



Introduction to Gear Milling Application

High speed gear milling cutter | High speed gear hob

Marketing Dept 01/03/2022

PREFACE



Ever since starting of industrialization, we humans have manufactured various mechanical equipment to replace manpower and transform energies into movements to meet our demands, achieving the current splendid human civilization.

Mechanical transmission is divided into three types: gear, belt, and direct drive. Gear transmission is mostly used in machine equipment, heavy-duty in particular. Major machineries applying large-modulus heavy-duty gear transmission include: 1. Wind power generators, 2. Construction machinery (excavators, cranes, tower cranes, shield machines, various large industrial gearboxes, etc.), 3. Port machinery (port cranes, engineering installation ships), 4. Gearboxes for train locomotives, etc. Based on the functional structure of gears, it can be further divided into two types: slewing bearings and variable-speed gears.

Gear Milling for Wind Power Generators



According to the analysis of the World Meteorological Organization (WMO) and the Academy of Meteorological Sciences of the China Meteorological Administration, the available wind energy resources on the earth totals 20 billion KW, which is 20 times of the available water energy resources on the earth. The available wind energy at the 10m altitude in China is 253 million KW. The available wind energy at sea is three times that of the land, and the available wind energy at the 50m altitude is twice that at the 10m altitude. Wind turbines are the major equipment to utilize the rich wind energy. Each wind turbine has a large number of gear rotating parts inside. As shown in the figure below, all of these put forward extremely high requirements for gear machining efficiency, and traditional high-speed steel and insert gear tools are far from meeting the requirements.

Mianyang Miangong Tools Co., Ltd. has long been committed to the research of cutting tools for the wind power industry, providing high-quality and efficient gear processing tools for our valued customers.

