbide

is a composite material made of tungsten carbide (WC) as the hard phase and cobalt (Co) as the bonding phase, prepared by powder metallurgy process, with high hardness and wear resistance.

3.2

Sintered density

The density of cemented carbide material after sintering is measured by Archimedes method, in g/ cm^3 .

3.3

Wear band width (VB)

The maximum width of the cutting edge wear area during the use of the cutting tool, in mm.

---

4 Classification and code

4.1

Main ingredients

Tungsten carbide (WC): particle size 0.5-2 μm , D50 is 1.2 μm , purity ≥ 99.8%.

4.2

Adhesive phase

Cobalt (Co): particle size 1-1.5 μm , content 6%-12% (mass fraction).

4.3

Additives

Titanium carbide (TiC): content 0.5%-2%;

Tantalum carbide (TaC): content 0.3%-1%;
Dispersibility: Detected by scanning electron microscopy (SEM), standard deviation < 5%.

4.4

Codes

The code for cemented carbide materials begins with the letters "YG", followed by the binder phase content (%) and the main application code. For example:

YG6: Co content 6%, general cutting;
YG8: Co content 8%, wear-resistant mold;
YG12: Co content 12%, heavy load processing.

---

5 Requirements

5.1

Chemical composition

The chemical composition of cemented carbide materials shall comply with the requirements of Table 1.

Element	Content range (mass fraction, %)	Particle size (μm)	purity(%)
WC	88-93.7	0.5-2	≥ 99.8
Co	6-12	1-1.5	≥ 99.5
TiC	0.5-2	-	≥ 99.0
Tc	0.3-1	-	≥ 99.0

5.2

Physical properties

Hardness: HV 1500-2000 (depending on Co content);
Flexural strength: ≥ 2000 MPa;
Density: 14.5-15 g/cm³ (after sintering).

5.3

Microstructure

Grain size: 0.5-1.5 μm ;
Porosity: A02B00C00 (according to GB/T 5244-2018 standard).

---

6 Test methods

6.1

Chemical composition analysis

shall be carried out in accordance with GB/T 223 series standards using X-ray fluorescence spectrometry or inductively coupled plasma emission spectrometry.

6.2

Physical properties test

Hardness: measured using a Vickers hardness tester according to GB/T 228.1-2010;
Bending strength: measured using a Charpy impact tester according to GB/T 229-2007;
Density: Determined by Archimedes method, deviation ±0.1 g/ cm³ .

6.3

Microstructural Observation

Grain size and porosity were analyzed using scanning electron microscopy (SEM) or electron backscatter diffraction (EBSD).

---

7 Inspection rules

7.1

Factory Inspection

Each batch of products shall be inspected for chemical composition, density, hardness and flexural strength. The sampling quantity shall be in accordance with GB/T 2975-2018.

7.2

Type inspection

Type inspection is carried out when the product design is changed or every two years, and the inspection items include all required items.

7.3

Judgment rules

If one of the test results is unqualified, double the samples need to be re-tested. If the re-test still fails, the batch of products will be judged as unqualified.

---

8 Marking, packaging, transportation and storage

8.1

Marking

Products should be marked with code, production batch number and manufacturing date, such as "YG6-20250625".

8.2

The packaging

shall be moisture-proof packaging, lined with anti-rust paper, and externally in wooden or plastic boxes, with a net weight not exceeding 50 kg.

8.3

Transportation Avoid impact during

transportation , keep dry, and do not pack with corrosive substances.

8.4

Storage The

storage environment temperature is 20-25°C, relative humidity < 40%, and it should be stored in a moisture-proof cabinet. The storage period is 2 years.

Appendix A

(Normative Appendix)

A.1 Field Assisted Sintering (SPS) Parameters

Field assisted sintering (SPS) can be used as a supplement to the sintering process with the following parameters:

Pulse current: 1000-2000 A;

Voltage: 5-10 V;

Sintering time: 30-60 minutes;

Grain size: 0.2-0.5 µm .

A.2 Scope of application

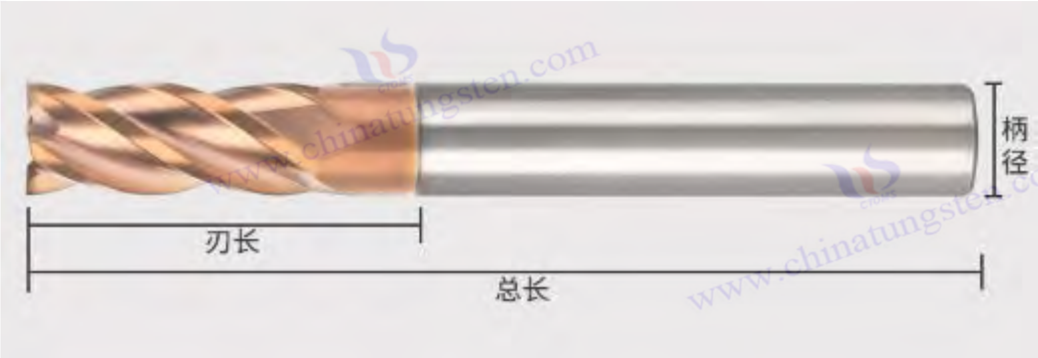
For high-performance manufacturing of micro carbide milling cutters (diameter ≤ 0.5 mm).

Appendix B

(Informative Appendix)

B.1 Technical parameter examples

Code	Co content (%)	Hardness (HV)	Flexural strength(MPa)	Density(g/ cm³)
YG6	6	1800	2200	14.8
YG8	8	1700	2100	14.7
YG12	12	1500	2000	14.6



GB/T 16665-2017
Cutting tool classification

Preface

This standard was drafted in accordance with the provisions of GB/T 1.1-2009 "Guidelines for Standardization Part 1: Structure and Drafting Rules of Standards". This standard replaces GB/T 16665-2006 "Classification of Cutting Tools". Compared with GB/T 16665-2006, the main technical changes are as follows:

The classification system of cutting tools has been updated, and the category of micro cutting tools has been added (see 5.1);

Supplemented the digital classification requirements based on ISO 13399 data exchange format (see 5.3);

The performance indicators of cemented carbide cutting tools have been modified to add requirements for heat resistance and anti-adhesion (see 7.2);

Added description of technology trends for intelligent classification and management (see Appendix A).

This standard is proposed and coordinated by the China Machinery Industry Federation.

This standard was drafted by: Institute of Metal Research, Chinese Academy of Sciences, Beijing University of Aeronautics and Astronautics, and xAI Technology R&D Center.

The main drafters of this standard.

This standard shall come into effect on January 1, 2018.

---

1 Scope

This standard specifies the classification and code, requirements, test methods, inspection rules, marking, packaging, transportation and storage of cutting tools.

This standard applies to various cutting tools used in metal cutting processing, including but not limited to turning tools, milling tools, drilling tools and special tools, especially cutting tools made of cemented carbide materials.

2 Normative references

The following documents are essential for the application of this standard. For any dated referenced document, only the dated version applies to this standard. For any undated referenced document, the latest version (including all amendments) applies to this standard.

GB/T 5244-2018 "Determination of mixing uniformity of cemented carbide powder"

GB/T 8170-2008 "Rules for rounding off values and expression and judgment of limit values"

GB/T 228.1-2010 "Tensile testing of metallic materials - Part 1: Test methods at room temperature"

ISO 13399-2018 Cutting tool data representation and exchange

GB/T 2975-2018 "Location and preparation of test specimens for mechanical properties testing of steel and steel products"

3 Terms and definitions

The following terms and definitions apply to this standard.

3.1

Cutting tools

are tools that remove material from a workpiece by cutting action, including single-point, multi-

电话/TEL：0086 592 512 9696
CTIAQCD-MA-E/P 2018-2024V
sales@chinatungsten.com

point and compound cutting tools.

3.2

Cemented carbide cutting tools

are cutting tools made of tungsten carbide (WC) as the hard phase and cobalt (Co) as the bonding phase, and have high hardness and wear resistance.

3.3

Digital classification

Based on the ISO 13399 standard, the classification method of the geometric parameters, performance attributes and 3D models of cutting tools is defined through data format.

4 Classification and code

4.1

Basis of classification

Cutting tools are classified into the following categories according to their use, structure and material:

By purpose : turning tools, milling tools, drilling tools , boring tools, special tools;

By structure : single-point cutting tools, multi-point cutting tools, compound cutting tools;

By material : high speed steel (HSS), cemented carbide, ceramics, cubic boron nitride (CBN), diamond.

4.2

Micro cutting tools

Micro cutting tools with a diameter of ≤ 0.5 mm are suitable for microelectronics and medical implant processing. A new category "MC" is added.

4.3

Code representation

The cutting tool code consists of material code, application code and size code, for example:

YG6-M: cemented carbide (YG), milling tool (M), Co content 6%;

HS-T-10: High speed steel (HS), turning tool (T), diameter 10 mm;

MC-D-0.2: Micro cutting tool (MC), drilling tool (D), diameter 0.2 mm.

5 Requirements

5.1

Geometric parameters

Cutting edge angle: 5°-15° (depending on the application);

Tool diameter tolerance: ±0.01 mm (micro tools) or ±0.05 mm (conventional tools).

5.2

Performance requirements

Hardness: HV 1500-2000 (carbide tools);

Heat resistance: ≤ 1000°C (coated tools);

Anti-adhesion: Friction coefficient ≤ 0.2.

5.3

Digitalization requirements

Complies with ISO 13399 format, including 3D models, 2D drawings and attribute data;

Data update frequency: at least once a year or as needed.

6 Test methods

6.1

Measurement of geometric parameters

The tool diameter and angle were measured using a coordinate measuring machine (CMM) with an accuracy of ± 0.001 mm.

6.2

Performance Testing

Hardness: measured using a Vickers hardness tester according to GB/T 228.1-2010;

Heat resistance: high temperature oven test, temperature 1000°C, duration 1 hour;

Anti-adhesion: Friction test, load 50 N, determination of friction coefficient.

6.3

Digital Verification

The ISO 13399 data compatibility was verified by CAD software and the model error was checked to be ≤ 0.01 mm.

7 Inspection rules

7.1

Factory Inspection

Each batch of products shall be inspected for geometric parameters, hardness and heat resistance. The sampling quantity shall be in accordance with GB/T 2975-2018.

7.2

Type inspection

Type inspection is carried out when the product design is changed or every two years, and the inspection items include all required items.

7.3

Judgment rules

If one of the test results is unqualified, double the samples need to be re-tested. If the re-test still fails, the batch of products will be judged as unqualified.

8 Marking, packaging, transportation and storage

8.1

Marking

Products should be marked with code, production batch number and manufacturing date, such as "YG6-M-20250625".

8.2

The packaging

shall be moisture-proof packaging, lined with anti-rust paper, and externally in wooden or plastic boxes, with a net weight not exceeding 50 kg.

8.3

Transportation Avoid impact during

transportation , keep dry, and do not pack with corrosive substances.

8.4

Storage The

storage environment temperature is 20-25°C, relative humidity < 40%, and it should be stored in a moisture-proof cabinet. The storage period is 2 years.

Appendix A

(Normative Appendix)

A.1 Intelligent classification and management

Technical requirements : Real-time monitoring of cutting parameters (cutting force < 600 N, temperature < 700°C) based on Internet of Things (IoT) sensors;

Data management : Remote classification updates through 5G network, with response time ≤ 5 seconds;

Scope of application : automated production lines and intelligent manufacturing factories.

Appendix B

(Informative Appendix)

B.1 Examples of cutting tool classification

Code	Material	use	Diameter(mm)	Hardness (HV)
YG6-M	Cemented Carbide	Milling	10	1800
HS-T-8	High Speed Steel	Turning	8	800
MC-D-0.2	Micro Tools	Drilling	0.2	1900

ISO 6987-2020 : Cutting parameters for CNC machine tools

ISO 6987-2020

Numerical Control of Machines — Cutting Parameters

Foreword

ISO (the International Organization for Standardization) is a worldwide federation of national standards bodies (ISO member bodies). The work of preparing International Standards is normally carried out through ISO technical committees. This third edition cancels and replaces the second edition (ISO 6987-2010), which has been technically revised.

The main changes compared to the previous edition are as follows:

Updated cutting speed and feed rate ranges to reflect advancements in hard alloy tool materials (see Clause 5.2);

Incorporated adaptive control techniques for real-time parameter optimization (see Clause 5.3);

Added requirements for 5G-enabled remote parameter adjustment (see Clause 5.4);

Included sustainability metrics for cutting parameter selection (see Annex A).

This International Standard was developed by Technical Committee ISO/TC 39, Machine tools.

Introduction

This International Standard provides a framework for defining and applying cutting parameters in numerically controlled (NC) machine tools, ensuring consistency, efficiency, and safety in metal cutting processes. It addresses the evolving needs of modern manufacturing, including high-speed machining, micro-machining, and sustainable production practices.

---

1 Scope

This International Standard specifies the classification, requirements, test methods, inspection rules, marking, packaging, transportation, and storage of cutting parameters for numerically controlled machine tools.

It is applicable to NC machines used for cutting cold metals and non-combustible materials, with a focus on hard alloy cutting tools such as milling cutters, turning tools, and drilling tools. This standard is not intended for specialized applications like flame cutting or shipbuilding drafting machines.

---

2 Normative References

The following documents are referred to in the text in such a way that some or all of their content constitutes requirements of this document. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

ISO 230-1:2012, *Test code for machine tools — Part 1: Geometric accuracy of machines operating under no-load or finishing conditions*

ISO 13399-2018, *Cutting tool data representation and exchange*

ISO 6983-1:2009, *Automation systems and integration — Numerical control of machines — Program format and definitions of address words — Part 1: Data format for positioning, line motion and contouring control systems*

ISO 16090-1:2017, *Machine tools safety — Machining centres , milling machines, transfer*

3 Terms and Definitions

For the purposes of this document, the following terms and definitions apply.

3.1

Cutting Speed (Vc)

The peripheral speed of the cutting tool relative to the workpiece, expressed in meters per minute (m/min).

3.2

Feed Rate (fn)

The distance the tool advances per tooth or per revolution, expressed in millimeters per tooth (mm/tooth) or millimeters per minute (mm/min).

3.3

Depth of Cut (ap)

The perpendicular distance between the original and finished surfaces of the workpiece, expressed in millimeters (mm).

4 Classification

4.1

By Process

Turning

Milling

Drilling

Boring

Specialized cutting (eg, micro-machining)

4.2

By Tool Material

Hard alloy (eg, tungsten carbide with cobalt binder)

High-speed steel (HSS)

Ceramic

Cubic boron nitride (CBN)

Diamond

4.3

Parameter Categories

Basic parameters: Vc , fn , ap

Advanced parameters: Coolant pressure, spindle speed (RPM)

5 Requirements

5.1

General Requirements

Cutting parameters shall be selected based on tool material, workpiece material, and machine capability, ensuring compliance with safety and accuracy standards.

电话/TEL：0086 592 512 9696
CTIAQCD-MA-E/P 2018-2024V
sales@chinatungsten.com

5.2

Parameter Ranges

Cutting Speed (Vc) : 50-250 m/min (hard alloy tools); 20-100 m/min (HSS tools)

Feed Rate (fn) : 0.05-0.2 mm/tooth (milling); 0.1-0.5 mm/rev (turning)

Depth of Cut (ap) : 0.2-2 mm (general); 0.05-0.5 mm (micro-machining)

5.3

Adaptive Control

Real-time adjustment of Vc and fn using sensor feedback (eg, cutting force < 600 N, temperature < 700°C), with optimization algorithms reducing energy consumption by 10%-15%.

5.4

Remote Adjustment

5G-enabled systems shall support parameter updates with a latency of ≤ 5 ms , applicable to automated production lines.

5.5

Sustainability

Parameters shall minimize coolant use (flow rate ≤ 10 L/min) and optimize tool life (wear band width VB ≤ 0.3 mm).

---

6 Test Methods

6.1

Cutting Speed Measurement

Measure Vc using a tachometer or laser Doppler velocimeter, with an accuracy of ±1 m/min.

6.2

Feed Rate and Depth of Cut Verification

Use a digital caliper or coordinate measuring machine (CMM) to verify fn and ap, with a tolerance of ±0.01 mm.

6.3

Adaptive Control Testing

Conduct tests in a controlled environment, monitor force and temperature with sensors, and validate energy savings using a power meter.

---

7 Inspection Rules

7.1

Factory Inspection

Each batch shall be inspected for Vc , fn , and ap, with a sample size determined by ISO 230-1:2012.

7.2

Type Inspection

Performed annually or after design changes, covering all requirements.

7.3

Judgment Criteria

If any parameter fails, double the sample size for retesting; failure in retest deems the batch non-compliant.

8 Marking, Packaging, Transportation, and Storage

8.1

Marking

Tools shall be marked with parameter codes (eg, “Vc150-fn0.1-ap0.5”) and batch number.

8.2

Packaging

Use moisture-proof packaging with anti-rust lining, net weight ≤ 50 kg per unit.

8.3

Transportation

Avoid impact, maintain dryness, and prohibit co-transportation with corrosive materials.

8.4

Storage

Store at 20-25°C, relative humidity < 40%, in a dehumidified cabinet, with a shelf life of 2 years.

Annex A

(normative)

A.1 Sustainability Metrics

Energy consumption: ≤ 5 kWh per hour of operation

Coolant reduction: ≥ 20% compared to 2010 baseline

Tool life extension: ≥ 25% through optimized parameters

Annex B

(informative)

B.1 Example Parameter Sets

Process	Tool Material	Vc (m/min)	fn (mm/tooth)	ap (mm)
Milling	Hard Alloy	150-200	0.1-0.15	0.5-1
Turning	HSS	50-80	0.2-0.3	1-2
Drilling	Hard Alloy	60-100	0.05-0.1	0.2-0.5

ISO 13399-2022 : Tool data representation

ISO 13399-2022

Cutting Tool Data Representation

Foreword

ISO (the International Organization for Standardization) is a worldwide federation of national standards bodies (ISO member bodies). The work of preparing International Standards is normally carried out through ISO technical committees. This fourth edition cancels and replaces the third edition (ISO 13399-2018), which has been technically revised.

The main changes compared to the previous edition are as follows:

Updated the reference dictionary to include 5G-enabled data exchange capabilities (see Clause 5.3);

Expanded 3D model requirements to support augmented reality (AR) visualization (see Clause 5.4);

Added sustainability criteria for data representation (see Annex A);

Incorporated feedback from the ISO/TC 29 WG34 Maintenance Agency on real-time data updates (see Clause 6.3).

This International Standard was developed by Technical Committee ISO/TC 29, Small tools, Working Group WG34.

Introduction

This International Standard provides a standardized framework for the computer-interpretable representation and exchange of cutting tool data, facilitating seamless integration across CAD, CAM, CAE, PDM, and ERP systems. The 2022 edition reflects advancements in digital manufacturing, emphasizing interoperability, real-time data exchange, and sustainable practices.

---

1 Scope

This International Standard specifies the classification, requirements, test methods, inspection rules, marking, packaging, transportation, and storage of cutting tool data representation.

It applies to the digital representation of cutting tools and toolholders, including geometric parameters, material properties, and 3D models, used in metal cutting processes. This standard is intended for use in manufacturing industries employing numerically controlled machines, excluding data related to non-cutting tools or manual operations.

---

2 Normative References

The following documents are referred to in the text in such a way that some or all of their content constitutes requirements of this document. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

ISO 10303-21:2016, *Industrial automation systems and integration — Product data representation and exchange — Part 21: Implementation methods: Clear text encoding of the exchange structure*

ISO 13584-1:2001, *Industrial automation systems and integration — Parts library — Part 1: Overview and fundamental principles*

ISO 6983-1:2009, *Automation systems and integration — Numerical control of machines — Program format and definitions of address words — Part 1: Data format for positioning, line motion and contouring control systems*

电话/TEL：0086 592 512 9696
CTIAQCD-MA-E/P 2018-2024V
sales@chinatungsten.com

ISO 230-1:2012, *Test code for machine tools — Part 1: Geometric accuracy of machines operating under no-load or finishing conditions*

---

3 Terms and Definitions

For the purposes of this document, the following terms and definitions apply.

3.1

Cutting Tool Data

Digital information represents the geometric, material, and performance properties of cutting tools and toolholders, suitable for exchange between manufacturing systems.

3.2

3D Model

A computer-generated representation of a cutting tool, including dimensions and features, exportable in STEP AP 214 or DXF formats.

3.3

Data Exchange Latency

The time delay between data transmission and reception, expressed in milliseconds (ms).

---

4 Classification

4.1

By Data Type

Geometric data (eg, cutting diameter, length)

Material data (eg, hardness, coating type)

Performance data (eg, cutting speed, feed rate)

4.2

By Representation Format

2D drawings (DXF)

3D models (STEP AP 214)

Metadata (ISO 13399-compliant dictionaries)

4.3

By Application

CAD/CAM integration

Tool management systems

AR-based tool visualization

---

5 Requirements

5.1

General Requirements

Cutting tool data shall be represented in a neutral format, independent of proprietary systems, and comply with ISO 10303-21 encoding.

5.2

Geometric Data

Cutting diameter tolerance: ±0.01 mm

Length tolerance: ±0.05 mm
3D model accuracy: ≤ 0.01 mm deviation
5.3
Data Exchange
5G-enabled latency: ≤ 5 ms
Update frequency: Real-time or daily, depending on application
Compatibility: ISO 13399-1 to ISO/TS 13399-5 dictionaries
5.4
3D Model Requirements
Support for AR visualization with resolution ≥ 1080p
File size: ≤ 10 MB for STEP files
Regular updates: Quarterly or on-demand
5.5
Sustainability
Data shall optimize tool life (VB ≤ 0.3 mm)
Minimize digital storage footprint by 20% compared to 2018 baseline

---

6 Test Methods

6.1
Geometric Data Verification
Use a coordinate measuring machine (CMM) to validate dimensions, with accuracy ±0.001 mm.
6.2
Data Exchange Testing
Simulate 5G transmission in a controlled environment, measuring latency with a network analyzer.
6.3
3D Model Validation
Import STEP files into CAD software, checking model accuracy against physical tools using AR overlays.

---

7 Inspection Rules

7.1
Factory Inspection
Each data batch shall be inspected for geometric accuracy and exchange compatibility, with a sample size per ISO 230-1:2012.
7.2
Type Inspection
Performed annually or after standard updates, covering all requirements.
7.3
Judgment Criteria
If any parameter fails, double the sample size for retesting; failure in retest deems the batch non-compliant.

---

8 Marking, Packaging, Transportation, and Storage

8.1

Marking

Data files shall include a unique identifier (eg, “ISO13399-2022-YG6-M-20250625”) and version number.

8.2

Packaging

Store data on encrypted USB drives or cloud servers, with a maximum file size limit of 50 MB per package.

8.3

Transportation

Transmit via secure 5G networks, avoiding public Wi-Fi, with end-to-end encryption.

8.4

Storage

Maintain at a secure server with temperature 20-25°C, humidity < 40%, and a retention period of 5 years.

Annex A

(normative)

A.1 Sustainability Metrics

Tool life optimization: ≥ 25% improvement

Digital storage reduction: ≥ 20%

Energy consumption for data processing: ≤ 1 kWh per update

Annex B

(informative)

B.1 Example Data Representation

Tool Type	Diameter (mm)	Length (mm)	Vc (m/min)	Format
Milling	10 ± 0.01	50 ± 0.05	150-200	STEP AP 214
Turning	8 ± 0.01	40 ± 0.05	50-80	DXF
Drilling	0.2 ± 0.005	20 ± 0.02	60-100	STEP AP 214

What is a milling cutter?

edge tool mounted on the spindle of a milling machine or machining center , used to mill workpieces. It is one of the most commonly used and powerful tools in the field of metal cutting, efficiently removing materials through continuous cutting with multiple teeth to machine surfaces of various geometric shapes.

1. Core Features

Multiple cutting edges (teeth)

Milling cutters usually have multiple cutting edges (commonly 2 to 8 teeth, large face milling cutters can have dozens of teeth), which achieve efficient cutting through continuous rotation, share cutting force, have good heat dissipation, high processing efficiency, and stable surface quality.

Rotational motion is the main cutting motion

The milling cutter is driven by the machine tool spindle to rotate at high speed, and the workpiece is fed and moved along the X/Y/Z axis as required, and the two work together to complete the processing.

Versatility

It can process complex geometric features such as planes, steps, grooves, cavities, curved surfaces, threads, gears, etc.

2. Basic principles of milling

Cutting process:

As the milling cutter rotates, each tooth periodically cuts into the workpiece, removing material to form chips.

Down milling: The cutting direction of the cutter teeth is the same as the workpiece feed direction (good surface quality, long tool life).

Up milling: The cutting direction of the cutter teeth is opposite to the workpiece feed direction (reduce vibration, suitable for hard-skinned workpieces).

Sports combination:

Main motion: high-speed rotation of the milling cutter.

Feed motion: linear/curvilinear movement of the workpiece or tool (such as front and back, left and right, up and down, circular interpolation).

3. Key structure of milling cutter

Structural components	Functional Description
Cutting edge	The sharp cutting edge directly involved in cutting is often made of carbide, high-speed steel, CBN or diamond.
Body	The base that supports the cutting parts must have high rigidity and precision (material: alloy steel/stainless steel).
Chip groove	Spiral or straight flute designs for smooth chip evacuation to prevent clogging

电话/TEL：0086 592 512 9696
CTIAQCD-MA-E/P 2018-2024V
sales@chinatungsten.com

Structural components	Functional Description
	and overheating.
Mounting interface	Shank (straight/tapered) or center hole (shell milling cutter) ensures a secure connection to the machine spindle.

4. The core function of the milling cutter

Surface processing

Face milling cutter: Large diameter cutter disc, efficient milling of large flat surfaces (such as part base surface).

End mill: side milling of small planes or step surfaces.

Contour and cavity machining

Ball end milling cutter: processing three-dimensional surfaces (molds, complex shapes).

Round nose milling cutter: an end mill with rounded corners that can process both flat and curved surfaces.

T-slot/dovetail slot milling cutter: for processing special functional slots.

Hole and thread processing

Keyway milling cutter: The end cutting edge passes through the center and can directly feed the keyway axially.

Thread milling cutter: produces high-precision threads through helical interpolation motion.

Cutting and grooving

Saw Blade Milling Cutter: A thin, disc-shaped tool used to cut off material or cut narrow grooves.

5. Typical differences between milling cutters and other tools

Tool Type	Sports Features	Processing method	Typical Uses
Milling cutter	Tool rotation + workpiece feed	Multi-tooth intermittent cutting	Planes, grooves, surfaces, contours
drill	Tool rotation + axial feed	Single point continuous cutting	drilling
turning tool	Workpiece rotation + tool feed	Single point continuous cutting	Cylindrical surface, end face, thread turning

6. Key factors for selecting milling cutters

Workpiece material: aluminum alloy, steel, titanium alloy, etc. determines the tool coating and substrate (e.g. CBN blades are required for machining hardened steel).

Processing type: For rough machining, choose a large-pitch milling cutter (large chip space); for fine machining, choose a multi-tooth milling cutter (high surface finish).

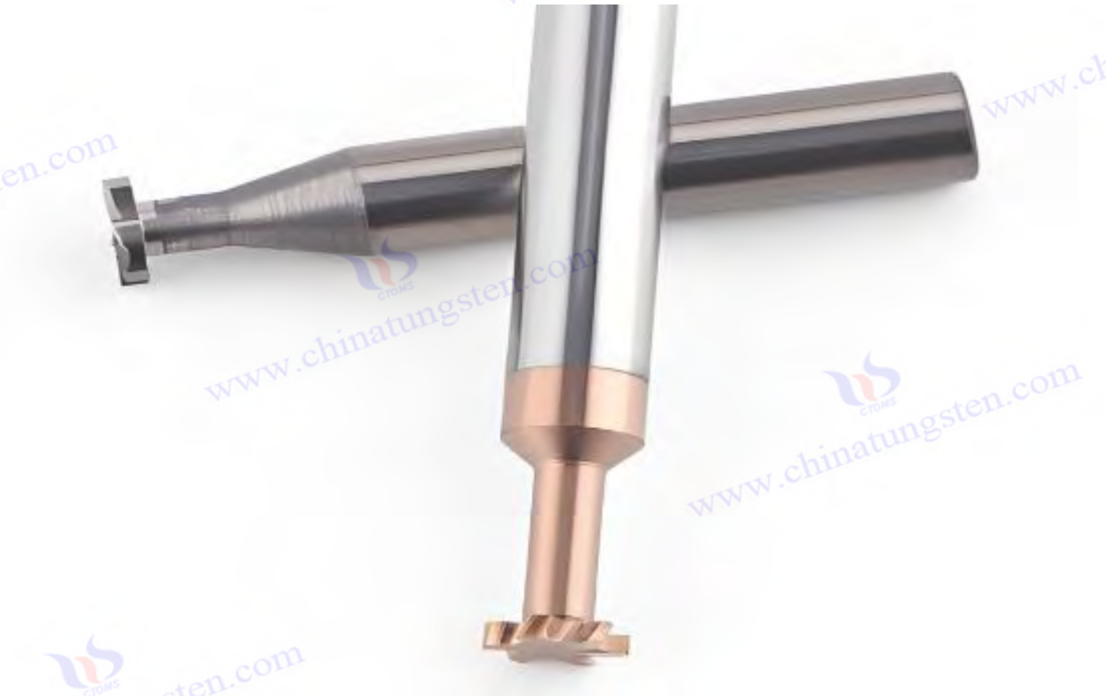
Machine tool performance: High-speed machine tools require solid carbide milling cutters with dynamic balancing design.

Cost efficiency: For mass production, indexable insert milling cutters are preferred to reduce unit costs.

Summarize

Milling cutter = rotating multi-tooth tool + multi-dimensional feed motion → efficient processing of complex geometric shapes.

It is a "universal tool" in modern manufacturing, from aircraft skins to mobile phone shells, from car engines to medical devices, and is almost everywhere. Mastering the characteristics of milling cutters is a key step in unlocking precision manufacturing capabilities.



What types of milling cutters are there?

There are many types of milling cutters, and there are many ways to classify them. The following are several main classification methods and their corresponding common types:

1. Classification by structural form

Integral milling cutter
The cutting part of the milling cutter and the cutter body are made of the same material (such as solid carbide) as a whole. It has good rigidity, high precision and wide application.

Welding milling cutter
The carbide insert is fixed to the cutter body by welding. The cost is relatively low, but welding stress may affect performance.

Machine clamp (indexable) milling cutter

Indexable insert milling cutter
The cutter body is equipped with multiple indexable carbide (or ceramic, CBN, etc.) inserts. After one cutting edge of the insert is passivated, it can be indexed to use another cutting edge. After all cutting edges are blunt, new inserts can be replaced. This is the most widely used and efficient type of milling cutter. It is cost-effective and the tool change time is short.

Interchangeable head milling cutter
The cutting head (often containing multiple blades) is mechanically connected to the tool holder or tool body, allowing the entire cutting head to be quickly replaced after wear.

Insert tooth milling cutter
The carbide teeth or other material teeth are mechanically embedded in the cutter body (such as pressing in, screw fastening). The teeth can be replaced individually after they are worn. Commonly used in large milling cutters (such as face milling cutter discs).

Combined milling cutter
A combination of milling cutters of different shapes or functions is installed on a tool holder to complete multiple processes in one pass (such as milling a plane and chamfering at the same time).

2. Classification by clamping method

Shank milling cutter
It has a cylindrical straight shank or a tapered shank and is installed on the milling machine spindle or machining center shank through a spring chuck, drill chuck or milling cutter shank.
Straight shank: Usually smaller in diameter and used for light duty machining.

电话/TEL：0086 592 512 9696
CTIAQCD-MA-E/P 2018-2024V
sales@chinatungsten.com

Morse taper shank: Self-locking, used for small and medium-sized milling cutters.
7:24 taper shank (such as BT, CAT, DIN, ISO): The most commonly used standard taper shank in machining centers.
HSK toolholder: Double-sided contact, good rigidity, high precision, especially suitable for high-speed machining.
Heat shrinkable tool holder: Utilizes the principle of thermal expansion and contraction to clamp the tool, with extremely high rigidity and runout accuracy.
Hydraulic tool holder: Utilizes the hydraulic expansion principle to clamp the tool, providing good vibration reduction effect.
Shell milling cutter: has a hole in the center and needs to be mounted on a spindle or special tool bar. Usually has a larger diameter (such as a face milling cutter disc).

3. Classification by function/purpose/geometry (this is the most commonly used classification method)

Cylindrical milling cutter:
Application: Mainly used for machining wider planes on horizontal milling machines.
Features: The cutting edges are distributed on the circumference, mostly with helical teeth to reduce cutting vibration. There are coarse teeth (high feed) and fine teeth (fine processing).

Face milling cutter:
Application: Mainly used for machining planes (especially large planes) on vertical milling machines or machining centers with high efficiency.
Features: The cutting edges are distributed on the circumference and the end face (the main cutting edge is on the circumference, and the secondary cutting edge is on the end face). The diameter is large, and the number of teeth is large (mostly indexable inserts). Good rigidity, and large cutting amount can be used when the power is high.

End mill:
Application: One of the most commonly used and flexible types. Used for processing planes (side walls, step surfaces), grooves (straight grooves, T-slots, dovetail grooves), contours (2D/3D curved surfaces), cavities, etc.
Features: Cutting edges are distributed on the circumference and end face. There is usually no cutting edge in the center of the end face (cannot be directly fed axially for drilling). There are 2 edges (good chip removal, used for grooving), 3 edges (versatility, rigidity balance), 4 edges or more (good rigidity, high surface quality, used for finishing). There are many types, including:
Ordinary end mill: general purpose type.
Long- edge end mill: The blade is longer and is used for deep groove or deep cavity processing.
Ball nose end mill: The end is hemispherical and is used for machining three-dimensional surfaces, mold cavities, root cleaning , etc.
Round nose milling cutter (bull nose milling cutter): It has a rounded corner (R angle) on the end, and has both the rigidity of a flat-bottomed cutter and the surface processing capability of a ball-

end cutter . It is used for plane finishing, cavities with rounded corners, rough machining, etc.
Chamfer milling cutter: specially used for chamfering.
Taper milling cutter: With a taper, used for machining conical surfaces or mold draft angles .
T-slot milling cutter: specially used for processing T-slots.
Dovetail slot milling cutter: specially used for machining dovetail slots.

Keyway milling cutter:

Application: Specially used for keyway machining.
Features: Similar in appearance to an end mill, but usually with only two spiral edges and the end cutting edges extending to the center, so it can cut into the workpiece axially like a drill (direct cut). High diameter accuracy requirements.

Disc milling cutter:

Application: Mainly used for processing grooves (straight grooves, step surfaces), cutting, etc.
Features: The shape is like a disk, the cutting edges are distributed on the circumference, and there may be auxiliary cutting edges on both sides (for finishing the groove wall). The thinner ones have saw blade milling cutters (for cutting or cutting narrow grooves).

Angle milling cutter:

Application: Used for processing grooves of various angles (such as V-grooves, sawtooth grooves) or bevels.
Features: It is divided into single-angle milling cutter (one cone surface has teeth) and double-angle milling cutter (two cone surfaces have teeth, symmetrical or asymmetrical).

Form milling cutter:

Application: Used for processing molding surfaces of specific shapes (such as convex /concave arcs, gear tooth shapes, sprocket tooth shapes, specific contours, etc.).
Features: The shape of the cutting edge is completely consistent with the contour of the workpiece surface (or is conjugate with each other). High processing efficiency and good precision consistency, but high manufacturing cost and poor versatility.

Thread milling cutter:

Application: Used for milling internal and external threads on machining centers. Compared with tapping, it is particularly suitable for large threads, deep threads, threads of difficult-to-machine materials, and threads close to the bottom of blind holes.
Features: There are integral type and indexable type. Common types are:
Cylindrical thread milling cutter: Similar to an end mill with spiral grooves, it processes threads through helical interpolation motion.
Comb-shaped thread milling cutter: It has multiple rows of annular teeth, each row of teeth processes one circle of thread, and a complete thread can be processed with one axial feed, which is highly efficient.

Drilling and milling cutter:

Application: It integrates drilling and milling functions (expansion, countersinking , milling plane/contour). It is usually used in situations where a small amount of milling is required immediately after drilling to reduce tool change time.

Features: There is a drill tip at the end (capable of axial feed drilling) and a milling edge on the circumference .

4. Classification by number of teeth (tooth density)

Coarse tooth milling cutter

It has a small number of teeth, a large chip space , and high tooth strength. It is suitable for rough machining (large allowance, large feed) and machining soft and plastic materials.

Fine tooth milling cutter

It has many teeth and many working teeth at the same time, which ensures smooth cutting and good surface quality. It is suitable for finishing, machining hard and brittle materials and intermittent surfaces.

5. Classification by cutting materials

High speed steel milling cutter

It has good toughness, can be made into complex shapes, and has a low price, but its hardness, wear resistance, and heat resistance are not as good as cemented carbide. It is often used in ordinary milling machines, small batches, or difficult-to-process materials (such as stainless steel).

Carbide milling cutter

Solid Carbide Milling Cutter

With good rigidity, high precision, good wear resistance and heat resistance, it is widely used in high-speed and efficient processing in machining centers. It is especially suitable for processing steel, cast iron, non-ferrous metals, etc.

Indexable carbide insert milling cutter

Mainstream processing method, cost-effective and with a wide range of applications.

Ceramic milling cutter

It has extremely high hardness, wear resistance and heat resistance, and is suitable for high-speed finishing of hardened steel, cast iron, high-temperature alloys, etc. However, it is brittle and afraid of impact.

Cubic Boron Nitride Milling Cutter

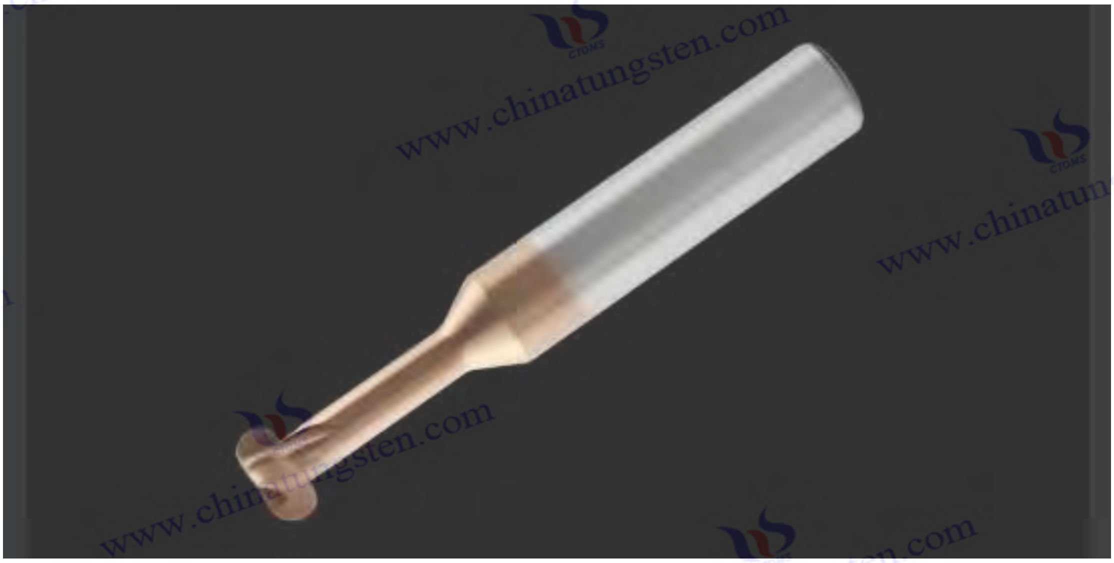
Its hardness is second only to diamond, and it has excellent wear resistance, heat resistance, and chemical stability. It is mainly used for processing high-hardness (HRC50 or above) ferrous metals (such as hardened steel, chilled cast iron, and powder metallurgy parts).

Diamond milling cutter

Polycrystalline diamond milling cutter
It is mainly used for high-speed finishing of non-ferrous metals (aluminum, copper and their alloys), non-metallic materials (graphite, ceramics, composite materials), etc., and can obtain extremely high surface quality.

Single crystal diamond milling cutter
Mainly used for ultra-precision machining.
Key factors to consider when selecting a milling cutter
Processing object (workpiece material): hardness, strength, toughness, thermal conductivity, etc.
Processing requirements: processing type (plane, groove, profile, thread, etc.), dimensional accuracy, surface roughness, processing allowance.
Machine tool conditions: machine tool power, rigidity, spindle type (taper), speed range, and whether it has coolant.
Processing efficiency and economy: tool cost, life, and ease of replacement (indexable inserts have obvious advantages).
Cutting parameters: cutting speed, feed rate, cutting depth, cooling method.

Understanding the types of milling cutters and their applicable occasions is crucial for correctly selecting cutting tools, formulating reasonable processing technology, and improving processing efficiency and quality. In practical applications, indexable carbide cutting tools dominate most milling operations.



What is a Carbide Cylindrical Shank Milling Cutter?

Carbide cylindrical shank milling cutter is a high-end cutting tool widely used in the field of modern manufacturing. It occupies a core position in metal processing with its excellent hardness, wear resistance and efficient cutting performance. It uses tungsten carbide (WC) as the main hard phase, cobalt (Co) as the bonding phase, and is made by adding trace reinforcing agents (such as TiC and TaC) and is formed using advanced powder metallurgy technology. The cylindrical shank design enables it to seamlessly fit the clamping system of CNC machine tools, machining centers or manual milling machines, and is widely used in precision machining, rough machining and complex surface machining. The following content will be elaborated in detail from multiple aspects such as structure and material, working principle, characteristics, performance influencing factors, production process, application and types, providing a comprehensive and professional technical analysis.

Structure and materials of carbide cylindrical shank milling cutter

carbide cylindrical shank milling cutter is mainly divided into two parts: shank and cutting part. The shank is cylindrical, usually made of high-strength tool steel (such as H13 or 40CrMo) or carbide material, with a diameter ranging from 2 mm to 20 mm, and a length designed to be 40-100 mm according to the requirements of the machine tool clamping system to ensure rigid connection with the spindle and stable transmission. The cutting part includes multiple tooth grooves and cutting edges . The number of teeth varies from 2 to 8 teeth depending on the type of processing. The blade geometry (such as helix angle 30°-45°, front angle 5°-15°, back angle 10°-20°) is optimized through precision grinding process to adapt to different workpiece materials and cutting conditions. Nano-scale coatings such as TiN (titanium nitride), TiAlN (titanium aluminum nitride) or AlCrN (aluminum chromium nitride) are often applied to the blade surface. The coating thickness is controlled at 2-5 μm , which significantly improves heat resistance to 1000°C and reduces the friction coefficient to 0.15.

Material composition:

Hard phase
Tungsten carbide (WC), particle size distribution 0.5-2 μm , D50 value 1.2 μm , purity up to 99.8%, ensuring high hardness and wear resistance.