Struction of Wind Power Generation

Blade Bearings

Blade drive bearings - External gear

Blade ring gear - Internal gear

Yaw Bearings

Blade drive bearings - External gear

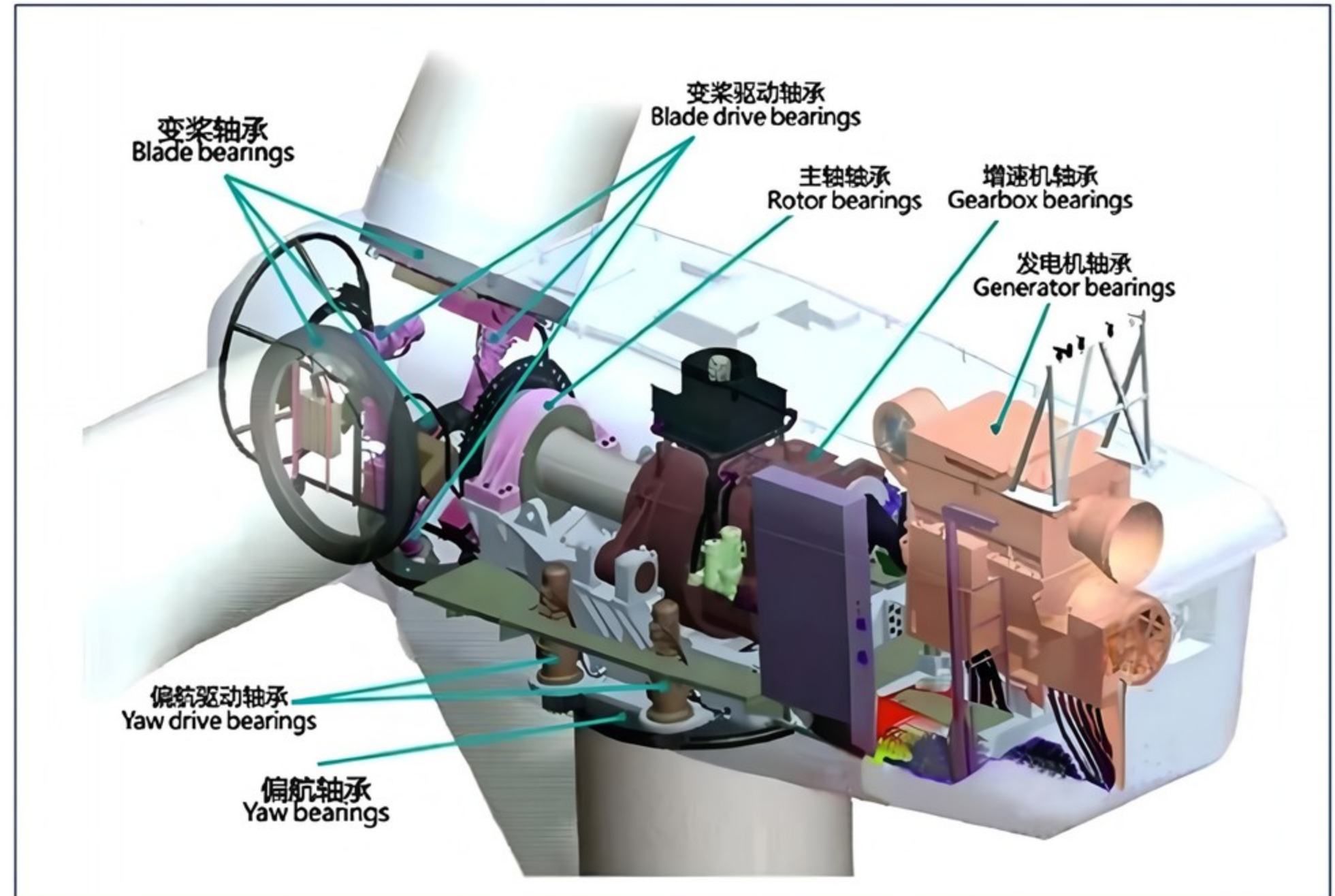
Blade ring gear - External gear

Gearbox

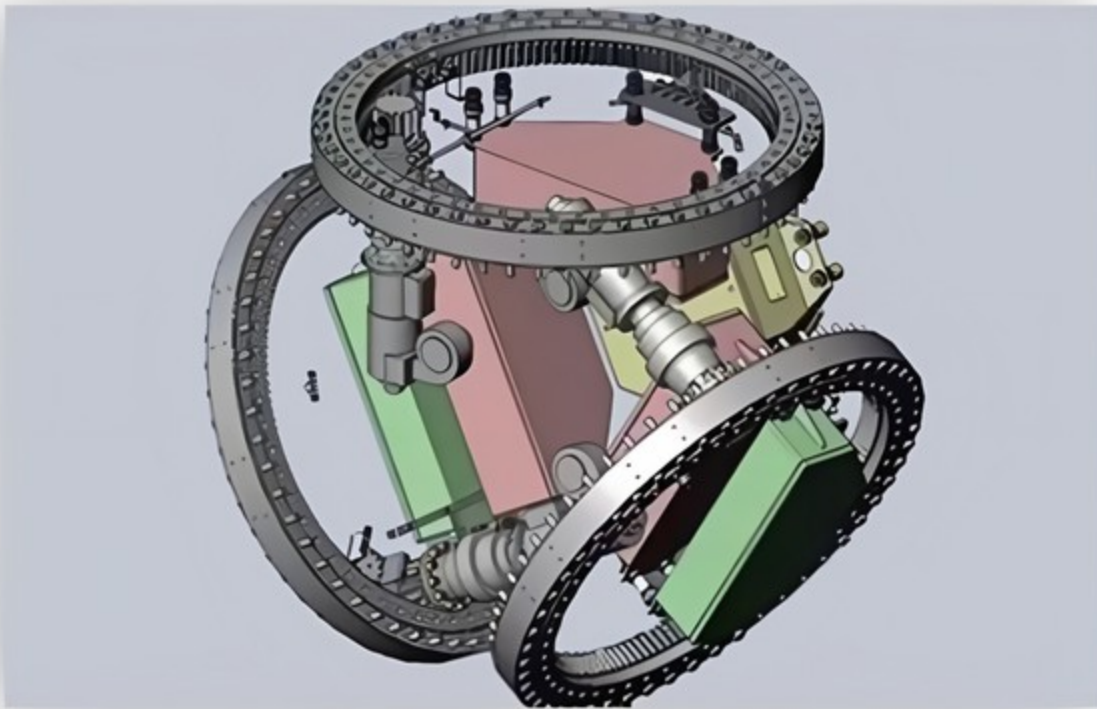
Sun gear - External gear

Planetary gear - External gear

Internal ring gear - Internal gear



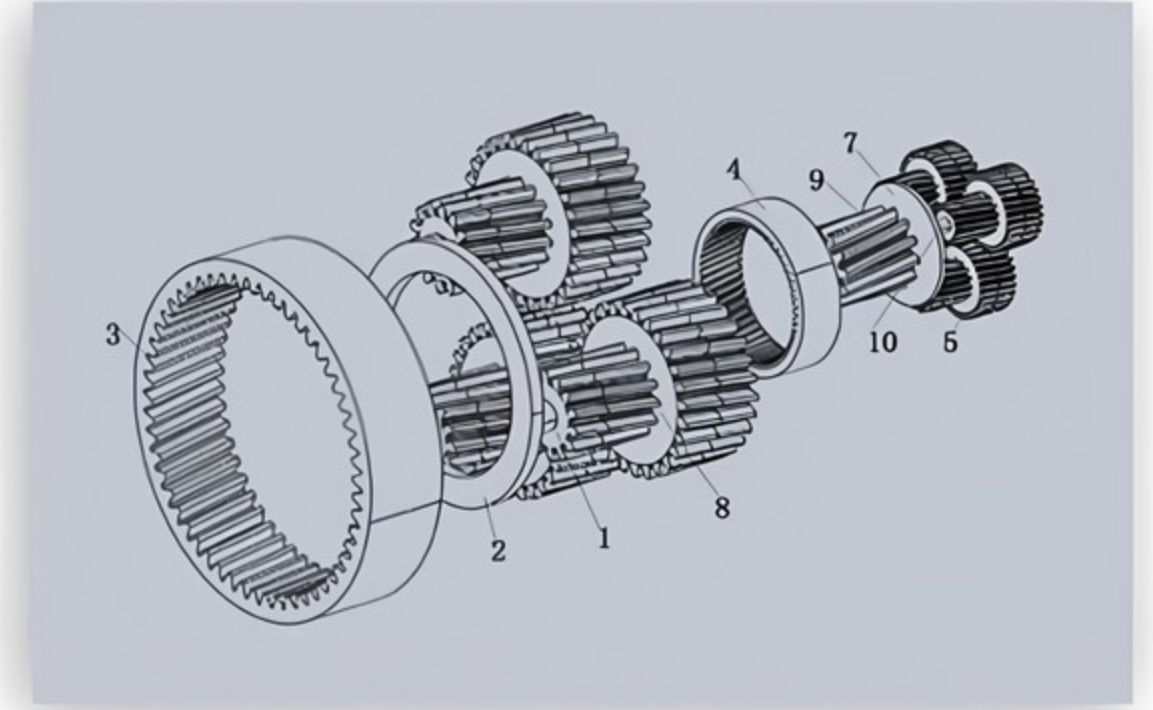
Structure of gear components of wind turbine generators



Blade Bearings

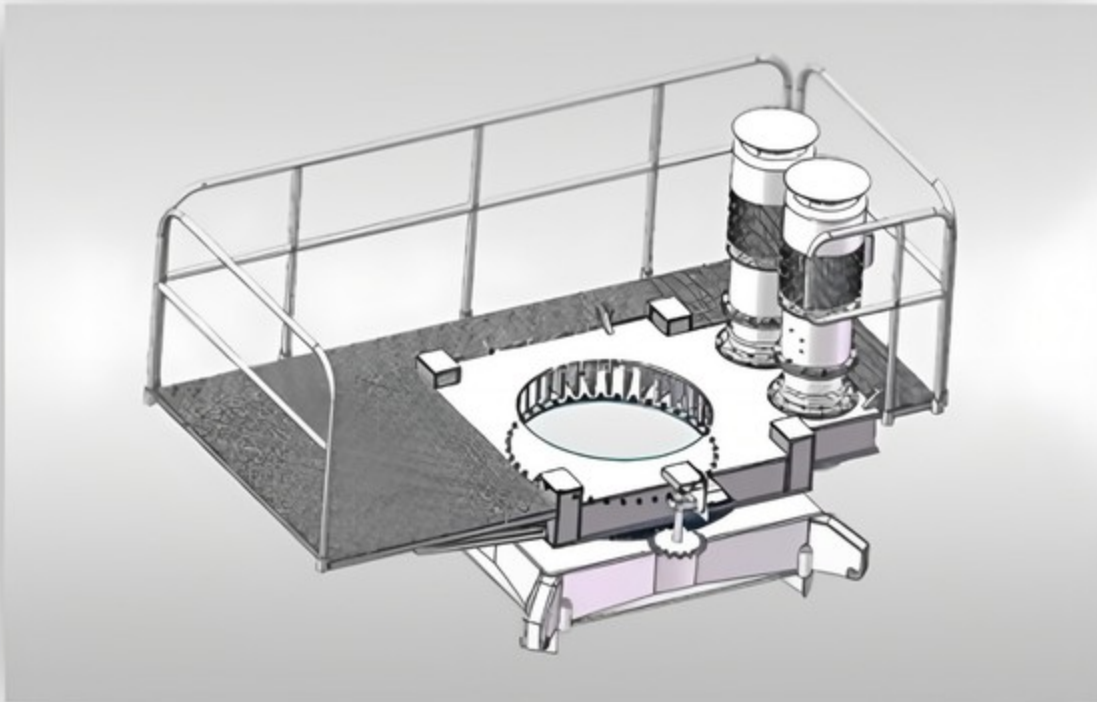


Yaw Bearings



Gear box of speeder

Structure of gear components of engineering machinery (cranes and tower cranes)

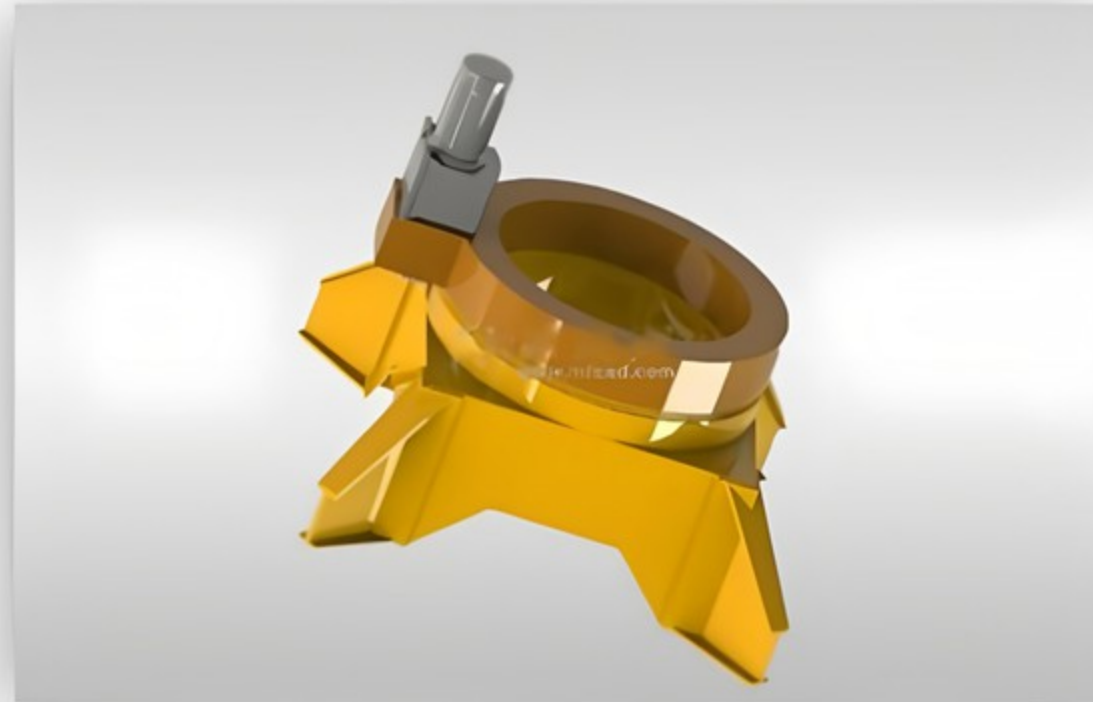


Gearbox

Sun gear - External gear

Planetary gear - External gear

Internal ring gear - Internal gear



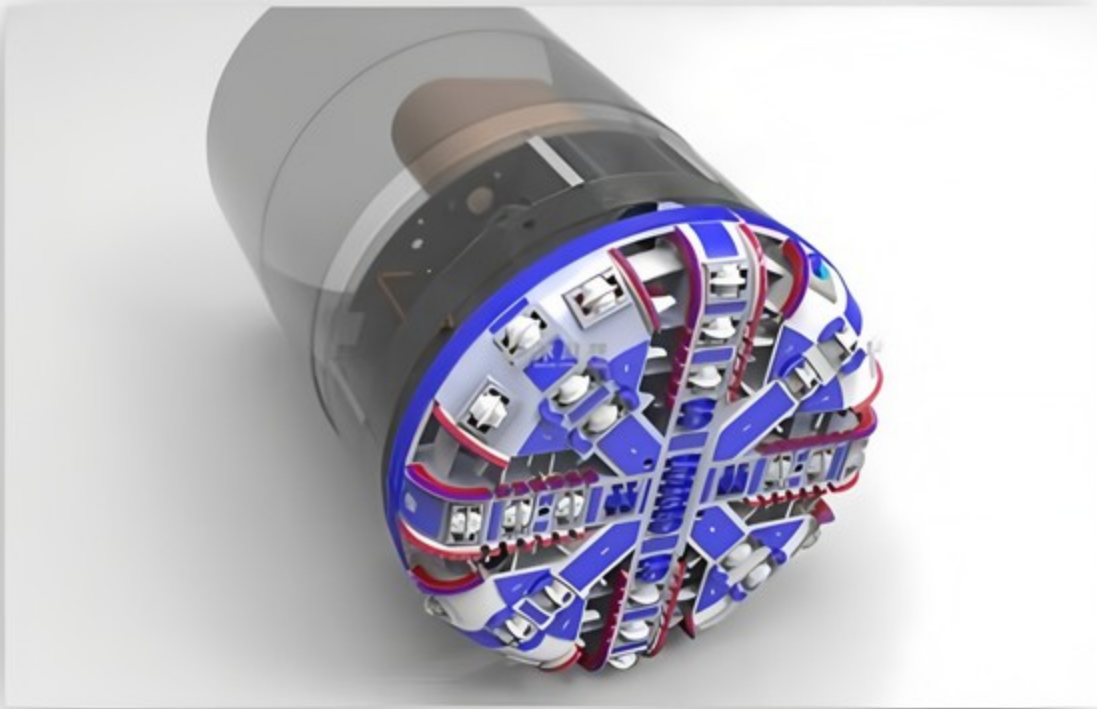
Slewing bearing

Slewing ring gear - Internal gear

Slewing mechanism- External gear



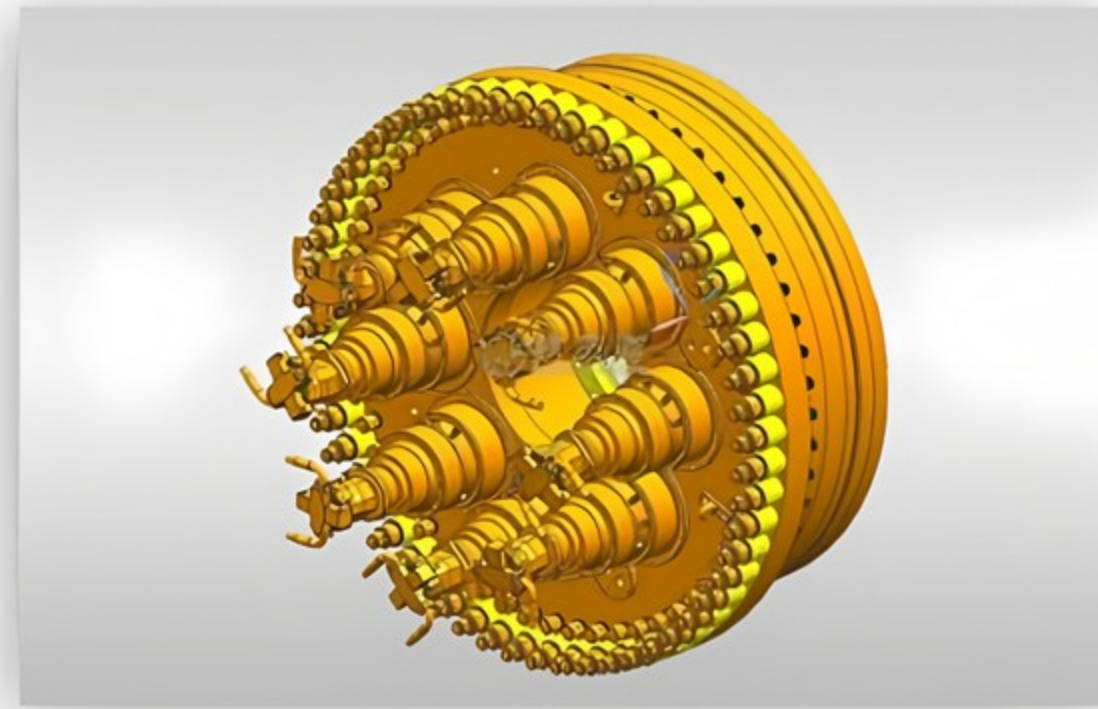
Structure of gear components of engineering machinery (Tunnel Boring Machines)