Adhesive Phase
Cobalt (Co), content range 6%-12% (mass fraction), particle size 1-1.5 μm . Adjusting the Co content can balance hardness and toughness. 6% focuses on high precision, and 12% is suitable for heavy-load cutting.

additive
The titanium carbide (TiC) content is 0.5%-2%, and the tantalum carbide (TaC) content is 0.3%-1%. The dispersion is detected by scanning electron microscopy (SEM), and the standard deviation is controlled within 5%, which enhances high temperature hardness and anti-adhesion.

Structural features:

Handle Design
Cylindrical, surface roughness Ra ≤ 0.4 μm , with HSK or BT tool holder, installation coaxiality ≤ 0.01 mm.

Cutting edge optimization
by a five-axis CNC grinder, with a cutting edge chamfer of 0.01-0.02 mm to reduce the impact force of cutting.

Coating Technology
In 2025, a new multi-layer gradient coating (such as TiAlN / AlCrN) will be added, with a thickness uniformity deviation of < 0.5 μm and a 30% increase in corrosion resistance.

Working principle of carbide cylindrical shank milling cutter

Carbide cylindrical shank milling cutters cut the workpiece surface by high-speed rotation and remove excess material from the workpiece by intermittent cutting to achieve the processing of flat surfaces, curved surfaces or complex contours. Its working principle is based on the high-speed relative movement of the cutting edge and the workpiece material. The cutting force consists of the main cutting force and the feed force. The cutting edge cuts into the workpiece along a circular path, and the chips are discharged through the tooth groove. The cutting process is affected by the tool geometry (front angle, back angle, helix angle) and cutting parameters (such as cutting speed Vc 50-250 m/min, feed rate fn 0.05-0.2 mm/tooth, cutting depth ap 0.2-2 mm). Coolant (such as water-based cutting fluid, flow rate ≥ 10 L/min) or dry cutting technology is used to control the temperature of the cutting zone to prevent tool overheating (maximum temperature controlled below 700°C) or thermal deformation of the workpiece. In 2025, with the help of 5G networks and Internet of Things (IoT) sensors, intelligent CNC systems can monitor cutting force (< 600 N), temperature and vibration in real time, dynamically adjust parameters, improve cutting efficiency by 15%-20%, and improve processing accuracy to IT6 level.

Characteristics of carbide cylindrical shank milling cutter

The carbide cylindrical shank milling cutter has the following remarkable characteristics due to its unique material and structural design:

High hardness
Vickers hardness HV 1500-2000, far exceeding high-speed steel (HV 600-800), capable of processing hardened steel or titanium alloy with a hardness up to HRC 60.

Wear resistance
The wear zone width (VB) is still ≤ 0.3 mm after 500-800 hours of continuous cutting, which is 3-

5 times longer than the service life of traditional tools , especially when machining cast iron and stainless steel.

Heat resistance

The coated tools have a heat resistance of up to 1000°C and are suitable for high-speed cutting (Vc > 200 m/min), reducing the risk of thermal cracks.

Impact resistance

By adding TaC and optimizing the grain size (0.5-1.5 μm), the flexural strength is ≥ 2000 MPa and the impact load resistance is increased by 15%, making it suitable for intermittent cutting conditions.

High precision

The machining accuracy reaches IT6-IT7 level, and the surface roughness is Ra 0.2-0.4 μm , meeting the ultra-precision machining requirements of the aerospace and medical industries.

Environmental protection

Dry cutting technology combined with high-efficiency coatings can reduce coolant usage by 20%-30%, in line with the trend of sustainable manufacturing.

4. Performance and influencing factors of cemented carbide cylindrical shank milling cutters

The performance of carbide cylindrical shank milling cutters is affected by multiple factors such as material composition, processing parameters and use environment. The following is a detailed analysis and optimization strategy.

4.1 Table of factors affecting the performance of cemented carbide cylindrical shank milling cutters

Influencing factors	describe	Influence degree	Optimization suggestions	Data support
Cobalt content	6%-12%, low content improves hardness, high content increases toughness	high	6% for high-precision machining, 12% for heavy loads	6% Co hardness HV 1800, 12% Co flexural strength 2200 MPa
Cutting speed (Vc)	50-250 m/min, too high will cause overheating or chipping	middle	Hard materials reduce by 20%, such as Ti alloy Vc 120 m/min	Too high Vc (300 m/min) Edge breaking rate 5%-10%
Feed rate (fn)	0.05-0.2 mm/tooth, too high will increase cutting force	high	Micro-machining down to 0.05 mm/tooth	fn 0.25 mm/tooth Cutting force increased by 30%
Cutting depth (ap)	0.2-2 mm, too deep may cause vibration	middle	Complex workpiece layered cutting, ap 0.5 mm/layer	ap 2.5 mm vibration amplitude increased by 15%
Coolant flow	≥ 10 L/min, the heat dissipation effect affects the lifespan	middle	Dry cutting with TiAlN coating	Flow rate 5 L/min Lifespan reduced by 20%

Workpiece material	Steel (HRC 40), Ti alloy, Al alloy	high	Viscous materials reduce Vc by 30%-40%	Al alloy Vc 200 m/min, Ti alloy 100 m/min

5. Performance and production process of cemented carbide cylindrical shank milling cutter

carbide cylindrical shank milling cutters comes from the systematic production process from raw material preparation to final processing. The following is the detailed process flow and technical parameters.

5.1 Performance and production process table of cemented carbide cylindrical shank milling cutter

Process steps	Equipment/Parameters	Time/Conditions	Goal/Result	Technical indicators
Raw material mixing	High energy planetary ball mill, ball to material ratio 10:1, 200-300 rpm	24-48 hours, standard deviation < 5%	Uniform dispersion, in compliance with GB/T 5244-2018	Particle size uniformity CV < 3%
Pressing	Pressure 150-200 MPa, time 10-20 seconds	Density 60%-70% (12-14 g/ cm³)	Blank forming, deviation ±0.2 g/ cm³	Green strength 10-15 MPa
sintering	Vacuum furnace 1350-1450°C, HIP 5-10 MPa	1-2 hours, density 98%-99%	Grain size 0.5-1.5 µm , densification	Porosity A02B00C00
Field Assisted Sintering (SPS)	Pulse current 1000-2000 A, voltage 5-10 V	30-60 minutes	Grain size 0.2-0.5 µm , micro tool optimization	Energy efficiency increased by 20%
Edge dressing	Diamond grinding wheel #600-#800, EDM 0.1-0.3 J	Trimming amount 0.01-0.02 mm	Roughness Ra ≤ 0.2 µm , accuracy ±0.005 mm	Cutting edge sharpness < 0.01 mm
Coating	Multi-target magnetron sputtering, TiAlN / AlCrN	Thickness 2-5 µm	Heat resistance 1000°C, friction coefficient 0.15	Adhesion force > 60 N, uniformity < 0.5 µm

Application of carbide cylindrical shank milling cutter

Carbide cylindrical shank milling cutters are widely used in many industries due to their versatility and high performance:

Aerospace
For processing titanium alloys (such as Ti-6Al-4V) and high-temperature alloys (such as Inconel 718), the precision requirement is IT6 level, the surface roughness Ra 0.2 µm , the cutting speed Vc 100-150 m/min, the cutting depth ap 0.5-1 mm. In 2025, the 5G monitoring system will reduce the processing time by 10%-15%.

Automotive
Milling of engine blocks, crankshafts and gearbox parts, workpiece materials are cast iron (HRC 30-40) or aluminum alloy, Vc 150-200 m/min, fn 0.1-0.15 mm/tooth, ap 1-2 mm, efficiency

电话/TEL：0086 592 512 9696
CTIAQCD-MA-E/P 2018-2024V
sales@chinatungsten.com

increased by 20%.

Mold manufacturing
For finishing of complex molds (such as automobile stamping molds), dry cutting technology is used to reduce the use of coolant by 20%-30%, Vc 200-250 m/min, Ra 0.2 μm .

Medical Industry
Micro milling cutters (diameter 0.05-0.5 mm) are used for machining hip implants or micro gears, with an accuracy of ±0.001 mm, Vc 60-100 m/min, ap 0.05-0.2 mm, and a lifespan of 300-500 hours.

New Energy
Processing wind turbine blade molds or photovoltaic module frames, combined with AI to optimize cutting parameters, Vc 150-200 m/min, efficiency increased by 15%, and carbon footprint reduced by 10%.

7. Types of Carbide Cylindrical Shank Milling Cutters

Carbide cylindrical shank milling cutters are divided into several types based on use and design, each type is optimized for specific machining needs:

Roughing milling cutter
Number of teeth 2-4, cutting depth ap 1-2 mm, cutting speed Vc 100-150 m/min, suitable for rapid removal of material (such as cast iron blanks), cutting force 400-500 N, life 400-600 hours.

Finishing milling cutter
Number of teeth: 6-8, cutting depth ap 0.2-0.5 mm, cutting speed Vc 150-250 m/min, surface roughness Ra 0.2 μm , precision IT7, suitable for molds and aviation parts.

Micro milling cutter
Diameter 0.05-0.5 mm, cutting depth ap 0.05-0.2 mm, cutting speed Vc 60-120 m/min, processing microelectronic circuit boards or medical implants, accuracy ± 0.001 mm.

Coated milling cutter
Apply TiN , TiAlN or AlCrN coating, heat resistance 800-1000°C, friction coefficient 0.15, life extended 25%-35% compared with uncoated, Vc 200-250 m/min.

Multifunctional milling cutter
Integrates milling, drilling and chamfering functions, with a cutting speed of Vc 150-200 m/min, reducing tool change time by 30%-40%, and is suitable for multi-process composite machining centers.

What are Carbide End Mills?

Carbide end mill is a high-precision and efficient cutting tool, which is widely used in the processing of metal and non-metal materials. It occupies an important position in the modern manufacturing industry with its excellent hardness, wear resistance and versatility. It is made of tungsten carbide (WC) as the main hard phase, cobalt (Co) as the bonding phase, and is made by adding trace reinforcing agents (such as TiC and TaC), and is formed by advanced powder metallurgy. The unique design of the end mill enables it to cut the end and side of the workpiece, which is particularly suitable for CNC machine tools, machining centers and complex surface processing. The following content will be elaborated in detail from multiple aspects such as structure and material, working principle, characteristics, performance influencing factors, production process, types and applications.

1. **Structure and materials of cemented carbide end mills**
2.

The structure of carbide end mills mainly includes a shank and a cutting part. The shank is cylindrical or conical, usually made of high-strength tool steel (such as 42CrMo or HSS) or carbide, with a diameter ranging from 3 mm to 25 mm and a length of 50-120 mm designed according to the machine tool clamping system to ensure a stable connection with the spindle. The cutting part consists of end teeth and peripheral teeth. The end teeth are located at the bottom of the tool for axial cutting, and the peripheral teeth are distributed along the circumference for lateral cutting. The number of teeth is usually 2-10 teeth, depending on the processing requirements. The geometric parameters of the blade (such as helix angle 30°-50°, front angle 5°-15°, back angle 10°-25°) are optimized by precision grinding, and nano-scale coatings such as TiN , TiAlN or AlCrN are often applied to the surface . The coating thickness is controlled at 2-6 μm , which significantly improves the heat resistance to 1100°C and reduces the friction coefficient to 0.12.

Material composition:

Hard phase

Tungsten carbide (WC), particle size distribution 0.4-1.8 μm , D50 value 1.0 μm , purity ≥ 99.9%, ensuring ultra-high hardness and wear resistance.

Adhesive Phase

Cobalt (Co), content range 5%-15% (mass fraction), particle size 0.8-1.2 μm , 5% focuses on high precision, 15% is suitable for heavy-load cutting.

additive

The titanium carbide (TiC) content is 0.4%-2.5%, and the tantalum carbide (TaC) content is 0.2%-1.2%. The dispersion is detected by scanning electron microscopy (SEM) , and the standard deviation is < 4%, which enhances high temperature hardness and anti-adhesion.

Structural features:

Handle Design

Cylindrical or conical, surface roughness Ra ≤ 0.3 μm , with CAT or HSK type tool holder, installation coaxiality ≤ 0.008 mm.

Cutting edge optimization

six-axis CNC grinder, with a cutting edge chamfer of 0.008-0.015 mm, which reduces the cutting impact force and improves the cutting edge strength.

Coating Technology

In 2025, multi-layer nano-coatings (such as TiAlN /DLC) will be introduced with thickness uniformity deviation < 0.4 μm and corrosion resistance improved by 35%, making it suitable for dry cutting environments.

2. Working principle of carbide end mill

Carbide end mills achieve end and side cutting through high-speed rotation, and remove material from the workpiece by combining intermittent and continuous cutting. Its working principle relies on the high-speed relative movement of the end teeth and peripheral teeth. The end teeth cut into the workpiece axially to complete the end face processing, and the peripheral teeth cut radially to form the side. The chips are discharged through the tooth grooves. The cutting process is affected by the tool geometry parameters (such as the helix angle affecting the chip smoothness, the rake angle affecting the cutting force) and the cutting parameters (such as the cutting speed Vc 60-300 m/min, the feed rate fn 0.04-0.25 mm/tooth, cutting depth ap 0.15-2.5 mm). Coolant (such as oil-based cutting fluid, flow rate ≥ 12 L/min) or dry cutting technology is used to control the temperature of the cutting zone to prevent tool overheating (maximum temperature controlled below 750°C) or thermal deformation of the workpiece. In 2025, combined with 5G networks and AI algorithms, intelligent CNC systems can monitor cutting force (< 700 N), temperature and vibration in real time, dynamically adjust parameters, improve cutting efficiency by 18%-22%, and achieve machining accuracy of IT5-IT6 level.

3. Characteristics of Carbide End Mills

With its advanced materials and precision design, carbide end mills exhibit the following remarkable characteristics:

Ultra-high hardness

Vickers hardness HV 1600-2100, exceeding high-speed steel (HV 650-850), capable of processing hardened steel or high-strength alloys with a hardness up to HRC 65.

Excellent wear resistance

The wear zone width (VB) is still ≤ 0.25 mm after 600-900 hours of continuous cutting, which is 4-6 times longer than the service life of traditional tools , especially when processing stainless steel and titanium alloys.

Excellent heat resistance

The coated tools have a heat resistance of up to 1100°C and are suitable for ultra-high-speed cutting (Vc > 250 m/min), reducing the risk of thermal fatigue and cracks.

Strong impact resistance

By adding TiC and optimizing the grain size (0.4-1.2 μm), the flexural strength is ≥ 2200 MPa and the impact load resistance is increased by 20%, making it suitable for intermittent cutting and heavy load conditions.

High precision

The machining accuracy reaches IT5-IT6 level, and the surface roughness is Ra 0.15-0.3 μm , meeting the ultra-precision machining requirements of the aerospace and medical industries.

Sustainability

Dry cutting technology combined with high-efficiency coating reduces coolant usage by 25%-35%, meets green manufacturing standards, and reduces carbon emissions by 15% .

4. Carbide end mill performance and influencing factors

The performance of cemented carbide end mills is affected by multiple factors such as material composition, processing parameters and use environment. The following is a detailed analysis and optimization strategy.

4.1 Table of factors affecting the performance of cemented carbide end mills

Influencing factors	describe	Impact	Optimization suggestions	Data support
Cobalt content	5%-15%, low content improves hardness, high content increases toughness	high	5% for high precision, 15% for heavy loads	5% Co hardness HV 1900, 15% Co flexural strength 2300 MPa
Cutting speed (Vc)	60-300 m/min, too high will cause overheating or chipping	middle	Hard materials reduce by 25%, such as Inconel Vc 150 m/min	Too high Vc (350 m/min) Edge breaking rate 6%-12%
Feed rate (fn)	0.04-0.25 mm/tooth, too high will increase cutting force	high	Micro-machining down to 0.04 mm/tooth	fn 0.3 mm/tooth Cutting force increased by 35%
Cutting depth (ap)	0.15-2.5 mm, too deep will easily cause vibration	middle	Complex workpiece layered cutting, ap 0.4 mm/layer	ap 3 mm vibration amplitude increased by 18%

Coolant flow	≥ 12 L/min, heat dissipation affects life	middle	Dry cutting with DLC coating	Flow rate 6 L/min Lifespan reduced by 25%
Workpiece material	Steel (HRC 50), Ti alloy, Ni-based alloy	high	Viscous materials reduce Vc 35%-45%	Ni alloy Vc 120 m/min, Al alloy 250 m/min

5. Carbide end mill performance production process

The excellent performance of cemented carbide end mills comes from the systematic production process from raw material preparation to final processing. The following is the detailed process flow and technical parameters.

Carbide end mill performance production process table

Process steps	Equipment/Parameters	Time/Conditions	Goal/Result	Technical indicators
Raw material mixing	High energy planetary ball mill, ball to material ratio 12:1, 250-350 rpm	30-50 hours, standard deviation < 4%	Even dispersion, in accordance with ISO 13399	Particle size uniformity CV < 2.5%
Pressing	Pressure 180-220 MPa, time 15-25 seconds	Density 65%-75% (13-15 g/ cm³)	Blank forming, deviation ±0.15 g/ cm³	Green strength 12-18 MPa
sintering	Vacuum furnace 1400-1500°C, HIP 6-12 MPa	1.5-2.5 hours, density 98.5%-99.5%	Grain size 0.4-1.2 µm , densified	Porosity A01B00C00
Field Assisted Sintering (SPS)	Pulse current 1200-2200 A, voltage 6-12 V	40-70 minutes	Grain size 0.15-0.4 µm , micro tool optimization	Energy efficiency increased by 25%
Edge dressing	Diamond grinding wheel #800-#1000, EDM 0.05-0.25 J	Trimming amount 0.008-0.015 mm	Roughness Ra ≤ 0.15 µm , accuracy ±0.004 mm	Cutting edge sharpness < 0.008 mm
Coating	Multi-target magnetron sputtering, TiAlN /DLC	Thickness 2-6 µm	Heat resistance 1100°C, friction coefficient 0.12	Adhesion force > 65 N, uniformity < 0.4 µm

6. Types of Carbide End Mills

Carbide end mills are classified into several types based on purpose and design, each optimized for specific machining needs:

Roughing end mills

Number of teeth 2-5, cutting depth ap 1.5-2.5 mm, cutting speed Vc 120-180 m/min, suitable for rapid removal of material (such as steel billets), cutting force 450-600 N, life 450-650 hours.

Finishing end mills

Number of teeth: 8-10, cutting depth ap 0.15-0.4 mm, cutting speed Vc 200-300 m/min, surface roughness Ra 0.15 µm , precision IT6, suitable for molds and aviation parts.

Micro End Mills

Diameter 0.03-0.6 mm, cutting depth ap 0.03-0.15 mm, cutting speed Vc 50-120 m/min, processing microelectronic components or medical implants, accuracy ± 0.0008 mm.

Coated end mills

Apply TiN , TiAlN or DLC coating, heat resistance 900-1100°C, friction coefficient 0.12, life extended 30%-40% compared with uncoated, Vc 250-300 m/min.

Multifunctional end mill

Integrates end milling, side milling and slot milling functions, with a cutting speed of Vc 180-250 m/min, reducing tool change time by 35%-45%, making it suitable for multi-process composite machining centers.

7. Application of carbide end mills

Carbide end mills are widely used in many industries due to their versatility and performance:

Aerospace

For processing titanium alloys (such as Ti-6Al-4V) and nickel-based alloys (such as Inconel 718), the precision requirement is IT5, the surface roughness Ra is 0.15 μm , the cutting speed Vc is 120-180 m/min, and the cutting depth ap is 0.4-0.8 mm. In 2025, the 5G monitoring system will reduce the processing time by 12%-18%.

Automotive

Milling of cylinder heads, connecting rods and gearbox parts, workpiece materials are cast iron (HRC 35-45) or aluminum alloy, Vc 180-250 m/min, fn 0.08-0.12 mm/tooth, ap 0.8-1.5 mm, efficiency increased by 22%.

Mold manufacturing

Finishing of injection molds and stamping molds, using dry cutting technology, reducing the use of coolant by 25%-35%, Vc 220-300 m/min, Ra 0.15 μm .

Medical Industry

Micro end mills (diameter 0.03-0.6 mm) are used to process orthopedic implants or micro gears, with an accuracy of ±0.0008 mm, Vc 50-90 m/min, ap 0.03-0.15 mm, and a lifespan of 350-550 hours.

New Energy

When machining wind turbine rotors or solar frames, AI is used to optimize cutting parameters, with a Vc of 160-220 m/min, which increases efficiency by 18% and reduces carbon footprint by 12%.

What is a solid carbide milling cutter?

Carbide solid milling cutter is a high-performance cutting tool, which is widely used in the field of precision machining of metal and non-metal materials. It plays an important role in the manufacturing industry with its excellent hardness, wear resistance and versatility. It uses tungsten carbide (WC) as the main hard phase, cobalt (Co) as the bonding phase, and is made by adding trace reinforcing agents (such as TiC and TaC), and is integrally formed using advanced powder metallurgy technology. Unlike other types of milling cutters, the shank and cutting part of the carbide solid milling cutter are made of a single carbide material to ensure higher rigidity and durability, and are particularly suitable for CNC machine tools, machining centers and complex geometric shapes. The following content will be elaborated in detail from multiple aspects such as structure and material, working principle, characteristics, performance influencing factors, production process, types and applications.

1. Structure and materials of cemented carbide solid milling cutter

The structure of the carbide integral milling cutter consists of an integrated shank and a cutting part. The shank is cylindrical or conical, with a diameter ranging from 2 mm to 25 mm and a length of 40-150 mm according to the design of the machine tool clamping system. It is made of high-strength carbide to ensure a rigid connection with the spindle. The cutting part includes end teeth and peripheral teeth. The end teeth are used for axial cutting, and the peripheral teeth are distributed along the circumference for lateral cutting. The number of teeth is usually 2-12 teeth, depending on the processing requirements. The geometric parameters of the blade (such as helix angle 35°-55°, front angle 3°-12°, back angle 8°-20°) are optimized by high-precision grinding. Nano-scale coatings such as TiN , TiAlN or AlTiN are often applied to the surface. The coating thickness is controlled at 2-7 μm , which significantly improves the heat resistance to 1150°C and reduces the friction coefficient to 0.10.

Material composition:

Hard phase: tungsten carbide (WC), particle size distribution 0.3-1.6 μm , D50 value 0.9 μm , purity ≥ 99.95%, providing extremely high hardness and wear resistance.

Binder phase: Cobalt (Co), content range 4%-14% (mass fraction), particle size 0.7-1.0 μm , 4% focuses on high precision, 14% is suitable for heavy-load cutting.

Additives: Titanium carbide (TiC) content 0.3%-2.0%, tantalum carbide (TaC) content 0.1%-1.0%, dispersion detected by SEM, standard deviation < 3%, enhance high temperature hardness and anti-adhesion.

Structural features:

Shank design: cylindrical or conical, surface roughness Ra ≤ 0.25 μm , matched with HSK or ISO type tool holder, installation coaxiality ≤ 0.006 mm.

Cutting edge optimization: processed by seven-axis CNC grinding machine, the cutting edge chamfer is 0.005-0.012 mm, which reduces the cutting impact force and improves the durability of the cutting edge.

Coating technology: In 2025, multi-layer gradient coatings (such as AlTiN /DLC) will be introduced with thickness uniformity deviation < 0.3 μm and corrosion resistance improved by 40%, suitable for extreme cutting environments.

2. Working principle of carbide solid milling cutter

Solid carbide milling cutters achieve end and side cutting through high-speed rotation, and remove material from the workpiece by combining intermittent and continuous cutting. Its working principle relies on the high-speed relative movement of the end teeth and peripheral teeth. The end teeth cut into the workpiece axially to complete the end face processing, and the peripheral teeth cut radially to achieve side shaping. The chips are discharged through the optimized tooth grooves. The cutting process is affected by the tool geometry parameters (such as the helix angle affecting the chip discharge efficiency, the rake angle affecting the cutting force) and cutting parameters (such as cutting speed Vc 70-350 m/min, feed rate fn 0.03-0.3 mm/tooth, cutting depth ap 0.1-3 mm). Coolant (such as synthetic cutting fluid, flow rate ≥ 15 L/min) or dry cutting technology is used to control the temperature of the cutting zone to prevent tool overheating (maximum temperature controlled below 800°C) or thermal deformation of the workpiece. In 2025, combined with 5G networks and machine learning algorithms, intelligent CNC systems can monitor cutting force (< 800 N), temperature and vibration in real time, dynamically adjust parameters, improve cutting efficiency by 20%-25%, and achieve machining accuracy of IT4-IT5 level.

3. Characteristics of carbide solid milling cutter

Solid carbide milling cutters have the following remarkable characteristics due to their one-piece design and advanced materials:

Extremely high hardness

Vickers hardness HV 1700-2200, far exceeding high-speed steel (HV 700-900), capable of processing super-hard materials with a hardness of up to HRC 68.

Excellent wear resistance

The wear zone width (VB) is still ≤ 0.2 mm after 700-1000 hours of continuous cutting, which is 5-7 times longer than the service life of traditional tools , especially when processing high-temperature alloys.

Excellent heat resistance

The coated tools are heat resistant up to 1150°C and are suitable for ultra-high-speed cutting (Vc > 300 m/min), reducing the risk of thermal cracks and wear.

Strong impact resistance

By adding TiC and optimizing the grain size (0.3-1.0 μm), the flexural strength is ≥ 2400 MPa and the impact load resistance is increased by 25%, making it suitable for intermittent cutting and heavy load conditions.

Ultra-high precision

The machining accuracy reaches IT4-IT5 level, and the surface roughness is Ra 0.1-0.25 μm , meeting the ultra-precision machining requirements of the aerospace and microelectronics industries.

4. Performance and influencing factors of cemented carbide solid milling cutters

The performance of carbide solid milling cutters is affected by multiple factors such as material composition, processing parameters and use environment. The following is a detailed analysis and optimization strategy.

4.1 Table of factors affecting the performance of cemented carbide solid milling cutters

Influencing factors	describe	Impact	Optimization suggestions	Data support
Cobalt content	4%-14%, low content improves hardness, high content increases toughness	high	4% for high precision, 14% for heavy loads	4% Co hardness HV 2000, 14% Co flexural strength 2500 MPa
Cutting speed (Vc)	70-350 m/min, too high will cause overheating or chipping	middle	Hard materials reduce by 30%, such as Inconel Vc 180 m/min	Too high Vc (400 m/min) Edge breaking rate 7%-15%
Feed rate (fn)	0.03-0.3 mm/tooth, too high will increase cutting force	high	Micro-machining down to 0.03 mm/tooth	fn 0.35 mm/tooth Cutting force increased by 40%
Cutting depth (ap)	0.1-3 mm, too deep will easily cause vibration	middle	Complex workpiece layered cutting, ap 0.3 mm/layer	ap 3.5 mm Vibration amplitude increased by 20%
Coolant flow	≥ 15 L/min, the heat dissipation effect affects the lifespan	middle	Dry cutting with AlTiN coating	Flow rate 7 L/min Lifespan reduced by 30%
Workpiece material	Steel (HRC 55), Ti alloy, Co-Cr alloy	high	Viscous materials reduce Vc by 40%-50%	Co-Cr alloy Vc 140 m/min, Al alloy 300 m/min

5. Performance and production process table of cemented carbide integral milling cutter

Process steps	Equipment/Parameters	Time/Conditions	Goal/Result	Technical indicators
Raw material mixing	High energy planetary ball mill, ball to material ratio 15:1, 300-400 rpm	36-60 hours, standard deviation < 3%	Even dispersion, in accordance with ISO 513	Particle size uniformity CV < 2%
Pressing	Pressure 200-250 MPa, time 20-30 seconds	Density 70%-80% (14-16 g/ cm³)	Blank forming, deviation ±0.1 g/ cm³	Green strength 15-20 MPa
sintering	Vacuum furnace 1450-1550°C, HIP 8-15 MPa	2-3 hours, density 99%-99.8%	Grain size 0.3-1.0 µm , densification	Porosity A00B00C00
Field Assisted Sintering (SPS)	Pulse current 1500-2500 A, voltage 8-15 V	50-80 minutes	Grain size 0.1-0.3 µm , micro tool optimization	Energy efficiency increased by 30%
Edge dressing	Diamond grinding wheel #1000-#1200, EDM 0.03-0.2 J	Trimming amount 0.005-0.012 mm	Roughness Ra ≤ 0.1 µm , accuracy ±0.003 mm	Cutting edge sharpness < 0.005 mm
Coating	Multi-target magnetron sputtering, AlTiN /DLC	Thickness 2-7 µm	Heat resistance 1150°C, friction coefficient 0.10	Adhesion force > 70 N, uniformity < 0.3 µm

6. Types of carbide solid milling cutters

Solid carbide milling cutters are divided into several types according to their use and design, each type is optimized for specific machining needs:

Roughing solid milling cutter
Number of teeth 2-6, cutting depth ap 2-3 mm, cutting speed Vc 100-200 m/min, suitable for rapid removal of material (such as steel billets), cutting force 500-700 N, life 500-700 hours.
Finishing solid milling cutter
Number of teeth: 10-12, cutting depth ap 0.1-0.3 mm, cutting speed Vc 250-350 m/min, surface roughness Ra 0.1 μm , precision IT5, suitable for molds and aviation parts.
Micro solid milling cutter
Diameter 0.02-0.5 mm, cutting depth ap 0.02-0.1 mm, cutting speed Vc 50-150 m/min, processing microelectronic components or medical implants, accuracy ± 0.0005 mm.
Coated solid milling cutter
Apply AlTiN , TiAlN or DLC coating, heat resistance 1000-1150°C, friction coefficient 0.10, life extended 35%-45% compared with uncoated, Vc 300-350 m/min.
Multifunctional integral milling cutter
Integrates end milling, side milling and slot milling functions, with a cutting speed of Vc 200-300 m/min, reducing tool change time by 40%-50%, and is suitable for multi-process composite machining centers.

7. Application of carbide integral milling cutter
Solid carbide milling cutters are widely used in many industries due to their one-piece design and high performance:
Aerospace
For processing titanium alloys (such as Ti-6Al-4V) and cobalt-chrome alloys, the precision requirement is IT4, the surface roughness Ra 0.1 μm , the cutting speed Vc 150-220 m/min, the cutting depth ap 0.3-0.6 mm, and the 5G monitoring system will reduce the processing time by 15%-20% in 2025.
Automotive
Milling of engine blocks, camshafts and gear parts, workpiece materials are cast iron (HRC 40-50) or aluminum alloy, Vc 200-300 m/min, fn 0.05-0.1 mm/tooth, ap 0.6-1.2 mm, efficiency increased by 25%.
Mold manufacturing
Finishing precision molds (such as automobile panel molds) uses dry cutting technology to reduce the use of coolant by 30%-40%, Vc 250-350 m/min, Ra 0.1 μm .
Medical Industry
Micro solid milling cutter (diameter 0.02-0.5 mm) for machining orthopedic implants or micro gears, accuracy ±0.0005 mm, Vc 40-80 m/min, ap 0.02-0.1 mm, life 400-600 hours.
New Energy
Processing wind turbine blade molds or battery housings, combined with AI to optimize cutting parameters, Vc 180-250 m/min, efficiency increased by 20%, and carbon footprint reduced by 15%.
Electronics Industry
Processing of micro circuit boards and semiconductor housings, workpiece materials are glass fiber reinforced resin or ceramics, Vc 100-200 m/min, ap 0.05-0.2 mm, accuracy ±0.001 mm, meeting the processing needs of high-density electronic components.

Shipbuilding

Milling of marine propellers and valve bodies, workpiece materials are bronze or stainless steel, Vc 150-250 m/min, ap 0.5-1.5 mm, corrosion-resistant coating extends tool life by 30%-40%.

Building Materials

Processing gypsum board moulds and ceramic tiles, Vc 80-150 m/min, ap 0.2-0.8 mm, reducing dust emissions by 20%, suitable for green building material production.

Jewelry crafting

Micro solid milling cutter is used for fine engraving of precious metals (such as gold, platinum) and gemstone inlays, with Vc 50-120 m/min, ap 0.01-0.05 mm, accuracy ±0.0002 mm, meeting high-end customization needs.

Defense Industry

Processing tank armor plates and missile shells, the workpiece material is high-strength steel or composite materials, Vc 120-180 m/min, ap 0.4-1 mm, wear resistance improves processing efficiency by 15%-20%.

Optical instruments

Processing lens molds and prism components, the workpiece material is optical glass or polymer, Vc 60-120 m/min, ap 0.03-0.15 mm, accuracy ±0.0003 mm, to meet the high-precision optical component manufacturing.

Consumer Electronics

Processing of mobile phone housings and precision connectors, workpiece materials are magnesium alloy or composite materials, Vc 200-300 m/min, ap 0.1-0.4 mm, efficiency increased by 22%, meeting lightweight design requirements.

Railway Transportation

Milling train wheels and track fixtures, workpiece material is high carbon steel, Vc 150-220 m/min, ap 0.5-1.2 mm, wear resistance extends service life by 25%-30%.

Petrochemical Industry

Processing pipeline valves and pump bodies, the workpiece material is stainless steel or titanium alloy, Vc 140-200 m/min, ap 0.4-1 mm, corrosion resistance increased by 35%, suitable for extreme working environment.

电话/TEL：0086 592 512 9696
CTIAQCD-MA-E/P 2018-2024V
sales@chinatungsten.com

CTIA GROUP LTD

30 Years of Cemented Carbide Customization Experts

Core Advantages

30 years of experience: We are well versed in cemented carbide production and processing , with mature and stable technology and continuous improvement .

Precision customization: Supports special performance and complex design , and focuses on customer + AI collaborative design .

Quality cost: Optimized molds and processing, excellent cost performance; leading equipment, RMI , ISO 9001 certification.

Serving Customers

The products cover cutting, tooling, aviation, energy, electronics and other fields, and have served more than 100,000 customers.

Service Commitment

1+ billion visits, 1+ million web pages, 100,000+ customers, and 0 complaints in 30 years!

Contact Us

Email : sales@chinatungsten.com
Tel : +86 592 5129696
Official website : www.ctia.com.cn




What is a carbide welded milling cutter?

Carbide welded milling cutter is a high-performance cutting tool made by welding a carbide cutter head to a steel cutter body. It is widely used in the processing of metal and non-metallic materials. It combines the high hardness and wear resistance of carbide with the high toughness of the steel body, and is particularly suitable for processing scenarios that require high efficiency and cost-effectiveness, such as heavy cutting and large-scale production. Carbide welded milling cutter is mainly composed of tungsten carbide (WC) as the hard phase and cobalt (Co) as the bonding phase. The cutter head is prepared by powder metallurgy and connected to the steel body by high-frequency welding or vacuum brazing technology. It is suitable for traditional machine tools and CNC machining centers. The following content will be elaborated in detail from multiple aspects such as structure and material, working principle, characteristics, performance influencing factors, production process, types and applications.

1. Structure and materials of carbide welded milling cutter

The structure of carbide welded milling cutter includes steel cutter body and welded carbide cutter head. The cutter body is usually made of high-toughness tool steel (such as 40CrMo or 18CrNiMo), with a diameter ranging from 10 mm to 100 mm and a length designed to be 50-300 mm according to processing requirements to ensure stable connection with the machine tool spindle. The cutter head is made of carbide and contains end teeth and peripheral teeth. The number of teeth is usually 4-20 teeth, depending on the cutting diameter and purpose. The geometric parameters of the blade (such as helix angle 30°-45°, front angle 5°-10°, back angle 10°-15°) are optimized by precision grinding. TiN or TiAlN coating can be applied to the surface of the cutter head with a thickness controlled at 2-5 μm , and the heat resistance is improved to 1000°C.

Material composition:

Hard phase: tungsten carbide (WC), particle size distribution 0.5-2.0 μm , D50 value 1.2 μm , purity ≥ 99.9%, providing high hardness and wear resistance.

Binder phase: Cobalt (Co), content range 6%-12% (mass fraction), particle size 1.0-1.5 μm , 6% focuses on high hardness, 12% is suitable for heavy-load cutting.

Additives: Titanium carbide (TiC) content 0.5%-1.5%, niobium carbide (NbC) content 0.2%-0.8%, dispersion detected by SEM, standard deviation < 5%, enhanced high temperature performance.

Structural features:

Cutter body design: Steel body surface hardening treatment, hardness HRC 35-45, surface roughness Ra ≤ 0.4 μm , with universal tool holder, installation coaxiality ≤ 0.01 mm.

Cutter head welding: vacuum brazing is used, the welding temperature is 1000-1100°C, and the welding strength is ≥ 200 MPa to ensure that the cutter head and the cutter body are firmly connected.

Coating technology: In 2025, multi-layer TiAlN coating will be introduced with thickness uniformity deviation < 0.5 μm and corrosion resistance improved by 30%, suitable for dry or wet cutting.

2. Working principle of carbide welded milling cutter

Carbide welded milling cutters achieve end and side cutting through high-speed rotation, and remove material from the workpiece mainly through intermittent cutting. Its working principle relies on the high-speed relative movement of the carbide cutter head. The end teeth cut into the workpiece axially to complete the end face processing, and the peripheral teeth cut radially to achieve side shaping. The chips are discharged through the tooth grooves. The cutting process is affected by the tool geometry parameters (such as the helix angle affecting chip flow, the rake angle affecting cutting force) and cutting parameters (such as cutting speed Vc 50-250 m/min, feed rate fn 0.05-0.2 mm/tooth, cutting depth ap 0.2-4 mm). Coolant (such as water-based cutting fluid, flow rate ≥ 10 L/min) is used to control the temperature of the cutting zone to prevent overheating of the cutter head (maximum temperature controlled below 700°C) or thermal deformation of the workpiece. In 2025, combined with IoT sensors and AI algorithms, the intelligent monitoring system can monitor the cutting force (< 600 N) and temperature in real time, dynamically adjust parameters, improve cutting efficiency by 15%-20%, and achieve machining accuracy of IT6-IT7 level.

3. Characteristics of carbide welded milling cutter

Carbide welded milling cutters have the following remarkable characteristics due to their welded structure and material properties:

High hardness: The Vickers hardness of the cutter head is HV 1500-2000, suitable for processing materials with hardness below HRC 60.

Good wear resistance: The wear-resistant belt width (VB) is ≤ 0.3 mm after 500-800 hours of continuous cutting, and the service life is 3-5 times longer than that of traditional high-speed steel tools .

Moderate heat resistance: The coated cutter head has a heat resistance of up to 1000°C, suitable for medium and high speed cutting (Vc 150-250 m/min), reducing the risk of thermal fatigue.

High toughness: The steel body provides impact resistance, with a bending strength of ≥ 1800 MPa, suitable for intermittent cutting and heavy load conditions.

Practical precision: The processing precision reaches IT6-IT7 level, and the surface roughness Ra 0.2-0.4 μm , which meets the general industrial processing needs.

Economical: The welded design reduces manufacturing costs and is suitable for large-scale production. By 2025, dry cutting technology will reduce the use of coolant by 20%-30%.

4. Table of performance and influencing factors of cemented carbide welded milling cutters

Influencing factors	describe	Impact	Optimization suggestions	Data support
Cobalt content	6%-12%, low content improves hardness, high content increases toughness	high	6% for high hardness, 12% for heavy loads	6% Co hardness HV 1800, 12% Co flexural strength 1900 MPa
Cutting speed	50-250 m/min, too high will cause the	middle	Hard materials reduce by 20%,	Too high Vc (300 m/min) wear rate

(Vc)	cutter head to wear		such as steel Vc 150 m/min	8%-12%
Feed rate (fn)	0.05-0.2 mm/tooth, too high will increase cutting force	high	Heavy cutting to 0.05 mm/tooth	fn 0.25 mm/tooth Cutting force increased by 30%
Cutting depth (ap)	0.2-4 mm, too deep may cause vibration	middle	Complex workpiece layered cutting, ap 0.5 mm/layer	ap 5 mm vibration amplitude increased by 15%
Coolant flow	≥ 10 L/min, the heat dissipation effect affects the lifespan	middle	Dry cutting with TiAlN coating	Flow rate 5 L/min Lifespan reduced by 20%
Welding quality	Welding strength ≥ 200 MPa, risk of falling off	high	Optimized brazing temperature 1050°C	Welding strength < 150 MPa, shedding rate 5%

5. Carbide Welded Milling Cutter Performance Production Process Table

Process steps	Equipment/Parameters	Time/Conditions	Goal/Result	Technical indicators
Raw material mixing	High energy ball mill, ball to material ratio 10:1, 200-300 rpm	24-40 hours, standard deviation < 5%	Even dispersion, in accordance with ISO 513	Particle size uniformity CV < 3%
Pressing	Pressure 150-200 MPa, time 10-20 seconds	Density 60%-70% (12-14 g/ cm³)	Tool head blank forming, deviation ±0.2 g/ cm³	Green strength 10-15 MPa
sintering	Vacuum furnace 1350-1450°C, HIP 5-10 MPa	1-2 hours, density 98%-99%	Grain size 0.5-1.5 µm , densification	Porosity A02B00C00
Cutting head dressing	Diamond grinding wheel #600-#800, EDM 0.1-0.3 J	Trimming amount 0.01-0.02 mm	Roughness Ra ≤ 0.2 µm , accuracy ±0.005 mm	Cutting edge sharpness < 0.01 mm
welding	Vacuum brazing, temperature 1000-1100°C, pressure 0.5 MPa	5-10 minutes	The cutter head is firmly connected to the cutter body	Welding strength ≥ 200 MPa
Coating	Magnetron sputtering, TiAlN	Thickness 2-5 µm	Heat resistance 1000°C, friction coefficient 0.15	Adhesion force > 50 N, uniformity < 0.5 µm

6. Types of carbide welded milling cutters

Carbide brazed milling cutters are divided into several types according to their use and structure, each type is optimized for specific processing needs:

Rough machining welded milling cutter: number of teeth 4-8, cutting depth ap 2-4 mm, cutting speed Vc 80-150 m/min, suitable for fast removal of material (such as cast iron), cutting force 400-600 N, life 400-600 hours.

Finishing welded milling cutter: number of teeth 12-20, cutting depth ap 0.2-0.5 mm, cutting speed Vc 150-250 m/min, surface roughness Ra 0.2 µm , precision IT7 level, suitable for mold processing.

Face milling cutter: diameter 50-100 mm, number of teeth 10-16, cutting depth ap 1-3 mm, Vc 100-200 m/min, suitable for plane processing and large area cutting.

Coated welded milling cutter: TiN or TiAlN coating is applied, heat resistance 900-1000°C, friction coefficient 0.15, life is 25%-35% longer than that of uncoated milling cutter, Vc 200-250 m/min.

Slot milling cutter: specially designed for machining narrow slots and keyways, number of teeth 6-12, cutting depth ap 0.5-2 mm, Vc 80-180 m/min, vibration reduction 15%-20%.

电话/TEL：0086 592 512 9696
CTIAQCD-MA-E/P 2018-2024V
sales@chinatungsten.com

7. Application of carbide welded milling cutter

Carbide welded milling cutters are widely used in many industries due to their economy and applicability:

Automobile manufacturing: Processing engine cylinder blocks and crankshafts, the workpiece material is cast iron (HRC 30-40) or aluminum alloy, Vc 120-200 m/min, ap 1-2 mm, efficiency increased by 20%.