Main bearing

Bearing external ring gear - External gear

Bearing internal ring gear - Internal gear

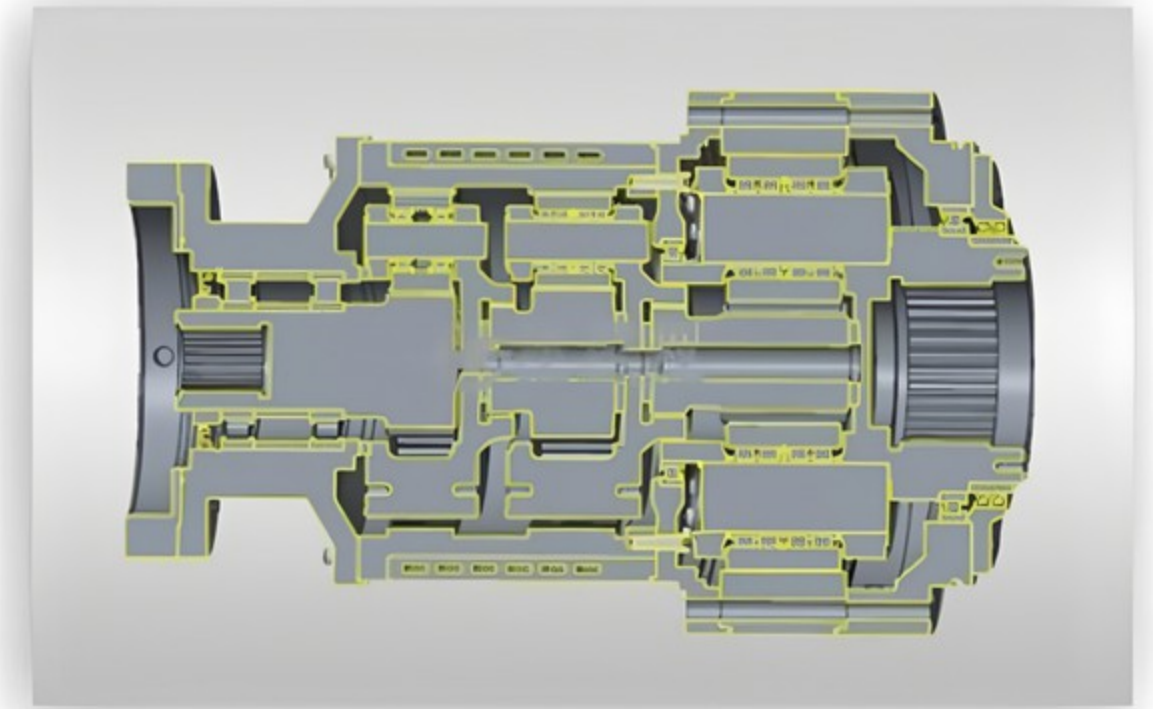


Reducer

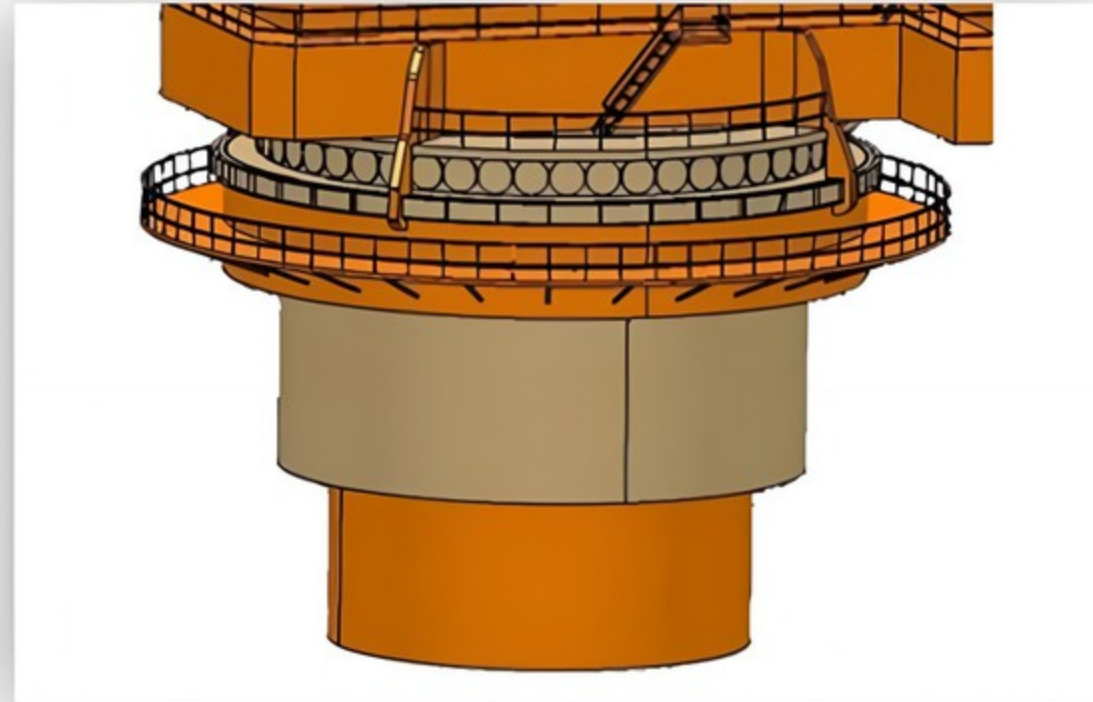
Sun gear - External gear

Planetary gear - External gear

Internal ring gear - Internal gear