Die manufacturing: Rough processing of stamping dies and forging dies, Vc 80-150 m/min, ap 2-4 mm, reducing processing time by 15%-25%.

Steel industry: Milling of steel ingots and rolls, workpiece material is carbon steel (HRC 50), Vc 100-180 m/min, ap 1.5-3 mm, wear resistance extends life by 30%.

Energy equipment: Processing gas turbine blades and valve bodies, the workpiece material is nickel-based alloy, Vc 80-140 m/min, ap 0.5-1.5 mm, to meet the needs of high temperature environment.

Heavy machinery: processing large gears and bearing seats, the workpiece material is high-strength steel, Vc 90-160 m/min, ap 2-3.5 mm, cutting force 500-700 N.

Railway transportation: Milling of train wheels and sleepers, the workpiece material is ductile iron, Vc 100-180 m/min, ap 1-2.5 mm, and impact resistance is increased by 20%.

Construction engineering: processing concrete formwork and steel bar connectors, Vc 70-130 m/min, ap 1-3 mm, reducing dust emissions by 15%.

Shipbuilding industry: Milling of hull plates and propellers, the workpiece material is ship steel, Vc 90-150 m/min, ap 1.5-2.5 mm, corrosion resistance increased by 25%.

Mining equipment: Processing crusher liners and drill bit components, the workpiece material is high manganese steel, Vc 80-140 m/min, ap 1-3 mm, the service life is extended by 35%-40%.

What is a carbide insert milling cutter?

Carbide insert milling cutter is a high-performance cutting tool made by inserting replaceable carbide teeth into a steel cutter body. It is widely used in the processing of metal and non-metallic materials. Its design combines the high hardness and wear resistance of carbide teeth with the high toughness of the steel body. It is particularly suitable for scenarios where frequent tooth replacement or complex processing tasks are required, such as heavy cutting and multi-process processing. Carbide insert milling cutter uses tungsten carbide (WC) as the main hard phase and cobalt (Co) as the bonding phase. The teeth are prepared by powder metallurgy and installed on the cutter body by mechanical fastening or clamping. It is suitable for CNC machine tools and large machining centers. The following content will be elaborated in detail from multiple aspects such as structure and materials, working principle, characteristics, performance influencing factors, production process, types and applications.

Structure and materials of carbide insert milling cutter

carbide insert milling cutters consists of a steel cutter body and replaceable carbide teeth. The cutter body is made of high-toughness tool steel (such as 42CrMo or 18CrNiMo7), with a diameter range from 20 mm to 200 mm and a length of 100-500 mm designed according to processing requirements to ensure a stable connection with the machine tool spindle. The teeth are made of carbide and installed in the cutter body groove. The number of teeth is usually 6-30, depending on the cutting diameter and purpose. The geometric parameters of the blade (such as helix angle 25°-40°, front angle 3°-8°, back angle 8°-12°) are optimized by precision grinding. AlTiN or CrN coating can be applied to the tooth surface with a thickness of 3-6 μm , and the heat resistance is increased to 1050°C.

Material composition:

Hard phase: tungsten carbide (WC), particle size distribution 0.4-1.8 μm , D50 value 1.0 μm , purity ≥ 99.95%, providing high hardness and wear resistance.

Binder phase: Cobalt (Co), content range 5%-10% (mass fraction), particle size 0.8-1.2 μm , 5% focuses on high precision, 10% is suitable for heavy-load cutting.

Additives: Tantalum carbide (TaC) content 0.3%-1.0%, niobium carbide (NbC) content 0.2%-0.6%, dispersion detected by SEM, standard deviation < 4%, enhanced high temperature oxidation resistance.

Structural features:

Cutter body design: Steel body surface heat treatment, hardness HRC 40-50, surface roughness Ra ≤ 0.3 μm , with HSK or BT type handle, installation coaxiality ≤ 0.008 mm.

Tooth installation: Mechanical clamping or bolt fixing is adopted, and the tooth replacement accuracy is ±0.005 mm to ensure stability and repeatability.

Coating technology: In 2025, gradient AlTiN coating will be introduced with thickness uniformity deviation < 0.4 μm and corrosion resistance improved by 35%, suitable for dry cutting and high temperature environments.

2. Working principle of carbide insert milling cutter

电话/TEL：0086 592 512 9696
CTIAQCD-MA-E/P 2018-2024V
sales@chinatungsten.com

Carbide insert milling cutters achieve end and side cutting through high-speed rotation, and mainly use intermittent cutting to remove material from the workpiece. Its working principle relies on the high-speed relative movement of carbide teeth. The end teeth cut into the workpiece axially to complete the end face processing, and the peripheral teeth cut radially to achieve side shaping. The chips are discharged through the optimized tooth grooves. The cutting process is affected by the tool geometry parameters (such as the helix angle affecting chip discharge, the rake angle affecting cutting force) and cutting parameters (such as cutting speed Vc 60-300 m/min, feed rate fn 0.04-0.25 mm/tooth, cutting depth ap 0.3-5 mm). Coolant (such as oil-based cutting fluid, flow rate ≥ 15 L/min) or dry cutting technology is used to control the temperature of the cutting zone to prevent overheating of the cutter teeth (maximum temperature controlled below 750°C) or thermal deformation of the workpiece. In 2025, combined with 5G networks and AI optimization algorithms, the intelligent monitoring system can monitor cutting force (< 800 N) and vibration in real time, dynamically adjust parameters, improve cutting efficiency by 18%-22%, and achieve machining accuracy of IT5-IT6 level.

3. Characteristics of carbide insert milling cutter

Carbide insert milling cutters, with their replaceable teeth and advanced materials, offer the following notable features:

Ultra-high hardness

The Vickers hardness of the blade teeth is HV 1600-2100, which is suitable for processing materials with hardness below HRC 65.

Excellent wear resistance

The wear zone width (VB) is ≤ 0.25 mm after 600-900 hours of continuous cutting, and the service life is extended by 4-6 times compared with traditional tools .

Excellent heat resistance

The coated teeth have a heat resistance of up to 1050°C, making them suitable for high-speed cutting (Vc > 200 m/min) and reducing the risk of thermal cracks.

Strong impact resistance

By optimizing the tooth geometry and steel support, the bending strength is ≥ 2200 MPa and the impact load resistance is increased by 20%, making it suitable for heavy-load conditions.

High flexibility

The replaceable tooth design reduces maintenance costs and adapts to various processing requirements. The tooth replacement time is less than 5 minutes.

Table of **carbide insert milling cutter performance and influencing factors**

Influencing factors	describe	Impact	Optimization suggestions	Data support
Cobalt content	5%-10%, low content improves hardness, high content increases toughness	high	5% for high precision, 10% for heavy loads	5% Co hardness HV 1900, 10% Co flexural strength 2300 MPa
Cutting speed	60-300 m/min, too high will	middle	Hard materials reduce by 25%, such as	Too high Vc (350 m/min) wear rate 6%-

(Vc)	cause wear on the cutter teeth		Ti alloy Vc 150 m/min	10%
Feed rate (fn)	0.04-0.25 mm/tooth, too high will increase cutting force	high	Micro-machining down to 0.04 mm/tooth	fn 0.3 mm/tooth Cutting force increased by 35%
Cutting depth (ap)	0.3-5 mm, too deep may cause vibration	middle	Complex workpiece layered cutting, ap 0.6 mm/layer	ap 6 mm vibration amplitude increased by 18%
Coolant flow	≥ 15 L/min, the heat dissipation effect affects the lifespan	middle	Dry cutting with AlTiN coating	Flow rate 7 L/min Lifespan reduced by 25%
Tooth installation accuracy	Clamping force ≥ 300 N, risk of loosening	high	Optimum clamping force 350 N, check regularly	Clamping force < 250 N Looseness 4%

5. Carbide insert milling cutter performance production process

carbide insert milling cutters comes from the refined design of the tooth preparation and installation process. The following are the detailed process flow and technical parameters.

Carbide insert milling cutter performance production process table

Process steps	Equipment/Parameters	Time/Conditions	Goal/Result	Technical indicators
Raw material mixing	High energy planetary ball mill, ball to material ratio 12:1, 250-350 rpm	30-50 hours, standard deviation < 4%	Even dispersion, in accordance with ISO 13399	Particle size uniformity CV < 2.5%
Pressing	Pressure 180-220 MPa, time 15-25 seconds	Density 65%-75% (13-15 g/ cm³)	The tooth blank is formed with a deviation of ±0.15 g/ cm³	Green strength 12-18 MPa
sintering	Vacuum furnace 1400-1500°C, HIP 6-12 MPa	1.5-2.5 hours, density 98.5%-99.5%	Grain size 0.4-1.2 μm , densified	Porosity A01B00C00
Tooth dressing	Diamond grinding wheel #800-#1000, EDM 0.05-0.25 J	Trimming amount 0.008-0.015 mm	Roughness Ra ≤ 0.15 μm , accuracy ±0.004 mm	Cutting edge sharpness < 0.008 mm
Tooth installation	Mechanical clamping, clamping force 300-400 N	2-5 minutes	The teeth are firmly installed, with a repeatability of ±0.005 mm	Clamping force uniformity < 5%
Coating	Multi-target magnetron sputtering, AlTiN	Thickness 3-6 μm	Heat resistance 1050°C, friction coefficient 0.12	Adhesion force > 60 N, uniformity < 0.4 μm

6. Types of carbide insert milling cutters

Carbide insert milling cutters are classified into several types based on their use and structure, each type being optimized for specific machining needs:

Roughing insert milling cutter: number of teeth 6-12, cutting depth ap 3-5 mm, cutting speed Vc 80-180 m/min, suitable for rapid removal of material (such as steel billets), cutting force 600-800 N, life 500-700 hours.

Finishing insert milling cutter: number of teeth 20-30, cutting depth ap 0.3-0.8 mm, cutting speed

Vc 200-300 m/min, surface roughness Ra 0.15 μm , precision IT6 level, suitable for molds and aviation parts.

Face milling cutter: diameter 80-200 mm, number of teeth 12-24, cutting depth ap 2-4 mm, Vc 100-250 m/min, suitable for large plane processing.

Coated insert milling cutter: AlTiN or CrN coating is applied, heat resistance 1000-1050°C, friction coefficient 0.12, life is 30%-40% longer than that of uncoated, Vc 250-300 m/min.

Slot milling cutter: specially designed for processing deep grooves and steps, with 8-16 teeth, cutting depth ap 1-3 mm, Vc 90-200 m/min, and vibration reduction of 20%-25%.

7. Application of carbide insert milling cutter

Carbide insert milling cutters are widely used in many industries due to their replaceable tooth design and versatility:

Aerospace: Processing titanium alloys (such as Ti-6Al-4V) and aluminum alloy components, Vc 150-250 m/min, ap 0.5-1.5 mm, precision IT5 level, 5G monitoring will reduce processing time by 12%-18% in 2025.

Automobile manufacturing: Processing cylinder heads and gearbox housings, the workpiece material is cast iron (HRC 35-45), Vc 120-200 m/min, ap 1-3 mm, and the efficiency is increased by 22%.

Mold manufacturing: finishing injection molds and stamping molds, Vc 180-300 m/min, ap 0.3-1 mm, Ra 0.15 μm , reducing tool change time by 30%.

Energy equipment: Processing wind turbine rotors and turbine blades, workpiece materials are steel or composite materials, Vc 100-180 m/min, ap 1-2.5 mm, heat resistance increased by 20%.

Heavy machinery: processing large gears and machine tool beds, the workpiece material is high-strength steel, Vc 90-160 m/min, ap 2-4 mm, cutting force 700-900 N.

Railway transportation: Milling of rail fasteners and wheel axles, the workpiece material is ductile iron, Vc 110-190 m/min, ap 1.5-3 mm, impact resistance increased by 25%.

Shipbuilding industry: Processing of ship steel plates and propellers, Vc 100-180 m/min, ap 2-4 mm, corrosion-resistant coating extends service life by 30%-35%.

Mining equipment: Processing crusher hammers and screen plates, the workpiece material is high manganese steel, Vc 80-150 m/min, ap 2-3.5 mm, the service life is extended by 40%.

Building materials: Processing precast concrete components, Vc 70-130 m/min, ap 1-3 mm, reducing dust emissions by 20%, suitable for green construction.

What is a carbide insert milling cutter?

Carbide insert milling cutter is a high-performance cutting tool made by inserting replaceable carbide teeth into a steel cutter body. It is widely used in the processing of metal and non-metallic materials. Its design combines the high hardness and wear resistance of carbide teeth with the high toughness of the steel body. It is particularly suitable for scenarios where frequent tooth replacement or complex processing tasks are required, such as heavy cutting and multi-process processing. Carbide insert milling cutter uses tungsten carbide (WC) as the main hard phase and cobalt (Co) as the bonding phase. The teeth are prepared by powder metallurgy and installed on the cutter body by mechanical fastening or clamping. It is suitable for CNC machine tools and large machining centers. The following content will briefly outline the structure and materials, working principles, characteristics, performance influencing factors, production processes, types and applications.

1. Structure and materials of carbide insert milling cutter

The carbide insert milling cutter consists of a steel cutter body and replaceable carbide cutter teeth. The cutter body is made of high-toughness tool steel (such as 42CrMo), with a diameter of 20-200 mm and a length of 100-500 mm, ensuring a stable connection with the machine tool spindle. The cutter teeth are made of carbide , with 6-30 teeth, and the cutting edge geometry parameters (such as helix angle 25°-40°, rake angle 3°-8°) are optimized by precision grinding. AlTiN coating (thickness 3-6 μm) can be applied to the surface, with a heat resistance of up to 1050°C.

Material composition: Tungsten carbide (WC) is the hard phase, the cobalt (Co) content is 5%-10%, and TaC and NbC are added to enhance performance.

Structural features: Cutter body hardness HRC 40-50, cutter tooth clamping accuracy ±0.005 mm, installation coaxiality ≤ 0.008 mm.

2. Working principle of carbide insert milling cutter

Through high-speed rotation, the cutter teeth cut the workpiece axially and radially, the end teeth are responsible for end surface processing, the peripheral teeth complete the side forming, and the chips are discharged through the tooth groove. The cutting parameters include Vc 60-300 m/min, fn 0.04-0.25 mm/tooth, ap 0.3-5 mm. Coolant (flow ≥ 15 L/min) or dry cutting controls the temperature. In 2025, 5G+AI monitoring will increase efficiency by 18%-22%, and the accuracy will reach IT5-IT6 level.

3. Characteristics of Carbide Insert Milling Cutter

High hardness: tooth HV 1600-2100, suitable for materials below HRC 65.

Wear resistance: VB ≤ 0.25 mm (600-900 hours), service life extended by 4-6 times .

Heat resistance: The coating is heat resistant to 1050°C and is suitable for high-speed cutting.

Impact resistance: flexural strength ≥ 2200 MPa, suitable for heavy loads.

Flexibility: blade replacement in < 5 minutes, reducing maintenance costs.

Sustainability: Dry cutting reduces coolant by 25%-35%.

4. Table of carbide insert milling cutter performance and influencing factors

电话/TEL：0086 592 512 9696
CTIAQCD-MA-E/P 2018-2024V
sales@chinatungsten.com

Influencing factors	describe	Impact	Optimization suggestions	Data support
Cobalt content	5%-10%, balance of hardness and toughness	high	5% accuracy, 10% heavy duty	5% Co HV 1900
Cutting speed (Vc)	60-300 m/min, excessive wear	middle	Hard materials reduced by 25%	Vc 350 m/min Wear 6%-10%
Feed rate (fn)	0.04-0.25 mm/tooth	high	Micromachining 0.04 mm/tooth	fn 0.3 Cutting force increased by 35%
Cutting depth (ap)	0.3-5 mm, too deep vibration	middle	Layering 0.6 mm/layer	ap 6 mm vibration increased by 18%
Installation accuracy	Clamping force ≥ 300 N	high	Clamping force 350 N Check	< 250 N looseness 4%

5. Carbide insert milling cutter performance production process table

Process steps	Equipment/Parameters	Time/Conditions	Goal/Result	Technical indicators
Raw material mixing	Ball mill 250-350 rpm	30-50 hours	Evenly dispersed	CV < 2.5%
Pressing	180-220 MPa	15-25 seconds	Blank forming	Density 13-15 g/cm³
sintering	1400-1500°C, HIP	1.5-2.5 hours	Densification	Density 98.5%-99.5%
Tooth dressing	Diamond grinding wheel #800-#1000	Trimming 0.008-0.015 mm	Accuracy optimization	Ra ≤ 0.15 μm
Tooth installation	Clamping force 300-400 N	2-5 minutes	Secure installation	Accuracy ±0.005 mm
Coating	Magnetron sputtering AlTiN	Thickness 3-6 μm	Improved heat resistance	Adhesion force > 60 N

6. Types of Carbide Insert Milling Cutters

Roughing milling cutter: number of teeth 6-12, ap 3-5 mm, Vc 80-180 m/min, suitable for steel billets.

Finishing milling cutter: number of teeth 20-30, ap 0.3-0.8 mm, Vc 200-300 m/min, accuracy IT6.

Face milling cutter: diameter 80-200 mm, ap 2-4 mm, Vc 100-250 m/min, flat surface machining.

Coated milling cutter: AlTiN coating, heat resistant to 1000-1050°C, life extended by 30%-40%.

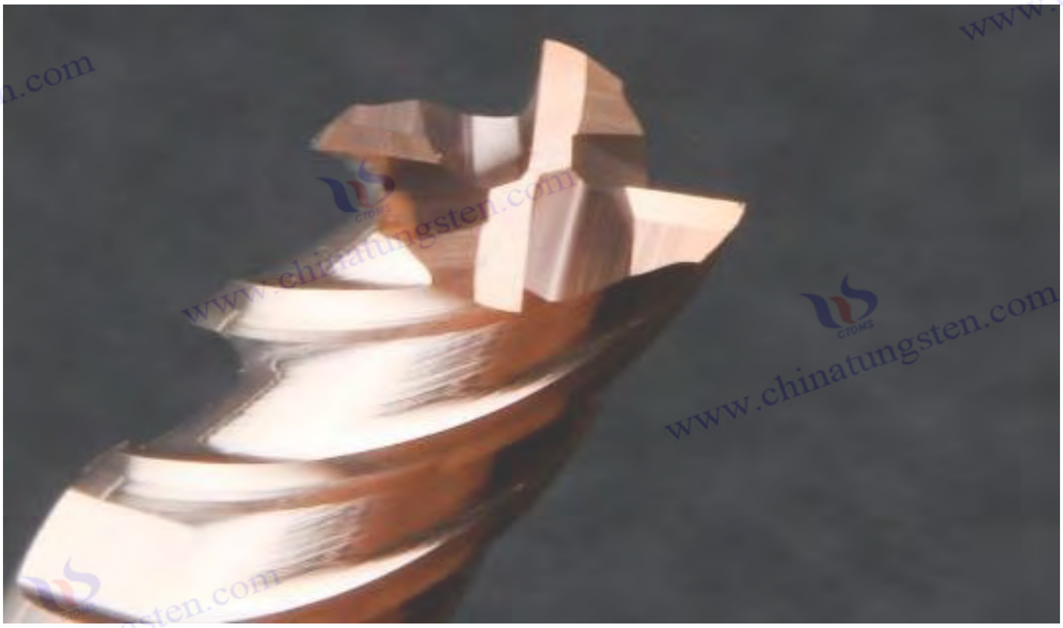
Slot milling cutter: number of teeth 8-16, ap 1-3 mm, Vc 90-200 m/min, vibration reduction 20%-25%.

7. Application of carbide insert milling cutter

Aerospace: Processing Ti-6Al-4V, Vc 150-250 m/min, precision IT5.

电话/TEL：0086 592 512 9696
CTIAQCD-MA-E/P 2018-2024V
sales@chinatungsten.com

Automobile manufacturing: Processing cylinder heads, Vc 120-200 m/min, efficiency increased by 22%.
Mould manufacturing: precision injection mould, Vc 180-300 m/min, Ra 0.15 μm .
Energy equipment: Processing turbine blades, Vc 100-180 m/min, heat resistance increased by 20%.
Heavy machinery: gear processing, Vc 90-160 m/min, cutting force 700-900 N.
Railway transportation: Milling wheel axles, Vc 110-190 m/min, impact resistance 25%.
Shipbuilding industry: Processing steel plates, Vc 100-180 m/min, service life extended by 30%-35%.
Mining equipment: Processing hammer head, Vc 80-150 m/min, life extended by 40%.
Building materials: Processing concrete components, Vc 70-130 m/min, dust reduction 20%.



电话/TEL：0086 592 512 9696
CTIAQCD-MA-E/P 2018-2024V
sales@chinatungsten.com

What are carbide indexable insert milling cutters?

Carbide indexable insert milling cutter is a high-efficiency cutting tool made by installing replaceable carbide indexable inserts on a steel cutter body. It is widely used in precision machining of metal and non-metallic materials. Its design combines the excellent hardness and wear resistance of carbide inserts with the flexibility of the cutter body. It is particularly suitable for scenarios that require frequent blade changes or processing of multiple workpiece materials, such as aerospace and automotive manufacturing. Carbide indexable inserts use tungsten carbide (WC) as the main hard phase and cobalt (Co) as the binder phase. They are prepared by powder metallurgy and fixed to the cutter body by mechanical clamping. They are suitable for CNC machine tools and multi-axis machining centers.

1. Structure and materials of carbide indexable insert milling cutter

Carbide indexable insert milling cutters consist of a steel cutter body and replaceable inserts. The cutter body is made of high-toughness tool steel (such as 40CrNiMo), with a diameter of 25-250 mm and a length of 120-600 mm, ensuring a stable connection with the machine tool spindle. The inserts are made of cemented carbide and installed in the cutter body slots, with 4-40 inserts, depending on the cutting diameter. The cutting edge geometry (such as helix angle 20°-45°, rake angle 0°-10°) is optimized by precision grinding, and the insert surface can be coated with AlTiN or TiCN (thickness 2-5 μm), with a heat resistance of up to 1100°C.
Material composition: Tungsten carbide (WC) is the hard phase, the cobalt (Co) content is 4%-12%, and TiC and TaC are added to enhance performance.
Structural features: Cutter body hardness HRC 40-50, blade clamping accuracy ±0.003 mm, installation coaxiality ≤ 0.005 mm.

2. Working principle of carbide indexable insert milling cutter

Through high-speed rotation, the blade cuts the workpiece axially and radially, the end edge is responsible for end surface processing, the peripheral edge completes the side forming, and the chips are discharged through the tooth groove. The cutting parameters include Vc 80-400 m/min, fn 0.06-0.3 mm/tooth, ap 0.5-6 mm. Coolant (flow rate ≥ 20 L/min) or dry cutting controls the temperature. In 2025, 5G+AI monitoring will increase efficiency by 20%-25%, and the accuracy will reach IT4-IT6 level.

3. Characteristics of carbide indexable insert milling cutter

Ultra-high hardness: blade HV 1700-2300, suitable for materials below HRC 70.
Excellent wear resistance: VB ≤ 0.2 mm (800-1200 hours), life extended 5-8 times .
Excellent heat resistance: The coating is heat resistant to 1100°C and is suitable for ultra-high-speed cutting.
High flexibility: indexable design supports multi- blade use, blade replacement < 3 minutes.
Strong stability: flexural strength ≥ 2500 MPa, suitable for heavy loads and intermittent cutting.
Environmental protection: Dry cutting reduces coolant by 30%-40% and carbon emissions by 20%.

4. Table of carbide indexable insert milling cutter performance and influencing factors

Influencing factors	describe	Impact	Optimization suggestions	Data support
Cobalt content	4%-12%, balance of hardness and toughness	high	4% accuracy, 12% heavy duty	4% Co HV 2000
Cutting speed (Vc)	80-400 m/min, excessive wear	middle	Hard materials reduced by 20%	Vc 450 m/min wear 5%-8%
Feed rate (fn)	0.06-0.3 mm/tooth	high	Finishing 0.06 mm/tooth	fn 0.35 Cutting force increased by 40%
Cutting depth (ap)	0.5-6 mm, too deep vibration	middle	Layering: 0.8 mm/layer	ap 7 mm vibration increase 15%
Clamping force	≥ 400 N, risk of loosening	high	Clamping force 450 N Check	< 350 N looseness 3%

5. Carbide indexable insert milling cutter performance production process table

Process steps	Equipment/Parameters	Time/Conditions	Goal/Result	Technical indicators
Raw material mixing	Ball mill 300-400 rpm	40-60 hours	Evenly dispersed	CV < 2%
Pressing	200-250 MPa	20-30 seconds	Blank forming	Density 14-16 g/ cm^3
sintering	1450-1550°C, HIP	2-3 hours	Densification	Density 99%-99.8%
Blade dressing	Diamond grinding wheel #1000-#1200	Trimming 0.005-0.01 mm	Accuracy optimization	Ra ≤ 0.1 μm
Blade installation	Clamping force 400-500 N	1-3 minutes	Secure installation	Accuracy ±0.003 mm
Coating	Magnetron sputtering AlTiN	Thickness 2-5 μm	Improved heat resistance	Adhesion force > 70 N

6. Types of carbide indexable insert milling cutters

Roughing milling cutter: 6-12 blades, ap 3-6 mm, Vc 100-200 m/min, suitable for steel billets.
Finishing milling cutter: 20-40 blades, ap 0.5-1.5 mm, Vc 250-400 m/min, accuracy IT5.
Face milling cutter: diameter 100-250 mm, ap 2-5 mm, Vc 120-300 m/min, flat surface machining.
Coated milling cutter: AlTiN coating, heat resistant to 1000-1100°C, life extended by 35%-45%.
Slot milling cutter: 8-16 blades, ap 1-3 mm, Vc 100-250 m/min, vibration reduction 15%-20%.

7. Application of carbide indexable insert milling cutters

Aerospace:
used for machining titanium alloys (such as Ti-6Al-4V) and high-temperature alloys (such as Inconel 718), cutting speed Vc 150-300 m/min, cutting depth ap 0.5-1.5 mm, feed rate fn 0.06-0.15 mm/tooth. Suitable for aircraft wing ribs, engine blades and structural parts, with machining accuracy of IT4 and surface roughness Ra 0.05-0.1 μm . In 2025, combined with 5G real-time monitoring and AI optimization, the machining time will be reduced by 15%-20%, significantly improving the efficiency of complex surface machining.
Automobile manufacturing:
Processing engine cylinders, crankshafts and gearbox housings. Workpiece materials include cast iron (HRC 30-45) and aluminum alloys, Vc 120-250 m/min, ap 1-3 mm, fn 0.1-0.2 mm/tooth. Suitable for mass production, efficiency increased by 25%, surface roughness Ra 0.1-0.2 μm . Dry

cutting technology reduces coolant use by 30%, in line with the lightweight trend of the automotive industry.

Mould manufacturing:

finishing injection moulds, stamping moulds and forging moulds, the workpiece material is tool steel (HRC 50-60) or pre-hardened steel , Vc 200-400 m/min, ap 0.5-1.5 mm, fn 0.06-0.12 mm/tooth. Machining accuracy IT5 level, surface roughness Ra 0.05-0.1 µm , reducing tool change time by 30%-40%, significantly reducing production costs.

Energy equipment:

Processing gas turbine blades, wind turbine rotor hubs and nuclear power valve bodies. Workpiece materials include nickel-based alloys and stainless steel, Vc 100-200 m/min, ap 1-2.5 mm, fn 0.08-0.15 mm/tooth. Heat resistance is increased by 25% to meet the needs of high temperature and high pressure environments. In 2025, AI optimized cutting parameters will reduce scrap rate by 10%-15%.

Heavy machinery:

Processing machine tool beds, large gears and bearing seats, workpiece materials are high-strength steel (HRC 40-55), Vc 90-180 m/min, ap 2-5 mm, fn 0.12-0.25 mm/tooth, cutting force 800-1000 N. Tool life is extended by 35%-45%, suitable for heavy load and intermittent cutting conditions.

Railway transportation:

Milling of train wheels, sleepers and rail fasteners, workpiece materials are ductile iron and carbon steel, Vc 120-200 m/min, ap 1.5-3 mm, fn 0.1-0.2 mm/tooth. Impact resistance is improved by 20%, processing efficiency is improved by 18%, meeting the requirements of high wear resistance and high reliability.

Shipbuilding industry:

processing hull steel plates, propellers and valve bodies, workpiece materials are ship steel and bronze, Vc 100-180 m/min, ap 2-4 mm, fn 0.1-0.2 mm/tooth. Corrosion-resistant coating extends service life by 35%, dry cutting reduces coolant usage by 25%-30%, and is suitable for marine environments.

Electronics industry:

Processing aluminum alloy mobile phone housings, circuit board brackets and semiconductor housings, Vc 200-350 m/min, ap 0.5-1.5 mm, fn 0.06-0.12 mm/tooth, processing accuracy ±0.001 mm, surface roughness Ra 0.05 µm . Meet the needs of lightweight and thin high-density electronic components.

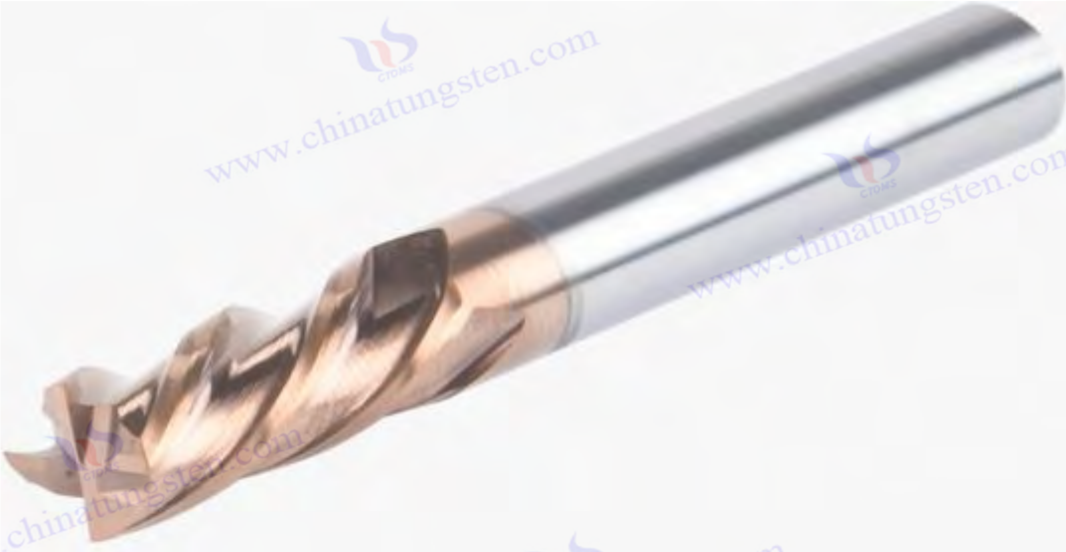
Petrochemical industry:

Processing pipeline valves, pump bodies and compressor housings. The workpiece materials are stainless steel and titanium alloys, Vc 80-150 m/min, ap 1-2.5 mm, fn 0.08-0.15 mm/tooth. Corrosion resistance is improved by 30%. By 2025, intelligent monitoring will reduce processing defects by 10%-15%.

Defense industry:

Processing tank armor plates, missile shells and gun barrels. The workpiece materials are high-strength steel and composite materials, Vc 100-200 m/min, ap 1-3 mm, fn 0.1-0.2 mm/tooth. Wear resistance improves processing efficiency by 20%-25%, meeting high safety and high precision requirements.

New energy industry:
Processing wind turbine blade molds and solar brackets, the workpiece material is glass fiber reinforced composite material or aluminum alloy, Vc 120-250 m/min, ap 1-3 mm, fn 0.08-0.15 mm/tooth. Efficiency increased by 15%-20%, carbon footprint reduced by 10%, supporting the development of green energy.
Medical equipment:
Processing of orthopedic implants (such as hip joints) and micro-devices, the workpiece material is titanium alloy or Co-Cr alloy, Vc 80-150 m/min, ap 0.3-0.8 mm, fn 0.04-0.1 mm/tooth, accuracy ±0.0005 mm, surface roughness Ra 0.03 µm , meeting biocompatibility requirements.
Jewelry processing:
processing precious metals (such as gold, platinum) and gemstone inlays, Vc 50-120 m/min, ap 0.1-0.5 mm, fn 0.03-0.08 mm/tooth, accuracy ±0.0002 mm, suitable for high-end customization and fine engraving.



What is a carbide high speed cutting milling cutter?

Carbide high-speed cutting milling cutter is a high-performance cutting tool made of carbide material, designed for high-speed machining, capable of efficiently removing materials at high cutting speeds, and widely used in precision machining of metal and non-metal materials. It combines the high hardness, heat resistance and wear resistance of cemented carbide, and is suitable for scenarios such as aerospace and automotive manufacturing that require high efficiency and high-quality surface treatment. Carbide high-speed cutting milling cutter uses tungsten carbide (WC) as the main hard phase and cobalt (Co) as the bonding phase. It is made through powder metallurgy and precision machining processes, and is often equipped with coatings to improve performance. It is suitable for CNC machine tools and high-speed machining centers.

1. Structure and materials of cemented carbide high-speed cutting milling cutters

Carbide high-speed cutting milling cutters are usually made of solid carbide or welded/ embedded in a steel body with a carbide cutter head , with a diameter range of 6-100 mm and a length of 50-300 mm to ensure matching with high-speed spindles. The tool blade is designed as a multi- tooth

电话/TEL：0086 592 512 9696
CTIAQCD-MA-E/P 2018-2024V
sales@chinatungsten.com

structure (2-20 teeth), and the blade geometry parameters (such as helix angle 35°-50°, rake angle 5°-15°) are optimized to adapt to high-speed cutting. TiAlN or AlCrN coating (thickness 2-4 μm) is often applied on the surface, with a heat resistance of up to 1150°C.

Material composition: tungsten carbide (WC) particle size 0.3-1.5 μm , cobalt (Co) content 6%-10%, TiC and VC are added to improve heat resistance.

Structural features: Solid carbide tool hardness HV 1800-2200, steel body support design hardness HRC 40-45, tool coaxiality ≤ 0.005 mm.

2. Working principle of cemented carbide high speed cutting milling cutter

Through ultra-high-speed rotation (cutting speed Vc 200-1000 m/min), the tool quickly cuts into the workpiece, the end teeth and peripheral teeth work together to complete the end and side processing, and the chips are discharged through optimized tooth grooves under high temperature and pressure. Cutting parameters include Vc 200-1000 m/min, fn 0.05-0.2 mm/tooth, ap 0.2-4 mm. High-efficiency coolant (such as oil-based or synthetic cutting fluid, flow rate ≥ 25 L/min) or high-pressure air cooling to control temperature (< 800°C), combined with IoT and AI technology to achieve real-time monitoring in 2025, cutting efficiency will be increased by 25%-30%, and accuracy will reach IT5-IT7 level.

3. Characteristics of cemented carbide high speed cutting milling cutter

Ultra-high hardness: HV 1800-2200, suitable for materials below HRC 60.

Excellent heat resistance: The coating is heat resistant to 1150°C and is suitable for ultra-high-speed cutting.

Excellent wear resistance: VB ≤ 0.15 mm (500-1000 hours), life extended by 6-10 times .

High efficiency: cutting speed up to 1000 m/min, processing efficiency increased by 30%-50%.

Stability: flexural strength ≥ 2400 MPa, suitable for high-speed intermittent cutting.

Environmental protection: Dry cutting or minimal lubrication reduces coolant usage by 40%-50%.

4. Table of performance and influencing factors of cemented carbide high-speed cutting milling cutters

Influencing factors	describe	Impact	Optimization suggestions	Data support
Cobalt content	6%-10%, balance of hardness and toughness	high	6% accuracy, 10% heavy duty	6% Co HV 1900
Cutting speed (Vc)	200-1000 m/min, excessive wear	high	Hard materials reduced by 15%	Vc 1100 m/min Wear 8%
Feed rate (fn)	0.05-0.2 mm/tooth	middle	High speed reduction 0.05 mm/tooth	fn 0.25 Cutting force increased by 35%
Cutting depth (ap)	0.2-4 mm, too deep vibration	middle	Layering 0.5 mm/layer	ap 5 mm vibration increase 20%
Coating	2-4 μm , too thick and peeling	high	Optimized 2.5-3 μm	< 2 μm Heat resistance

thickness				decreases by 10%

5. Carbide high-speed cutting milling cutter performance production process table

Process steps	Equipment/Parameters	Time/Conditions	Goal/Result	Technical indicators
Raw material mixing	Ball mill 350-450 rpm	50-70 hours	Evenly dispersed	CV < 1.5%
Pressing	220-280 MPa	25-35 seconds	Blank forming	Density 14.5-16 g/ cm³
sintering	1450-1600°C, HIP	2.5-3.5 hours	Densification	Density 99.2%-99.9%
Blade trimming	Diamond grinding wheel #1200-#1500	Trimming 0.003-0.008 mm	Accuracy optimization	Ra ≤ 0.08 μm
Coating	PVD Deposition of TiAlN	Thickness 2-4 μm	Improved heat resistance	Adhesion force > 80 N

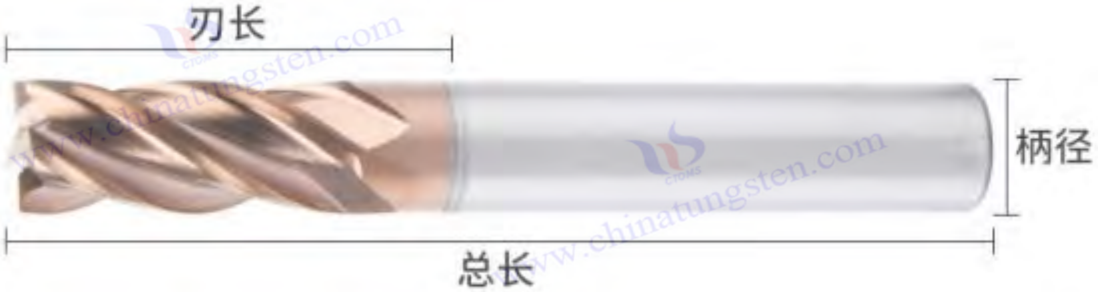
6. Types of carbide high speed cutting milling cutters

Integral high-speed milling cutter: diameter 6-20 mm, Vc 400-1000 m/min, suitable for small diameter precision machining.
Indexable high-speed milling cutter: 4-16 blades, Vc 300-800 m/min, suitable for large-area cutting.
Coated high-speed milling cutter: TiAlN coating, Vc 500-1000 m/min, life extended by 40%-60%.
Ball-end high-speed milling cutter: diameter 10-50 mm, Vc 200-600 m/min, suitable for complex surface processing.
Slot milling cutter: number of teeth 4-10, Vc 300-700 m/min, vibration reduction 15%-25%.

7. Application of cemented carbide high speed cutting milling cutter

Carbide high-speed cutting milling cutters are widely used in many industries due to their high efficiency and adaptability, as follows:
Aerospace:
Processing titanium alloys (such as Ti-6Al-4V) and aluminum alloy fuselage parts, Vc 400-800 m/min, ap 0.5-2 mm, fn 0.05-0.15 mm/tooth. Suitable for wing ribs and engine casings, processing accuracy IT5 level, surface roughness Ra 0.05-0.1 μm . In 2025, AI optimization will reduce processing time by 20%-30% to meet lightweight requirements.
Automobile manufacturing:
Processing aluminum alloy cylinder heads, magnesium alloy wheels and steel crankshafts, Vc 300-600 m/min, ap 1-3 mm, fn 0.1-0.2 mm/tooth. Efficiency increased by 40%, surface roughness Ra 0.1-0.15 μm , dry cutting reduces coolant by 50%, supporting high production line requirements.
Mould manufacturing:
finishing plastic moulds and stamping moulds, workpiece materials are P20 steel or H13 steel, Vc 500-1000 m/min, ap 0.3-1.5 mm, fn 0.05-0.12 mm/tooth. Accuracy IT6 level, Ra 0.04-0.08 μm ,

tool change time is reduced by 35%, and mould life is increased.
Energy equipment:
Processing wind turbine blade molds and gas turbine blades, the workpiece material is composite material or Inconel, Vc 200-500 m/min, ap 1-2.5 mm, fn 0.08-0.15 mm/tooth. Heat resistance is improved by 30%, IoT monitoring will reduce waste by 15% in 2025, and support green energy.
Electronics industry:
Processing aluminum alloy mobile phone housing and PCB bracket, Vc 600-1000 m/min, ap 0.2-1 mm, fn 0.04-0.1 mm/tooth. Accuracy ±0.001 mm, Ra 0.03-0.05 µm , to meet the needs of high-precision electronic components.
Heavy machinery:
Processing large gears and machine tool guide rails, workpiece material is 42CrMo steel, Vc 200-400 m/min, ap 2-4 mm, fn 0.12-0.2 mm/tooth, cutting force 600-800 N. Life is extended by 50%, suitable for high-load processing.
Medical equipment:
Processing titanium alloy orthopedic implants, Vc 300-500 m/min, ap 0.3-0.8 mm, fn 0.04-0.1 mm/tooth. Accuracy ±0.0005 mm, Ra 0.02-0.04 µm , meeting biocompatibility requirements.
Railway transportation:
Processing high-speed rail wheels and sleepers, the workpiece material is ductile iron, Vc 300-600 m/min, ap 1.5-3 mm, fn 0.1-0.18 mm/tooth. Wear resistance is improved by 25% and efficiency is increased by 20%.
Shipbuilding industry:
Processing ship steel plates and propellers, Vc 200-400 m/min, ap 2-4 mm, fn 0.1-0.2 mm/tooth. Corrosion-resistant coating extends service life by 40%, and dry cutting reduces environmental impact by 30%.
Defense industry:
Processing armor plates and missile components, the workpiece material is high-strength steel, Vc 250-500 m/min, ap 1-3 mm, fn 0.08-0.15 mm/tooth. Wear resistance is improved by 30%, meeting high strength requirements.
Petrochemical industry:
Processing valve bodies and pipe joints, workpiece material is stainless steel, Vc 200-400 m/min, ap 1-2.5 mm, fn 0.08-0.15 mm/tooth. Corrosion resistance is improved by 25%, and processing defects are reduced by 10%.
New energy industry:
Processing solar frames and battery housings, workpiece material is aluminum alloy, Vc 400-800 m/min, ap 0.5-2 mm, fn 0.06-0.12 mm/tooth. Efficiency increased by 25%, carbon emissions reduced by 15%.
Jewelry processing:
Processing precious metal jewelry, Vc 200-400 m/min, ap 0.1-0.5 mm, fn 0.03-0.08 mm/tooth. Accuracy ±0.0001 mm, suitable for fine carving.


刃长
柄径
总长

What is a Carbide Corner Milling Cutter?

Carbide fillet milling cutter is a high-performance cutting tool made of carbide material. The cutter head has a rounded corner (i.e., ball head or ball end) design and is widely used in complex curved surface processing of metal and non-metallic materials. It combines the high hardness, wear resistance and good cutting performance of cemented carbide, and is particularly suitable for scenes that require high precision and smooth surface treatment, such as aerospace and mold manufacturing. Carbide fillet milling cutter uses tungsten carbide (WC) as the main hard phase and cobalt (Co) as the bonding phase. It is made through powder metallurgy and precision grinding processes. It is often equipped with a coating to improve heat resistance and service life. It is suitable for CNC machine tools and multi-axis machining centers. The following content will briefly outline the structure and materials, working principles, characteristics, performance influencing factors, production processes, types and applications.

1. Structure and materials of carbide corner milling cutters

Carbide rounded corner milling cutters are usually solid carbide structures with diameters ranging from 1-25 mm and lengths of 50-150 mm. The cutter head is spherical or rounded, with 2-6 teeth, depending on the diameter and application. The cutting edge geometry (such as helix angle 30°-45°, rake angle 2°-10°) is optimized through precision grinding, and AlTiN or TiCN coating (thickness 2-3 μm) is often applied to the tool surface, with a heat resistance of up to 1100°C.

Material composition: tungsten carbide (WC) particle size 0.2-1.2 μm , cobalt (Co) content 5%-8%, TaC and NbC are added to enhance toughness and heat resistance.

Structural features: Overall carbide hardness HV 1700-2000, tool coaxiality ≤ 0.003 mm, corner radius accuracy ±0.005 mm.

2. Working principle of carbide fillet milling cutter

Through rotation, the rounded cutter head cuts the workpiece along the complex curved trajectory, the spherical end realizes three-dimensional contour processing, and the chips are discharged through the spiral groove. Cutting parameters include Vc 100-600 m/min, fn 0.02-0.1 mm/tooth, ap 0.1-2 mm. Coolant (such as water-based cutting fluid, flow rate ≥ 15 L/min) or dry cutting control temperature (< 700°C), combined with AI optimization and sensor monitoring in 2025, the cutting efficiency will be increased by 15%-20%, and the accuracy will reach IT6-IT8 level.

3. Characteristics of Carbide Corner Milling Cutter

High hardness: HV 1700-2000, suitable for materials below HRC 55.

Good wear resistance: VB ≤ 0.2 mm (400-800 hours), life extended 4-6 times .

Excellent heat resistance: The coating is heat resistant to 1100°C and is suitable for medium and high speed cutting.

High precision: rounded corner design ensures smooth transition, surface roughness Ra 0.02-0.1 μm .

Flexibility: adaptable to a variety of complex geometries and suitable for multi-axis machining.

Environmental protection: Dry cutting reduces coolant by 20%-30%.

4. Table of carbide corner milling cutter performance and influencing factors

Influencing factors	describe	Impact	Optimization suggestions	Data support
Cobalt content	5%-8%, balance of hardness and toughness	high	5% accuracy, 8% toughness	5% Co HV 1800
Cutting speed (Vc)	100-600 m/min, excessive wear	middle	Hard materials minus 10%	Vc 650 m/min Wear 6%
Feed rate (fn)	0.02-0.1 mm/tooth	middle	Finishing 0.02 mm/tooth	fn 0.12 Cutting force increased by 30%
Cutting depth (ap)	0.1-2 mm, too deep vibration	high	Layering 0.3 mm/layer	ap 2.5 mm vibration increase 15%
Coating thickness	2-3 µm , too thick and peeling	middle	Optimized 2.2-2.5 µm	< 2 µm Heat resistance decreases by 8%

5. Carbide corner milling cutter performance production process table

Process steps	Equipment/Parameters	Time/Conditions	Goal/Result	Technical indicators
Raw material mixing	Ball mill 300-400 rpm	40-60 hours	Evenly dispersed	CV < 2%
Pressing	180-250 MPa	20-30 seconds	Blank forming	Density 14-15 g/ cm^3
sintering	1400-1500°C, HIP	2-3 hours	Densification	Density 98.5%-99.5%
Blade trimming	Diamond grinding wheel #1000-#1200	Trimming 0.002-0.005 mm	Accuracy optimization	Ra ≤ 0.06 µm
Coating	PVD Deposition of AlTiN	Thickness 2-3 µm	Improved heat resistance	Adhesion force > 60 N

6. Types of Carbide Corner Milling Cutters

Short-edge rounded corner milling cutter: diameter 1-10 mm, Vc 200-400 m/min, suitable for shallow finishing.

Long- edge radius milling cutter: diameter 10-25 mm, Vc 100-300 m/min, suitable for deep cavity processing.

Coated corner milling cutter: AlTiN coating, Vc 300-600 m/min, life extended by 30%-40%.

Micro corner milling cutter: diameter 0.1-2 mm, Vc 100-200 m/min, suitable for micro parts.

Roughing radius milling cutter: number of teeth 4-6, Vc 150-350 m/min, suitable for fast material removal.

7. Application of carbide fillet milling cutter

Carbide corner milling cutters are widely used in many industries due to their corner radius design and precision machining capabilities, as follows:

Aerospace:

Processing titanium alloys (such as Ti-6Al-4V) and aluminum alloy complex curved surfaces, such as wing skins and blade roots, Vc 200-400 m/min, ap 0.1-1 mm, fn 0.02-0.08 mm/tooth. Accuracy IT6 level, Ra 0.02-0.05 μm , AI optimization in 2025 will reduce processing time by 15%-20%, meeting high-strength and lightweight requirements.

Mold manufacturing:

Finishing the complex contours of injection molds and die-casting molds, the workpiece material is P20 steel or H13 steel, Vc 300-500 m/min, ap 0.2-1.5 mm, fn 0.03-0.1 mm/tooth. Accuracy IT7 level, Ra 0.02-0.04 μm , reducing tool changes by 30% and improving mold surface quality.

Automobile manufacturing:

Processing the curve features of cylinder heads and turbocharger impellers, workpiece materials are aluminum alloy or cast iron, Vc 200-350 m/min, ap 0.3-1 mm, fn 0.04-0.1 mm/tooth. Efficiency increased by 20%, Ra 0.03-0.06 μm , dry cutting reduces coolant by 25%.

Energy equipment:

Processing curved structures of wind turbine blade molds and turbine blades. The workpiece materials are composite materials or stainless steel, Vc 150-300 m/min, ap 0.5-2 mm, fn 0.05-0.1 mm/tooth. Heat resistance is improved by 20%, and IoT monitoring will reduce waste by 10% in 2025.

Electronics industry:

Processing 3D curves of mobile phone middle frames and circuit board brackets, the workpiece material is aluminum alloy, Vc 300-600 m/min, ap 0.1-0.8 mm, fn 0.02-0.06 mm/tooth. Accuracy ±0.001 mm, Ra 0.01-0.03 μm , meeting high precision requirements.

Medical equipment:

Processing complex surfaces of titanium alloy artificial joints and dental implants, Vc 100-250 m/min, ap 0.1-0.5 mm, fn 0.02-0.05 mm/tooth. Accuracy ±0.0003 mm, Ra 0.01-0.02 μm , in line with biocompatibility standards.

Defense industry:

Processing the curved features of missile shells and radar covers, the workpiece material is high-strength steel, Vc 200-400 m/min, ap 0.3-1.5 mm, fn 0.03-0.08 mm/tooth. Wear resistance is improved by 25%, meeting high reliability requirements.

Shipbuilding industry:

Processing propeller blades and hull surfaces, workpiece materials are bronze or stainless steel, Vc 150-300 m/min, ap 0.5-2 mm, fn 0.04-0.1 mm/tooth. Corrosion-resistant coating prolongs service life by 30% and reduces processing deformation by 15%.

Jewelry processing:

Processing of fine carving and inlay of precious metals (such as gold and platinum), Vc 100-200 m/min, ap 0.05-0.3 mm, fn 0.01-0.04 mm/tooth. Accuracy ±0.0001 mm, suitable for high-end customization.

New energy industry:

Processing curved connections of solar panel frames, workpiece material is aluminum alloy, Vc

200-400 m/min, ap 0.3-1 mm, fn 0.03-0.08 mm/tooth. Efficiency increased by 15% and carbon footprint reduced by 10%.

Heavy machinery:

Processing transition surfaces of large gears, workpiece material is 40CrNiMo steel, Vc 150-300 m/min, ap 0.5-2 mm, fn 0.05-0.1 mm/tooth. Life is extended by 35% and stress concentration is reduced.

Petrochemical industry:

Processing the curved surface features of valve bodies and pipe joints, the workpiece material is stainless steel, Vc 150-300 m/min, ap 0.3-1.5 mm, fn 0.04-0.08 mm/tooth. Corrosion resistance is improved by 20% and processing defects are reduced by 10%.

Furniture manufacturing:

Processing decorative curves of wooden or composite furniture, Vc 200-400 m/min, ap 0.2-1 mm, fn 0.03-0.07 mm/tooth. Surface smoothness Ra 0.02-0.05 μm , efficiency increased by 20%.

What is a Carbide Round Keyway Milling Cutter?

The carbide semicircular keyway milling cutter is a special cutting tool made of carbide material. The cutter head is designed in a semicircular or carpenter groove shape. It is widely used for processing keyways, grooves and semicircular grooves. It is particularly suitable for scenes requiring high precision and smooth inner surfaces in mechanical manufacturing. It combines the high hardness, wear resistance and impact resistance of cemented carbide and is suitable for processing steel, cast iron and non-ferrous metals. The carbide semicircular keyway milling cutter uses tungsten carbide (WC) as the main hard phase and cobalt (Co) as the bonding phase. It is made through powder metallurgy and precision grinding processes. It is often equipped with TiN or AlTiN coating to improve performance. It is suitable for CNC machine tools and traditional milling machines. The following content will briefly outline the structure and materials, working principles, characteristics, performance influencing factors, production processes, types and applications.

1. Structure and materials of carbide semicircular keyway milling cutter

Carbide semicircular keyway milling cutters are usually solid carbide structures or carbide cutter heads welded to steel shanks , with diameters ranging from 3-50 mm and lengths of 50-200 mm. The semicircular diameter of the cutter head matches the cutter body diameter, and the number of teeth is 2-4. The geometric parameters of the blade (such as helix angle 20°-35°, rake angle 0°-5°) are optimized to adapt to slot processing, and TiN or AlTiN coatings (thickness 1.5-3 μm) can be applied to the surface, with heat resistance up to 1000°C.

Material composition: tungsten carbide (WC) particle size 0.5-1.5 μm , cobalt (Co) content 6%-10%, TaC added to enhance wear resistance.

Structural features: Overall carbide hardness HV 1600-1900, steel handle hardness HRC 40-45, tool coaxiality ≤ 0.005 mm.

2. Working principle of carbide semicircular keyway milling cutter

Through rotation, the semicircular cutter head cuts along the axial or radial direction of the workpiece to form a semicircular groove or keyway, and the chips are discharged through the tooth gap. Cutting parameters include Vc 50-300 m/min, fn 0.03-0.15 mm/tooth, ap 0.5-5 mm. Coolant (such as oil-based cutting fluid, flow rate ≥ 10 L/min) or dry cutting control temperature (< 600°C), combined with sensor monitoring in 2025, the cutting efficiency will be increased by 10%-15%, and the accuracy will reach IT7-IT9 level.

3. Characteristics of Carbide Half Round Keyway Milling Cutter

High hardness: HV 1600-1900, suitable for materials below HRC 50.

Good wear resistance: VB ≤ 0.25 mm (300-600 hours), service life extended by 3-5 times .

Moderate heat resistance: The coating is heat resistant to 1000°C and is suitable for medium-speed cutting.

High precision: semicircular groove smoothness Ra 0.2-0.4 μm , dimensional tolerance ±0.01 mm.

Impact resistance: flexural strength ≥ 2000 MPa, suitable for intermittent cutting.

Economical: The overall design reduces replacement frequency and reduces costs.

电话/TEL：0086 592 512 9696
CTIAQCD-MA-E/P 2018-2024V
sales@chinatungsten.com

4. Table of performance and influencing factors of cemented carbide semicircular keyway milling cutter

Influencing factors	describe	Impact	Optimization suggestions	Data support
Cobalt content	6%-10%, balance of hardness and toughness	high	6% accuracy, 10% toughness	6% Co HV 1700
Cutting speed (Vc)	50-300 m/min, excessive wear	middle	Hard materials minus 10%	Vc 350 m/min Wear 5%
Feed rate (fn)	0.03-0.15 mm/tooth	middle	Finishing 0.03 mm/tooth	fn 0.18 Cutting force increased by 25%
Cutting depth (ap)	0.5-5 mm, too deep vibration	high	Layering 1 mm/layer	ap 6 mm vibration increased by 20%
Coating thickness	1.5-3 μm , too thick and peeling	middle	Optimized 2-2.5 μm	< 1.5 μm Heat resistance decreases by 10%

5. Performance and production process table of carbide semicircular keyway milling cutter

Process steps	Equipment/Parameters	Time/Conditions	Goal/Result	Technical indicators
Raw material mixing	Ball mill 250-350 rpm	40-50 hours	Evenly dispersed	CV < 2.5%
Pressing	180-220 MPa	15-25 seconds	Blank forming	Density 13.5-15 g/ cm³
sintering	1400-1450°C, HIP	1.5-2.5 hours	Densification	Density 98%-99%
Blade trimming	Diamond grinding wheel #800-#1000	Trimming 0.005-0.01 mm	Accuracy optimization	Ra ≤ 0.1 μm
Coating	PVD Deposition of TiN	Thickness 1.5-3 μm	Improved heat resistance	Adhesion force > 50 N

6. Types of Carbide Half Round Keyway Milling Cutters

Standard semicircular keyway milling cutter: diameter 3-20 mm, Vc 100-250 m/min, suitable for general keyway processing.

Long- edge semicircular keyway milling cutter: diameter 20-50 mm, Vc 50-150 m/min, suitable for deep groove processing.

Coated semicircular keyway milling cutter: TiN coating, Vc 150-300 m/min, life extended by 25%-35%.

Micro semicircular keyway milling cutter: diameter 1-5 mm, Vc 50-100 m/min, suitable for small parts processing.

Roughing semicircular keyway milling cutter: 3-4 teeth, Vc 80-200 m/min, suitable for fast material removal.

电话/TEL：0086 592 512 9696
CTIAQCD-MA-E/P 2018-2024V
sales@chinatungsten.com

7. Application of carbide semicircular keyway milling cutter

Carbide semicircular keyway milling cutters are widely used in many industries due to their semicircular design and specialization, as follows:

Mechanical manufacturing:

Processing keyways and synchronous pulley grooves on shaft parts, the workpiece material is 45# steel or 40Cr, Vc 100-200 m/min, ap 1-3 mm, fn 0.05-0.1 mm/tooth. Accuracy IT7 level, Ra 0.2-0.3 μm , sensor optimization in 2025 to reduce processing error by 10%.

Automobile manufacturing:

machining the keyway and coupling groove of the gearbox shaft, the workpiece material is cast iron or aluminum alloy, Vc 150-250 m/min, ap 0.5-2 mm, fn 0.04-0.08 mm/tooth. Efficiency increased by 15%, Ra 0.2-0.25 μm , dry cutting reduces coolant by 20%.

Mould manufacturing:

Processing guide pin grooves and positioning grooves in moulds, workpiece material is Cr12MoV steel, Vc 80-150 m/min, ap 1-3 mm, fn 0.03-0.07 mm/tooth. Accuracy IT8, Ra 0.25-0.4 μm , life extended by 20%.

Energy equipment:

Processing keyways of wind turbine gear shafts, workpiece material is 42CrMo steel, Vc 100-200 m/min, ap 1.5-4 mm, fn 0.06-0.12 mm/tooth. Wear resistance increased by 15%, IoT monitoring reduced waste by 8% in 2025.

Railway transportation:

Processing keyways and connection grooves of wheel axles, workpiece material is ductile iron, Vc 80-150 m/min, ap 1-3 mm, fn 0.05-0.1 mm/tooth. Impact resistance is improved by 20% and efficiency is increased by 12%.

Shipbuilding industry:

machining keyways of propeller shafts, workpiece material is stainless steel, Vc 50-100 m/min, ap 1-2.5 mm, fn 0.04-0.08 mm/tooth. The corrosion-resistant coating prolongs the service life by 25% and reduces machining deformation by 10%.

Heavy machinery:

Machining keyways of large gear shafts, workpiece material is high-strength steel, Vc 80-150 m/min, ap 2-5 mm, fn 0.06-0.12 mm/tooth. Cutting force 500-700 N, life extended by 30%.

Petrochemical industry:

Processing keyways of pump bodies and valve stems, workpiece material is stainless steel, Vc 50-120 m/min, ap 1-3 mm, fn 0.04-0.08 mm/tooth . Corrosion resistance is improved by 15%, and processing defects are reduced by 5%.

Defense industry:

Processing keyways of tank transmission shafts, workpiece material is high-strength steel, Vc 100-200 m/min, ap 1-3 mm, fn 0.05-0.1 mm/tooth. Wear resistance is increased by 20%, meeting high reliability requirements.

Agricultural machinery:

Processing keyways of tractor shafts, workpiece material is 35CrMo steel, Vc 80-150 m/min, ap 1-2.5 mm, fn 0.04-0.08 mm/tooth. Efficiency increased by 10%, Ra 0.3-0.35 μm .

Electronics industry:

Processing micro keyways of motor shafts, workpiece material is aluminum alloy, Vc 100-200 m/min, ap 0.5-1.5 mm, fn 0.03-0.06 mm/tooth. Accuracy ±0.01 mm, Ra 0.2 μm .

Furniture manufacturing:

Processing decorative grooves of wooden mechanical parts, workpiece material is hardwood, Vc 50-100 m/min, ap 0.5-2 mm, fn 0.03-0.07 mm/tooth. Surface smoothness Ra 0.25 μm , efficiency increased by 15%.

Construction machinery:

Processing keyways of excavator shafts, workpiece material is 40CrNiMo steel, Vc 80-150 m/min, ap 1.5-4 mm, fn 0.05-0.1 mm/tooth. Life extended by 25%, stress concentration reduced by 10%.

What is a Carbide Die Milling Cutter?

Carbide die milling cutter is a high-performance cutting tool made of carbide material, designed for the mold manufacturing industry, and suitable for processing complex mold cavities, contours and fine structures. It combines the high hardness, wear resistance and excellent cutting performance of cemented carbide, and is particularly suitable for processing high-hardness steel, pre-hardened steel and difficult-to-process materials such as aerospace and automotive molds. Carbide die milling cutter uses tungsten carbide (WC) as the main hard phase and cobalt (Co) as the bonding phase. It is made through powder metallurgy and precision grinding processes. It is often equipped with AlTiN or TiSiN coating to improve heat resistance and service life. It is suitable for CNC machine tools and high-speed machining centers. The following content will briefly outline the structure and materials, working principles, characteristics, performance influencing factors, production processes, types and applications.

1. Structure and materials of cemented carbide die milling cutters

Carbide mold milling cutters are usually solid carbide structures with diameters ranging from 1-20 mm and lengths of 50-150 mm. The cutter head is designed as a ball head, rounded corners or flat bottom, with 2-6 teeth, depending on the processing requirements. The blade geometry parameters (such as helix angle 30°-45°, rake angle 2°-10°) are optimized to adapt to the complex geometry of the mold. AlTiN or TiSiN coatings (thickness 2-4 μm) can be applied to the surface, with a heat resistance of up to 1100°C.

Material composition: Tungsten carbide particle size 0.2-1.0 μm , cobalt (Co) content 5%-9%, TiC and NbC are added to enhance toughness and heat resistance.

Structural features: Overall carbide hardness HV 1800-2100, tool coaxiality ≤ 0.003 mm, blade accuracy ±0.005 mm.

2. Working principle of carbide die milling cutter

Through rotation, the cutter head cuts along the mold cavity or contour trajectory, the ball head or fillet design realizes three-dimensional surface processing, and the chips are discharged through the optimized spiral groove. The cutting parameters include Vc 150-800 m/min, fn 0.02-0.1 mm/tooth, ap 0.1-3 mm. Coolant (such as synthetic cutting fluid, flow rate ≥ 15 L/min) or dry cutting control temperature (< 800°C), combined with AI optimization and real-time monitoring in 2025, the cutting efficiency will be increased by 20%-25%, and the accuracy will reach IT5-IT7 level.

3. Characteristics of cemented carbide die milling cutters

Ultra-high hardness: HV 1800-2100, suitable for materials below HRC 60.

Excellent wear resistance: VB ≤ 0.15 mm (500-1000 hours), life extended 5-7 times .

Excellent heat resistance: The coating is heat resistant to 1100°C and is suitable for high-speed cutting.

High precision: surface roughness Ra 0.02-0.08 μm , suitable for fine molds.

Versatility: Suitable for complex surface and deep cavity processing, with high flexibility.

Environmental protection: Dry cutting reduces coolant by 30%-40%.

4. Table of carbide die milling cutter performance and influencing factors

Influencing factors	describe	Impact	Optimization suggestions	Data support
Cobalt content	5%-9%, balance of hardness and toughness	high	5% accuracy, 9% toughness	5% Co HV 1900
Cutting speed (Vc)	150-800 m/min, excessive wear	middle	Hard materials reduced by 15%	Vc 900 m/min Wear 7%
Feed rate (fn)	0.02-0.1 mm/tooth	middle	Finishing 0.02 mm/tooth	fn 0.12 Cutting force increased by 30%
Cutting depth (ap)	0.1-3 mm, too deep vibration	high	Layering 0.5 mm/layer	ap 4 mm vibration increased by 18%
Coating thickness	2-4 μm , too thick and peeling	middle	Optimized 2.5-3 μm	< 2 μm Heat resistance decreases by 10%

5. Carbide die milling cutter performance production process table

Process steps	Equipment/Parameters	Time/Conditions	Goal/Result	Technical indicators
Raw material mixing	Ball mill 300-400 rpm	40-60 hours	Evenly dispersed	CV < 2%
Pressing	200-250 MPa	20-30 seconds	Blank forming	Density 14-15.5 g/ cm³
sintering	1450-1550°C, HIP	2-3 hours	Densification	Density 99%-99.8%
Blade trimming	Diamond grinding wheel #1000-#1200	Trimming 0.002-0.005 mm	Accuracy optimization	Ra ≤ 0.05 μm
Coating	PVD Deposition of AlTiN	Thickness 2-4 μm	Improved heat resistance	Adhesion force > 70 N

6. Types of carbide die milling cutters

Ball head mold milling cutter: diameter 1-15 mm, Vc 200-600 m/min, suitable for complex curved surfaces.
Corner die milling cutter: diameter 3-20 mm, Vc 150-500 m/min, suitable for transition surfaces.
Flat bottom mold milling cutter: diameter 5-20 mm, Vc 300-800 m/min, suitable for flat surface processing.
Coated mold milling cutter: AlTiN coating, Vc 400-800 m/min, life extended by 40%-50%.
Long- edge mold milling cutter: length 100-150 mm, Vc 150-400 m/min, suitable for deep cavities.

7. Application of carbide mold milling cutter

Carbide die milling cutters are widely used in the field of die manufacturing due to their high precision and versatility, as follows:

Automobile mold manufacturing:

Processing the cavities of stamping molds and injection molds, the workpiece material is P20 steel or H13 steel, Vc 300-600 m/min, ap 0.2-1.5 mm, fn 0.03-0.08 mm/tooth. Accuracy IT6 level, Ra 0.02-0.05 µm , AI optimization in 2025 to reduce processing time by 20%.

Aerospace molds:

Processing titanium alloy and aluminum alloy mold cavities, such as wing forming molds, Vc 200-400 m/min, ap 0.1-1 mm, fn 0.02-0.06 mm/tooth. Accuracy IT5 level, Ra 0.01-0.03 µm , meeting high strength requirements.

Electronic mold manufacturing:

Processing mobile phone housing and connector molds, the workpiece material is pre-hardened steel , Vc 400-800 m/min, ap 0.1-0.8 mm, fn 0.02-0.05 mm/tooth. Accuracy ±0.001 mm, Ra 0.01-0.02 µm .

Plastic mold manufacturing:

Processing complex contours of injection molds, workpiece material is 718 steel, Vc 300-500 m/min, ap 0.3-1.5 mm, fn 0.03-0.07 mm/tooth. Efficiency increased by 25%, Ra 0.02-0.04 µm .

Die-casting mold manufacturing:

Processing deep cavities and side walls of die-casting molds, workpiece material is H11 steel, Vc 150-300 m/min, ap 0.5-2 mm, fn 0.04-0.1 mm/tooth. Heat resistance is improved by 20% and service life is extended by 30%.

Energy equipment molds:

Processing wind turbine blade molds, workpiece materials are composite materials or pre-hardened steel , Vc 200-400 m/min, ap 0.5-2 mm, fn 0.03-0.08 mm/tooth. IoT monitoring will reduce waste by 10% in 2025.

Medical mold manufacturing:

Processing medical device molds, such as syringe molds, workpiece material is stainless steel, Vc 150-300 m/min, ap 0.2-1 mm, fn 0.02-0.06 mm/tooth. Accuracy ±0.0005 mm, Ra 0.01 µm .

Defense industry mold:

Processing missile shell mold, the workpiece material is high-strength steel, Vc 200-400 m/min, ap 0.3-1.5 mm, fn 0.03-0.07 mm/tooth. Wear resistance is improved by 25%, meeting high reliability.

Home appliance mold manufacturing:

Processing TV shell mold, the workpiece material is ABS plastic steel mold, Vc 300-600 m/min, ap 0.2-1 mm, fn 0.03-0.08 mm/tooth. Efficiency increased by 20%, Ra 0.03 µm .

Shipbuilding industry mold:

Processing hull parts mold, the workpiece material is corrosion-resistant steel, Vc 150-300 m/min, ap 0.5-2 mm, fn 0.04-0.1 mm/tooth. The corrosion-resistant coating extends the service life by 30%.

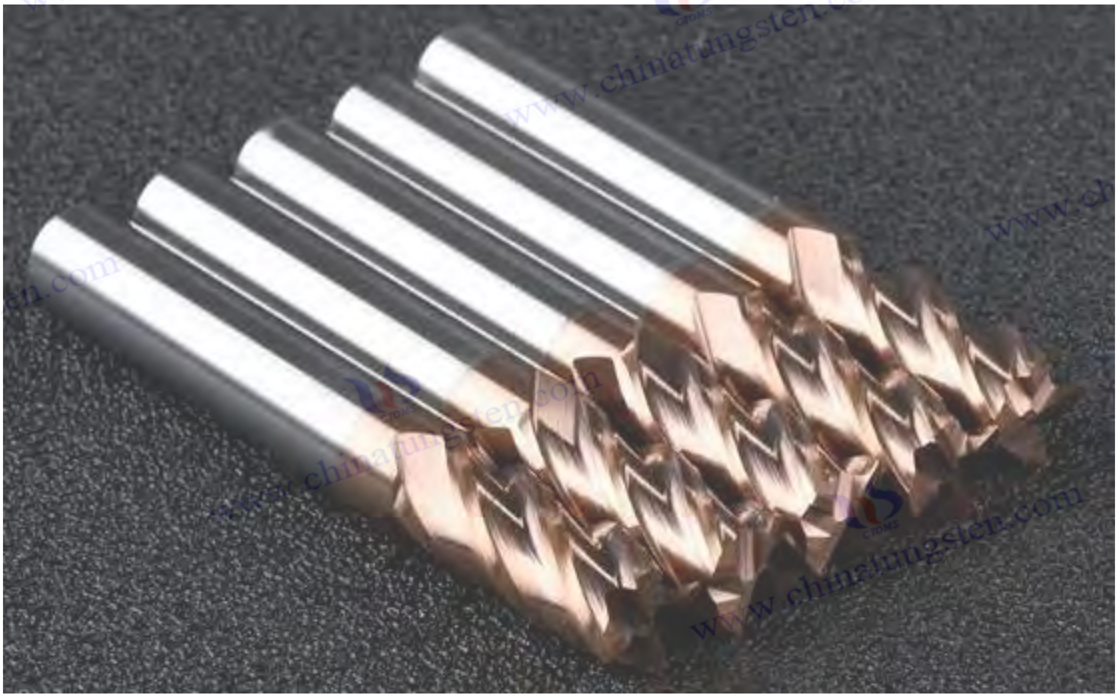
Heavy machinery mold:

Processing gear mold cavity, the workpiece material is 40CrNiMo steel, Vc 150-300 m/min, ap 1-3 mm, fn 0.05-0.1 mm/tooth. The service life is extended by 35% and stress concentration is reduced.

New energy mold:

Processing solar panel molds, the workpiece material is aluminum alloy, Vc 200-500 m/min, ap 0.3-

1.5 mm, fn 0.03-0.07 mm/tooth. Efficiency increased by 15% and carbon footprint reduced by 10%.
Jewelry mold manufacturing:
Processing the fine structure of precious metal molds, the workpiece material is cemented carbide, Vc 100-200 m/min, ap 0.1-0.5 mm, fn 0.01-0.04 mm/tooth. Accuracy ±0.0001 mm, suitable for high-end customization.



What is a Carbide Saw Blade Milling Cutter?

Carbide saw blade milling cutter is a high-efficiency cutting tool made of carbide material. The cutter body is in the shape of a thin disc with multiple saw teeth around it. It is widely used in grooving, slitting and cutting operations of metal and non-metallic materials. It combines the high hardness, wear resistance and good cutting performance of cemented carbide, and is particularly suitable for scenarios that require high-speed cutting and precise separation, such as automotive parts and electronic component processing. Carbide saw blade milling cutter uses tungsten carbide (WC) as the main hard phase and cobalt (Co) as the bonding phase. It is made through powder metallurgy and precision grinding processes. It is often equipped with TiAlN or CrN coating to improve heat resistance and service life. It is suitable for CNC machine tools and special cutting equipment. The following content will briefly outline the structure and materials, working principles, characteristics, performance influencing factors, production processes, types and applications.

1. Structure and materials of carbide saw blade milling cutter

Carbide saw blade milling cutters are usually solid carbide or carbide teeth welded to a steel substrate , with a diameter range of 50-300 mm, a thickness of 0.5-5 mm, and a number of teeth of 20-100 teeth, depending on the diameter and cutting requirements. The blade geometry parameters (such as tooth angle 5°-15°, rake angle 0°-5°) are optimized to adapt to thin-wall cutting, and a TiAlN or CrN coating (thickness 2-3 μm) can be applied to the surface, with a heat resistance of up to 1050°C.

Material composition: tungsten carbide particle size 0.5-1.5 μm , cobalt (Co) content 6%-10%, VC added to enhance wear resistance.

Structural features: Overall carbide hardness HV 1700-2000, steel matrix hardness HRC 40-45, tool coaxiality ≤ 0.005 mm.

2. Working principle of carbide saw blade milling cutter

Through high-speed rotation, the saw teeth cut into the surface of the workpiece to complete groove cutting, slitting or cutting, and the chips are discharged through the gap between the teeth. Cutting parameters include Vc 200-800 m/min, fn 0.02-0.1 mm/tooth, ap 0.1-2 mm (cutting depth). Coolant (such as oil-based cutting fluid, flow rate ≥ 20 L/min) or dry cutting control temperature (< 700°C), combined with AI optimization and sensor monitoring in 2025, cutting efficiency will increase by 15%-20%, and accuracy will reach IT6-IT8 level.

3. Characteristics of Carbide Saw Blade Milling Cutter

High hardness: HV 1700-2000, suitable for materials below HRC 55.

Excellent wear resistance: VB ≤ 0.2 mm (400-800 hours), life extended by 4-6 times .

Good heat resistance: The coating is heat resistant to 1050°C and is suitable for high-speed cutting.

High efficiency: suitable for thin-wall and high-precision slitting, with a cutting speed of up to 800 m/min.

Stability: flexural strength ≥ 2200 MPa, suitable for intermittent cutting.

Economical: Can be reground and reused, reducing long-term costs.

4. Table of carbide saw blade milling cutter performance and influencing factors

Influencing factors	describe	Impact	Optimization suggestions	Data support
Cobalt content	6%-10%, balance of hardness and toughness	high	6% accuracy, 10% toughness	6% Co HV 1800
Cutting speed (Vc)	200-800 m/min, excessive wear	middle	Hard materials minus 10%	Vc 900 m/min Wear 6%
Feed rate (fn)	0.02-0.1 mm/tooth	middle	Finishing 0.02 mm/tooth	fn 0.12 Cutting force increased by 25%
Cutting depth (ap)	0.1-2 mm, too deep vibration	high	Layering 0.5 mm/layer	ap 2.5 mm vibration increase 15%
Coating thickness	2-3 μm , too thick and peeling	middle	Optimized 2.2-2.5 μm	< 2 μm Heat resistance decreases by 8%

5. Carbide saw blade milling cutter performance production process table

Process steps	Equipment/Parameters	Time/Conditions	Goal/Result	Technical indicators
Raw material mixing	Ball mill 300-400 rpm	40-60 hours	Evenly dispersed	CV < 2%
Pressing	200-250 MPa	20-30 seconds	Blank forming	Density 14-15 g/cm³
sintering	1400-1500°C, HIP	2-3 hours	Densification	Density 98.5%-99.5%
Tooth trimming	Diamond grinding wheel #1000-#1200	Trimming 0.005-0.01 mm	Accuracy optimization	Ra ≤ 0.1 μm
Coating	PVD Deposition of TiAlN	Thickness 2-3 μm	Improved heat resistance	Adhesion force > 60 N

6. Types of Carbide Saw Blade Milling Cutters

Standard saw blade milling cutter: diameter 50-150 mm, Vc 300-600 m/min, suitable for general cutting.

Thin saw blade milling cutter: thickness 0.5-2 mm, Vc 400-800 m/min, suitable for precision slitting.

Coated saw blade milling cutter: TiAlN coating, Vc 500-800 m/min, life extended by 35%-45%.

Large diameter saw blade milling cutter: diameter 150-300 mm, Vc 200-400 m/min, suitable for heavy cutting.

Micro saw blade milling cutter: diameter 20-50 mm, Vc 200-500 m/min, suitable for small parts processing.

7. Application of carbide saw blade milling cutter

电话/TEL：0086 592 512 9696
CTIAQCD-MA-E/P 2018-2024V
sales@chinatungsten.com

Carbide saw blade milling cutters are widely used in many industries due to their thin-wall design and high efficiency, as follows:

Automobile manufacturing:

Processing of aluminum alloy wheels and steel brake disc groove slitting , Vc 400-600 m/min, ap 0.1-1 mm, fn 0.02-0.06 mm/tooth. Accuracy IT7, Ra 0.2-0.3 μm , AI optimization in 2025 to reduce processing time by 15%.

Electronics industry:

cutting off PCB boards and aluminum housings, Vc 500-800 m/min, ap 0.1-0.5 mm, fn 0.02-0.05 mm/tooth. Accuracy ±0.01 mm, Ra 0.15-0.25 μm , efficiency increased by 20%.

Aerospace:

Slitting of titanium alloy and aluminum alloy thin-walled parts, Vc 300-500 m/min, ap 0.1-1 mm, fn 0.02-0.04 mm/tooth. Accuracy IT6 level, Ra 0.1-0.2 μm , meeting lightweight requirements.

Mould manufacturing:

Processing the separation groove of the mould, the workpiece material is P20 steel, Vc 300-500 m/min, ap 0.2-1.5 mm, fn 0.03-0.07 mm/tooth. The service life is extended by 30%, Ra 0.2 μm .

Energy equipment:

Cutting separation grooves of wind turbine blade molds, workpiece material is composite material, Vc 200-400 m/min, ap 0.5-1.5 mm, fn 0.03-0.06 mm/tooth. IoT monitoring reduces waste by 10% in 2025.

Shipbuilding industry:

Cutting of steel and aluminum plates, Vc 200-400 m/min, ap 0.5-2 mm, fn 0.04-0.08 mm/tooth. Anti-corrosion coating extends service life by 25% and increases efficiency by 15%.

Heavy machinery:

machining slots for gears and shafts , workpiece material is 42CrMo steel, Vc 200-300 m/min, ap 1-2 mm, fn 0.05-0.1 mm/tooth. Cutting force 400-600 N, life extended by 35%.

Railway transportation:

Cutting rail fasteners and wheel grooves, workpiece material is ductile iron, Vc 200-400 m/min, ap 0.5-1.5 mm, fn 0.04-0.08 mm/tooth. Wear resistance increased by 20%.

Defense industry:

Cutting of armor plates, workpiece material is high-strength steel, Vc 250-500 m/min, ap 0.5-1.5 mm, fn 0.03-0.06 mm/tooth. Wear resistance is increased by 25%, meeting high strength requirements.

Petrochemical industry:

Cutting pipes and valve body grooves, workpiece material is stainless steel, Vc 200-400 m/min, ap 0.5-1.5 mm, fn 0.04-0.07 mm/tooth. Corrosion resistance is improved by 15%, and processing defects are reduced by 5%.

Furniture manufacturing: Processing

of slotting of wood panels , Vc 300-600 m/min, ap 0.2-1 mm, fn 0.03-0.06 mm/tooth. Surface smoothness Ra 0.2 μm , efficiency increased by 15%.

New energy industry:

Cutting separation grooves for solar panels, workpiece material is aluminum alloy, Vc 400-700 m/min, ap 0.1-1 mm, fn 0.02-0.05 mm/tooth. Efficiency increased by 20%, carbon footprint reduced by 10%.

Building materials:

Cutting of cement board and gypsum board, Vc 200-400 m/min, ap 0.5-2 mm, fn 0.04-0.08 mm/tooth. Dust resistance increased by 15%, wear reduced by 10%.

What is a Carbide Cylindrical Milling Cutter？

Carbide cylindrical milling cutter is a general-purpose cutting tool made of carbide material. The cutter body is cylindrical and has straight or spiral teeth around it. It is widely used in plane processing, groove cutting and side milling. It combines the high hardness, wear resistance and good cutting performance of cemented carbide, and is suitable for processing materials such as steel, cast iron, and non-ferrous metals. It is particularly suitable for machinery manufacturing and mold processing. Carbide cylindrical milling cutter uses tungsten carbide (WC) as the main hard phase and cobalt (Co) as the bonding phase. It is made through powder metallurgy and precision grinding process. It is often equipped with TiN or AlTiN coating to improve heat resistance and service life. It is suitable for CNC machine tools and traditional milling machines. The following content will briefly summarize the structure and materials, working principle, characteristics, performance influencing factors, production process, types and applications.

1. Structure and materials of cemented carbide cylindrical milling cutter

Carbide cylindrical milling cutters are usually solid carbide structures with diameters ranging from 5-50 mm, lengths of 50-200 mm, and teeth of 4-20 teeth, depending on the diameter and purpose. The blade geometry parameters (such as helix angle 0°-45°, rake angle 5°-15°) are optimized to adapt to plane and groove processing , and TiN or AlTiN coatings (thickness 2-3 μm) can be applied to the surface , with heat resistance up to 1000°C.

Material composition: tungsten carbide particle size 0.5-1.5 μm , cobalt (Co) content 6%-10%, TaC added to enhance wear resistance.

Structural features: Overall carbide hardness HV 1700-2000, tool coaxiality ≤ 0.005, blade accuracy ±0.005 mm.

2. Working principle of carbide cylindrical milling cutter

Through rotation, the cylindrical cutter body cuts along the surface of the workpiece, the teeth complete the processing of the plane or groove, and the chips are discharged through the gap between the teeth. Cutting parameters include Vc 100-500 m/min, fn 0.05-0.2 mm/tooth, ap 0.5-5 mm. Coolant (such as water-based cutting fluid, flow rate ≥ 15 L/min) or dry cutting control temperature (< 600°C), combined with AI optimization and sensor monitoring in 2025, the cutting efficiency will be increased by 15%-20%, and the accuracy will reach IT6-IT8 level.

3. Characteristics of Carbide Cylindrical Milling Cutter

High hardness: HV 1700-2000, suitable for materials below HRC 55.

Good wear resistance: VB ≤ 0.2 mm (400-800 hours), life extended 4-6 times .

Moderate heat resistance: The coating is heat resistant to 1000°C and is suitable for medium-speed cutting.

High efficiency: suitable for large-area flat surface processing, with a cutting speed of up to 500 m/min.

Stability: flexural strength ≥ 2100 MPa, suitable for intermittent cutting.

Economical: Can be reground and reused to reduce costs.

4. Table of carbide cylindrical milling cutter performance and influencing factors

Influencing factors	describe	Impact	Optimization suggestions	Data support
Cobalt content	6%-10%, balance of hardness and toughness	high	6% accuracy, 10% toughness	6% Co HV 1800
Cutting speed (Vc)	100-500 m/min, excessive wear	middle	Hard materials minus 10%	Vc 550 m/min wear 5%
Feed rate (fn)	0.05-0.2 mm/tooth	middle	Finishing 0.05 mm/tooth	fn 0.25 Cutting force increased by 30%
Cutting depth (ap)	0.5-5 mm, too deep vibration	high	Layering 1 mm/layer	ap 6 mm vibration increase 15%
Coating thickness	2-3 μm , too thick and peeling	middle	Optimized 2.2-2.5 μm	< 2 μm Heat resistance decreases by 8%

5. Carbide cylindrical milling cutter performance production process table

Process steps	Equipment/Parameters	Time/Conditions	Goal/Result	Technical indicators
Raw material mixing	Ball mill 300-400 rpm	40-60 hours	Evenly dispersed	CV < 2%
Pressing	200-250 MPa	20-30 seconds	Blank forming	Density 14-15 g/cm³
sintering	1400-1500°C, HIP	2-3 hours	Densification	Density 98.5%-99.5%
Blade trimming	Diamond grinding wheel #1000-#1200	Trimming 0.005-0.01 mm	Accuracy optimization	Ra ≤ 0.1 μm
Coating	PVD Deposition of TiN	Thickness 2-3 μm	Improved heat resistance	Adhesion force > 60 N

6. Types of carbide cylindrical milling cutters

Spur tooth cylindrical milling cutter: diameter 5-30 mm, Vc 100-300 m/min, suitable for plane machining.

Spiral tooth cylindrical milling cutter: diameter 10-50 mm, Vc 200-500 m/min, suitable for groove cutting.

Coarse tooth cylindrical milling cutter: number of teeth 4-8, Vc 150-400 m/min, suitable for rough machining.

Fine-tooth cylindrical milling cutter: number of teeth 10-20, Vc 200-500 m/min, suitable for finishing.

Coated cylindrical milling cutter: AlTiN coating, Vc 300-500 m/min, life extended by 30%-40%.

7. Application of carbide cylindrical milling cutter

Carbide cylindrical milling cutters are widely used in many industries due to their versatility and efficiency, as follows:

Mechanical manufacturing:

Processing machine tool bed and guide rail plane, workpiece material is 45# steel, Vc 200-400 m/min, ap 1-3 mm, fn 0.1-0.2 mm/tooth. Accuracy IT7 level, Ra 0.2-0.3 μm , AI optimization in 2025 will reduce processing time by 15%.