Structure of gear components of engineering machinery (Port cranes & Wind turbine installation vessels)



Gearbox

Sun gear - External gear

Planetary gear - External gear

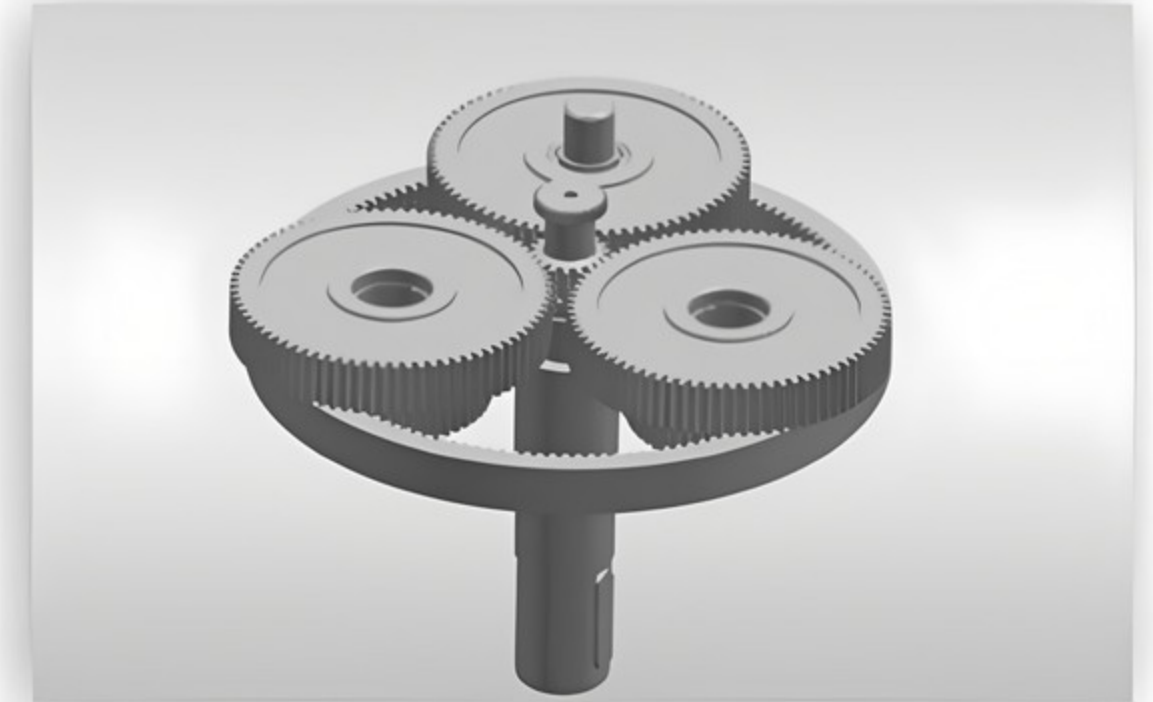
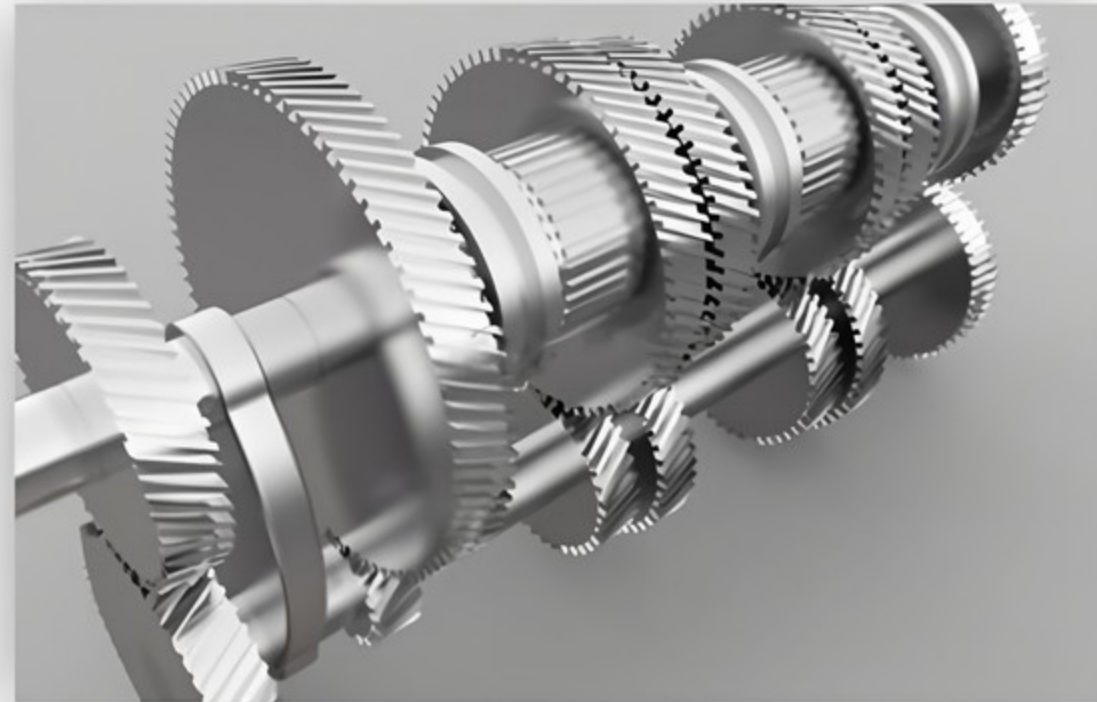
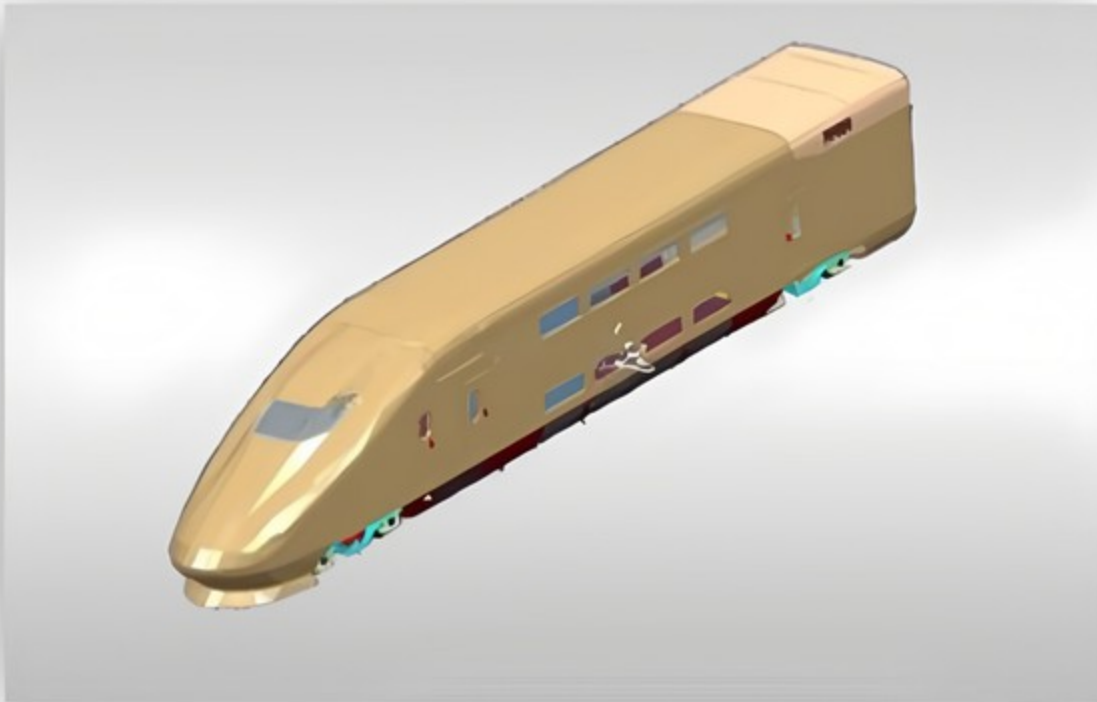
Internal ring gear - Internal gear