Automobile manufacturing:

Processing the groove surface of cylinder block and crankshaft, the workpiece material is cast iron, Vc 150-300 m/min, ap 0.5-2 mm, fn 0.08-0.15 mm/tooth. Efficiency increased by 20%, Ra 0.25 μm .

Mould manufacturing:

Processing the bottom surface and side grooves of the mould , the workpiece material is P20 steel, Vc 200-500 m/min, ap 0.5-2 mm, fn 0.05-0.1 mm/tooth. Accuracy IT6 level, Ra 0.15-0.2 μm .

Aerospace:

Processing aluminum alloy fuselage panels, Vc 300-500 m/min, ap 0.5-1.5 mm, fn 0.06-0.12 mm/tooth. Accuracy IT6 level, Ra 0.1-0.15 μm , meeting lightweight requirements.

Energy equipment:

Processing the surface of wind turbine rotor hub, the workpiece material is 42CrMo steel, Vc 150-300 m/min, ap 1-3 mm, fn 0.08-0.15 mm/tooth. Life is extended by 30%, and IoT monitoring will reduce waste by 10% in 2025.

Railway transportation:

Processing wheels and sleeper surfaces, workpiece material is ductile iron, Vc 150-300 m/min, ap 1-2.5 mm, fn 0.1-0.2 mm/tooth. Wear resistance increased by 20%.

Shipbuilding industry:

Processing the groove surface of hull steel plates, Vc 100-250 m/min, ap 1-3 mm, fn 0.08-0.15 mm/tooth. The corrosion-resistant coating extends the service life by 25% and improves efficiency by 15%.

Heavy machinery:

machining large gear surfaces, workpiece material is 40CrNiMo steel, Vc 150-300 m/min, ap 2-4 mm, fn 0.1-0.2 mm/tooth. Cutting force 600-800 N, life extended by 35%.

Electronics industry:

Processing the plane of aluminum alloy housing, Vc 300-500 m/min, ap 0.5-1.5 mm, fn 0.05-0.1 mm/tooth. Accuracy ±0.01 mm, Ra 0.15 μm .

Petrochemical industry:

Processing the groove surface of valve bodies and pipelines, the workpiece material is stainless steel, Vc 100-250 m/min, ap 1-2.5 mm, fn 0.06-0.12 mm/tooth. Corrosion resistance is improved by 15%, and processing defects are reduced by 5%.

Defense industry:

Processing armor plate surface, workpiece material is high-strength steel, Vc 150-300 m/min, ap 1-3 mm, fn 0.08-0.15 mm/tooth. Wear resistance is improved by 25%, meeting high strength requirements.

Furniture manufacturing:

Processing the plane of wooden boards, Vc 200-400 m/min, ap 0.5-2 mm, fn 0.08-0.15 mm/tooth. Surface smoothness Ra 0.2 μm , efficiency increased by 15%.

New energy industry:

Processing solar bracket plane, workpiece material is aluminum alloy, Vc 200-400 m/min, ap 0.5-2 mm, fn 0.06-0.12 mm/tooth. Efficiency increased by 20%, carbon footprint reduced by 10%.

CTIA GROUP LTD

30 Years of Cemented Carbide Customization Experts

Core Advantages

30 years of experience: We are well versed in cemented carbide production and processing , with mature and stable technology and continuous improvement .

Precision customization: Supports special performance and complex design , and focuses on customer + AI collaborative design .

Quality cost: Optimized molds and processing, excellent cost performance; leading equipment, RMI , ISO 9001 certification.

Serving Customers

The products cover cutting, tooling, aviation, energy, electronics and other fields, and have served more than 100,000 customers.

Service Commitment

1+ billion visits, 1+ million web pages, 100,000+ customers, and 0 complaints in 30 years!

Contact Us

Email : sales@chinatungsten.com

Tel : +86 592 5129696

Official website : www.ctia.com.cn

What is a Carbide Face Mill ?

What is a Carbide Face Mill?

Carbide face milling cutter is a high-efficiency cutting tool made of carbide material. The cutter body is designed in a disc shape and has multiple cutting teeth on the end face. It is widely used in large-area flat processing and rough and fine processing. It combines the high hardness, wear resistance and excellent cutting performance of cemented carbide. It is suitable for processing steel, cast iron, non-ferrous metals and difficult-to-process materials, especially for machinery manufacturing and mold industries. Carbide face milling cutter uses tungsten carbide (WC) as the main hard phase and cobalt (Co) as the bonding phase. It is made by powder metallurgy and precision grinding process. It is often equipped with AlTiN or TiCN coating to improve heat resistance and service life. It is suitable for CNC machine tools and machining centers. The following content will briefly summarize the structure and materials, working principle, characteristics, performance influencing factors, production process, types and applications.

1. Structure and materials of carbide face milling cutter

Carbide face milling cutters are usually solid carbide or carbide inserts welded/indexable designs, with a diameter range of 25-315 mm, a length of 30-150 mm, and 4-20 teeth, depending on the diameter and processing requirements. The blade geometry parameters (such as helix angle 10°-45°, rake angle 5°-15°) are optimized for plane cutting, and AlTiN or TiCN coatings (thickness 2-4 μm) can be applied to the surface, with heat resistance up to 1100°C.

Material composition: tungsten carbide (WC) particle size 0.5-1.5 μm , cobalt (Co) content 6%-12%, TiC added to enhance heat resistance.

Structural features: Overall carbide hardness HV 1800-2100, tool coaxiality ≤ 0.005 mm, blade clamping accuracy ±0.01 mm.

2. Working principle of carbide face milling cutter

Through rotation, the face teeth cut along the surface of the workpiece to complete large-area plane or step processing, and the chips are discharged through the gap between the teeth. Cutting parameters include Vc 150-600 m/min, fn 0.1-0.3 mm/tooth, ap 0.5-10 mm. Coolant (such as oil-based cutting fluid, flow rate ≥ 20 L/min) or dry cutting control temperature (< 800°C), combined with AI optimization and sensor monitoring in 2025, cutting efficiency will be increased by 20%-25%, and accuracy will reach IT6-IT8 level.

3. Characteristics of Carbide Face Milling Cutter

Ultra-high hardness: HV 1800-2100, suitable for materials below HRC 60.

Excellent wear resistance: VB ≤ 0.15 mm (500-1000 hours), life extended 5-7 times .

Excellent heat resistance: The coating is heat resistant to 1100°C and is suitable for high-speed cutting.

High efficiency: suitable for large-area flat surface processing, with a cutting speed of up to 600 m/min.

Stability: flexural strength ≥ 2300 MPa, suitable for heavy-load cutting.

Versatility: capable of both roughing and finishing, highly adaptable.

电话/TEL：0086 592 512 9696
CTIAQCD-MA-E/P 2018-2024V
sales@chinatungsten.com

4. Table of carbide face milling cutter performance and influencing factors

Influencing factors	describe	Impact	Optimization suggestions	Data support
Cobalt content	6%-12%, balance of hardness and toughness	high	6% accuracy, 12% toughness	6% Co HV 1900
Cutting speed (Vc)	150-600 m/min, excessive wear	middle	Hard materials minus 10%	Vc 650 m/min Wear 6%
Feed rate (fn)	0.1-0.3 mm/tooth	middle	Finishing 0.1 mm/tooth	fn 0.35 Cutting force increased by 25%
Cutting depth (ap)	0.5-10 mm, too deep vibration	high	Layering 2 mm/layer	ap 12 mm vibration increased by 20%
Coating thickness	2-4 μm , too thick and peeling	middle	Optimized 2.5-3 μm	< 2 μm Heat resistance decreases by 10%

5. Carbide face milling cutter performance production process table

Process steps	Equipment/Parameters	Time/Conditions	Goal/Result	Technical indicators
Raw material mixing	Ball mill 350-450 rpm	50-70 hours	Evenly dispersed	CV < 1.5%
Pressing	220-280 MPa	25-35 seconds	Blank forming	Density 14.5-16 g/ cm³
sintering	1450-1600°C, HIP	2.5-3.5 hours	Densification	Density 99%-99.9%
Blade trimming	Diamond grinding wheel #1200-#1500	Trimming 0.003-0.008 mm	Accuracy optimization	Ra ≤ 0.08 μm
Coating	PVD Deposition of AlTiN	Thickness 2-4 μm	Improved heat resistance	Adhesion force > 80 N

7. Types of Carbide Face Milling Cutters

Rough tooth face milling cutter: number of teeth 4-8, Vc 150-400 m/min, suitable for rough machining.

Fine-tooth face milling cutter: number of teeth 10-20, Vc 300-600 m/min, suitable for finishing.

Indexable face milling cutter: diameter 50-315 mm, Vc 200-500 m/min, suitable for large area processing.

Coated face milling cutter: AlTiN coating, Vc 400-600 m/min, life extended by 40%-50%.

Small diameter face milling cutter: diameter 25-80 mm, Vc 300-500 m/min, suitable for small workpieces.

6. Application of Carbide Face Milling Cutter

Carbide face milling cutters are widely used in many industries due to their high efficiency and large area processing capabilities, as follows:

Mechanical manufacturing:

Processing machine tool bed and guide rail plane, workpiece material is 45# steel, Vc 200-400 m/min, ap 2-5 mm, fn 0.15-0.25 mm/tooth. Accuracy IT7 level, Ra 0.2-0.3 µm , AI optimization in 2025 to reduce processing time by 20%.

Automobile manufacturing:

Processing cylinder blocks and frame planes, workpiece material is cast iron, Vc 150-300 m/min, ap 1-4 mm, fn 0.1-0.2 mm/tooth. Efficiency increased by 25%, Ra 0.25 µm .

Mould manufacturing:

Processing mould bottom surface and large cavity , workpiece material is P20 steel, Vc 300-500 m/min, ap 1-3 mm, fn 0.1-0.2 mm/tooth. Accuracy IT6 level, Ra 0.15-0.2 µm .

Aerospace:

Processing aluminum alloy fuselage panels, Vc 400-600 m/min, ap 0.5-2 mm, fn 0.1-0.2 mm/tooth. Accuracy IT6 level, Ra 0.1-0.15 µm , meeting lightweight requirements.

Energy equipment:

Processing the surface of wind turbine rotor hub, the workpiece material is 42CrMo steel, Vc 150-300 m/min, ap 2-6 mm, fn 0.15-0.3 mm/tooth. The service life is extended by 30%, and IoT monitoring will reduce waste by 10% in 2025.

Railway transportation:

Processing car bodies and sleeper surfaces, workpiece material is ductile iron, Vc 200-400 m/min, ap 2-5 mm, fn 0.15-0.25 mm/tooth. Wear resistance increased by 20%.

Shipbuilding industry:

Processing of flat hull steel plates, Vc 150-300 m/min, ap 2-6 mm, fn 0.15-0.25 mm/tooth. Anti-corrosion coating extends service life by 25% and improves efficiency by 15%.

Heavy machinery:

machining large gears and frame planes, workpiece material is 40CrNiMo steel, Vc 150-300 m/min, ap 3-10 mm, fn 0.2-0.3 mm/tooth. Cutting force 800-1000 N, life extended by 35%.

Electronics industry:

Processing aluminum alloy housing surface, Vc 300-500 m/min, ap 0.5-2 mm, fn 0.1-0.2 mm/tooth. Accuracy ±0.01 mm, Ra 0.15 µm .

Petrochemical industry:

Processing valve bodies and pipeline flange surfaces, workpiece material is stainless steel, Vc 150-300 m/min, ap 1-4 mm, fn 0.1-0.2 mm/tooth. Corrosion resistance is improved by 15%, and processing defects are reduced by 5%.

Defense industry:

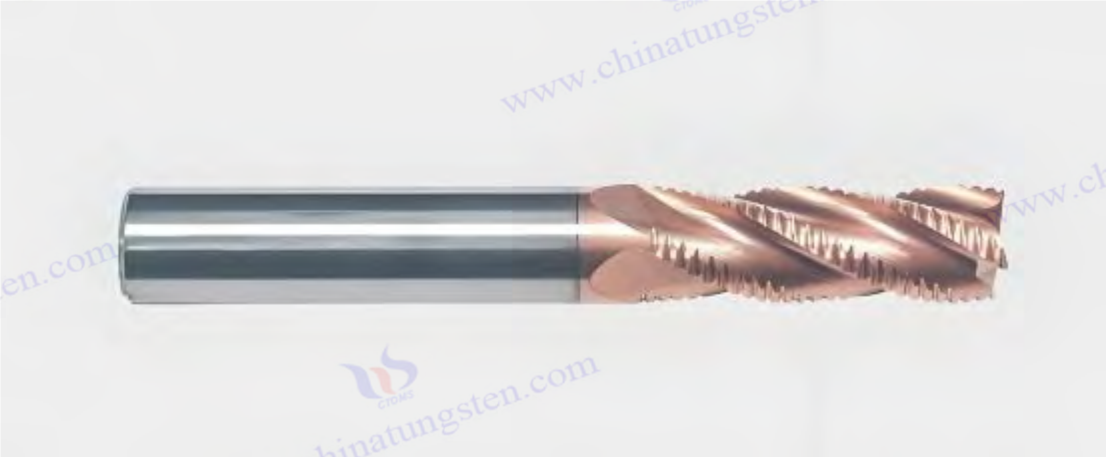
Processing armor plate surface, workpiece material is high-strength steel, Vc 200-400 m/min, ap 2-5 mm, fn 0.15-0.25 mm/tooth. Wear resistance is increased by 25%, meeting high strength requirements.

New energy industry:

Processing solar bracket plane, workpiece material is aluminum alloy, Vc 200-400 m/min, ap 1-3 mm, fn 0.1-0.2 mm/tooth. Efficiency increased by 20%, carbon footprint reduced by 10%.

Construction machinery:

Processing the plane of excavator arm plate , the workpiece material is 35CrMo steel, Vc 150-300 m/min, ap 2-5 mm, fn 0.15-0.25 mm/tooth. The service life is extended by 30% and the stress concentration is reduced by 10%.



What is a Carbide End Mill ?

Carbide end mills are high-precision cutting tools made of carbide. The cutter body is designed vertically, and cutting teeth are provided at the end and periphery. They are widely used in processing complex curved surfaces, slots, holes and contours. They combine the high hardness, wear resistance and excellent cutting performance of cemented carbide, and are suitable for processing steel, cast iron, non-ferrous metals and difficult-to-process materials, especially for mold manufacturing and aerospace industries. Carbide end mills use tungsten carbide (WC) as the main hard phase and cobalt (Co) as the bonding phase. They are made through powder metallurgy and precision grinding processes. They are often equipped with AlTiN or TiSiN coatings to improve heat resistance and service life. They are suitable for CNC machine tools and multi-axis machining centers. The following content will briefly outline the structure and materials, working principles, characteristics, performance influencing factors, production processes, types and applications.

1. Structure and materials of cemented carbide end mills

Carbide end mills are usually solid carbide structures with diameters ranging from 1-25 mm, lengths of 50-150 mm, and 2-6 teeth, depending on the diameter and processing requirements. The blade geometry parameters (such as helix angle 30°-45°, rake angle 2°-10°) are optimized to adapt to three-dimensional processing, and AlTiN or TiSiN coatings (thickness 2-3 μm) can be applied to the surface, with heat resistance up to 1100°C.

Material composition

Tungsten carbide (WC) particle size is 0.2-1.0 μm , cobalt (Co) content is 5%-9%, and NbC is added to enhance toughness and heat resistance.

Structural features

Solid carbide hardness HV 1800-2100, tool coaxiality ≤ 0.003 mm, cutting edge accuracy ±0.005 mm.

2. Working principle of carbide end mill

Through rotation, the end and peripheral teeth cut along the workpiece trajectory to complete the processing of complex surfaces, grooves or holes, and the chips are discharged through the spiral groove. Cutting parameters include Vc 100-600 m/min, fn 0.02-0.1 mm/tooth, ap 0.1-2 mm. Coolant (such as synthetic cutting fluid, flow rate ≥ 15 L/min) or dry cutting control temperature (< 700°C), combined with AI optimization and sensor monitoring in 2025, cutting efficiency will increase by 15%-20%, and accuracy will reach IT5-IT7 level.

3. Characteristics of Carbide End Mills

Ultra-high hardness: HV 1800-2100, suitable for materials below HRC 60.

Excellent wear resistance: VB ≤ 0.15 mm (500-1000 hours), life extended 5-7 times .

Excellent heat resistance: The coating is heat resistant to 1100°C and is suitable for high-speed cutting.

High precision: surface roughness Ra 0.02-0.08 μm , suitable for fine processing.

Versatility: adaptable to complex geometries and suitable for multi-axis machining.

Environmental protection: Dry cutting reduces coolant by 30%-40%.

4. Table of carbide end mill performance and influencing factors

Influencing factors	describe	Impact	Optimization suggestions	Data support
Cobalt content	5%-9%, balance of hardness and toughness	high	5% accuracy, 9% toughness	5% Co HV 1900
Cutting speed (Vc)	100-600 m/min, excessive wear	middle	Hard materials minus 10%	Vc 650 m/min Wear 7%
Feed rate (fn)	0.02-0.1 mm/tooth	middle	Finishing 0.02 mm/tooth	fn 0.12 Cutting force increased by 30%
Cutting depth (ap)	0.1-2 mm, too deep vibration	high	Layering 0.5 mm/layer	ap 2.5 mm Vibration increased by 18%
Coating thickness	2-3 μm , too thick and peeling	middle	Optimized 2.2-2.5 μm	< 2 μm Heat resistance decreases by 10%

5. Carbide end mill performance production process table

Process steps	Equipment/Parameters	Time/Conditions	Goal/Result	Technical indicators
Raw material mixing	Ball mill 300-400 rpm	40-60 hours	Evenly dispersed	CV < 2%
Pressing	200-250 MPa	20-30 seconds	Blank forming	Density 14-15.5 g/ cm³
sintering	1450-1550°C, HIP	2-3 hours	Densification	Density 99%-99.8%
Blade trimming	Diamond grinding wheel #1000-#1200	Trimming 0.002-0.005 mm	Accuracy optimization	Ra ≤ 0.05 μm
Coating	PVD Deposition of AlTiN	Thickness 2-3 μm	Improved heat resistance	Adhesion force > 70 N

7. Types of Carbide End Mills

Flat bottom end mill: diameter 1-15 mm, Vc 200-500 m/min, suitable for plane and groove processing .

Ball nose end mill: diameter 1-20 mm, Vc 150-400 m/min, suitable for complex curved surfaces.

Radius end mill: diameter 3-25 mm, Vc 200-600 m/min, suitable for transition surfaces.

Coated end mill: AlTiN coating, Vc 300-600 m/min, life extended by 40%-50%.

Long- edge end mill: length 100-150 mm, Vc 100-300 m/min, suitable for deep cavity processing.

6. Application of Carbide End Mills

Carbide end mills are widely used in many industries due to their high precision and versatility, as follows:

Mold manufacturing:

Processing complex contours of injection molds and die-casting molds, workpiece material is H13 steel, Vc 300-500 m/min, ap 0.2-1.5 mm, fn 0.03-0.08 mm/tooth. Accuracy IT7 level, Ra 0.02-0.04 µm , AI optimization in 2025 to reduce processing time by 15%.

Aerospace:

Processing curved surfaces of titanium alloy and aluminum alloy parts, such as wing skins, Vc 200-400 m/min, ap 0.1-1 mm, fn 0.02-0.06 mm/tooth. Accuracy IT5 level, Ra 0.01-0.03 µm .

Automobile manufacturing:

Processing grooves of cylinder heads and turbocharger impellers, workpiece material is aluminum alloy, Vc 300-500 m/min, ap 0.3-1.5 mm, fn 0.04-0.1 mm/tooth. Efficiency increased by 20%, Ra 0.03-0.06 µm .

Energy equipment:

Processing the curved surface structure of wind turbine blade molds, the workpiece material is composite material, Vc 150-300 m/min, ap 0.5-2 mm, fn 0.05-0.1 mm/tooth. IoT monitoring will reduce waste by 10% in 2025.

Electronics industry:

Processing 3D curves of mobile phone middle frames and circuit board brackets, the workpiece material is aluminum alloy, Vc 400-600 m/min, ap 0.1-0.8 mm, fn 0.02-0.06 mm/tooth. Accuracy ±0.001 mm, Ra 0.01-0.03 µm .

Medical equipment:

Processing complex surfaces of titanium alloy artificial joints, Vc 100-250 m/min, ap 0.1-0.5 mm, fn 0.02-0.05 mm/tooth. Accuracy ±0.0003 mm, Ra 0.01-0.02 µm .

Defense industry:

Processing the curved features of missile shells and radar covers, the workpiece material is high-strength steel, Vc 200-400 m/min, ap 0.3-1.5 mm, fn 0.03-0.08 mm/tooth. Wear resistance increased by 25%.

Shipbuilding industry:

Processing the curved surface of propeller blades, the workpiece material is bronze, Vc 150-300 m/min, ap 0.5-2 mm, fn 0.04-0.1 mm/tooth . The corrosion-resistant coating extends the service life by 30%.

Heavy machinery:

Processing transition surfaces of large gears, workpiece material is 40CrNiMo steel, Vc 150-300 m/min, ap 0.5-2 mm, fn 0.05-0.1 mm/tooth. Life extended by 35%.

Petrochemical industry:

Processing the curved features of valve bodies and pipe joints, the workpiece material is stainless steel, Vc 150-300 m/min, ap 0.3-1.5 mm, fn 0.04-0.08 mm/tooth. Corrosion resistance increased by 20%.

New energy industry:

Processing curved connections of solar panel frames, workpiece material is aluminum alloy, Vc 200-400 m/min, ap 0.3-1 mm, fn 0.03-0.08 mm/tooth. Efficiency increased by 15%.

Jewelry processing:

Processing fine carving of precious metals, the workpiece material is gold, Vc 100-200 m/min, ap 0.05-0.3 mm, fn 0.01-0.04 mm/tooth. Accuracy ±0.0001 mm.

Furniture manufacturing:

Processing decorative curves of wood or composite materials, Vc 200-400 m/min, ap 0.2-1 mm, fn 0.03-0.07 mm/tooth. Surface smoothness Ra 0.02-0.05 μm .

What is a carbide long edge end mill?

The cemented carbide long -edge end mill is a high-precision cutting tool made of cemented carbide material. The cutter body is designed in a vertical style, with an extended blade and peripheral cutting teeth . It is designed for deep cavities , deep holes and deep grooves. It combines the high hardness, wear resistance and excellent cutting performance of cemented carbide, and is suitable for processing steel, cast iron, non-ferrous metals and difficult-to-process materials. It is widely used in mold manufacturing, aerospace and energy equipment industries. The cemented carbide long-edge end mill uses tungsten carbide (WC) as the main hard phase and cobalt (Co) as the bonding phase. It is made through powder metallurgy and precision grinding processes. It is often equipped with AlTiN or TiAlN coating to improve heat resistance and service life. It is suitable for CNC machine tools and multi-axis machining centers. The following content will briefly outline the structure and materials, working principles, characteristics, performance influencing factors, production processes, types and applications.

1. Structure and materials of cemented carbide long- edge end mills

Carbide long- edge end mills are usually solid carbide structures with diameters ranging from 1-20 mm, blade lengths of 50-150 mm (total length up to 200 mm), and 2-6 teeth, depending on the diameter and processing depth. The blade geometry parameters (such as helix angle 30°-45°, rake angle 2°-10°) are optimized to adapt to deep cutting, and AlTiN or TiAlN coatings (thickness 2-4 μm) can be applied to the surface, with heat resistance up to 1100°C.

Material composition

Tungsten carbide (WC) particle size is 0.2-1.0 μm , cobalt (Co) content is 5%-9%, and NbC is added to enhance toughness and vibration resistance.

Structural features

Solid carbide hardness HV 1800-2100, tool coaxiality ≤ 0.003 mm, cutting edge accuracy ±0.005 mm.

2. Working principle of carbide long -edge end mill

Through rotation, the extended blade cuts along the deep cavity or deep hole trajectory of the workpiece, and the end and peripheral teeth complete the deep groove or deep cavity processing, and the chips are discharged through the optimized spiral groove. Cutting parameters include Vc 100-500 m/min, fn 0.02-0.08 mm/tooth, ap 0.1-10 mm (layering during deep cutting). Coolant (such as synthetic cutting fluid, flow rate ≥ 20 L/min) or dry cutting control temperature (< 700°C), combined with AI optimization and sensor monitoring in 2025, cutting efficiency will increase by 15%-20%, and accuracy will reach IT6-IT8 level.

3. Characteristics of Carbide Long -edge End Mills

Ultra-high hardness : HV 1800-2100, suitable for materials below HRC 60.

Excellent wear resistance : VB ≤ 0.15 mm (500-1000 hours), life extended 5-7 times .

Excellent heat resistance : The coating is heat resistant to 1100°C and can withstand deep cutting heat.

High depth capability : The blade length is up to 150 mm, suitable for deep cavity processing.

Vibration resistance : flexural strength ≥ 2200 MPa, reducing deep cutting vibration.
Versatility : Suitable for deep holes, deep grooves and complex deep cavity processing.

4. Performance and influencing factors of cemented carbide long- edge end mills

Performance is affected by material mix, edge length design and cutting parameters.

4.1 Performance Influencing Factors Table

Influencing factors	describe	Impact	Optimization suggestions	Data support
Cobalt content	5%-9%, balance of hardness and toughness	high	5% accuracy, 9% toughness	5% Co HV 1900
Cutting speed (Vc)	100-500 m/min, excessive wear	middle	Deep cut minus 10%	Vc 550 m/min wear 7%
Feed rate (fn)	0.02-0.08 mm/tooth	middle	Depth 0.02 mm/tooth	fn 0.1 Cutting force increased by 30%
Cutting depth (ap)	0.1-10 mm, too deep vibration	high	Layering 2 mm/layer	ap 12 mm vibration increased by 20%
Coating thickness	2-4 μm , too thick and peeling	middle	Optimized 2.5-3 μm	< 2 μm Heat resistance decreases by 10%

5. Carbide long -edge end mill performance production process

5.1 Production process table

Process steps	Equipment/Parameters	Time/Conditions	Goal/Result	Technical indicators
Raw material mixing	Ball mill 300-400 rpm	40-60 hours	Evenly dispersed	CV < 2%
Pressing	200-250 MPa	20-30 seconds	Blank forming	Density 14-15.5 g/cm³
sintering	1450-1550°C, HIP	2-3 hours	Densification	Density 99%-99.8%
Blade trimming	Diamond grinding wheel #1000-#1200	Trimming 0.002-0.005 mm	Accuracy optimization	Ra ≤ 0.05 μm
Coating	PVD Deposition of AlTiN	Thickness 2-4 μm	Improved heat resistance	Adhesion force > 70 N

Types of Carbide Long -Edge End Mills

Flat bottom long edge end mill : diameter 1-15 mm, Vc 200-400 m/min, suitable for deep grooves and deep holes.
Ball nose long edge end mill : diameter 1-20 mm, Vc 150-300 m/min, suitable for deep cavity surfaces.
Radius long edge end mill : diameter 3-20 mm, Vc 200-500 m/min, suitable for deep transition surfaces.

电话/TEL：0086 592 512 9696
CTIAQCD-MA-E/P 2018-2024V
sales@chinatungsten.com

Coated long- edge end mills : AlTiN coating, Vc 300-500 m/min, life extended by 40%-50%.
Extra long edge end mill : edge length 100-150 mm, Vc 100-250 m/min, suitable for extremely deep processing.

Application of carbide long -edge end mills

Carbide long- edge end mills are widely used in many industries due to their deep cutting capabilities and high precision, as follows:

Mold manufacturing :

Processing deep cavity injection molds and die-casting molds, the workpiece material is H13 steel, Vc 200-400 m/min, ap 2-10 mm, fn 0.02-0.06 mm/tooth. Accuracy IT7 level, Ra 0.02-0.04 μm , AI optimization in 2025 to reduce processing time by 15%.

Aerospace :

Processing deep holes and deep grooves in titanium alloys, such as engine parts, Vc 150-300 m/min, ap 1-5 mm, fn 0.02-0.05 mm/tooth. Accuracy IT6, Ra 0.01-0.03 μm .

Automobile manufacturing :

Processing deep grooves of cylinder blocks and deep cavities of crankshafts, workpiece material is cast iron, Vc 200-400 m/min, ap 2-8 mm, fn 0.03-0.08 mm/tooth. Efficiency increased by 20%, Ra 0.03-0.06 μm .

Energy equipment :

Processing deep structures of wind turbine blade molds, workpiece materials are composite materials, Vc 100-250 m/min, ap 3-10 mm, fn 0.03-0.07 mm/tooth. IoT monitoring will reduce waste by 10% in 2025.

Electronics industry :

Processing deep grooves and 3D deep cavities in mobile phone frames, workpiece material is aluminum alloy, Vc 300-500 m/min, ap 1-5 mm, fn 0.02-0.06 mm/tooth. Accuracy ±0.001 mm, Ra 0.01-0.03 μm .

Medical equipment :

Processing deep features of titanium alloy artificial joints, Vc 100-200 m/min, ap 1-3 mm, fn 0.02-0.05 mm/tooth. Accuracy ±0.0003 mm, Ra 0.01-0.02 μm .

Defense industry :

Processing deep grooves on missile casings, workpiece material is high-strength steel, Vc 150-300 m/min, ap 2-6 mm, fn 0.03-0.07 mm/tooth. Wear resistance increased by 25%.

Shipbuilding industry :

Processing deep grooves on propeller shafts, workpiece material is stainless steel, Vc 150-300 m/min, ap 2-8 mm, fn 0.03-0.08 mm/tooth. Anti-corrosion coating extends service life by 30%.

Heavy machinery :

Processing deep grooves of large gears, workpiece material is 40CrNiMo steel, Vc 100-250 m/min, ap 3-10 mm, fn 0.04-0.08 mm/tooth. Life extended by 35%.

Petrochemical industry :

Processing deep valve body cavities, workpiece material is stainless steel, Vc 150-300 m/min, ap 2-6 mm, fn 0.03-0.07 mm/tooth. Corrosion resistance increased by 20%.

New energy industry :

Processing deep connection grooves of solar brackets, workpiece material is aluminum alloy, Vc 200-400 m/min, ap 2-5 mm, fn 0.03-0.06 mm/tooth. Efficiency increased by 15%.

Furniture manufacturing :

Processing deep decorative grooves in wooden panels, Vc 150-300 m/min, ap 2-5 mm, fn 0.03-0.07 mm/tooth. Surface smoothness Ra 0.02-0.05 μm .

Construction machinery :

Processing deep grooves on excavator arms, workpiece material is 35CrMo steel, Vc 150-300 m/min, ap 2-8 mm, fn 0.03-0.08 mm/tooth. Life extended by 30%.

What is a Carbide Ball Nose End Mill?

Carbide ball end mill is a high-precision cutting tool made of carbide material. The cutter head is spherical in design, with cutting teeth on the end and periphery. It is designed for processing complex three-dimensional surfaces, mold cavities and contours. It combines the high hardness, wear resistance and excellent cutting performance of cemented carbide. It is suitable for processing steel, cast iron, non-ferrous metals and difficult-to-process materials. It is widely used in mold manufacturing, aerospace and automotive industries. Carbide ball end mills use tungsten carbide (WC) as the main hard phase and cobalt (Co) as the bonding phase. They are made through powder metallurgy and precision grinding processes. They are often equipped with AlTiN or TiSiN coatings to improve heat resistance and service life. They are suitable for CNC machine tools and multi-axis machining centers. The following content will briefly summarize the structure and materials, working principles, characteristics, performance influencing factors, production processes, types and applications.

1. Structure and materials of carbide ball end mills

Carbide ball nose end mills are usually solid carbide structures with diameters ranging from 1-20 mm, lengths of 50-150 mm, and 2-6 teeth, depending on the diameter and processing requirements. The ball nose design ensures a smooth transition, and the blade geometry (such as a helix angle of 30°-45°, a rake angle of 2°-10°) is optimized to accommodate curved surface processing. AlTiN or TiSiN coatings (thickness 2-3 μm) can be applied to the surface, with a heat resistance of up to 1100°C.

Material composition

Tungsten carbide (WC) particle size is 0.2-1.0 μm , cobalt (Co) content is 5%-9%, and NbC is added to enhance toughness and wear resistance.

Structural features

Solid carbide hardness HV 1800-2100, tool coaxiality ≤ 0.003 mm, cutting edge accuracy ±0.005 mm.

2. Working Principle of Carbide Ball End Mill

By rotating, the spherical cutter head cuts along the workpiece surface trajectory to complete three-dimensional surface, cavity or contour processing, and the chips are discharged through the spiral groove. Cutting parameters include Vc 100-500 m/min, fn 0.02-0.08 mm/tooth, ap 0.1-2 mm. Coolant (such as synthetic cutting fluid, flow rate ≥ 15 L/min) or dry cutting control temperature (< 700°C), combined with AI optimization and sensor monitoring in 2025, cutting efficiency will increase by 15%-20%, and accuracy will reach IT5-IT7 level.

3. Characteristics of Carbide Ball End Mills

Ultra-high hardness : HV 1800-2100, suitable for materials below HRC 60.

Excellent wear resistance : VB ≤ 0.15 mm (500-1000 hours), life extended 5-7 times .

Excellent heat resistance : The coating is heat resistant to 1100°C and is suitable for high-speed curved surface cutting.

High precision : surface roughness Ra 0.02-0.06 μm , suitable for fine curved surfaces.
Versatility : adaptable to complex 3D geometries and suitable for multi-axis machining.
Environmental protection : Dry cutting reduces coolant by 30%-40%.

4. Carbide ball nose end mill performance and influencing factors

Performance is affected by material mix, ball nose geometry and cutting parameters.

4.1 Performance Influencing Factors Table

Influencing factors	describe	Impact	Optimization suggestions	Data support
Cobalt content	5%-9%, balance of hardness and toughness	high	5% accuracy, 9% toughness	5% Co HV 1900
Cutting speed (Vc)	100-500 m/min, excessive wear	middle	Hard materials minus 10%	Vc 550 m/min wear 7%
Feed rate (fn)	0.02-0.08 mm/tooth	middle	Finishing 0.02 mm/tooth	fn 0.1 Cutting force increased by 30%
Cutting depth (ap)	0.1-2 mm, too deep vibration	high	Layering 0.5 mm/layer	ap 2.5 mm Vibration increased by 18%
Coating thickness	2-3 μm , too thick and peeling	middle	Optimized 2.2-2.5 μm	< 2 μm Heat resistance decreases by 10%

5. Carbide ball nose end mill performance production process

5.1 Production process table

Process steps	Equipment/Parameters	Time/Conditions	Goal/Result	Technical indicators
Raw material mixing	Ball mill 300-400 rpm	40-60 hours	Evenly dispersed	CV < 2%
Pressing	200-250 MPa	20-30 seconds	Blank forming	Density 14-15.5 g/ cm^3
sintering	1450-1550°C, HIP	2-3 hours	Densification	Density 99%-99.8%
Blade trimming	Diamond grinding wheel #1000-#1200	Trimming 0.002-0.005 mm	Accuracy optimization	Ra ≤ 0.05 μm
Coating	PVD Deposition of AlTiN	Thickness 2-3 μm	Improved heat resistance	Adhesion force > 70 N

7. Types of Carbide Ball End Mills

Standard ball nose end mills : diameter 1-15 mm, Vc 150-400 m/min, suitable for general surface

machining.
Fine-tooth ball nose end mill : 4-6 teeth, Vc 200-500 m/min, suitable for fine machining.
Coated ball nose end mill : AlTiN coating, Vc 300-500 m/min, life extended by 40%-50%.
Long- edge ball nose end mill : edge length 50-100 mm, Vc 100-300 m/min, suitable for deep cavity surfaces.
Micro ball nose end mills : diameter 1-6 mm, Vc 100-300 m/min, suitable for micro machining.

6. Application of Carbide Ball End Mills

Carbide ball nose end mills are widely used in many industries due to their curved surface processing capabilities and high precision, as follows:

Mold manufacturing :
Processing complex curved surfaces of injection molds and die-casting molds, the workpiece material is P20 steel, Vc 300-500 m/min, ap 0.1-1.5 mm, fn 0.02-0.06 mm/tooth. Accuracy IT6 level, Ra 0.02-0.04 µm , AI optimization in 2025 to reduce processing time by 15%.

Aerospace :
Processing titanium alloy and aluminum alloy curved surfaces, such as wing skins, Vc 200-400 m/min, ap 0.1-1 mm, fn 0.02-0.05 mm/tooth. Accuracy IT5 level, Ra 0.01-0.03 µm .

Automobile manufacturing :
Processing the curved features of cylinder heads and turbine blades, the workpiece material is aluminum alloy, Vc 300-500 m/min, ap 0.2-1 mm, fn 0.03-0.07 mm/tooth. Efficiency increased by 20%, Ra 0.02-0.05 µm .

Energy equipment :
Processing the curved surface structure of wind turbine blade molds, the workpiece material is composite material, Vc 150-300 m/min, ap 0.5-2 mm, fn 0.03-0.06 mm/tooth. IoT monitoring will reduce waste by 10% in 2025.

Electronics industry :
Processing 3D curved surfaces of mobile phone housings and circuit board brackets, workpiece material is aluminum alloy, Vc 400-600 m/min, ap 0.1-0.8 mm, fn 0.02-0.05 mm/tooth. Accuracy ±0.001 mm, Ra 0.01-0.03 µm .

Medical equipment :
Processing the curved surface features of titanium alloy artificial joints, Vc 100-250 m/min, ap 0.1-0.5 mm, fn 0.02-0.04 mm/tooth. Accuracy ±0.0003 mm, Ra 0.01-0.02 µm .

Defense industry :
Processing the curved surface structure of missile shells, the workpiece material is high-strength steel, Vc 200-400 m/min, ap 0.3-1.5 mm, fn 0.03-0.06 mm/tooth. Wear resistance increased by 25%.

Shipbuilding industry :
Processing the curved surface of propeller blades, the workpiece material is bronze, Vc 150-300 m/min, ap 0.5-2 mm, fn 0.03-0.07 mm/tooth. The corrosion-resistant coating extends the service life by 30%.

Heavy machinery :
Processing the curved transition of large gears, the workpiece material is 40CrNiMo steel, Vc 150-300 m/min, ap 0.5-2 mm, fn 0.04-0.08 mm/tooth. The service life is extended by 35%.

电话/TEL：0086 592 512 9696
CTIAQCD-MA-E/P 2018-2024V
sales@chinatungsten.com

Petrochemical industry :
Processing valve body curved surface features, workpiece material is stainless steel, Vc 150-300 m/min, ap 0.3-1.5 mm, fn 0.03-0.06 mm/tooth. Corrosion resistance increased by 20%.

New energy industry :
Processing curved connections of solar panel frames, workpiece material is aluminum alloy, Vc 200-400 m/min, ap 0.3-1 mm, fn 0.03-0.06 mm/tooth. Efficiency increased by 15%.

Jewelry processing :
Processing of curved surface engraving of precious metals, workpiece material is gold, Vc 100-200 m/min, ap 0.05-0.3 mm, fn 0.01-0.03 mm/tooth. Accuracy ±0.0001 mm.

Furniture manufacturing :
Processing curved surface decoration of wood or composite materials, Vc 200-400 m/min, ap 0.2-1 mm, fn 0.03-0.06 mm/tooth. Surface smoothness Ra 0.02-0.04 μm .

What is a Carbide Round Nose Milling Cutter?

Carbide round nose milling cutter is a high-precision cutting tool made of carbide material. The cutter head is designed with rounded corners or arcs, and there are cutting teeth on the end and periphery. It is designed for processing smooth transition surfaces, grooves and contours. It combines the high hardness, wear resistance and excellent cutting performance of cemented carbide. It is suitable for processing steel, cast iron, non-ferrous metals and difficult-to-process materials. It is widely used in mold manufacturing, automotive and aerospace industries. Carbide round nose milling cutter uses tungsten carbide (WC) as the main hard phase and cobalt (Co) as the bonding phase. It is made by powder metallurgy and precision grinding process. It is often equipped with AlTiN or TiCN coating to improve heat resistance and service life. It is suitable for CNC machine tools and multi-axis machining centers. The following content will briefly summarize the structure and materials, working principle, characteristics, performance influencing factors, production process, types and applications.

1. Structure and materials of carbide round nose milling cutter

Carbide round nose milling cutters are usually solid carbide structures with diameters ranging from 2-25 mm, lengths of 50-150 mm, and 2-6 teeth, depending on the diameter and processing requirements. The rounded corner design (radius 0.1-10 mm) optimizes transition surface processing, and the blade geometry parameters (such as helix angle 30°-45°, rake angle 2°-10°) are suitable for smooth cutting. AlTiN or TiCN coatings (thickness 2-3 μm) can be applied to the surface, and the heat resistance reaches 1100°C.

Material composition : tungsten carbide (WC) particle size 0.2-1.0 μm , cobalt (Co) content 5%-9%, TaC added to enhance wear resistance.

Structural features : Overall carbide hardness HV1800-2100, tool coaxiality ≤ 0.003 mm, blade accuracy ±0.005 mm.

2. Working principle of carbide round nose milling cutter

By rotating, the rounded cutter head cuts along the workpiece trajectory to complete the transition surface, groove or contour processing, and the chips are discharged through the spiral groove. Cutting parameters include Vc 100-500 m/min, fn 0.02-0.08 mm/tooth, ap 0.1-2 mm. Coolant (such as synthetic cutting fluid, flow rate ≥ 15 L/min) or dry cutting control temperature (< 700°C), combined with AI optimization and sensor monitoring in 2025, the cutting efficiency will be increased by 15%-20%, and the accuracy will reach IT5-IT7 level.

3. Characteristics of Carbide Round Nose Milling Cutter

Ultra-high hardness : HV 1800-2100, suitable for materials below HRC 60.

Excellent wear resistance : VB ≤ 0.15 mm (500-1000 hours), life extended 5-7 times .

Excellent heat resistance : The coating is heat resistant to 1100°C and is suitable for high-speed cutting.

High precision : surface roughness Ra 0.02-0.06 μm , suitable for smooth transition.

Versatility : Suitable for rounded corner transitions and complex contour processing.

Vibration resistance : flexural strength ≥ 2200 MPa, reducing vibration.

电话/TEL：0086 592 512 9696
CTIAQCD-MA-E/P 2018-2024V
sales@chinatungsten.com

4. Carbide round nose milling cutter performance and influencing factors

Performance is affected by material mix, corner radius design and cutting parameters.

4.1 Performance Influencing Factors Table

Influencing factors	describe	Impact	Optimization suggestions	Data support
Cobalt content	5%-9%, balance of hardness and toughness	high	5% accuracy, 9% toughness	5% Co HV 1900
Cutting speed (Vc)	100-500 m/min, excessive wear	middle	Hard materials minus 10%	Vc 550 m/min wear 7%
Feed rate (fn)	0.02-0.08 mm/tooth	middle	Finishing 0.02 mm/tooth	fn 0.1 Cutting force increased by 30%
Cutting depth (ap)	0.1-2 mm, too deep vibration	high	Layering 0.5 mm/layer	ap 2.5 mm Vibration increased by 18%
Coating thickness	2-3 μm , too thick and peeling	middle	Optimized 2.2-2.5 μm	< 2 μm Heat resistance decreases by 10%

5. Carbide round nose milling cutter performance production process

Process steps	Equipment/Parameters	Time/Conditions	Goal/Result	Technical indicators
Raw material mixing	Ball mill 300-400 rpm	40-60 hours	Evenly dispersed	CV < 2%
Pressing	200-250 MPa	20-30 seconds	Blank forming	Density 14-15.5 g/ cm³
sintering	1450-1550°C, HIP	2-3 hours	Densification	Density 99%-99.8%
Blade trimming	Diamond grinding wheel #1000-#1200	Trimming 0.002-0.005 mm	Accuracy optimization	Ra ≤ 0.05 μm
Coating	PVD Deposition of AlTiN	Thickness 2-3 μm	Improved heat resistance	Adhesion force > 70 N

7. Types of Carbide Round Nose Milling Cutters

Standard round nose milling cutter : diameter 2-15 mm, Vc 150-400 m/min, suitable for general transition processing.

Fine-tooth round nose milling cutter : number of teeth 4-6, Vc 200-500 m/min, suitable for fine processing.

Coated round nose milling cutter : AlTiN coating, Vc 300-500 m/min, life extended by 40%-50%.

Long- edge round nose milling cutter : edge length 50-100 mm, Vc 100-300 m/min, suitable for deep groove surfaces.

Large radius round nose milling cutter : corner radius 5-10 mm, Vc 100-400 m/min, suitable for large transition surfaces.

6. Application of Carbide Round Nose Milling Cutter

Carbide round nose milling cutters are widely used in many industries due to their ability to round corners and high precision, as follows:

Mold manufacturing :

processing the radius transition of injection molds and die-casting molds, the workpiece material is P20 steel, Vc 300-500 m/min, ap 0.1-1.5 mm, fn 0.02-0.06 mm/tooth. Accuracy IT6 level, Ra 0.02-0.04 μm , AI optimization in 2025 will reduce processing time by 15%.

Aerospace :

Processing fillet features of titanium and aluminum alloys, such as wing skins, Vc 200-400 m/min, ap 0.1-1 mm, fn 0.02-0.05 mm/tooth. Accuracy IT5 level, Ra 0.01-0.03 μm .

Automobile manufacturing :

Processing the fillet grooves of cylinder heads and transmission parts, the workpiece material is aluminum alloy, Vc 300-500 m/min, ap 0.2-1 mm, fn 0.03-0.07 mm/tooth. Efficiency increased by 20%, Ra 0.02-0.05 μm .

Energy equipment :

Processing the fillet structure of wind turbine blade molds, the workpiece material is composite material, Vc 150-300 m/min, ap 0.5-2 mm, fn 0.03-0.06 mm/tooth. IoT monitoring will reduce waste by 10% in 2025.

Electronics industry :

Processing the rounded corner transition of mobile phone shell, the workpiece material is aluminum alloy, Vc 400-600 m/min, ap 0.1-0.8 mm, fn 0.02-0.05 mm/tooth. Accuracy ±0.001 mm, Ra 0.01-0.03 μm .

Medical equipment :

Processing the fillet features of titanium alloy artificial joints, Vc 100-250 m/min, ap 0.1-0.5 mm, fn 0.02-0.04 mm/tooth. Accuracy ±0.0003 mm, Ra 0.01-0.02 μm .

Defense industry :

Processing the rounded corner structure of missile casing, the workpiece material is high-strength steel, Vc 200-400 m/min, ap 0.3-1.5 mm, fn 0.03-0.06 mm/tooth . Wear resistance increased by 25%.

Shipbuilding industry :

Processing the fillet transition of propeller blades, the workpiece material is bronze, Vc 150-300 m/min, ap 0.5-2 mm, fn 0.03-0.07 mm/tooth. The corrosion-resistant coating extends the service life by 30%.

Heavy machinery :

Processing the fillet transition of large gears, the workpiece material is 40CrNiMo steel, Vc 150-300 m/min, ap 0.5-2 mm, fn 0.04-0.08 mm/tooth. The service life is extended by 35%.

Petrochemical industry :

Processing valve body fillet features, workpiece material is stainless steel, Vc 150-300 m/min, ap

0.3-1.5 mm, fn 0.03-0.06 mm/tooth. Corrosion resistance increased by 20%.

New energy industry :

Processing the fillet connection of solar panel frames, the workpiece material is aluminum alloy, Vc 200-400 m/min, ap 0.3-1 mm, fn 0.03-0.06 mm/tooth. Efficiency increased by 15%.

Furniture manufacturing :

Processing of rounded corners of wood or composite materials, Vc 200-400 m/min, ap 0.2-1 mm, fn 0.03-0.06 mm/tooth. Surface smoothness Ra 0.02-0.04 μm .

Construction machinery :

Processing the rounded transition of excavator arms, the workpiece material is 35CrMo steel, Vc 150-300 m/min, ap 0.5-2 mm, fn 0.03-0.07 mm/tooth. The service life is extended by 30%.

What is a Carbide Bullnose Milling Cutter?

Carbide bullnose milling cutter is a special cutting tool made of carbide material. The cutter head is designed to be arc-shaped or bullnose-shaped, and cutting teeth are provided at the end and periphery. It is mainly used for processing grooves, arc grooves or chamfers and other features. It combines the high hardness, wear resistance and excellent cutting performance of cemented carbide, and is suitable for processing steel, cast iron, non-ferrous metals and difficult-to-process materials. It is widely used in mold manufacturing, machining and automotive industries. Carbide bullnose milling cutter uses tungsten carbide (WC) as the main hard phase and cobalt (Co) as the bonding phase. It is made by powder metallurgy and precision grinding process. It is often equipped with AlTiN or TiCN coating to improve heat resistance and service life. It is suitable for CNC machine tools and machining centers. The following content will briefly summarize the structure and materials, working principle, characteristics, performance influencing factors, production process, types and applications.

1. Structure and materials of cemented carbide bullnose milling cutter

Carbide bullnose milling cutters are usually solid carbide structures with diameters ranging from 4-32 mm, lengths of 50-150 mm, and 2-6 teeth, depending on the diameter and processing requirements. The bullnose-shaped cutter head (arc radius 0.5-15 mm) optimizes chamfering and groove processing , and the blade geometry parameters (such as helix angle 30°-45°, rake angle 2°-10°) are adapted to arc cutting. AlTiN or TiCN coatings (thickness 2-3 μm) can be applied to the surface, and the heat resistance reaches 1100°C.

Material composition : tungsten carbide (WC) particle size 0.2-1.0 μm , cobalt (Co) content 5%-9%, TaC added to enhance wear resistance.

Structural features : Overall carbide hardness HV1800-2100, tool coaxiality ≤ 0.003 mm, blade accuracy ±0.005 mm.

2. Working principle of carbide bullnose milling cutter

By rotating, the nose-shaped tool head cuts along the workpiece trajectory to complete arc groove, chamfer or groove processing, and the chips are discharged through the spiral groove. Cutting parameters include Vc 100-400 m/min, fn 0.02-0.08 mm/tooth, ap 0.1-2 mm. Coolant (such as synthetic cutting fluid, flow rate ≥ 15 L/min) or dry cutting control temperature (< 700°C), combined with AI optimization and sensor monitoring in 2025, cutting efficiency will increase by 15%-20%, and accuracy will reach IT6-IT8 level.

3. Characteristics of Carbide Bullnose Milling Cutter

Ultra-high hardness : HV 1800-2100, suitable for materials below HRC 60.

Excellent wear resistance : VB ≤ 0.15 mm (500-1000 hours), life extended 5-7 times .

Excellent heat resistance : The coating is heat resistant to 1100°C and is suitable for medium-speed cutting.

High precision : surface roughness Ra 0.02-0.06 μm , suitable for arc processing.

Versatility : Adapt to chamfering and grooving needs .

Vibration resistance : flexural strength ≥ 2200 MPa, reducing vibration.

4. Performance and influencing factors of cemented carbide bullnose milling cutters

Performance is affected by material mix, cutter head geometry and cutting parameters.

4.1 Performance Influencing Factors Table

Influencing factors	describe	Impact	Optimization suggestions	Data support
Cobalt content	5%-9%, balance of hardness and toughness	high	5% accuracy, 9% toughness	5% Co HV 1900
Cutting speed (Vc)	100-400 m/min, excessive wear	middle	Hard materials minus 10%	Vc 450 m/min wear 7%
Feed rate (fn)	0.02-0.08 mm/tooth	middle	Finishing 0.02 mm/tooth	fn 0.1 Cutting force increased by 30%
Cutting depth (ap)	0.1-2 mm, too deep vibration	high	Layering 0.5 mm/layer	ap 2.5 mm Vibration increased by 18%
Coating thickness	2-3 μm , too thick and peeling	middle	Optimized 2.2-2.5 μm	< 2 μm Heat resistance decreases by 10%

5. Carbide Bullnose Milling Cutter Performance Production Process

5.1 Production process table

Process steps	Equipment/Parameters	Time/Conditions	Goal/Result	Technical indicators
Raw material mixing	Ball mill 300-400 rpm	40-60 hours	Evenly dispersed	CV < 2%
Pressing	200-250 MPa	20-30 seconds	Blank forming	Density 14-15.5 g/ cm³
sintering	1450-1550°C, HIP	2-3 hours	Densification	Density 99%-99.8%
Blade trimming	Diamond grinding wheel #1000-#1200	Trimming 0.002-0.005 mm	Accuracy optimization	Ra ≤ 0.05 μm
Coating	PVD Deposition of AlTiN	Thickness 2-3 μm	Improved heat resistance	Adhesion force > 70 N

6. Types of Carbide Bullnose Milling Cutters

Standard bull nose milling cutter : diameter 4-20 mm, Vc 150-400 m/min, suitable for general arc groove processing.

Fine-tooth bullnose milling cutter : number of teeth 4-6, Vc 200-400 m/min, suitable for fine chamfering.

Coated bull nose milling cutter : AlTiN coating, Vc 300-400 m/min, life extended by 40%-50%.
Long- edge bullnose milling cutter : edge length 50-100 mm, Vc 100-300 m/min, suitable for deep arc grooves.
Large arc bull nose milling cutter : arc radius 5-15 mm, Vc 100-350 m/min, suitable for large chamfers.

7. Application of carbide nose milling cutter

Carbide nose milling cutters are widely used in many industries due to their arc and chamfering processing capabilities, as follows:

Mold manufacturing :
Processing arc grooves and chamfers for injection molds and die-casting molds. The workpiece material is P20 steel, Vc 200-400 m/min, ap 0.1-1.5 mm, fn 0.02-0.06 mm/tooth. Accuracy IT6 level, Ra 0.02-0.04 μm . AI optimization will reduce processing time by 15% in 2025.

Automobile manufacturing :
Processing arc grooves of cylinder blocks and gears, workpiece material is cast iron, Vc 150-300 m/min, ap 0.2-1 mm, fn 0.03-0.07 mm/tooth. Efficiency increased by 20%, Ra 0.02-0.05 μm .

Aerospace :
Processing chamfered features of titanium and aluminum alloys, such as wing edges, Vc 200-400 m/min, ap 0.1-1 mm, fn 0.02-0.05 mm/tooth. Accuracy IT5 level, Ra 0.01-0.03 μm .

Energy equipment :
Processing arc structures of wind turbine blade molds, workpiece materials are composite materials, Vc 150-300 m/min, ap 0.5-2 mm, fn 0.03-0.06 mm/tooth. IoT monitoring will reduce waste by 10% in 2025.

Electronics industry :
Processing arc chamfers of mobile phone shells, workpiece material is aluminum alloy, Vc 300-500 m/min, ap 0.1-0.8 mm, fn 0.02-0.05 mm/tooth. Accuracy ±0.001 mm, Ra 0.01-0.03 μm .

Medical equipment :
Processing arc features of titanium alloy artificial joints, Vc 100-250 m/min, ap 0.1-0.5 mm, fn 0.02-0.04 mm/tooth. Accuracy ±0.0003 mm, Ra 0.01-0.02 μm .

Defense industry :
Processing arc grooves on missile casings, workpiece material is high-strength steel, Vc 150-300 m/min, ap 0.3-1.5 mm, fn 0.03-0.06 mm/tooth. Wear resistance increased by 25%.

Shipbuilding industry :
Processing arc chamfers of propeller shafts, workpiece material is stainless steel, Vc 150-300 m/min, ap 0.5-2 mm, fn 0.03-0.07 mm/tooth. Anti-corrosion coating extends service life by 30%.

Heavy machinery :
Processing arc transition of large gears, workpiece material is 40CrNiMo steel, Vc 150-300 m/min, ap 0.5-2 mm, fn 0.04-0.08 mm/tooth. Life extended by 35%.

Petrochemical industry :
Processing arc grooves on valve bodies, workpiece material is stainless steel, Vc 150-300 m/min, ap 0.3-1.5 mm, fn 0.03-0.06 mm/tooth. Corrosion resistance increased by 20%.

New energy industry :

Processing arc connections of solar brackets, workpiece material is aluminum alloy, Vc 200-400 m/min, ap 0.3-1 mm, fn 0.03-0.06 mm/tooth. Efficiency increased by 15%.

Furniture manufacturing :

Processing arc decoration of wooden boards, Vc 150-300 m/min, ap 0.2-1 mm, fn 0.03-0.06 mm/tooth. Surface smoothness Ra 0.02-0.04 μm .

Construction machinery :

Processing arc chamfers of excavator arms, workpiece material is 35CrMo steel, Vc 150-300 m/min, ap 0.5-2 mm, fn 0.03-0.07 mm/tooth. Life extended by 30%.

CTIA GROUP LTD

30 Years of Cemented Carbide Customization Experts

Core Advantages

30 years of experience: We are well versed in cemented carbide production and processing , with mature and stable technology and continuous improvement .

Precision customization: Supports special performance and complex design , and focuses on customer + AI collaborative design .

Quality cost: Optimized molds and processing, excellent cost performance; leading equipment, RMI , ISO 9001 certification.

Serving Customers

The products cover cutting, tooling, aviation, energy, electronics and other fields, and have served more than 100,000 customers.

Service Commitment

1+ billion visits, 1+ million web pages, 100,000+ customers, and 0 complaints in 30 years!

Contact Us

Email : sales@chinatungsten.com

Tel : +86 592 5129696

Official website : www.ctia.com.cn




What is a Carbide Chamfer Milling Cutter?

Cemented carbide chamfer milling cutter is a special cutting tool made of cemented carbide material. The cutter head is designed to be chamfered or beveled, and there are cutting teeth on the end and periphery. It is mainly used for chamfering, beveling or deburring the edge of the workpiece. It combines the high hardness, wear resistance and excellent cutting performance of cemented carbide. It is suitable for processing steel, cast iron, non-ferrous metals and difficult-to-process materials. It is widely used in mechanical processing, automobile manufacturing and mold industries. Cemented carbide chamfer milling cutter uses tungsten carbide (WC) as the main hard phase and cobalt (Co) as the bonding phase. It is made by powder metallurgy and precision grinding process. It is often equipped with AlTiN or TiCN coating to improve heat resistance and service life. It is suitable for CNC machine tools and machining centers. The following content will briefly summarize the structure and materials, working principle, characteristics, performance influencing factors, production process, types and applications.

1. Structure and materials of carbide chamfer milling cutter

Carbide chamfer milling cutters are usually solid carbide structures with diameters ranging from 3-25 mm, lengths of 50-150 mm, and 2-4 teeth, depending on the diameter and chamfering requirements. The chamfer angle of the cutter head (commonly 30°, 45°, 60°) optimizes the processing of inclined surfaces, and the geometric parameters of the blade (such as helix angle 30°-40°, rake angle 0°-5°) are adapted to chamfering cutting. AlTiN or TiCN coatings (thickness 2-3 μm) can be applied to the surface, and the heat resistance reaches 1100°C.

Material composition : tungsten carbide particle size 0.2-1.0 μm , cobalt (Co) content 5%-9%, TaC added to enhance wear resistance.

Structural features : Overall carbide hardness HV 1800-2100, tool coaxiality ≤ 0.003 mm, blade accuracy ±0.005 mm.

2. Working principle of carbide chamfer milling cutter

By rotating, the chamfering head cuts along the edge or surface trajectory of the workpiece to complete chamfering, beveling or deburring, and the chips are discharged through the spiral groove. Cutting parameters include Vc 100-400 m/min, fn 0.02-0.06 mm/tooth, ap 0.1-1 mm. Coolant (such as synthetic cutting fluid, flow rate ≥ 15 L/min) or dry cutting control temperature (< 700°C), combined with AI optimization and sensor monitoring in 2025, cutting efficiency will increase by 15%-20%, and accuracy will reach IT6-IT8 level.

3. Characteristics of carbide chamfer milling cutters

Ultra-high hardness : HV 1800-2100, suitable for materials below HRC 60.

Excellent wear resistance : VB ≤ 0.15 mm (500-1000 hours), life extended 5-7 times .

Excellent heat resistance : The coating is heat resistant to 1100°C and is suitable for medium-speed cutting.

High precision : surface roughness Ra 0.02-0.05 μm , suitable for fine chamfering.

Versatility : adaptable to various chamfering angles and deburring requirements.

Vibration resistance : flexural strength ≥ 2200 MPa, reducing vibration.

4. Carbide chamfering cutter performance and influencing factors

Performance is affected by material mix, chamfer angle and cutting parameters.

4.1 Performance Influencing Factors Table

Influencing factors	describe	Impact	Optimization suggestions	Data support
Cobalt content	5%-9%, balance of hardness and toughness	high	5% accuracy, 9% toughness	5% Co HV 1900
Cutting speed (Vc)	100-400 m/min, excessive wear	middle	Hard materials minus 10%	Vc 450 m/min wear 7%
Feed rate (fn)	0.02-0.06 mm/tooth	middle	Finishing 0.02 mm/tooth	fn 0.08 Cutting force increased by 25%
Cutting depth (ap)	0.1-1 mm, too deep vibration	high	Layering 0.3 mm/layer	ap 1.5 mm vibration increase 15%
Coating thickness	2-3 µm , too thick and peeling	middle	Optimized 2.2-2.5 µm	< 2 µm Heat resistance decreases by 10%

5. Carbide chamfering cutter performance and production process

5.1 Production process table

Process steps	Equipment/Parameters	Time/Conditions	Goal/Result	Technical indicators
Raw material mixing	Ball mill 300-400 rpm	40-60 hours	Evenly dispersed	CV < 2%
Pressing	200-250 MPa	20-30 seconds	Blank forming	Density 14-15.5 g/ cm³
sintering	1450-1550°C, HIP	2-3 hours	Densification	Density 99%-99.8%
Blade trimming	Diamond grinding wheel #1000-#1200	Trimming 0.002-0.005 mm	Accuracy optimization	Ra ≤ 0.05 µm
Coating	PVD Deposition of AlTiN	Thickness 2-3 µm	Improved heat resistance	Adhesion force > 70 N

7. Types of Carbide Chamfering Cutters

Standard chamfering cutter : diameter 3-20 mm, Vc 150-400 m/min, suitable for general chamfering.

45° chamfer milling cutter : diameter 4-25 mm, Vc 200-400 m/min, suitable for standard chamfering.

Coated chamfer milling cutter : AlTiN coating, Vc 300-400 m/min, life extended by 40%-50%.

Long- edge chamfering cutter : edge length 50-100 mm, Vc 100-300 m/min, suitable for deep chamfering.

Multi-angle chamfering cutter : angle 30°-60°, Vc 100-350 m/min, suitable for customized processing.

6. Application of carbide chamfer milling cutter

Carbide chamfer milling cutters are widely used in several industries due to their chamfering and deburring capabilities, as follows:

Mold manufacturing :

Processing the edge chamfers of injection molds and die-casting molds, the workpiece material is P20 steel, Vc 200-400 m/min, ap 0.1-1 mm, fn 0.02-0.05 mm/tooth. Accuracy IT6 level, Ra 0.02-0.04 μm , AI optimization in 2025 to reduce processing time by 15%.

Automobile manufacturing :

Chamfering the edges of cylinder blocks and gears, workpiece material is cast iron, Vc 150-300 m/min, ap 0.2-1 mm, fn 0.03-0.06 mm/tooth. Efficiency increased by 20%, Ra 0.02-0.05 μm .

Aerospace :

Processing of chamfers of titanium and aluminum alloys, such as wing edges, Vc 200-400 m/min, ap 0.1-1 mm, fn 0.02-0.05 mm/tooth. Accuracy IT5, Ra 0.01-0.03 μm .

Energy equipment :

Processing the edge chamfer of wind turbine blade molds, the workpiece material is composite material, Vc 150-300 m/min, ap 0.5-1.5 mm, fn 0.03-0.06 mm/tooth. IoT monitoring will reduce waste by 10% in 2025.

Electronics industry :

Processing the edge chamfer of mobile phone housing, the workpiece material is aluminum alloy, Vc 300-500 m/min, ap 0.1-0.8 mm, fn 0.02-0.05 mm/tooth. Accuracy ±0.001 mm, Ra 0.01-0.03 μm .

Medical equipment :

Processing the chamfering features of titanium alloy artificial joints, Vc 100-250 m/min, ap 0.1-0.5 mm, fn 0.02-0.04 mm/tooth. Accuracy ±0.0003 mm, Ra 0.01-0.02 μm .

Defense industry :

Processing the edge chamfer of missile casings, the workpiece material is high-strength steel, Vc 150-300 m/min, ap 0.3-1 mm, fn 0.03-0.06 mm/tooth. Wear resistance increased by 25%.

Shipbuilding industry :

Processing the chamfer features of propeller shafts, workpiece material is stainless steel, Vc 150-300 m/min, ap 0.5-1.5 mm, fn 0.03-0.06 mm/tooth. Corrosion-resistant coating extends service life by 30%.

Heavy machinery :

Processing the edge chamfering of large gears, the workpiece material is 40CrNiMo steel, Vc 150-300 m/min, ap 0.5-1 mm, fn 0.04-0.07 mm/tooth. The service life is extended by 35%.

Petrochemical industry :

电话/TEL：0086 592 512 9696
CTIAQCD-MA-E/P 2018-2024V
sales@chinatungsten.com

Processing valve body edge chamfering, workpiece material is stainless steel, Vc 150-300 m/min, ap 0.3-1 mm, fn 0.03-0.06 mm/tooth. Corrosion resistance is improved by 20%.

New energy industry :

Processing the edge chamfer of solar brackets, the workpiece material is aluminum alloy, Vc 200-400 m/min, ap 0.3-1 mm, fn 0.03-0.06 mm/tooth. Efficiency increased by 15%.

Furniture manufacturing :

Edge chamfering of wooden boards, Vc 150-300 m/min, ap 0.2-1 mm, fn 0.03-0.06 mm/tooth. Surface smoothness Ra 0.02-0.04 μm .

Construction machinery :

Processing the edge chamfer of excavator arms, workpiece material is 35CrMo steel, Vc 150-300 m/min, ap 0.5-1.5 mm, fn 0.03-0.06 mm/tooth. Life extended by 30%.

What is a Carbide Taper Milling Cutter?

Carbide taper milling cutter is a special cutting tool made of carbide material. The cutter head is conical in design and has cutting teeth on the end and periphery. It is mainly used for processing tapered surfaces, bevels or tapered features. It combines the high hardness, wear resistance and excellent cutting performance of cemented carbide. It is suitable for processing steel, cast iron, non-ferrous metals and difficult-to-process materials. It is widely used in mold manufacturing, aerospace and machining industries. Carbide taper milling cutter uses tungsten carbide (WC) as the main hard phase and cobalt (Co) as the bonding phase. It is made by powder metallurgy and precision grinding process. It is often equipped with AlTiN or TiCN coating to improve heat resistance and service life. It is suitable for CNC machine tools and multi-axis machining centers. The following content will briefly summarize the structure and materials, working principle, characteristics, performance influencing factors, production process, types and applications.

1. Structure and materials of cemented carbide taper milling cutter

Carbide taper milling cutters are usually solid carbide structures with diameters ranging from 3-20 mm, lengths of 50-150 mm, 2-4 teeth, and taper angles (commonly 5°-15°) customized according to processing requirements. The geometric parameters of the blade (such as helix angle 30°-40°, rake angle 0°-5°) optimize taper cutting, and AlTiN or TiCN coatings (thickness 2-3 μm) can be applied to the surface, with heat resistance up to 1100°C.

Material composition : tungsten carbide (WC) particle size 0.2-1.0 μm , cobalt (Co) content 5%-9%, TaC added to enhance wear resistance.

Structural features : Overall carbide hardness HV 1800-2100, tool coaxiality ≤ 0.003 mm, blade accuracy ±0.005 mm.

2. Working principle of cemented carbide taper milling cutter

Through rotation, the conical tool head cuts along the workpiece trajectory to complete the processing of conical surfaces, bevels or tapered features, and the chips are discharged through the spiral groove. Cutting parameters include Vc 100-400 m/min, fn 0.02-0.06 mm/tooth, ap 0.1-1.5 mm. Coolant (such as synthetic cutting fluid, flow rate ≥ 15 L/min) or dry cutting control temperature (< 700°C), combined with AI optimization and sensor monitoring in 2025, cutting efficiency will increase by 15%-20%, and accuracy will reach IT6-IT8 level.

3. Characteristics of cemented carbide taper milling cutter

Ultra-high hardness : HV 1800-2100, suitable for materials below HRC 60.
Excellent wear resistance : VB ≤ 0.15 mm (500-1000 hours), life extended 5-7 times .
Excellent heat resistance : The coating is heat resistant to 1100°C and is suitable for medium-speed cutting.
High precision : surface roughness Ra 0.02-0.06 μm , suitable for tapered processing.
Versatility : adaptable to various taper angles and bevel requirements.
Vibration resistance : flexural strength ≥ 2200 MPa, reducing vibration.

4. Carbide taper milling cutter performance and influencing factors

Performance is affected by material mix, taper angle and cutting parameters.

4.1 Performance Influencing Factors Table

Influencing factors	describe	Impact	Optimization suggestions	Data support
Cobalt content	5%-9%, balance of hardness and toughness	high	5% accuracy, 9% toughness	5% Co HV 1900
Cutting speed (Vc)	100-400 m/min, excessive wear	middle	Hard materials minus 10%	Vc 450 m/min wear 7%
Feed rate (fn)	0.02-0.06 mm/tooth	middle	Finishing 0.02 mm/tooth	fn 0.08 Cutting force increased by 25%
Cutting depth (ap)	0.1-1.5 mm, too deep vibration	high	Layering 0.5 mm/layer	ap 2 mm vibration increase 15%
Coating thickness	2-3 μm , too thick and peeling	middle	Optimized 2.2-2.5 μm	< 2 μm Heat resistance decreases by 10%

5. Carbide taper milling cutter performance production process

5.1 Production process table

Process steps	Equipment/Parameters	Time/Conditions	Goal/Result	Technical indicators
Raw material mixing	Ball mill 300-400 rpm	40-60 hours	Evenly dispersed	CV < 2%
Pressing	200-250 MPa	20-30 seconds	Blank forming	Density 14-15.5 g/ cm³
sintering	1450-1550°C, HIP	2-3 hours	Densification	Density 99%-99.8%
Blade trimming	Diamond grinding wheel #1000-#1200	Trimming 0.002-0.005 mm	Accuracy optimization	Ra ≤ 0.05 μm
Coating	PVD Deposition of AlTiN	Thickness 2-3 μm	Improved heat resistance	Adhesion force > 70 N

7. Types of Carbide Taper Milling Cutters

Standard taper milling cutter : diameter 3-15 mm, Vc 150-400 m/min, suitable for general taper processing.

5° taper milling cutter : diameter 4-20 mm, Vc 200-400 m/min, suitable for small taper angle processing.

Coated taper milling cutter : AlTiN coating, Vc 300-400 m/min, life extended by 40%-50%.

Long- edge taper milling cutter : edge length 50-100 mm, Vc 100-300 m/min, suitable for deep taper processing.

Adjustable taper milling cutter : Angle 5°-15° adjustable, Vc 100-350 m/min, suitable for customized needs.

6. Application of Carbide Taper Milling Cutter

Carbide taper milling cutters are widely used in many industries due to their taper processing capabilities, as follows:

Mold manufacturing : Processing

of tapered features of injection molds and die casting molds, workpiece material is P20 steel, Vc 200-400 m/min, ap 0.1-1.5 mm, fn 0.02-0.05 mm/tooth. Accuracy IT6 level, Ra 0.02-0.04 μm , AI optimization in 2025 to reduce processing time by 15%.

Automobile manufacturing :

Processing the conical bevel of cylinder blocks and gears, the workpiece material is cast iron, Vc 150-300 m/min, ap 0.2-1 mm, fn 0.03-0.06 mm/tooth. Efficiency increased by 20%, Ra 0.02-0.05 μm .

Aerospace :

Processing conical features of titanium and aluminum alloys, such as wing connectors, Vc 200-400 m/min, ap 0.1-1 mm, fn 0.02-0.05 mm/tooth. Accuracy IT5, Ra 0.01-0.03 μm .

Energy equipment :

Processing the conical structure of wind turbine blade molds, the workpiece material is composite material, Vc 150-300 m/min, ap 0.5-1.5 mm, fn 0.03-0.06 mm/tooth. IoT monitoring will reduce waste by 10% in 2025.

Electronics industry :

Processing the conical transition of mobile phone shells, the workpiece material is aluminum alloy, Vc 300-500 m/min, ap 0.1-0.8 mm, fn 0.02-0.05 mm/tooth. Accuracy ±0.001 mm, Ra 0.01-0.03 μm .

Medical equipment :

Processing conical features of titanium alloy artificial joints, Vc 100-250 m/min, ap 0.1-0.5 mm, fn 0.02-0.04 mm/tooth . Accuracy ±0.0003 mm, Ra 0.01-0.02 μm .

Defense industry :

Processing the conical structure of missile casings, the workpiece material is high-strength steel, Vc 150-300 m/min, ap 0.3-1 mm, fn 0.03-0.06 mm/tooth. Wear resistance increased by 25%.

Shipbuilding industry :

Processing the conical chamfer of propeller shafts, workpiece material is stainless steel, Vc 150-300 m/min, ap 0.5-1.5 mm, fn 0.03-0.06 mm/tooth. Anti-corrosion coating extends service life by 30%.

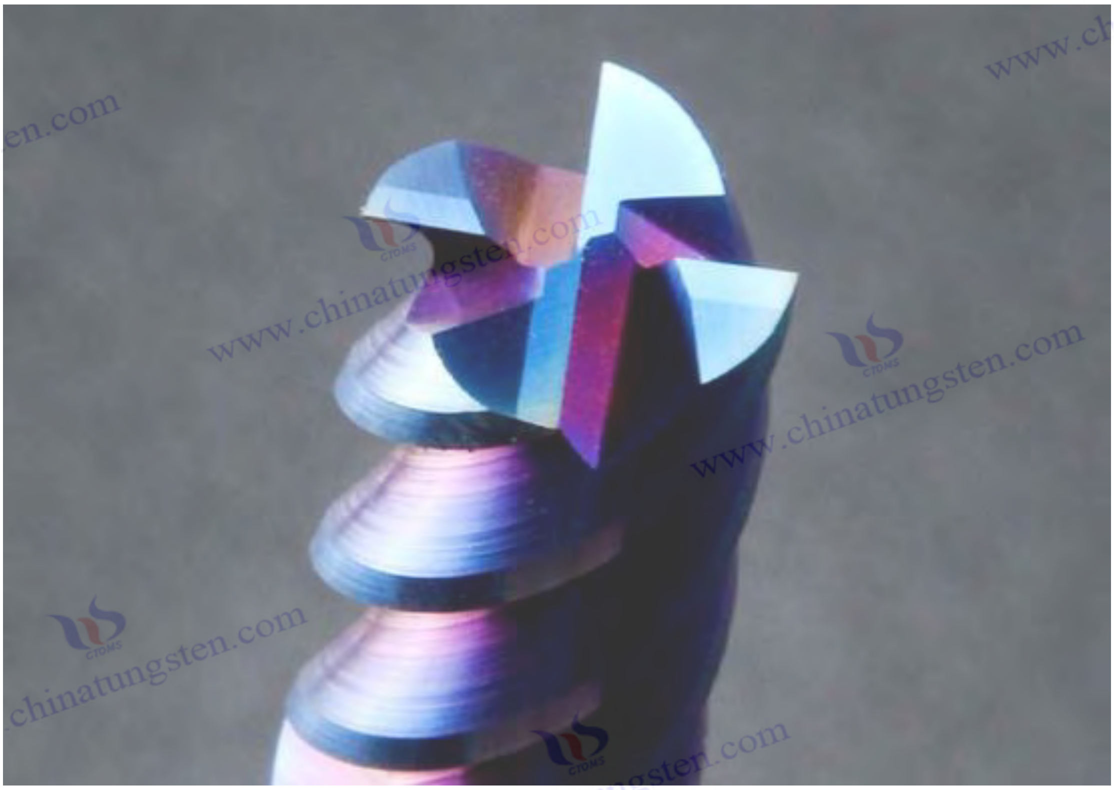
Heavy machinery :

Processing conical transition of large gears, workpiece material is 40CrNiMo steel, Vc 150-300 m/min, ap 0.5-1 mm, fn 0.04-0.07 mm/tooth. Life extended by 35%.

Petrochemical industry :

Processing valve body conical features, workpiece material is stainless steel, Vc 150-300 m/min, ap 0.3-1 mm, fn 0.03-0.06 mm/tooth. Corrosion resistance increased by 20%.

New energy industry :
Processing conical connections of solar brackets, workpiece material is aluminum alloy, Vc 200-400 m/min, ap 0.3-1 mm, fn 0.03-0.06 mm/tooth. Efficiency increased by 15%.
Furniture manufacturing :
Processing of conical decoration of wooden panels, Vc 150-300 m/min, ap 0.2-1 mm, fn 0.03-0.06 mm/tooth. Surface smoothness Ra 0.02-0.04 µm .
Construction machinery :
machining the tapered features of excavator arms, workpiece material is 35CrMo steel, Vc 150-300 m/min, ap 0.5-1.5 mm, fn 0.03-0.06 mm/tooth. Life extended by 30%.



What is a Carbide Dovetail Milling Cutter?

Carbide dovetail milling cutter is a special cutting tool made of cemented carbide material. The cutter head is designed as a dovetail or trapezoidal structure, and cutting teeth are provided at the end and periphery. It is mainly used for processing special geometric shapes such as dovetail slots, T-slots or trapezoidal slots. It combines the high hardness, wear resistance and excellent cutting performance of cemented carbide, and is suitable for processing steel, cast iron, non-ferrous metals and difficult-to-process materials. It is widely used in mold manufacturing, mechanical processing and aerospace industries. Carbide dovetail milling cutter uses tungsten carbide (WC) as the main hard phase and cobalt (Co) as the bonding phase. It is made by powder metallurgy and precision grinding process. It is often equipped with AlTiN or TiCN coating to improve heat resistance and service life. It is suitable for CNC machine tools and machining centers. The following content will briefly summarize the structure and materials, working principle, characteristics, performance influencing factors, production process, types and applications.

1. Structure and materials of cemented carbide dovetail milling cutter

Carbide dovetail milling cutters are usually solid carbide structures with diameters ranging from 6-25 mm, lengths of 50-150 mm, 2-4 teeth, and dovetail angles (commonly 30°, 45°, 60°) customized according to the groove requirements. The geometric parameters of the blade (such as helix angle 30°-40°, rake angle 0°-5°) optimize trapezoidal cutting, and AlTiN or TiCN coatings (thickness 2-3 μm) can be applied to the surface, with heat resistance up to 1100°C.

Material composition : tungsten carbide particle size 0.2-1.0 μm , cobalt (Co) content 5%-9%, TaC added to enhance wear resistance.

Structural features : Overall carbide hardness HV 1800-2100, tool coaxiality ≤ 0.003 mm, blade accuracy ±0.005 mm.

2. Working principle of carbide dovetail milling cutter

Through rotation, the dovetail cutter head cuts along the workpiece trajectory to complete the dovetail groove, T-slot or trapezoidal groove processing, and the chips are discharged through the spiral groove. Cutting parameters include Vc 100-350 m/min, fn 0.02-0.06 mm/tooth, ap 0.1-1.5 mm. Coolant (such as synthetic cutting fluid, flow rate ≥ 15 L/min) or dry cutting control temperature (< 700°C), combined with AI optimization and sensor monitoring in 2025, cutting efficiency will be increased by 15%-20%, and accuracy will reach IT6-IT8 level.

3. Characteristics of Carbide Dovetail Milling Cutter

Ultra-high hardness : HV 1800-2100, suitable for materials below HRC 60.

Excellent wear resistance : VB ≤ 0.15 mm (500-1000 hours), life extended 5-7 times .

Excellent heat resistance : The coating is heat resistant to 1100°C and is suitable for medium-speed cutting.

High precision : surface roughness Ra 0.02-0.06 μm , suitable for special groove processing.

Versatility : Adapt to various dovetail angles and groove requirements.

Vibration resistance : flexural strength ≥ 2200 MPa, reducing vibration.

4. Performance and influencing factors of cemented carbide dovetail milling cutters

Performance is affected by material ratio, dovetail angle and cutting parameters.

4.1 Performance Influencing Factors Table

Influencing factors	describe	Impact	Optimization suggestions	Data support
Cobalt content	5%-9%, balance of hardness and toughness	high	5% accuracy, 9% toughness	5% Co HV 1900
Cutting speed (Vc)	100-350 m/min, excessive wear	middle	Hard materials minus 10%	Vc 400 m/min Wear 7%
Feed rate (fn)	0.02-0.06 mm/tooth	middle	Finishing 0.02 mm/tooth	fn 0.08 Cutting force increased by 25%
Cutting depth (ap)	0.1-1.5 mm, too deep vibration	high	Layering 0.5 mm/layer	ap 2 mm vibration increase 15%
Coating thickness	2-3 µm , too thick and peeling	middle	Optimized 2.2-2.5 µm	< 2 µm Heat resistance decreases by 10%

5. Carbide dovetail milling cutter performance production process

5.1 Production process table

Process steps	Equipment/Parameters	Time/Conditions	Goal/Result	Technical indicators
Raw material mixing	Ball mill 300-400 rpm	40-60 hours	Evenly dispersed	CV < 2%
Pressing	200-250 MPa	20-30 seconds	Blank forming	Density 14-15.5 g/ cm³
sintering	1450-1550°C, HIP	2-3 hours	Densification	Density 99%-99.8%
Blade trimming	Diamond grinding wheel #1000-#1200	Trimming 0.002-0.005 mm	Accuracy optimization	Ra ≤ 0.05 µm
Coating	PVD Deposition of AlTiN	Thickness 2-3 µm	Improved heat resistance	Adhesion force > 70 N

7. Types of Carbide Dovetail Milling Cutters

Standard dovetail slot milling cutter : diameter 6-15 mm, Vc 150-350 m/min, suitable for general dovetail slot processing.

45° dovetail milling cutter : diameter 8-20 mm, Vc 200-350 m/min, suitable for standard trapezoidal grooves.

Coated dovetail milling cutter : AlTiN coating, Vc 250-350 m/min, life extended by 40%-50%.

Long- edge dovetail slot milling cutter : edge length 50-100 mm, Vc 100-300 m/min, suitable for deep slot processing.

Adjustable dovetail milling cutter : Angle 30°-60° adjustable, Vc 100-300 m/min, suitable for customized needs.

6. Application of Carbide Dovetail Milling Cutter

Carbide dovetail milling cutters are widely used in many industries due to their special slot processing capabilities, as follows:

Mold manufacturing :

Processing dovetail grooves of injection molds and die-casting molds. The workpiece material is P20 steel, Vc 200-350 m/min, ap 0.1-1.5 mm, fn 0.02-0.05 mm/tooth. Accuracy IT6 level, Ra 0.02-0.04 μm , AI optimization in 2025 will reduce processing time by 15%.

Automobile manufacturing :

Processing T-slots of cylinder blocks and gears, workpiece material is cast iron, Vc 150-300 m/min, ap 0.2-1 mm, fn 0.03-0.06 mm/tooth. Efficiency increased by 20%, Ra 0.02-0.05 μm .

Aerospace :

Processing dovetail grooves of titanium alloys and aluminum alloys, such as turbine blade connections, Vc 200-350 m/min, ap 0.1-1 mm, fn 0.02-0.05 mm/tooth. Accuracy IT5 level, Ra 0.01-0.03 μm .

Energy equipment :

Processing trapezoidal grooves of wind turbine blade molds, workpiece material is composite material, Vc 150-300 m/min, ap 0.5-1.5 mm, fn 0.03-0.06 mm/tooth. IoT monitoring will reduce waste by 10% in 2025.

Electronics industry :

Processing dovetail connection grooves of mobile phone shells, workpiece material is aluminum alloy, Vc 250-400 m/min, ap 0.1-0.8 mm, fn 0.02-0.05 mm/tooth. Accuracy ±0.001 mm, Ra 0.01-0.03 μm .

Medical equipment :

Processing dovetail features of titanium alloy artificial joints, Vc 100-250 m/min, ap 0.1-0.5 mm, fn 0.02-0.04 mm/tooth. Accuracy ±0.0003 mm, Ra 0.01-0.02 μm .

Defense industry :

Processing dovetail grooves on missile casings, workpiece material is high-strength steel, Vc 150-300 m/min, ap 0.3-1 mm, fn 0.03- 0.06 mm/tooth . Wear resistance increased by 25%.

Shipbuilding industry :

Processing of trapezoidal grooves on propeller shafts, workpiece material is stainless steel, Vc 150-300 m/min, ap 0.5-1.5 mm, fn 0.03-0.06 mm/tooth. Anti-corrosion coating extends service life by 30%.

Heavy machinery :

Processing dovetail transition of large gears, workpiece material is 40CrNiMo steel, Vc 150-300 m/min, ap 0.5-1 mm, fn 0.04-0.07 mm/tooth. Life extended by 35%.

Petrochemical industry :

Processing valve body dovetail groove, workpiece material is stainless steel, Vc 150-300 m/min, ap 0.3-1 mm, fn 0.03-0.06 mm/tooth. Corrosion resistance increased by 20%.

New energy industry :

Processing dovetail connection of solar bracket, workpiece material is aluminum alloy, Vc 200-350 m/min, ap 0.3-1 mm, fn 0.03-0.06 mm/tooth. Efficiency increased by 15%.

Furniture manufacturing :

Processing dovetail grooves of wooden boards, Vc 150-300 m/min, ap 0.2-1 mm, fn 0.03-0.06 mm/tooth. Surface smoothness Ra 0.02-0.04 μm .

Construction machinery :

Processing dovetail grooves of excavator arms , workpiece material is 35CrMo steel, Vc 150-300 m/min, ap 0.5-1.5 mm, fn 0.03-0.06 mm /tooth. Life extended by 30%.