Slewing bearing

Slewing ring gear - Internal gear

Slewing mechanism- External gear

Structure of Gear components of Locomotives



Planetary gear transmission system

Sun gear - External gear

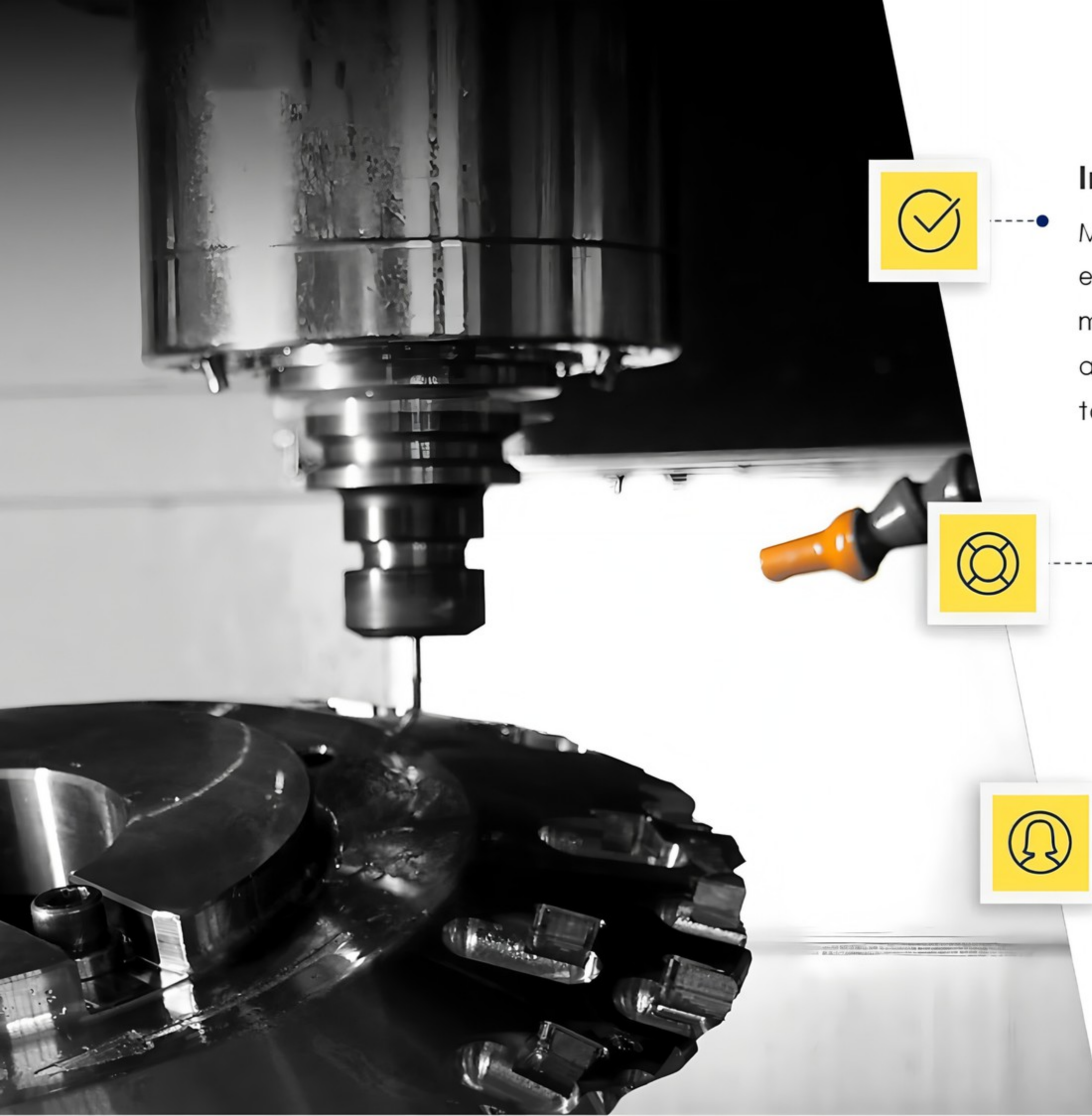
Planetary gear - External gear

Internal ring gear - Internal gear



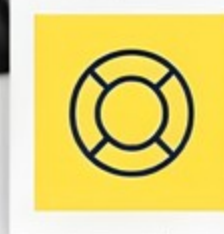
High-speed Gear Milling Cutter

Gear rough milling cutter (Gear semi finish milling cutter) | Gear finish milling cutter



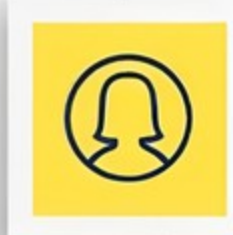
Insert

Made of special carbides to achieve shock-resistant excellence. High-precision special CNC grinding machine is adopted to obtain nano-level precision and edge processing. State-of-art coating technology to make sure of superb performance.