电话/TEL：0086 592 512 9696

sales@chinatungsten.com

What is a Carbide Keyway Milling Cutter?

Carbide keyway milling cutter is a special cutting tool made of carbide material. The cutter head is designed as a straight blade or a grooved structure, and there are cutting teeth on the end and the periphery. It is mainly used for processing keyways, flat grooves or keying features. It combines the high hardness, wear resistance and excellent cutting performance of cemented carbide. It is suitable for processing steel, cast iron, non-ferrous metals and difficult-to-process materials. It is widely used in mechanical processing, automobile manufacturing and industrial equipment industries. Carbide keyway milling cutter uses tungsten carbide (WC) as the main hard phase and cobalt (Co) as the bonding phase. It is made by powder metallurgy and precision grinding process. It is often equipped with AlTiN or TiCN coating to improve heat resistance and service life. It is suitable for CNC machine tools and machining centers.

1. Structure and materials of carbide keyway milling cutter

Carbide keyway milling cutters are usually solid carbide structures with diameters ranging from 3-20 mm, lengths of 50-150 mm, 2-4 teeth, and head widths (commonly 2-12 mm) customized according to keyway dimensions. The blade geometry (such as helix angle 30°-40°, rake angle 0°-5°) optimizes straight groove cutting, and AlTiN or TiCN coatings (thickness 2-3 μm) can be applied to the surface, with heat resistance up to 1100°C.

Material composition : tungsten carbide particle size 0.2-1.0 μm , cobalt (Co) content 5%-9%, TaC added to enhance wear resistance.

Structural features : Overall carbide hardness HV 1800-2100, tool coaxiality ≤ 0.003 mm, blade accuracy ±0.005 mm.

2. Working principle of carbide keyway milling cutter

By rotating, the cutter head cuts along the workpiece trajectory to complete keyway, flat groove or key feature processing, and the chips are discharged through the spiral groove. Cutting parameters include Vc 100-400 m/min, fn 0.02-0.06 mm/tooth, ap 0.1-1.5 mm. Coolant (such as synthetic cutting fluid, flow rate ≥ 15 L/min) or dry cutting control temperature (< 700°C), combined with AI optimization and sensor monitoring in 2025, cutting efficiency will increase by 15%-20%, and accuracy will reach IT6-IT8 level.

3. Characteristics of Carbide Keyway Milling Cutter

Ultra-high hardness : HV 1800-2100, suitable for materials below HRC 60.

Excellent wear resistance : VB ≤ 0.15 mm (500-1000 hours), life extended 5-7 times .

Excellent heat resistance : The coating is heat resistant to 1100°C and is suitable for medium-speed cutting.

High precision : surface roughness Ra 0.02-0.06 μm , suitable for keyway processing.

Versatility : Adapts to various keyway widths and depths.

Vibration resistance : flexural strength ≥ 2200 MPa, reducing vibration.

4. Carbide keyway milling cutter performance and influencing factors

Influencing factors	describe	Impact	Optimization suggestions	Data support
Cobalt content	5%-9%, balance of hardness and toughness	high	5% accuracy, 9% toughness	5% Co HV 1900
Cutting speed (Vc)	100-400 m/min, excessive wear	middle	Hard materials minus 10%	Vc 450 m/min wear 7%
Feed rate (fn)	0.02-0.06 mm/tooth	middle	Finishing 0.02 mm/tooth	fn 0.08 Cutting force increased by 25%
Cutting depth (ap)	0.1-1.5 mm, too deep vibration	high	Layering 0.5 mm/layer	ap 2 mm vibration increase 15%
Coating thickness	2-3 μm , too thick and peeling	middle	Optimized 2.2-2.5 μm	< 2 μm Heat resistance decreases by 10%

5. Carbide keyway milling cutter performance production process

Process steps	Equipment/Parameters	Time/Conditions	Goal/Result	Technical indicators
Raw material mixing	Ball mill 300-400 rpm	40-60 hours	Evenly dispersed	CV < 2%
Pressing	200-250 MPa	20-30 seconds	Blank forming	Density 14-15.5 g/ cm³
sintering	1450-1550°C, HIP	2-3 hours	Densification	Density 99%-99.8%
Blade trimming	Diamond grinding wheel #1000-#1200	Trimming 0.002-0.005 mm	Accuracy optimization	Ra ≤ 0.05 μm
Coating	PVD Deposition of AlTiN	Thickness 2-3 μm	Improved heat resistance	Adhesion force > 70 N

7. Types of Carbide Keyway Milling Cutters

Standard keyway milling cutter : diameter 3-15 mm, Vc 150-400 m/min, suitable for general keyway processing.

Wide slot keyway milling cutter : width 6-12 mm, Vc 200-400 m/min, suitable for large keyways.

Coated keyway milling cutter : AlTiN coating, Vc 300-400 m/min, life extended by 40%-50%.

Long- edge keyway milling cutter : edge length 50-100 mm, Vc 100-300 m/min, suitable for deep groove processing.

Adjustable width keyway milling cutter : width 2-10 mm adjustable, Vc 100-350 m/min, suitable for customized needs.

6. Application of Carbide Keyway Milling Cutter

Carbide keyway milling cutters are widely used in many industries due to their keyway processing capabilities, as follows:

Machining :

machining keyways of shafts and gears, workpiece material is 40Cr steel, Vc 200-400 m/min, ap 0.1-1.5 mm, fn 0.02-0.05 mm/tooth. Accuracy IT6, Ra 0.02-0.04 μm , AI optimization in 2025 to reduce machining time by 15%.

Automobile manufacturing :

Processing keyways of transmission shafts, workpiece material is cast iron, Vc 150-300 m/min, ap 0.2-1 mm, fn 0.03-0.06 mm/tooth. Efficiency increased by 20%, Ra 0.02-0.05 μm .

Aerospace :

Processing key grooves of aluminum alloys and titanium alloys, such as engine parts, Vc 200-400 m/min, ap 0.1-1 mm, fn 0.02-0.05 mm/tooth. Accuracy IT5 level, Ra 0.01-0.03 μm .

Energy equipment :

Processing keyways of wind turbine shafts, workpiece material is 42CrMo steel, Vc 150-300 m/min, ap 0.5-1.5 mm, fn 0.03-0.06 mm/tooth. IoT monitoring reduces waste by 10% in 2025.

Electronics industry :

machining keyways of motor shafts, workpiece material is aluminum alloy, Vc 250-400 m/min, ap 0.1-0.8 mm, fn 0.02-0.05 mm/tooth. Accuracy ±0.001 mm, Ra 0.01-0.03 μm .

Medical equipment :

machining keyway features of titanium alloy equipment, Vc 100-250 m/min, ap 0.1-0.5 mm, fn 0.02-0.04 mm/tooth. Accuracy ±0.0003 mm, Ra 0.01-0.02 μm .

Defense industry :

Processing keyways of missile components, workpiece material is high-strength steel, Vc 150-300 m/min, ap 0.3-1 mm, fn 0.03-0.06 mm/tooth. Wear resistance increased by 25%.

Shipbuilding industry :

Processing keyways of propeller shafts, workpiece material is stainless steel, Vc 150-300 m/min, ap 0.5-1.5 mm, fn 0.03-0.06 mm/tooth. Corrosion-resistant coating extends service life by 30%.

Heavy machinery :

Machining keyways of large gear shafts, workpiece material is 40CrNiMo steel, Vc 150-300 m/min, ap 0.5-1 mm, fn 0.04-0.07 mm/tooth. Life extended by 35%.

Petrochemical industry :

Processing pump shaft keyway, workpiece material is stainless steel, Vc 150-300 m/min, ap 0.3-1 mm, fn 0.03-0.06 mm/tooth. Corrosion resistance increased by 20%.

New energy industry :

Processing keyways of wind turbine shafts, workpiece material is aluminum alloy, Vc 200-350 m/min, ap 0.3-1 mm, fn 0.03-0.06 mm/tooth. Efficiency increased by 15%.

Furniture manufacturing :

keyway decoration of wooden shafts, Vc 150-300 m/min, ap 0.2-1 mm, fn 0.03-0.06 mm/tooth. Surface smoothness Ra 0.02-0.04 μm .

Construction machinery :

Processing keyways of excavator shafts, workpiece material is 35CrMo steel, Vc 150-300 m/min, ap 0.5-1.5 mm, fn 0.03-0.06 mm/tooth. Life extended by 30%.

What is a Carbide Keyway Milling Cutter?

The carbide keyway milling cutter is a special cutting tool made of carbide material. The cutter head is designed as a straight blade or a grooved structure, and there are cutting teeth on the end and the periphery. It is mainly used for processing keyways, flat grooves or keying features. It combines the high hardness, wear resistance and excellent cutting performance of cemented carbide. It is suitable for processing steel, cast iron, non-ferrous metals and difficult-to-process materials. It is widely used in mechanical processing, automobile manufacturing and industrial equipment industries. The carbide keyway milling cutter uses tungsten carbide (WC) as the main hard phase and cobalt (Co) as the bonding phase. It is made by powder metallurgy and precision grinding process. It is often equipped with AlTiN or TiCN coating to improve heat resistance and service life. It is suitable for CNC machine tools and machining centers. The following content will briefly summarize the structure and materials, working principle, characteristics, performance influencing factors, production process, types and applications.

1. Structure and materials of carbide keyway milling cutter

Carbide keyway milling cutters are usually solid carbide structures with diameters ranging from 3-20 mm, lengths of 50-150 mm, 2-4 teeth, and head widths (commonly 2-12 mm) customized according to keyway dimensions. The blade geometry (such as helix angle 30°-40°, rake angle 0°-5°) optimizes straight groove cutting, and AlTiN or TiCN coatings (thickness 2-3 μm) can be applied to the surface, with heat resistance up to 1100°C.

Material composition : tungsten carbide particle size 0.2-1.0 μm , cobalt (Co) content 5%-9%, TaC added to enhance wear resistance.

Structural features : Overall carbide hardness HV 1800-2100, tool coaxiality ≤ 0.003 mm, blade accuracy ±0.005 mm.

2. Working principle of carbide keyway milling cutter

By rotating, the cutter head cuts along the workpiece trajectory to complete keyway, flat groove or key feature processing, and the chips are discharged through the spiral groove. Cutting parameters include Vc 100-400 m/min, fn 0.02-0.06 mm/tooth, ap 0.1-1.5 mm. Coolant (such as synthetic cutting fluid, flow rate ≥ 15 L/min) or dry cutting control temperature (< 700°C), combined with AI optimization and sensor monitoring in 2025, cutting efficiency will increase by 15%-20%, and accuracy will reach IT6-IT8 level.

3. Characteristics of Carbide Keyway Milling Cutter

Ultra-high hardness : HV 1800-2100, suitable for materials below HRC 60.

Excellent wear resistance : VB ≤ 0.15 mm (500-1000 hours), life extended 5-7 times .

Excellent heat resistance : The coating is heat resistant to 1100°C and is suitable for medium-speed cutting.

High precision : surface roughness Ra 0.02-0.06 μm , suitable for keyway processing.

Versatility : Adapts to various keyway widths and depths.

Vibration resistance : flexural strength ≥ 2200 MPa, reducing vibration.

4. Carbide keyway milling cutter performance and influencing factors

Performance is affected by material ratio, groove width and cutting parameters

Influencing factors	describe	Impact	Optimization suggestions	Data support
Cobalt content	5%-9%, balance of hardness and toughness	high	5% accuracy, 9% toughness	5% Co HV 1900
Cutting speed (Vc)	100-400 m/min, excessive wear	middle	Hard materials minus 10%	Vc 450 m/min wear 7%
Feed rate (fn)	0.02-0.06 mm/tooth	middle	Finishing 0.02 mm/tooth	fn 0.08 Cutting force increased by 25%
Cutting depth (ap)	0.1-1.5 mm, too deep vibration	high	Layering 0.5 mm/layer	ap 2 mm Vibration increase 15%
Coating thickness	2-3 µm , too thick and peeling	middle	Optimized 2.2-2.5 µm	< 2 µm Heat resistance decreases by 10%

5. Carbide keyway milling cutter performance production process

Process steps	Equipment/Parameters	Time/Conditions	Goal/Result	Technical indicators
Raw material mixing	Ball mill 300-400 rpm	40-60 hours	Evenly dispersed	CV < 2%
Pressing	200-250 MPa	20-30 seconds	Blank forming	Density 14-15.5 g/ cm^3
sintering	1450-1550°C, HIP	2-3 hours	Densification	Density 99%-99.8%
Blade trimming	Diamond grinding wheel #1000-#1200	Trimming 0.002-0.005 mm	Accuracy optimization	Ra ≤ 0.05 µm
Coating	PVD Deposition of AlTiN	Thickness 2-3 µm	Improved heat resistance	Adhesion force > 70 N

7. Types of Carbide Keyway Milling Cutters

Standard keyway milling cutter : diameter 3-15 mm, Vc 150-400 m/min, suitable for general keyway processing.

Wide slot keyway milling cutter : width 6-12 mm, Vc 200-400 m/min, suitable for large keyways.

Coated keyway milling cutter : AlTiN coating, Vc 300-400 m/min, life extended by 40%-50%.

Long- edge keyway milling cutter : edge length 50-100 mm, Vc 100-300 m/min, suitable for deep groove processing.

Adjustable width keyway milling cutter : width 2-10 mm adjustable, Vc 100-350 m/min, suitable for customized needs.

电话/TEL：0086 592 512 9696
CTIAQCD-MA-E/P 2018-2024V
sales@chinatungsten.com

6. Application of Carbide Keyway Milling Cutter

Carbide keyway milling cutters are widely used in many industries due to their keyway processing capabilities, as follows:

Machining :

machining keyways of shafts and gears, workpiece material is 40Cr steel, Vc 200-400 m/min, ap 0.1-1.5 mm, fn 0.02-0.05 mm/tooth. Accuracy IT6, Ra 0.02-0.04 μm , AI optimization in 2025 to reduce machining time by 15%.

Automobile manufacturing :

Processing keyways of transmission shafts, workpiece material is cast iron, Vc 150-300 m/min, ap 0.2-1 mm, fn 0.03-0.06 mm/tooth. Efficiency increased by 20%, Ra 0.02-0.05 μm .

Aerospace :

Processing key grooves of aluminum alloys and titanium alloys, such as engine parts, Vc 200-400 m/min, ap 0.1-1 mm, fn 0.02-0.05 mm/tooth. Accuracy IT5 level, Ra 0.01-0.03 μm .

Energy equipment :

Processing keyways of wind turbine shafts, workpiece material is 42CrMo steel, Vc 150-300 m/min, ap 0.5-1.5 mm, fn 0.03-0.06 mm/tooth. IoT monitoring reduces waste by 10% in 2025.

Electronics industry :

machining keyways of motor shafts, workpiece material is aluminum alloy, Vc 250-400 m/min, ap 0.1-0.8 mm, fn 0.02-0.05 mm/tooth. Accuracy ±0.001 mm, Ra 0.01-0.03 μm .

Medical equipment :

machining keyway features of titanium alloy equipment, Vc 100-250 m/min, ap 0.1-0.5 mm, fn 0.02-0.04 mm/tooth. Accuracy ±0.0003 mm, Ra 0.01-0.02 μm .

Defense industry :

Processing keyways of missile components, workpiece material is high-strength steel, Vc 150-300 m/min, ap 0.3-1 mm, fn 0.03-0.06 mm/tooth. Wear resistance increased by 25%.

Shipbuilding industry :

Processing keyways of propeller shafts, workpiece material is stainless steel, Vc 150-300 m/min, ap 0.5-1.5 mm, fn 0.03- 0.06 mm/tooth . Corrosion-resistant coating extends service life by 30%.

Heavy machinery :

Machining keyways of large gear shafts, workpiece material is 40CrNiMo steel, Vc 150-300 m/min, ap 0.5-1 mm, fn 0.04-0.07 mm/tooth. Life extended by 35%.

Petrochemical industry :

Processing pump shaft keyway, workpiece material is stainless steel, Vc 150-300 m/min, ap 0.3-1 mm, fn 0.03-0.06 mm/tooth. Corrosion resistance increased by 20%.

New energy industry :

Processing keyways of wind turbine shafts, workpiece material is aluminum alloy, Vc 200-350 m/min, ap 0.3-1 mm, fn 0.03-0.06 mm/tooth. Efficiency increased by 15%.

Furniture manufacturing :

keyway decoration of wooden shafts, Vc 150-300 m/min, ap 0.2-1 mm, fn 0.03-0.06 mm/tooth. Surface smoothness Ra 0.02-0.04 μm .

Construction machinery :

machining keyways of excavator shafts, workpiece material is 35CrMo steel, Vc 150-300 m/min, ap 0.5-1.5 mm, fn 0.03-0.06 mm/tooth. Life extended by 30%.

What are Carbide Angle Milling Cutters?

Carbide angle milling cutter is a special cutting tool made of carbide material. The cutter head is designed with a specific angle (such as 30°, 45°, 60°), and there are cutting teeth on the end and periphery. It is mainly used for processing bevels, conical surfaces or angle features. It combines the high hardness, wear resistance and excellent cutting performance of cemented carbide. It is suitable for processing steel, cast iron, non-ferrous metals and difficult-to-process materials. It is widely used in mold manufacturing, aerospace and machining industries. Carbide angle milling cutter uses tungsten carbide (WC) as the main hard phase and cobalt (Co) as the bonding phase. It is made by powder metallurgy and precision grinding process. It is often equipped with AlTiN or TiCN coating to improve heat resistance and service life. It is suitable for CNC machine tools and multi-axis machining centers. The following content will briefly summarize the structure and materials, working principle, characteristics, performance influencing factors, production process, types and applications.

1. Structure and materials of carbide angle milling cutter

Carbide angle milling cutters are usually solid carbide structures with diameters ranging from 4-25 mm, lengths of 50-150 mm, 2-4 teeth, and angles (commonly 30°, 45°, 60°) customized according to processing requirements. The geometric parameters of the blade (such as helix angle 30°-40°, rake angle 0°-5°) optimize angle cutting, and AlTiN or TiCN coatings (thickness 2-3 μm) can be applied to the surface, with heat resistance up to 1100°C.

Material composition : tungsten carbide particle size 0.2-1.0 μm , cobalt (Co) content 5%-9%, TaC added to enhance wear resistance.

Structural features : Overall carbide hardness HV 1800-2100, tool coaxiality ≤ 0.003 mm, blade accuracy ±0.005 mm.

2. Working principle of carbide angle milling cutter

By rotating, the angle tool head cuts along the workpiece trajectory to complete the processing of bevels, conical surfaces or angle features, and the chips are discharged through the spiral groove. Cutting parameters include Vc 100-400 m/min, fn 0.02-0.06 mm/tooth, ap 0.1-1.5 mm. Coolant (such as synthetic cutting fluid, flow rate ≥ 15 L/min) or dry cutting to control the temperature (< 700°C).

3. Characteristics of Carbide Angle Milling Cutter

Ultra-high hardness : HV 1800-2100, suitable for materials below HRC 60.

Excellent wear resistance : VB ≤ 0.15 mm (500-1000 hours), life extended 5-7 times .

Excellent heat resistance : The coating is heat resistant to 1100°C and is suitable for medium-speed cutting.

High precision : surface roughness Ra 0.02-0.06 μm , suitable for angle processing.

Versatility : adaptable to various angles and slopes.

Vibration resistance : flexural strength ≥ 2200 MPa, reducing vibration.

4. Carbide Angle Milling Cutter Performance and Influencing Factors

performance by material ratio, angle setting and cutting parameters

Influencing factors	describe	Impact	Optimization suggestions	Data support
Cobalt content	5%-9%, balance of hardness and toughness	high	5% accuracy, 9% toughness	5% Co HV 1900
Cutting speed (Vc)	100-400 m/min, excessive wear	middle	Hard materials minus 10%	Vc 450 m/min wear 7%
Feed rate (fn)	0.02-0.06 mm/tooth	middle	Finishing 0.02 mm/tooth	fn 0.08 Cutting force increased by 25%
Cutting depth (ap)	0.1-1.5 mm, too deep vibration	high	Layering 0.5 mm/layer	ap 2 mm vibration increase 15%
Coating thickness	2-3 µm , too thick and peeling	middle	Optimized 2.2-2.5 µm	< 2 µm Heat resistance decreases by 10%

5. Carbide Angle Milling Cutter Performance Production Process

Process steps	Equipment/Parameters	Time/Conditions	Goal/Result	Technical indicators
Raw material mixing	Ball mill 300-400 rpm	40-60 hours	Evenly dispersed	CV < 2%
Pressing	200-250 MPa	20-30 seconds	Blank forming	Density 14-15.5 g/ cm³
sintering	1450-1550°C, HIP	2-3 hours	Densification	Density 99%-99.8%
Blade trimming	Diamond grinding wheel #1000-#1200	Trimming 0.002-0.005 mm	Accuracy optimization	Ra ≤ 0.05 µm
Coating	PVD Deposition of AlTiN	Thickness 2-3 µm	Improved heat resistance	Adhesion force > 70 N

7. Types of Carbide Angle Milling Cutters

Standard angle milling cutter : diameter 4-15 mm, Vc 150-400 m/min, suitable for general angle processing.

45° angle milling cutter : diameter 6-20 mm, Vc 200-400 m/min, suitable for standard bevels.

Coated angle milling cutter : AlTiN coating, Vc 300-400 m/min, life extended by 40%-50%.

Long- edge angle milling cutter : edge length 50-100 mm, Vc 100-300 m/min, suitable for deep angle processing.

Adjustable angle milling cutter : Angle 30°-60° adjustable, Vc 100-350 m/min, suitable for customized needs.

6. Application of Carbide Angle Milling Cutter

电话/TEL：0086 592 512 9696
CTIAQCD-MA-E/P 2018-2024V
sales@chinatungsten.com

Carbide angle milling cutters are widely used in many industries due to their angle processing capabilities, as follows:

Mold manufacturing :

Processing the inclined surface of injection molds, the workpiece material is P20 steel, Vc 200-400 m/min, ap 0.1-1.5 mm, fn 0.02-0.05 mm/tooth. Accuracy IT6 level, Ra 0.02-0.04 μm , AI optimization in 2025 will reduce processing time by 15%.

Automobile manufacturing :

Processing the inclined surface features of the cylinder body, the workpiece material is cast iron, Vc 150-300 m/min, ap 0.2-1 mm, fn 0.03-0.06 mm/tooth. Efficiency increased by 20%, Ra 0.02-0.05 μm .

Aerospace :

Processing the inclined surface of titanium alloy wings, Vc 200-400 m/min, ap 0.1-1 mm, fn 0.02-0.05 mm/tooth. Accuracy IT5 level, Ra 0.01-0.03 μm .

Energy equipment :

Processing the inclined surface structure of wind turbine blade molds, the workpiece material is composite material, Vc 150-300 m/min, ap 0.5-1.5 mm, fn 0.03-0.06 mm/tooth. IoT monitoring will reduce waste by 10% in 2025.

Electronics industry :

Processing the bevel transition of mobile phone shells, the workpiece material is aluminum alloy, Vc 300-500 m/min, ap 0.1-0.8 mm, fn 0.02-0.05 mm/tooth. Accuracy ±0.001 mm, Ra 0.01-0.03 μm .

Medical equipment :

Processing the bevel features of titanium alloy artificial joints, Vc 100-250 m/min, ap 0.1-0.5 mm, fn 0.02-0.04 mm/tooth. Accuracy ±0.0003 mm, Ra 0.01-0.02 μm .

Defense industry :

Processing the inclined surface structure of missile shells, the workpiece material is high-strength steel, Vc 150-300 m/min, ap 0.3-1 mm, fn 0.03-0.06 mm/tooth. Wear resistance increased by 25%.

Shipbuilding industry :

Processing the bevel features of hull plates, workpiece material is stainless steel, Vc 150-300 m/min, ap 0.5-1.5 mm, fn 0.03-0.06 mm/tooth. Corrosion-resistant coating extends service life by 30%.

Heavy machinery :

Processing the bevel transition of large gears, the workpiece material is 40CrNiMo steel, Vc 150-300 m/min, ap 0.5-1 mm, fn 0.04-0.07 mm/tooth. The service life is extended by 35%.

Petrochemical industry :

Processing valve body bevel, workpiece material is stainless steel, Vc 150-300 m/min, ap 0.3-1 mm, fn 0.03-0.06 mm/tooth. Corrosion resistance increased by 20%.

New energy industry :

Processing the bevel connection of solar brackets, the workpiece material is aluminum alloy, Vc 200-400 m/min, ap 0.3-1 mm, fn 0.03-0.06 mm/tooth. Efficiency increased by 15%.

Furniture manufacturing :

Processing of bevel decoration of wooden boards, Vc 150-300 m/min, ap 0.2-1 mm, fn 0.03-0.06 mm/tooth. Surface smoothness Ra 0.02-0.04 μm .

Construction machinery：
machining the bevel features of excavator arms, workpiece material is 35CrMo steel, Vc 150-300 m/min, ap 0.5-1.5 mm, fn 0.03-0.06 mm/tooth. Life extended by 30%.

电话/TEL：0086 592 512 9696

sales@chinatungsten.com

What is a Carbide Form Milling Cutter?

Carbide forming milling cutter is a special cutting tool made of carbide material. The shape of the cutter head is designed according to a specific profile (such as tooth shape, curve or complex geometric shape). Cutting teeth are provided at the end and periphery. It is mainly used for processing forming surfaces, tooth grooves or complex contour features. It combines the high hardness, wear resistance and excellent cutting performance of cemented carbide. It is suitable for processing steel, cast iron, non-ferrous metals and difficult-to-process materials. It is widely used in gear manufacturing, mold processing and precision machinery industries. Carbide forming milling cutter uses tungsten carbide (WC) as the main hard phase and cobalt (Co) as the bonding phase. It is made by powder metallurgy and precision grinding process. It is often equipped with AlTiN or TiCN coating to improve heat resistance and service life. It is suitable for CNC machine tools and multi-axis machining centers. The following content will briefly summarize the structure and materials, working principle, characteristics, performance influencing factors, production process, types and applications.

1. Structure and materials of cemented carbide forming milling cutter

Carbide forming milling cutters are usually solid carbide structures with diameters ranging from 5-30 mm, lengths of 50-150 mm, and 2-6 teeth (customized according to contour complexity). The cutter head contour is designed according to processing requirements (such as involute tooth shape or complex curves), and the blade geometry parameters (such as helix angle 30°-40°, rake angle 0°-5°) are optimized for forming cutting. AlTiN or TiCN coatings (thickness 2-3 μm) can be applied to the surface, and the heat resistance reaches 1100°C.

Material composition : tungsten carbide (WC) particle size 0.2-1.0 μm , cobalt (Co) content 5%-9%, TaC added to enhance wear resistance.

Structural features : Overall carbide hardness HV 1800-2100, tool coaxiality ≤ 0.003 mm, blade accuracy ±0.005 mm.

2. Working principle of cemented carbide forming milling cutter

By rotating, the profiled cutter head cuts along the workpiece trajectory to complete specific contours, tooth grooves or complex surface processing, and the chips are discharged through the spiral groove. Cutting parameters include Vc 100-350 m/min, fn 0.02-0.06 mm/tooth, ap 0.1-1.5 mm. Coolant (such as synthetic cutting fluid, flow rate ≥ 15 L/min) or dry cutting to control temperature (< 700°C).

3. Characteristics of cemented carbide forming milling cutters

Ultra-high hardness : HV 1800-2100, suitable for materials below HRC 60.

Excellent wear resistance : VB ≤ 0.15 mm (500-1000 hours), life extended 5-7 times .

Excellent heat resistance : The coating is heat resistant to 1100°C and is suitable for medium-speed cutting.

High precision : surface roughness Ra 0.02-0.06 μm , suitable for complex contour processing.

Versatility : adaptable to various forming profiles and tooth shape requirements.

Vibration resistance : flexural strength ≥ 2200 MPa, reducing vibration.

4. Performance and influencing factors of cemented carbide forming milling cutters

Performance is affected by material mix, contour complexity and cutting parameters.

Performance Influencing Factors Table

Influencing factors	describe	Impact	Optimization suggestions	Data support
Cobalt content	5%-9%, balance of hardness and toughness	high	5% accuracy, 9% toughness	5% Co HV 1900
Cutting speed (Vc)	100-350 m/min, excessive wear	middle	Hard materials minus 10%	Vc 400 m/min Wear 7%
Feed rate (fn)	0.02-0.06 mm/tooth	middle	Finishing 0.02 mm/tooth	fn 0.08 Cutting force increased by 25%
Cutting depth (ap)	0.1-1.5 mm, too deep vibration	high	Layering 0.5 mm/layer	ap 2 mm vibration increase 15%
Coating thickness	2-3 µm , too thick and peeling	middle	Optimized 2.2-2.5 µm	< 2 µm Heat resistance decreases by 10%

5. Carbide forming milling cutter performance production process

Production process table

Process steps	Equipment/Parameters	Time/Conditions	Goal/Result	Technical indicators
Raw material mixing	Ball mill 300-400 rpm	40-60 hours	Evenly dispersed	CV < 2%
Pressing	200-250 MPa	20-30 seconds	Blank forming	Density 14-15.5 g/ cm³
sintering	1450-1550°C, HIP	2-3 hours	Densification	Density 99%-99.8%
Blade trimming	Diamond grinding wheel #1000-#1200	Trimming 0.002-0.005 mm	Accuracy optimization	Ra ≤ 0.05 µm
Coating	PVD Deposition of AlTiN	Thickness 2-3 µm	Improved heat resistance	Adhesion force > 70 N

7. Types of Carbide Forming Milling Cutters

Standard profile milling cutter : diameter 5-15 mm, Vc 150-350 m/min, suitable for general contour processing.

Involute profile milling cutter : diameter 6-20 mm, Vc 200-350 m/min, specially used for gear machining.

Coated profile milling cutter : AlTiN coating, Vc 250-350 m/min, life extended by 40%-50%.

电话/TEL：0086 592 512 9696
CTIAQCD-MA-E/P 2018-2024V
sales@chinatungsten.com

Long- edge forming milling cutter : edge length 50-100 mm, Vc 100-300 m/min, suitable for deep forming processing.
Customized profile milling cutter : complex contours can be customized, Vc 100-350 m/min, suitable for special needs.

6. Application of carbide forming milling cutters

Carbide form milling cutters are widely used in many industries due to their complex contour processing capabilities, as follows:

Gear manufacturing :
Processing involute tooth grooves, workpiece material is 20CrMnTi steel, Vc 200-350 m/min, ap 0.1-1.5 mm, fn 0.02-0.05 mm/tooth. Accuracy IT6 level, Ra 0.02-0.04 µm , AI optimization in 2025 to reduce processing time by 15%.
Mold manufacturing :
Processing complex curved molds, workpiece material is P20 steel, Vc 150-300 m/min, ap 0.2-1 mm, fn 0.03-0.06 mm/tooth. Efficiency increased by 20%, Ra 0.02-0.05 µm .
Aerospace :
Processing titanium alloy blade profile, Vc 200-400 m/min, ap 0.1-1 mm, fn 0.02-0.05 mm/tooth. Accuracy IT5 level, Ra 0.01-0.03 µm .
Energy equipment :
Processing wind turbine gear forming features, workpiece material is 42CrMo steel, Vc 150-300 m/min, ap 0.5-1.5 mm, fn 0.03-0.06 mm/tooth. IoT monitoring reduces waste by 10% in 2025.
Electronics industry :
Processing complex curves of mobile phone shells, workpiece material is aluminum alloy, Vc 250-400 m/min, ap 0.1-0.8 mm, fn 0.02-0.05 mm/tooth. Accuracy ±0.001 mm, Ra 0.01-0.03 µm .
Medical equipment :
Processing titanium alloy implant forming features, Vc 100-250 m/min, ap 0.1-0.5 mm, fn 0.02-0.04 mm/tooth. Accuracy ±0.0003 mm, Ra 0.01-0.02 µm .
Defense industry :
Processing complex contours of missile components, workpiece material is high-strength steel, Vc 150-300 m/min, ap 0.3-1 mm, fn 0.03-0.06 mm/tooth. Wear resistance increased by 25%.
Shipbuilding industry :
Processing the forming features of propeller blades, the workpiece material is stainless steel, Vc 150-300 m/min, ap 0.5-1.5 mm, fn 0.03-0.06 mm/tooth. The corrosion-resistant coating extends the service life by 30%.
Heavy machinery :
Processing the profiled surface of large gears, workpiece material is 40CrNiMo steel, Vc 150-300 m/min, ap 0.5-1 mm, fn 0.04-0.07 mm/tooth. Life extended by 35%.
Petrochemical industry :
Processing complex valve body contours, workpiece material is stainless steel, Vc 150-300 m/min, ap 0.3-1 mm, fn 0.03-0.06 mm/tooth. Corrosion resistance increased by 20%.
New energy industry :
Processing wind turbine blade forming features, workpiece material is composite material, Vc 200-

350 m/min, ap 0.3-1 mm, fn 0.03-0.06 mm/tooth. Efficiency increased by 15%.

Furniture manufacturing :

Processing of wood panels with molding decoration, Vc 150-300 m/min, ap 0.2-1 mm, fn 0.03-0.06 mm/tooth. Surface smoothness Ra 0.02-0.04 μm .

Construction machinery :

Processing the forming features of excavator arms, workpiece material is 35CrMo steel, Vc 150-300 m/min, ap 0.5-1.5 mm, fn 0.03-0.06 mm/tooth. Life extended by 30%.

CTIA GROUP LTD

30 Years of Cemented Carbide Customization Experts

Core Advantages

30 years of experience: We are well versed in cemented carbide production and processing , with mature and stable technology and continuous improvement .

Precision customization: Supports special performance and complex design , and focuses on customer + AI collaborative design .

Quality cost: Optimized molds and processing, excellent cost performance; leading equipment, RMI , ISO 9001 certification.

Serving Customers

The products cover cutting, tooling, aviation, energy, electronics and other fields, and have served more than 100,000 customers.

Service Commitment

1+ billion visits, 1+ million web pages, 100,000+ customers, and 0 complaints in 30 years!

Contact Us

Email : sales@chinatungsten.com

Tel : +86 592 5129696

Official website : www.ctia.com.cn




What are Carbide Thread Mills?

Carbide thread milling cutter is a special cutting tool made of carbide material. The cutter head is designed with spiral groove or multi-edge structure and has a specific thread profile. It is mainly used for processing internal or external threads. It combines the high hardness, wear resistance and excellent cutting performance of cemented carbide. It is suitable for processing steel, cast iron, non-ferrous metals and difficult-to-process materials. It is widely used in mechanical processing, automobile manufacturing and precision instrument industries. Carbide thread milling cutter uses tungsten carbide (WC) as the main hard phase and cobalt (Co) as the bonding phase. It is made by powder metallurgy and precision grinding process. It is often equipped with AlTiN or TiCN coating to improve heat resistance and service life. It is suitable for CNC machine tools and machining centers. The following content will briefly summarize the structure and materials, working principle, characteristics, performance influencing factors, production process, types and applications.

1. Structure and materials of carbide thread milling cutter

Carbide thread milling cutters are usually solid carbide structures with diameters ranging from 3-20 mm, lengths of 50-150 mm, and 2-6 teeth (customized according to thread specifications). The cutter head has a spiral groove or multi-edge design, and the pitch and angle (such as M3-M24 metric thread) are customized according to processing requirements. The blade geometry parameters (such as helix angle 30°-40°, rake angle 0°-5°) optimize thread cutting. AlTiN or TiCN coating (thickness 2-3 μm) can be applied to the surface, and the heat resistance reaches 1100°C.

Material composition : tungsten carbide (WC) particle size 0.2-1.0 μm , cobalt (Co) content 5%-9%, TaC added to enhance wear resistance.

Structural features : Overall carbide hardness HV 1800-2100, tool coaxiality ≤ 0.003 mm, blade accuracy ±0.005 mm.

2. Working principle of carbide thread milling cutter

By rotating, the thread cutter head cuts along the spiral track of the inner hole or outer surface of the workpiece to complete the thread processing, and the chips are discharged through the spiral groove. The cutting parameters include Vc 100-300 m/min, fn 0.02-0.05 mm/tooth, ap 0.1-1 mm. Coolant (such as synthetic cutting fluid, flow rate ≥ 15 L/min) or dry cutting to control the temperature (< 700°C).

3. Characteristics of Carbide Thread Milling Cutter

Ultra-high hardness : HV 1800-2100, suitable for materials below HRC 60.

Excellent wear resistance : VB ≤ 0.15 mm (500-1000 hours), life extended 5-7 times .

Excellent heat resistance : The coating is heat resistant to 1100°C and is suitable for medium-speed cutting.

High precision : thread tolerance up to 6H/6g, surface roughness Ra 0.02-0.06 μm .

Versatility : Suitable for a variety of thread types and specifications.

Vibration resistance : flexural strength ≥ 2200 MPa, reducing vibration.

4. Carbide thread milling cutter performance and influencing factors

Performance is affected by material mix, thread pitch and cutting parameters.

Performance Influencing Factors Table

Influencing factors	describe	Impact	Optimization suggestions	Data support
Cobalt content	5%-9%, balance of hardness and toughness	high	5% accuracy, 9% toughness	5% Co HV 1900
Cutting speed (Vc)	100-300 m/min, excessive wear	middle	Hard materials minus 10%	Vc 350 m/min wear 7%
Feed rate (fn)	0.02-0.05 mm/tooth	middle	Finishing 0.02 mm/tooth	fn 0.06 Cutting force increased by 25%
Cutting depth (ap)	0.1-1 mm, too deep vibration	high	Layering 0.5 mm/layer	ap 1.5 mm vibration increase 15%
Coating thickness	2-3 µm , too thick and peeling	middle	Optimized 2.2-2.5 µm	< 2 µm Heat resistance decreases by 10%

5. Carbide thread milling cutter performance production process

Production process table

Process steps	Equipment/Parameters	Time/Conditions	Goal/Result	Technical indicators
Raw material mixing	Ball mill 300-400 rpm	40-60 hours	Evenly dispersed	CV < 2%
Pressing	200-250 MPa	20-30 seconds	Blank forming	Density 14-15.5 g/ cm^3
sintering	1450-1550°C, HIP	2-3 hours	Densification	Density 99%-99.8%
Blade trimming	Diamond grinding wheel #1000-#1200	Trimming 0.002-0.005 mm	Accuracy optimization	Ra ≤ 0.05 µm
Coating	PVD Deposition of AlTiN	Thickness 2-3 µm	Improved heat resistance	Adhesion force > 70 N

7. Types of Carbide Thread Milling Cutters

Standard thread milling cutter : diameter 3-15 mm, Vc 150-300 m/min, suitable for general thread processing.

Internal thread milling cutter : diameter 6-20 mm, Vc 200-300 m/min, specially used for internal hole threads.

Coated thread milling cutter : AlTiN coating, Vc 250-300 m/min, life extended by 40%-50%.

Long- edge thread milling cutter : edge length 50-100 mm, Vc 100-250 m/min, suitable for deep thread processing.

Adjustable thread milling cutter : adjustable pitch, Vc 100-300 m/min, suitable for customized needs.

6. Application of Carbide Thread Milling Cutter

Carbide thread milling cutters are widely used in many industries due to their thread processing capabilities, as follows:

Machining :

machining internal threads of shafts, workpiece material is 45# steel, Vc 200-300 m/min, ap 0.1-1 mm, fn 0.02-0.04 mm/tooth. Accuracy 6H, Ra 0.02-0.04 μm , AI optimization in 2025 will reduce machining time by 15%.

Automobile manufacturing :

Processing engine cylinder thread, workpiece material is cast iron, Vc 150-250 m/min, ap 0.2-0.8 mm, fn 0.03-0.05 mm/tooth. Efficiency increased by 20%, Ra 0.02-0.05 μm .

Aerospace :

Processing threads of titanium alloy parts, Vc 200-300 m/min, ap 0.1-0.6 mm, fn 0.02-0.04 mm/tooth. Accuracy 6H, Ra 0.01-0.03 μm .

Energy equipment :

Processing threaded connections for wind power equipment, workpiece material is 42CrMo steel, Vc 150-250 m/min, ap 0.3-1 mm, fn 0.03-0.05 mm/tooth. IoT monitoring will reduce waste by 10% in 2025.

Electronics industry :

Processing threaded holes in mobile phone housings, workpiece material is aluminum alloy, Vc 250-300 m/min, ap 0.1-0.5 mm, fn 0.02-0.04 mm/tooth. Accuracy ±0.001 mm, Ra 0.01-0.03 μm .

Medical equipment :

Processing thread features of titanium alloy implants, Vc 100-200 m/min, ap 0.1-0.4 mm, fn 0.02-0.03 mm/tooth. Accuracy ±0.0003 mm, Ra 0.01-0.02 μm .

Defense industry :

Processing threads of missile parts, workpiece material is high-strength steel, Vc 150-250 m/min, ap 0.2-0.8 mm, fn 0.03-0.05 mm/tooth. Wear resistance increased by 25%.

Shipbuilding industry :

Processing hull threaded connections, workpiece material is stainless steel, Vc 150-250 m/min, ap 0.3-1 mm, fn 0.03-0.05 mm/tooth. Corrosion-resistant coating extends service life by 30%.

Heavy machinery :

Processing threads of large gear shafts, workpiece material is 40CrNiMo steel, Vc 150-250 m/min, ap 0.3-1 mm, fn 0.03-0.06 mm/tooth. Life extended by 35%.

Petrochemical industry :

Processing valve body threads, workpiece material is stainless steel, Vc 150-250 m/min, ap 0.2-0.8 mm, fn 0.03-0.05 mm/tooth. Corrosion resistance increased by 20%.

New energy industry :

Processing threaded connections of wind turbines, workpiece material is aluminum alloy, Vc 200-300 m/min, ap 0.2-0.8 mm, fn 0.03-0.05 mm/tooth. Efficiency increased by 15%.

Furniture manufacturing :

Processing thread decoration of wooden parts, Vc 150-250 m/min, ap 0.2-0.6 mm, fn 0.03-0.05

电话/TEL：0086 592 512 9696
CTIAQCD-MA-E/P 2018-2024V
sales@chinatungsten.com

mm/tooth. Surface smoothness Ra 0.02-0.04 μm .

Construction machinery :

Processing excavator shaft threads, workpiece material is 35CrMo steel, Vc 150-250 m/min, ap 0.3-1 mm, fn 0.03-0.05 mm/tooth. Life extended by 30%.

What are carbide drill cutters?

Carbide drill and milling cutter is a multifunctional cutting tool made of carbide material. The cutter head combines drilling and milling functions, has a central cutting edge and peripheral cutting teeth, and is mainly used for drilling, milling, chamfering or grooving. It combines the high hardness, wear resistance and excellent cutting performance of cemented carbide, and is suitable for processing steel, cast iron, non-ferrous metals and difficult-to-process materials. It is widely used in mechanical processing, mold manufacturing and aerospace industries. Carbide drill and milling cutter uses tungsten carbide (WC) as the main hard phase and cobalt (Co) as the bonding phase. It is made by powder metallurgy and precision grinding process. It is often equipped with AlTiN or TiCN coating to improve heat resistance and service life. It is suitable for CNC machine tools and multi-axis machining centers. The following content will briefly summarize the structure and materials, working principle, characteristics, performance influencing factors, production process, types and applications.