Body

Made of first-class forged steel, with excellent strength and hardness; shock resistant and wear-resistant



Service

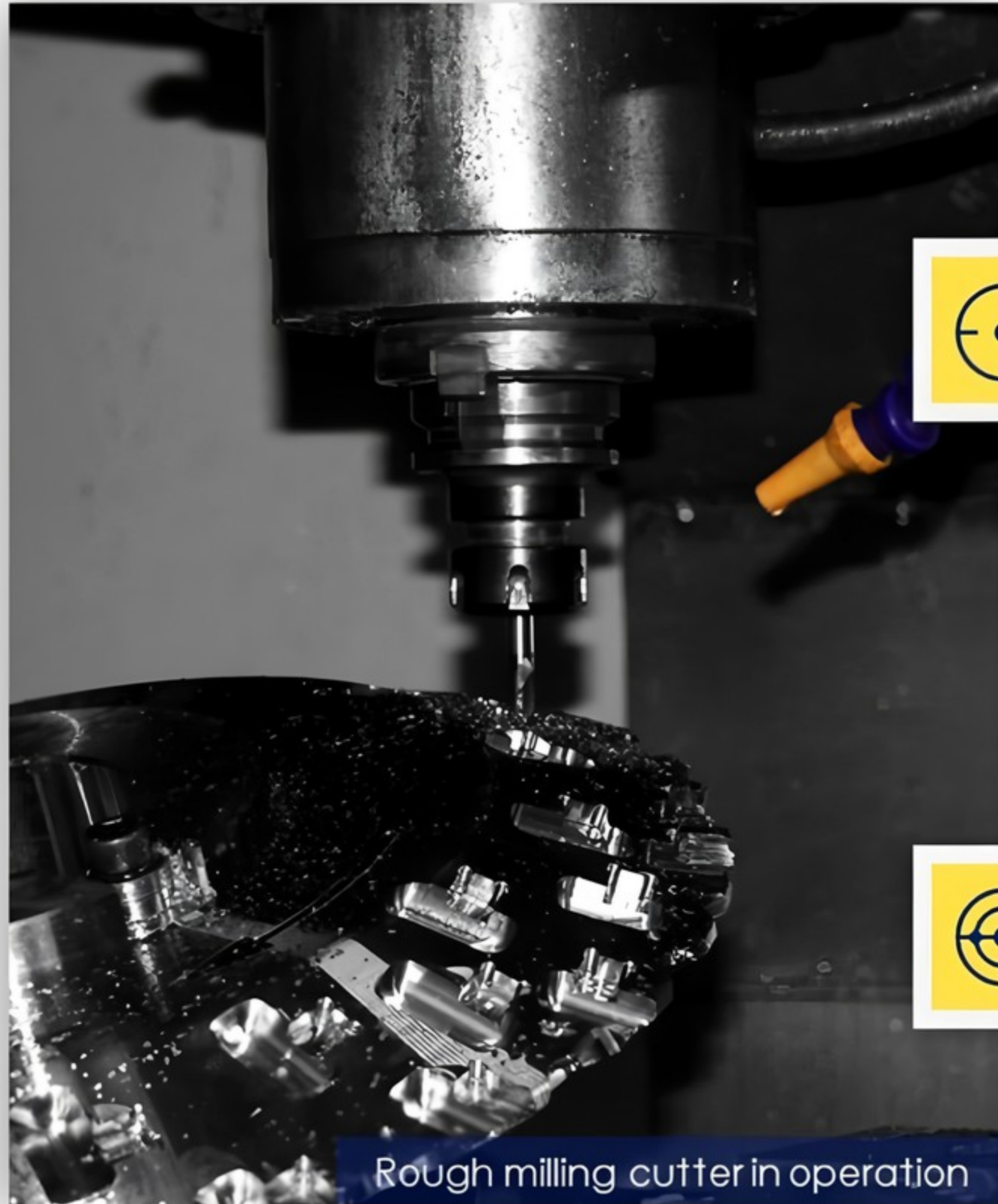
With decades' experience and practices, we have a unique understanding about the structure and design of cutting tools, delivering best performance and efficiency to our clients.



Gear rough milling cutter

Gear rough milling cutter (Gear semi finish milling cutter)

Slewing bearing gear rough milling for wind power generators



Gear rough milling cutter

There are two types: involute and non-involute.

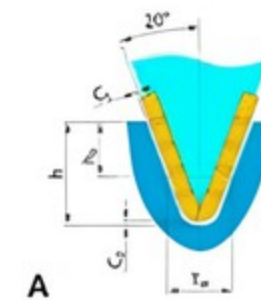
The involute type 's advantage is its inserts are in the shape of curve , leaving more space for following finishing milling.

The non-involute type is capable of machining of various pitches and modules.

Our innovative new double sided positive inserts are advantageous alternative to the conventional ones.

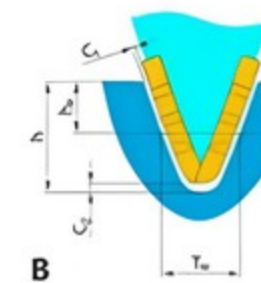
Arrangement of inserts

Rough milling cutter MGD..S
Semi-finishing milling cutter MGD..E



Rough milling cutter MGD..S

capable of machining of various pitches and modules



Semi-finishing milling cutter MGD..E

linear fit design makes smoother tooth overlap, leaving even space for following finishing milling.