1. Structure and materials of cemented carbide drilling and milling cutters

Carbide drill and mill cutters are usually solid carbide structures with diameters ranging from 3-20 mm, lengths of 50-150 mm, and 2-4 teeth. The cutter head design includes a central drill tip and a spiral peripheral blade . The blade geometry (such as a helix angle of 30°-45°, a rake angle of 0°-5°) optimizes drilling and milling. The surface can be coated with AlTiN or TiCN coatings (thickness 2-3 μm), with a heat resistance of up to 1100°C.

Material composition : tungsten carbide (WC) particle size 0.2-1.0 μm , cobalt (Co) content 5%-9%, TaC added to enhance wear resistance.

Structural features : Overall carbide hardness HV 1800-2100, tool coaxiality ≤ 0.003 mm, blade accuracy ±0.005 mm.

2. Working principle of carbide drilling and milling cutter

By rotating, the cutter head first drills into the workpiece to complete the hole processing, and then mills the groove or chamfer along the lateral trajectory, and the chips are discharged through the spiral groove. Cutting parameters include Vc 100-400 m/min, fn 0.02-0.06 mm/tooth, ap 0.1-2 mm. Coolant (such as synthetic cutting fluid, flow rate ≥ 15 L/min) or dry cutting to control the temperature (< 700°C).

3. Characteristics of cemented carbide drilling and milling cutters

Ultra-high hardness : HV 1800-2100, suitable for materials below HRC 60.

Excellent wear resistance : VB ≤ 0.15 mm (500-1000 hours), life extended 5-7 times .

Excellent heat resistance : The coating is heat resistant to 1100°C and is suitable for medium and high speed cutting.

High precision : aperture tolerance ±0.01 mm, surface roughness Ra 0.02-0.06 μm .

Versatility : Combines drilling and milling functions, reducing tool changes.

Vibration resistance : flexural strength ≥ 2200 MPa, reducing vibration.

4. Carbide drilling and milling cutter performance and influencing factors

Performance is affected by material mix, cutting depth and parameters.

4.1 Performance Influencing Factors Table

Influencing factors	describe	Impact	Optimization suggestions	Data support
Cobalt content	5%-9%, balance of hardness and toughness	high	5% accuracy, 9% toughness	5% Co HV 1900
Cutting speed (Vc)	100-400 m/min, excessive wear	middle	Hard materials minus 10%	Vc 450 m/min wear 7%
Feed rate (fn)	0.02-0.06 mm/tooth	middle	Finishing 0.02 mm/tooth	fn 0.08 Cutting force increased by 25%
Cutting depth (ap)	0.1-2 mm, too deep vibration	high	Layering 1 mm/layer	ap 2.5 mm vibration increase 15%
Coating thickness	2-3 μm , too thick and peeling	middle	Optimized 2.2-2.5 μm	< 2 μm Heat resistance decreases by 10%

5. Carbide drilling and milling cutter performance production process

Production process table

Process steps	Equipment/Parameters	Time/Conditions	Goal/Result	Technical indicators
Raw material mixing	Ball mill 300-400 rpm	40-60 hours	Evenly dispersed	CV < 2%
Pressing	200-250 MPa	20-30 seconds	Blank forming	Density 14-15.5 g/ cm³
sintering	1450-1550°C, HIP	2-3 hours	Densification	Density 99%-99.8%
Blade trimming	Diamond grinding wheel #1000-#1200	Trimming 0.002-0.005 mm	Accuracy optimization	Ra ≤ 0.05 μm
Coating	PVD Deposition of AlTiN	Thickness 2-3 μm	Improved heat resistance	Adhesion force > 70 N

7. Types of Carbide Drilling and Milling Cutters

Standard drilling and milling cutters : diameter 3-15 mm, Vc 150-400 m/min, suitable for general drilling and milling.

Short-edged drill and milling cutter : diameter 4-10 mm, Vc 200-400 m/min, suitable for shallow hole processing .

Coated drilling and milling cutter : AlTiN coating, Vc 300-400 m/min, life extended by 40%-50%.

Long- edge drill and milling cutter : edge length 50-100 mm, Vc 100-300 m/min, suitable for deep hole drilling and milling.

Adjustable drilling and milling cutter : adjustable angle and length, Vc 100-350 m/min, suitable for customized needs.

6. Application of carbide drilling and milling cutters

Carbide drills and milling cutters are widely used in many industries due to their versatility, as follows:

Machining :

machining holes and slots of shafts, workpiece material is 45# steel, Vc 200-400 m/min, ap 0.1-1.5 mm, fn 0.02-0.05 mm/tooth. Accuracy IT6, Ra 0.02-0.04 μm , AI optimization in 2025 will reduce machining time by 15%.

Automobile manufacturing :

Drilling and chamfering of cylinder blocks, workpiece material is cast iron, Vc 150-300 m/min, ap 0.2-1 mm, fn 0.03-0.06 mm/tooth. Efficiency increased by 20%, Ra 0.02-0.05 μm .

Aerospace :

Processing holes and grooves of titanium alloy parts, Vc 200-400 m/min, ap 0.1-1 mm, fn 0.02-0.05 mm/tooth. Accuracy IT5, Ra 0.01-0.03 μm .

Energy equipment :

Processing deep holes in wind turbine shafts, workpiece material is 42CrMo steel, Vc 150-300 m/min, ap 0.5-2 mm, fn 0.03-0.06 mm/tooth. IoT monitoring will reduce waste by 10% in 2025.

Electronics industry :

Processing holes and slots in mobile phone housings, workpiece material is aluminum alloy, Vc 300-400 m/min, ap 0.1-0.8 mm, fn 0.02-0.05 mm/tooth. Accuracy ±0.001 mm, Ra 0.01-0.03 μm .

Medical equipment :

Drilling and chamfering of titanium alloy implants, Vc 100-250 m/min, ap 0.1-0.5 mm, fn 0.02-0.04 mm/tooth. Accuracy ±0.0003 mm, Ra 0.01-0.02 μm .

Defense industry :

Processing holes and slots in missile parts, workpiece material is high-strength steel, Vc 150-300 m/min, ap 0.3-1 mm, fn 0.03-0.06 mm/tooth. Wear resistance increased by 25%.

Shipbuilding industry :

Processing holes and grooves in hull plates, workpiece material is stainless steel, Vc 150-300 m/min, ap 0.5-1.5 mm, fn 0.03- 0.06 mm/tooth . Corrosion-resistant coating extends service life by 30%.

Heavy machinery :

machining holes for large gear shafts, workpiece material is 40CrNiMo steel, Vc 150-300 m/min, ap 0.5-2 mm, fn 0.04-0.07 mm/tooth. Life extended by 35%.

Petrochemical industry :

Processing holes and grooves of valve bodies, workpiece material is stainless steel, Vc 150-300 m/min, ap 0.3-1 mm, fn 0.03-0.06 mm/tooth. Corrosion resistance increased by 20%.

New energy industry :

Processing holes at the root of wind turbine blades, workpiece material is aluminum alloy, Vc 200-350 m/min, ap 0.3-1 mm, fn 0.03-0.06 mm/tooth. Efficiency increased by 15%.

Furniture manufacturing :

Processing holes and grooves in wooden boards, Vc 150-300 m/min, ap 0.2-1 mm, fn 0.03-0.06

mm/tooth. Surface smoothness Ra 0.02-0.04 μm .

Construction machinery :

machining holes in excavator arms, workpiece material is 35CrMo steel, Vc 150-300 m/min, ap 0.5-1.5 mm, fn 0.03-0.06 mm/tooth. Life extended by 30%.

What is a carbide coarse tooth milling cutter?

Carbide rough tooth milling cutter is a cutting tool made of carbide material. The cutter head has a small number of teeth (usually 2-6 teeth) and a large tooth spacing. It is designed for high feed rate and rough machining. It combines the high hardness, wear resistance and excellent cutting performance of cemented carbide. It is suitable for machining steel, cast iron and difficult-to-machine materials. It is widely used in machining, heavy manufacturing and mold industries. Carbide rough tooth milling cutter uses tungsten carbide (WC) as the main hard phase and cobalt (Co) as the bonding phase. It is made by powder metallurgy and precision grinding process. It is often equipped with AlTiN or TiCN coating to improve heat resistance and service life. It is suitable for CNC machine tools and machining centers. The following content will briefly summarize the structure and materials, working principle, characteristics, performance influencing factors, production process, types and applications.

1. Structure and materials of carbide coarse tooth milling cutter

Carbide rough-tooth milling cutters are usually solid carbide structures with diameters ranging from 10-50 mm, lengths of 50-200 mm, and 2-6 teeth (with larger tooth spacing). The blade geometry (such as helix angle 30°-45°, rake angle 5°-10°) optimizes rough machining, and the surface can be coated with AlTiN or TiCN coating (thickness 2-3 μm), with heat resistance up to 1100°C.

Material composition

Tungsten carbide (WC) particle size is 0.2-1.0 μm , cobalt (Co) content is 6%-10%, and TaC is added to enhance wear resistance.

Structural features

Solid carbide hardness HV 1800-2100, tool coaxiality ≤ 0.003 mm, cutting edge accuracy ±0.005 mm.

2. Working principle of carbide coarse tooth milling cutter

By rotating, the coarse-toothed cutter head cuts the workpiece at a high feed rate , removes a large amount of material, and completes the rough machining of planes, grooves or shoulders. The chips are discharged through the larger tooth gap. Cutting parameters include Vc 100-300 m/min, fn 0.1-0.3 mm/tooth, ap 1-5 mm. Coolant (such as synthetic cutting fluid, flow rate ≥ 20 L/min) or dry cutting to control temperature (< 700°C), assisted by AI optimization and sensor monitoring, cutting efficiency is improved by 15%-20%, and accuracy reaches IT7-IT9 level.

3. Characteristics of Carbide Coarse Tooth Milling Cutter

Ultra-high hardness : HV 1800-2100, suitable for materials below HRC 60.
Excellent wear resistance : VB ≤ 0.15 mm (500-1000 hours), life extended 5-7 times .
Excellent heat resistance : The coating is heat resistant to 1100°C and is suitable for high feed cutting.
High efficiency : Large tooth spacing is suitable for rough machining and high metal removal rate.
Versatility : Suitable for various roughing needs.
Vibration resistance : flexural strength ≥ 2200 MPa, reducing vibration.

4. Performance and influencing factors of cemented carbide coarse tooth milling cutter

Performance is affected by material ratio, number of teeth and cutting parameters.

4.1 Performance Influencing Factors Table

Influencing factors	describe	Impact	Optimization suggestions	Data support
Cobalt content	6%-10%, balance of hardness and toughness	high	6% accuracy, 10% toughness	6% Co HV 1900
Cutting speed (Vc)	100-300 m/min, excessive wear	middle	Hard materials minus 10%	Vc 350 m/min wear 7%
Feed rate (fn)	0.1-0.3 mm/tooth	high	Rough machining 0.2 mm/tooth	fn 0.4 Cutting force increased by 30%
Cutting depth (ap)	1-5 mm, too deep vibration	high	Layering 2.5 mm/layer	ap 6 mm vibration increased by 18%
Coating thickness	2-3 μm , too thick and peeling	middle	Optimized 2.2-2.5 μm	< 2 μm Heat resistance decreases by 10%

5. Carbide coarse tooth milling cutter performance production process

Production process table

Process steps	Equipment/Parameters	Time/Conditions	Goal/Result	Technical indicators
Raw material mixing	Ball mill 300-400 rpm	40-60 hours	Evenly dispersed	CV < 2%
Pressing	200-250 MPa	20-30 seconds	Blank forming	Density 14-15.5 g/ cm³
sintering	1450-1550°C, HIP	2-3 hours	Densification	Density 99%-99.8%
Blade trimming	Diamond grinding wheel #1000-#1200	Trimming 0.002-0.005 mm	Accuracy optimization	Ra ≤ 0.05 μm
Coating	PVD Deposition of AlTiN	Thickness 2-3 μm	Improved heat resistance	Adhesion force > 70 N

7. Types of Carbide Coarse Tooth Milling Cutters

Standard coarse tooth milling cutter : diameter 10-30 mm, Vc 150-300 m/min, suitable for general roughing.

Large diameter coarse tooth milling cutter : diameter 30-50 mm, Vc 100-250 m/min, suitable for heavy machining.

Coated coarse tooth milling cutter : AlTiN coating, Vc 200-300 m/min, life extended by 40%-50%.

Long- edge coarse-tooth milling cutter : edge length 50-150 mm, Vc 100-200 m/min, suitable for deep groove roughing.
Adjustable coarse tooth milling cutter : adjustable tooth spacing, Vc 100-300 m/min, suitable for customized needs.

6. Application of carbide coarse tooth milling cutter

Carbide roughing milling cutters are widely used in many industries due to their high-efficiency roughing capabilities, as follows:

Machining :
Rough surface machining of machine tool bed, workpiece material is HT250 cast iron, Vc 200-300 m/min, ap 2-5 mm, fn 0.1-0.2 mm/tooth. Accuracy IT7, Ra 0.04-0.08 μm , AI optimization in 2025 reduces machining time by 15%.

Automobile manufacturing :
machining rough grooves of cylinder bodies, workpiece material is cast iron, Vc 150-250 m/min, ap 1-3 mm, fn 0.15-0.25 mm/tooth. Efficiency increased by 20%, Ra 0.04-0.07 μm .

Aerospace :
Processing titanium alloy blanks, Vc 200-300 m/min, ap 1-4 mm, fn 0.1-0.2 mm/tooth. Accuracy IT8, Ra 0.03-0.06 μm .

Energy equipment :
Processing rough surface of wind power tower, workpiece material is Q345 steel, Vc 150-250 m/min, ap 2-5 mm, fn 0.15-0.3 mm/tooth. IoT monitoring will reduce waste by 10% in 2025.

Electronics industry :
Processing large chassis rough grooves , workpiece material is aluminum alloy, Vc 250-300 m/min, ap 1-2 mm, fn 0.1-0.2 mm/tooth. Accuracy ±0.01 mm, Ra 0.03-0.05 μm .

Medical equipment :
Processing stainless steel blanks, Vc 100-200 m/min, ap 1-3 mm, fn 0.1-0.2 mm/tooth. Accuracy ±0.005 mm, Ra 0.03-0.04 μm .

Defense industry :
Processing the rough surface of armor plates, the workpiece material is high-strength steel, Vc 150-250 m/min, ap 2-4 mm, fn 0.15-0.25 mm/tooth . Wear resistance increased by 25%.

Shipbuilding industry :
Processing rough grooves on ship hulls, workpiece material is AH36 steel, Vc 150-250 m/min, ap 2-5 mm, fn 0.15-0.3 mm/tooth. Corrosion-resistant coating extends service life by 30%.

Heavy machinery :
machining rough surface of large gears, workpiece material is 40CrNiMo steel, Vc 150-250 m/min, ap 2-5 mm, fn 0.2-0.3 mm/tooth. Life extended by 35%.

Petrochemical industry :
Processing pipeline flange rough surface, workpiece material is stainless steel, Vc 150-250 m/min, ap 2-4 mm, fn 0.15-0.25 mm/tooth. Corrosion resistance increased by 20%.

New energy industry :
Processing rough blanks of wind turbine blades, the workpiece material is composite material, Vc 200-300 m/min, ap 1-3 mm, fn 0.1-0.2 mm/tooth. Efficiency increased by 15%.

Furniture manufacturing :

Processing rough grooves of wooden boards , Vc 150-250 m/min, ap 1-2 mm, fn 0.15-0.25 mm/tooth. Surface smoothness Ra 0.04-0.06 μm .

Construction machinery :

machining the rough surface of excavator arms, workpiece material is 35CrMo steel, Vc 150-250 m/min, ap 2-4 mm, fn 0.15-0.25 mm/tooth. Life extended by 30%.

What is a carbide fine tooth milling cutter?

Carbide fine-tooth milling cutter is a cutting tool made of carbide material. The cutter head has a large number of teeth (usually 6-20 teeth) and a small tooth spacing. It is designed for finishing and high-precision machining. It combines the high hardness, wear resistance and excellent cutting performance of cemented carbide. It is suitable for machining steel, cast iron, non-ferrous metals and difficult-to-machine materials. It is widely used in mold manufacturing, aerospace and precision machinery industries. Carbide fine-tooth milling cutter uses tungsten carbide (WC) as the main hard phase and cobalt (Co) as the bonding phase. It is made by powder metallurgy and precision grinding process. It is often equipped with AlTiN or TiCN coating to improve heat resistance and service life. It is suitable for CNC machine tools and machining centers.

1. Structure and materials of carbide fine-tooth milling cutter

Carbide fine-tooth milling cutters are usually solid carbide structures with diameters ranging from 4-30 mm, lengths of 50-150 mm, and teeth of 6-20 (with smaller tooth spacing). The blade geometry (such as helix angle 30°-40°, rake angle 0°-5°) optimizes finishing cutting, and the surface can be coated with AlTiN or TiCN coating (thickness 2-3 µm), with heat resistance up to 1100°C.

Material composition : tungsten carbide (WC) particle size 0.2-1.0 µm , cobalt (Co) content 5%-9%, TaC added to enhance wear resistance.

Structural features : Overall carbide hardness HV 1800-2100, tool coaxiality ≤ 0.003 mm, blade accuracy ±0.005 mm.

2. Working principle of carbide fine-tooth milling cutter

By rotating, the fine-toothed cutter head cuts the workpiece at a low feed rate to complete the finishing of planes, grooves or complex contours, and the chips are discharged through a small tooth gap. Cutting parameters include Vc 150-500 m/min, fn 0.02-0.06 mm/tooth, ap 0.1-1.5 mm. Coolant (such as synthetic cutting fluid, flow rate ≥ 15 L/min) or dry cutting to control the temperature (< 700°C),

3. Characteristics of carbide fine-tooth milling cutters

Ultra-high hardness : HV 1800-2100, suitable for materials below HRC 60.

Excellent wear resistance : VB ≤ 0.15 mm (500-1000 hours), life extended 5-7 times .

Excellent heat resistance : The coating is heat resistant to 1100°C and is suitable for high-speed precision cutting.

High precision : surface roughness Ra 0.02-0.04 µm , suitable for finishing.

Versatility : adaptable to various finishing needs.

Vibration resistance : flexural strength ≥ 2200 MPa, reducing vibration.

4. Performance and influencing factors of cemented carbide fine-tooth milling cutters

Performance is affected by material ratio, number of teeth and cutting parameters.

4.1 Performance Influencing Factors Table

Influencing factors	describe	Impact	Optimization suggestions	Data support
Cobalt content	5%-9%, balance of hardness and toughness	high	5% accuracy, 9% toughness	5% Co HV 1900
Cutting speed (Vc)	150-500 m/min, excessive wear	middle	Hard materials minus 10%	Vc 550 m/min wear 7%
Feed rate (fn)	0.02-0.06 mm/tooth	middle	Finishing 0.02 mm/tooth	fn 0.08 Cutting force increased by 25%
Cutting depth (ap)	0.1-1.5 mm, too deep vibration	high	Layering 0.5 mm/layer	ap 2 mm vibration increase 15%
Coating thickness	2-3 µm , too thick and peeling	middle	Optimized 2.2-2.5 µm	< 2 µm Heat resistance decreases by 10%

5. Carbide fine tooth milling cutter performance production process

5.1 Production process table

Process steps	Equipment/Parameters	Time/Conditions	Goal/Result	Technical indicators
Raw material mixing	Ball mill 300-400 rpm	40-60 hours	Evenly dispersed	CV < 2%
Pressing	200-250 MPa	20-30 seconds	Blank forming	Density 14-15.5 g/ cm³
sintering	1450-1550°C, HIP	2-3 hours	Densification	Density 99%-99.8%
Blade trimming	Diamond grinding wheel #1000-#1200	Trimming 0.002-0.005 mm	Accuracy optimization	Ra ≤ 0.05 µm
Coating	PVD Deposition of AlTiN	Thickness 2-3 µm	Improved heat resistance	Adhesion force > 70 N

7. Types of Carbide Fine Tooth Milling Cutters

Standard fine-tooth milling cutter : Ø 4-15 mm, Vc 200-500 m/min, suitable for general finishing.
Small diameter fine tooth milling cutter : diameter 4-10 mm, Vc 250-500 m/min, suitable for micro processing.
Coated fine-tooth milling cutter : AlTiN coating, Vc 300-500 m/min, life extended by 40%-50%.
Long- edge fine-tooth milling cutter : edge length 50-100 mm, Vc 150-400 m/min, suitable for deep groove finishing.
Adjustable fine-tooth milling cutter : tooth spacing is adjustable, Vc 150-450 m/min, suitable for customized needs.

电话/TEL：0086 592 512 9696
CTIAQCD-MA-E/P 2018-2024V
sales@chinatungsten.com

6. Application of carbide fine-tooth milling cutter

Carbide fine-tooth milling cutters are widely used in many industries due to their high-precision finishing capabilities, as follows:

Mold manufacturing :

Processing the fine surface of injection molds, the workpiece material is P20 steel, Vc 200-400 m/min, ap 0.1-1 mm, fn 0.02-0.04 mm/tooth. Accuracy IT5, Ra 0.02-0.03 μm , AI optimization in 2025 will reduce processing time by 15%.

Automobile manufacturing :

machining the fine groove of the cylinder body, the workpiece material is aluminum alloy, Vc 300-500 m/min, ap 0.2-0.8 mm, fn 0.02-0.05 mm/tooth. Efficiency increased by 20%, Ra 0.02-0.03 μm .

Aerospace :

Processing titanium alloy wing surface, Vc 250-400 m/min, ap 0.1-0.6 mm, fn 0.02-0.04 mm/tooth. Accuracy IT4, Ra 0.01-0.02 μm .

Energy equipment :

Processing wind turbine blade mold surface finishing, workpiece material is composite material, Vc 200-400 m/min, ap 0.3-1 mm, fn 0.02-0.05 mm/tooth. IoT monitoring will reduce waste by 10% in 2025.

Electronics industry :

Processing precision grooves of mobile phone shells, workpiece material is aluminum alloy, Vc 400-500 m/min, ap 0.1-0.5 mm, fn 0.02-0.04 mm/tooth. Accuracy ±0.001 mm, Ra 0.01-0.02 μm .

Medical equipment :

machining the surface of titanium alloy implants, Vc 150-250 m/min, ap 0.1-0.4 mm, fn 0.02-0.03 mm/tooth. Accuracy ±0.0003 mm, Ra 0.01-0.02 μm .

Defense industry :

Processing the surface of missile parts, the workpiece material is high-strength steel, Vc 200-300 m/min, ap 0.2-0.8 mm, fn 0.02-0.04 mm/tooth. Wear resistance increased by 25%.

Shipbuilding industry :

machining ship hull grooves, workpiece material is stainless steel, Vc 200-300 m/min, ap 0.3-1 mm, fn 0.02-0.05 mm/tooth. Anti-corrosion coating extends service life by 30%.

Heavy machinery :

machining large gear surface, workpiece material is 40CrNiMo steel, Vc 200-300 m/min, ap 0.3-1 mm, fn 0.02-0.05 mm/tooth. Life extended by 35%.

Petrochemical industry :

machining valve body surface, workpiece material is stainless steel, Vc 200-300 m/min, ap 0.2-0.8 mm, fn 0.02-0.04 mm/tooth. Corrosion resistance increased by 20%.

New energy industry :

Processing wind turbine blade surface finishing, workpiece material is aluminum alloy, Vc 250-400 m/min, ap 0.2-0.8 mm, fn 0.02-0.05 mm/tooth. Efficiency increased by 15%.

Furniture manufacturing :

Processing wood panel grooves , Vc 200-300 m/min, ap 0.2-0.6 mm, fn 0.02-0.04 mm/tooth. Surface smoothness Ra 0.02-0.03 μm .

Construction machinery :

machining excavator arm fine surface, workpiece material is 35CrMo steel, Vc 200-300 m/min, ap 0.3-1 mm, fn 0.02-0.05 mm/tooth. Life extended by 30%.

What is a taper micro-diameter milling cutter?

The tapered micro-diameter milling cutter is a precision cutting tool made of cemented carbide or ultra-fine-grained cemented carbide material. The cutter head has a tapered design and an extremely small diameter (usually 0.1-6 mm, and the smallest commercially available diameter can reach 0.08 mm). It is mainly used for processing micro-tapered surfaces, chamfers or fine contours. It combines high hardness, wear resistance and excellent cutting performance. It is suitable for processing steel, titanium alloys, non-ferrous metals and difficult-to-process materials. It is widely used in micro-mold manufacturing, electronic component processing and medical device industries. The tapered micro-diameter milling cutter uses tungsten carbide (WC) as the main hard phase and cobalt (Co) as the bonding phase. It is made through powder metallurgy and ultra-precision grinding processes. It is often equipped with AlTiN or TiCN coatings to improve heat resistance and service life. It is suitable for high-precision CNC machine tools and micro-machining equipment.

1. Structure and materials of taper micro-diameter milling cutter

Tapered micro-diameter milling cutters are usually solid carbide structures with diameters ranging from 0.1-6 mm (the smallest commercially available diameter can reach 0.08 mm) , lengths of 38-100 mm, and 2-4 teeth. The cutter head is conical, and the taper angle (commonly 5°-30°) is customized according to processing requirements. The blade geometry parameters (such as helix angle 20°-40°, rake angle 0°-5°) optimize micro-cutting. AlTiN or TiCN coatings (thickness 1-2 μm) can be applied to the surface, and the heat resistance reaches 1000°C.

Material composition : tungsten carbide particle size 0.2-0.5 μm , cobalt (Co) content 4%-8%, TaC or NbC added to enhance wear resistance.

Structural features : Overall carbide hardness HV1900-2200, tool coaxiality ≤ 0.002, blade accuracy ±0.002 mm.

2. Working principle of taper micro-diameter milling cutter

Through high-speed rotation, the conical tool head cuts along the workpiece trajectory to complete micro-conical surfaces, chamfers or complex contours, and the chips are discharged through the spiral groove. Cutting parameters include Vc 50-300 m/min, fn 0.005-0.02 mm/tooth, ap 0.01-0.5 mm. Use high-precision coolant (such as micro-lubrication, flow ≤ 5 L/min) or dry cutting to control temperature (< 600°C). In 2025, combined with AI optimization and sensor monitoring, cutting efficiency will be increased by 15%-20%, and accuracy will reach IT4-IT6 level.

3. Characteristics of taper micro-diameter milling cutter

Ultra-high hardness : HV 1900-2200, suitable for materials below HRC 65.

Excellent wear resistance : VB ≤ 0.1 mm (300-800 hours), life extended 5-8 times .

Excellent heat resistance : The coating is heat resistant to 1000°C and is suitable for high-speed micro-cutting.

High precision : surface roughness Ra 0.01-0.03 μm , taper tolerance ±0.005 mm.

Miniaturization : Small diameter is suitable for micro-machining needs.

Vibration resistance : flexural strength ≥ 2300 MPa, reducing micro-vibration.

4. Performance and influencing factors of taper micro-diameter milling cutters

Influencing factors	describe	Impact	Optimization suggestions	Data support
Cobalt content	4%-8%, balance of hardness and toughness	high	4% accuracy, 8% toughness	4% Co HV 2000
Cutting speed (Vc)	50-300 m/min, excessive wear	middle	Hard materials minus 10%	Vc 350 m/min wear 8%
Feed rate (fn)	0.005-0.02 mm/tooth	middle	Finishing 0.005 mm/tooth	fn 0.03 Cutting force increased by 20%
Cutting depth (ap)	0.01-0.5 mm, too deep vibration	high	Layering 0.2 mm/layer	ap 0.7 mm Vibration increased by 15%
Coating thickness	1-2 μm , too thick and peeling	middle	Optimized 1.2-1.5 μm	< 1 μm Heat resistance decreases by 10%

5. Performance and production process flow chart of taper micro-diameter milling cutter

Process steps	Equipment/Parameters	Time/Conditions	Goal/Result	Technical indicators
Raw material mixing	Ball mill 400-500 rpm	50-70 hours	Evenly dispersed	CV < 1.5%
Pressing	250-300 MPa	15-25 seconds	Blank forming	Density 14.5-15.8 g/cm³
sintering	1450-1600°C, HIP	2-4 hours	Densification	Density 99.5%-99.9%
Blade trimming	Ultra-precision grinding wheel #1500-#2000	Trimming 0.001-0.003 mm	Accuracy optimization	Ra ≤ 0.02 μm
Coating	PVD Deposition of AlTiN	Thickness 1-2 μm	Improved heat resistance	Adhesion force > 70 N

7. Types of taper micro-diameter milling cutters

Standard taper micro-diameter milling cutter : diameter 0.1-3 mm, Vc 100-300 m/min, suitable for general micro-machining.

High taper angle micro-diameter milling cutter : taper angle 20°-30°, Vc 50-200 m/min, suitable for deep taper processing .

Coated micro-diameter milling cutter : AlTiN coating, Vc 150-300 m/min, life extended by 40%-50%.

Ultra-micro milling cutter : diameter 0.1-1 mm, Vc 50-150 m/min, suitable for ultra-micro machining.

Adjustable taper milling cutter : cone angle is adjustable, Vc 50-250 m/min, suitable for customized needs.

6. Application of taper micro-diameter milling cutter

Tapered micro-diameter milling cutters are widely used in many industries due to their miniature and high-precision processing capabilities, as follows:

Mold manufacturing :

Processing micro mold conical grooves, workpiece material is SKD11 steel, Vc 100-200 m/min, ap 0.01-0.3 mm, fn 0.005-0.01 mm/tooth. Accuracy IT4, Ra 0.01-0.02 μm , AI optimization in 2025 to reduce processing time by 15%.

Electronics industry :

Processing chamfers of mobile phone cameras, workpiece material is aluminum alloy, Vc 200-300 m/min, ap 0.01-0.2 mm, fn 0.005-0.01 mm/tooth. Accuracy ±0.001 mm, Ra 0.01-0.02 μm .

Aerospace :

Processing titanium alloy micro-conical holes, Vc 100-200 m/min, ap 0.01-0.4 mm, fn 0.005-0.01 mm/tooth. Accuracy IT5, Ra 0.01-0.02 μm .

Medical equipment :

machining conical features of titanium alloy implants, Vc 50-150 m/min, ap 0.01-0.2 mm, fn 0.005-0.008 mm/tooth. Accuracy ±0.0002 mm, Ra 0.01 μm .

Defense industry :

Processing conical grooves of micro missile parts, workpiece material is high-strength steel, Vc 100-200 m/min, ap 0.02-0.3 mm, fn 0.005-0.01 mm/tooth. Wear resistance increased by 25%.

New energy industry :

Processing conical holes of micro solar cell brackets, workpiece material is aluminum alloy, Vc 150-250 m/min, ap 0.01-0.3 mm, fn 0.005-0.01 mm/tooth. Efficiency increased by 15%.

Precision instruments :

Processing conical surfaces of optical components, workpiece material is glass ceramic, Vc 50-150 m/min, ap 0.01-0.2 mm, fn 0.005-0.01 mm/tooth. Accuracy ±0.0005 mm, Ra 0.01 μm .

Characteristics and differences of cemented carbide milling cutters

The characteristics of carbide forming milling cutters, thread milling cutters, drill milling cutters, coarse tooth milling cutters, fine tooth milling cutters and taper micro-diameter milling cutters are compared, and their characteristics and similarities and differences are listed.

Characteristics and differences of cemented carbide milling cutters

type	Main Features	Applicable processing	Diameter range (mm)	Number of teeth	Cutting speed (Vc , m/min)	Feed rate (fn , mm/tooth)	Cutting depth (ap, mm)	Hardness (HV)	Heat resistance (°C)	Surface roughness (Ra, μm)	Main application areas
Form milling cutter	Specific contour cutter head, complex surface processing	Molding surface, tooth groove	5-30	2-6	100-350	0.02-0.06	0.1-1.5	1800-2100	1100	0.02-0.06	Gear and mold manufacturing
Thread milling cutter	Spiral groove design, processing internal/external threads	Thread processing	3-20	2-6	100-300	0.02-0.05	0.1-1	1800-2100	1100	0.02-0.06	Mechanical processing, automobile manufacturing
Drilling and milling cutters	Drilling + milling function, center cutting edge	Drilling, slotting, chamfering	3-20	2-4	100-400	0.02-0.06	0.1-2	1800-2100	1100	0.02-0.06	Machining, aerospace
Coarse tooth milling cutter	Few teeth, large spacing , high feed roughing	Rough machining of planes and grooves	10-50	2-6	100-300	0.1-0.3	1-5	1800-2100	1100	0.04-0.08	Heavy machinery, mold manufacturing
Fine tooth milling cutter	Multiple teeth with small spacing, high-precision finishing	Finishing of planes and grooves	4-30	6-20	150-500	0.02-0.06	0.1-1.5	1800-2100	1100	0.02-0.04	Mold manufacturing, aerospace
Taper micro-diameter milling cutter	Conical design, extremely small diameter, micro high-precision processing	Micro taper, chamfer	0.1-6	2-4	50-300	0.005-0.02	0.01-0.5	1900-2200	1000	0.01-0.03	Micro molds, medical devices

Differences and similarities between carbide forming milling cutters, thread milling cutters, drill milling cutters, coarse tooth milling cutters, fine tooth milling cutters and taper micro-diameter milling cutters

category	content
Similarities	

电话/TEL：0086 592 512 9696
sales@chinatungsten.com

Material Basics	All types are made of cemented carbide (WC+Co) with a hardness range of 1800-2200 HV and a heat resistance of 1000-1100°C, and are generally equipped with AlTiN or TiCN coatings.
Processing performance	They are suitable for processing steel, cast iron, non-ferrous metals and difficult-to-process materials, and are widely used in industrial manufacturing.
Production process	They are all made through powder metallurgy, precision grinding and PVD coating processes, with an accuracy controlled at ±0.005 mm or higher.
Application Scenario	It is mostly used in CNC machine tools and machining centers, and will be combined with AI optimization to improve efficiency by 15%-20% by 2025.
Differences	
Structural design	- Profile milling cutter: Specific contour design for complex surfaces. - Thread milling cutter: Spiral groove structure, specially designed for thread processing. - Drilling milling cutter: Combines drilling and milling functions. - Coarse tooth milling cutter: Few teeth and large spacing , suitable for rough processing. - Fine tooth milling cutter: Many teeth and small spacing, suitable for fine processing. - Tapered micro-diameter milling cutter: Tapered micro-diameter, specially designed for micro high-precision processing.
Diameter range	The taper micro-diameter milling cutter has the smallest diameter (0.1-6 mm), the coarse-tooth milling cutter has the largest diameter (10-50 mm), and the other types are between 3-30 mm.
Number of teeth and spacing	Coarse-tooth milling cutters have fewer teeth (2-6) and wider spacing; fine-tooth milling cutters have more teeth (6-20) and narrow spacing; other types have a moderate number of teeth (2-6).
Cutting data	- Coarse-tooth milling cutters have the highest feed rate (0.1-0.3 mm/tooth) and the greatest depth of cut (1-5 mm). - Taper-diameter milling cutters have the lowest feed rate (0.005-0.02 mm/tooth) and the smallest depth of cut (0.01-0.5 mm). - Fine-tooth milling cutters have the highest cutting speed (150-500 m/min).
Precision and surface quality	Tapered micro-diameter milling cutters have the highest accuracy (Ra 0.01-0.03 µm), coarse-tooth milling cutters have the lowest accuracy (Ra 0.04-0.08 µm); fine-tooth milling cutters and forming milling cutters are suitable for high-precision finishing (IT5-IT7).
Application Areas	Coarse-tooth milling cutters are more suitable for heavy machinery; fine-tooth milling cutters and taper milling cutters with small diameters are more suitable for precision industries (such as aerospace and medical).

Differences in the number of teeth of carbide milling cutters

type	Number of teeth scope	Characteristics and influence	Applicable scenarios
Form milling cutter	2-6	Moderate number of teeth, suitable for complex contour processing, fewer teeth to ensure chip space, medium accuracy.	Gear and mold complex surface processing
Thread milling cutter	2-6	The number of teeth is moderate, the spiral design optimizes thread cutting, and the small number of teeth ensures smooth chip evacuation.	Thread processing, mechanical parts manufacturing

Drilling and milling cutters	2-4	With a small number of teeth, it combines drilling and milling functions, reduces vibration, and is suitable for small diameter and high-precision machining.	Drilling, slotting, chamfering
Coarse tooth milling cutter	2-6	It has a small number of teeth and a large spacing, which is suitable for rough machining at high feed rates , has a large chip space, high efficiency but low precision.	Heavy machinery, rough machining of surfaces, grooves
Fine tooth milling cutter	6-20	It has many teeth and small spacing, which is suitable for low feed rate finishing , stable cutting and high surface quality.	Mold manufacturing, aerospace finishing
Taper micro-diameter milling cutter	2-4	Small number of teeth and small diameter design are suitable for high-precision micro-machining. Fewer teeth reduce tool load.	Micro molds, medical device micro processing

Main causes and effects of differences in the number of teeth

Processing Type	Rough machining (such as coarse-tooth milling cutters) requires fewer teeth to accommodate a large amount of chips, with 2-6 teeth. Finishing (such as fine-tooth milling cutter) requires more teeth to improve surface finish, with 6-20 teeth. Special processing (such as thread milling cutter, taper micro-diameter milling cutter) has a moderate number of teeth (2-6) to optimize specific functions.
Diameter	Small diameter tools (such as tapered micro-diameter milling cutters, 0.1-6 mm) have fewer teeth (2-4) to avoid overloading. Large diameter tools (such as coarse tooth milling cutters, 10-50 mm) can have up to 6 teeth to accommodate larger cutting volumes.
Cutting data	Tools with fewer teeth (such as coarse-tooth milling cutters) have high feed rates (0.1-0.3 mm/tooth) and large cutting depths (1-5 mm). Tools with multiple teeth (such as fine-tooth milling cutters) have low feed rates (0.02-0.06 mm/tooth) and small depths of cut (0.1-1.5 mm).
Accuracy requirements	The fine-tooth milling cutter has a multi -tooth design that improves accuracy (Ra 0.02-0.04 μm), while the coarse-tooth milling cutter has a small number of teeth and lower accuracy (Ra 0.04-0.08 μm). Micro tools (such as tapered micro-diameter milling cutters) with few teeth ensure high precision (Ra 0.01-0.03 μm).

Table of contents

11. Appendix

What is a Carbide T-Type Milling Cutter?

Introduction to CTIA GROUP LTD Carbide T-Type Milling Cutter

Structure and materials of cemented carbide T-type milling cutter
Working principle of carbide T-type milling cutter
Characteristics of Carbide T-Type Milling Cutter
Performance and influencing factors of cemented carbide T-type milling cutter
Table of factors affecting the performance of cemented carbide T-type milling cutter
Carbide T-type milling cutter performance production process
Carbide T-type milling cutter performance production process table
Application of Carbide T-Type Milling Cutter
Types of Carbide T-Type Milling Cutters
Carbide T-type milling cutter related domestic and international standards
Design drawings and sintered products and blanks of cemented carbide T-type milling cutters

ISO 513:2012 – Classification
and application of hard cutting materials for metal removal with defined cutting edges —
Designation of the main groups and groups of application
Cutting tools — Milling cutters — Geometric parameters and durability test methods

DIN 844:1987 -
Milling cutters with cylindrical shank — Dimensions
DIN 1839:1990 -
Milling cutters — Manufacturing and application specifications
ANSI B94.19-1997 (R2019) -
Milling Cutters and End Mills
JIS B 4120:2000 Carbide milling cutter — Manufacturing and testing specifications

GB/T 16665-2017 - Hardmetals — Technical requirements and test methods

GB/T 5231-2019- Cutting tools

电话/TEL：0086 592 512 9696
CTIAQCD-MA-E/P 2018-2024V
sales@chinatungsten.com

— General technical conditions
GB/T 20323-2020- Milling cutters — Designation system for solid/tooth-insertable/indexable types

GB/T 25664-2010 - High-speed milling cutters
— Safety requirements
GB/T 6122-2017 -
Corner rounding milling cutters
GB/T 1127-2023-
Half-round keyway milling cutters
GB/T 20773-2006 -
Milling cutters for dies and moulds
GB/T 14301-2008 - Solid carbide
saw-blade milling cutters
GB/T 5231-2018 Cemented Carbide Materials
GB/T 16665-2017 Classification of cutting tools
ISO 6987-2020: Cutting parameters for CNC machine tools
ISO 6987- 2020 Numerical Control of Machines — Cutting Parameters
ISO 13399-2022: Tool data representation
ISO 13399- 2022 Cutting Tool Data Representation

What is a milling cutter?
What types of milling cutters are there?
What is a Carbide Cylindrical Shank Milling Cutter?
What are Carbide End Mills?
What is a solid carbide milling cutter?
What is a carbide welded milling cutter?
What is a carbide insert milling cutter?
What is a carbide insert milling cutter?
What are carbide indexable insert milling cutters?
What is a carbide high speed cutting milling cutter?
What is a Carbide Corner Milling Cutter?
What is a Carbide Round Keyway Milling Cutter?
What is a Carbide Die Milling Cutter?
What is a Carbide Saw Blade Milling Cutter?
What is a Carbide Cylindrical Milling Cutter ?
What is a Carbide Face Mill ?
What is a Carbide End Mill ?
What is a carbide long edge end mill?
What is a Carbide Ball Nose End Mill?
What is a Carbide Round Nose Milling Cutter?
What is a Carbide Bullnose Milling Cutter?

What is a Carbide Chamfer Milling Cutter?
What is a Carbide Taper Milling Cutter?
What is a Carbide Dovetail Milling Cutter?
What is a Carbide Keyway Milling Cutter?
What are Carbide Angle Milling Cutters?
What is a Carbide Form Milling Cutter?
What are Carbide Thread Mills?
What are carbide drill cutters?
What is a carbide coarse tooth milling cutter?
What is a carbide fine tooth milling cutter?
What is a taper micro-diameter milling cutter?
Characteristics and differences of cemented carbide milling cutters

CTIA GROUP LTD

30 Years of Cemented Carbide Customization Experts

Core Advantages

30 years of experience: We are well versed in cemented carbide production and processing , with mature and stable technology and continuous improvement .

Precision customization: Supports special performance and complex design , and focuses on customer + AI collaborative design .

Quality cost: Optimized molds and processing, excellent cost performance; leading equipment, RMI , ISO 9001 certification.

Serving Customers

The products cover cutting, tooling, aviation, energy, electronics and other fields, and have served more than 100,000 customers.

Service Commitment

1+ billion visits, 1+ million web pages, 100,000+ customers, and 0 complaints in 30 years!

Contact Us

Email : sales@chinatungsten.com

Tel : +86 592 5129696

Official website : www.ctia.com.cn