Range of Module of Gear Rough Milling Cutters (M6-M45)
Range of Diameter of Gear Rough Milling Cutters ($\Phi 200$ - $\Phi 500$)

M10 Rough milling cutter



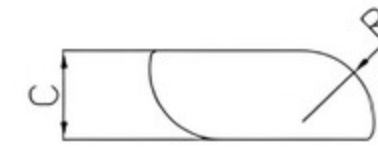
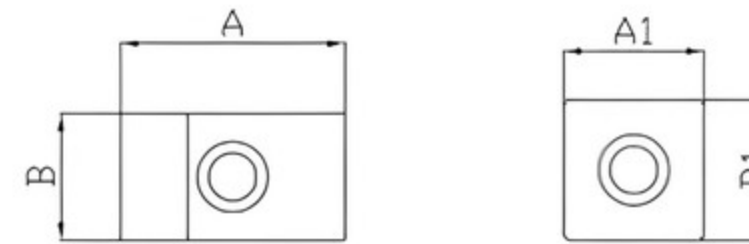
M24 Rough milling cutter



M40 Rough milling cutter

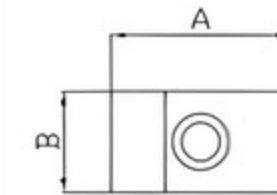


Various inserts for gear rough milling cutters

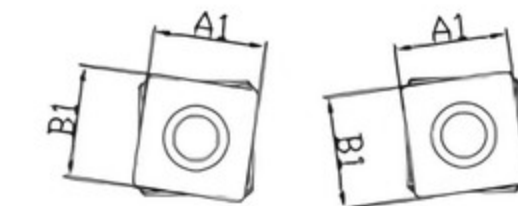


Top pitch insert

Side pitch insert



Top pitch insert



Side pitch insert

**Conventional double
negative rake angle**

**Creative double
positive rake angle**

Recommended Parameters for D420 High-speed Milling Cutters

Pitch					Depth of cut			
Module	Addendum coefficient	Dedendum coefficient	Addendum modification coefficient	Standard pitch depth	a1	a2	a3	a4
M10	1	1.25	0	22.5	21	22.5		
M12	1	1.25	0	27	25.5	27		
M14	1	1.25	0	31.5	30	31.5		
M16	1	1.25	0	36	34.5	36		
M18	1	1.25	0	40.5	35	39	40.5	
M20	1	1.25	0	45	39	43.5	45	
M22	1	1.25	0	49.5	40	48	49.5	
M24	1	1.25	0	54	40	50	53	54
M25	1	1.25	0	56.25	40	50	55	56.25

Maching method				M10/12	M14	M16	M18	M20	M22	M24/25
High-speed milling pitch	Internal and external pitch	Rough milling cutter rotation speed 95	a1			F320	F320	F320	F280	F280
			a2							F320

Example of rough milling application



Internal gear rough milling

Milling machining parameters

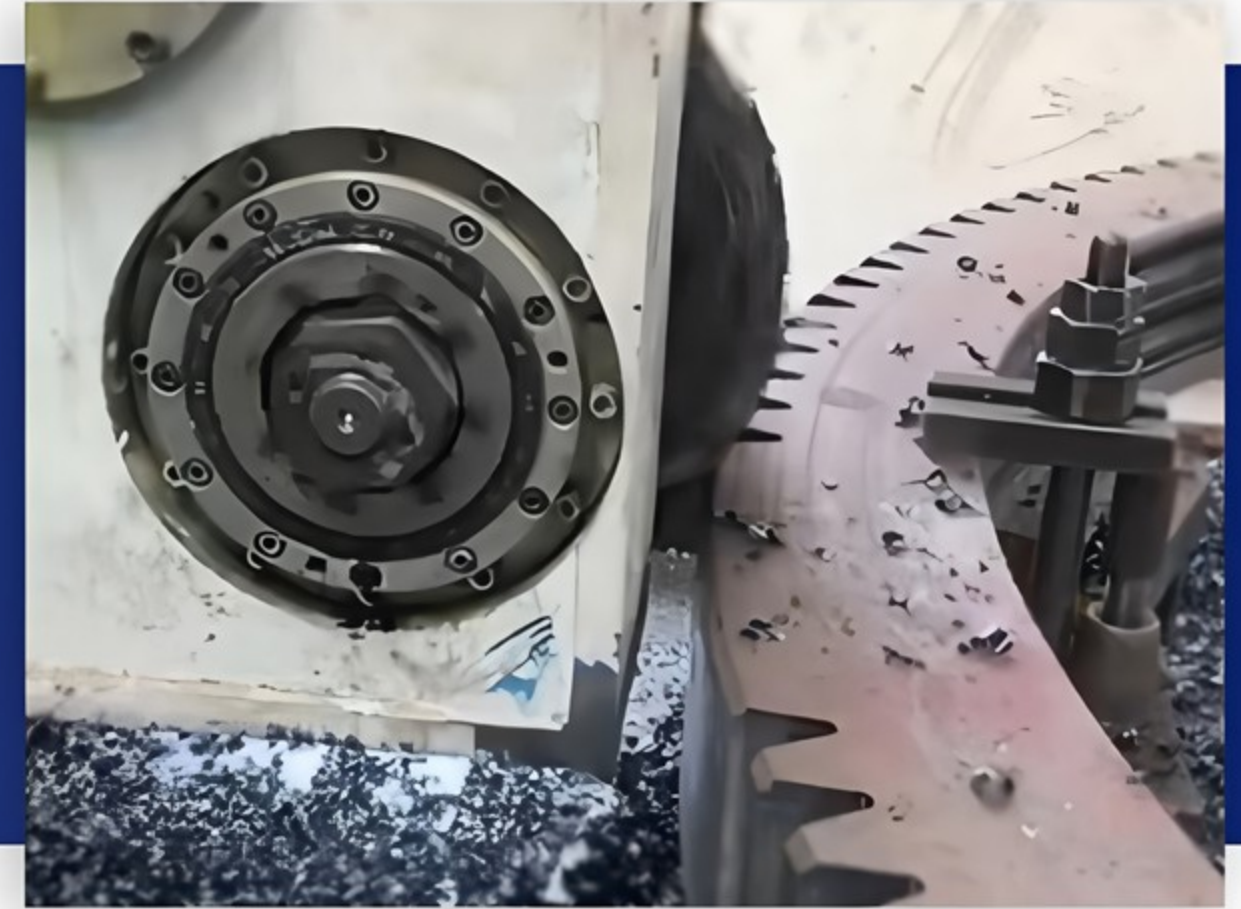
Depth of cut 30.5mm

Rotating speed: S90

Feed: F100

Brand of machine: Nnijing Gongda CNC Technology

Power consumption : 70kw



External gear rough milling

Milling machining parameters

Depth of cut 30.5mm

Rotating speed: S90

Feed: F100

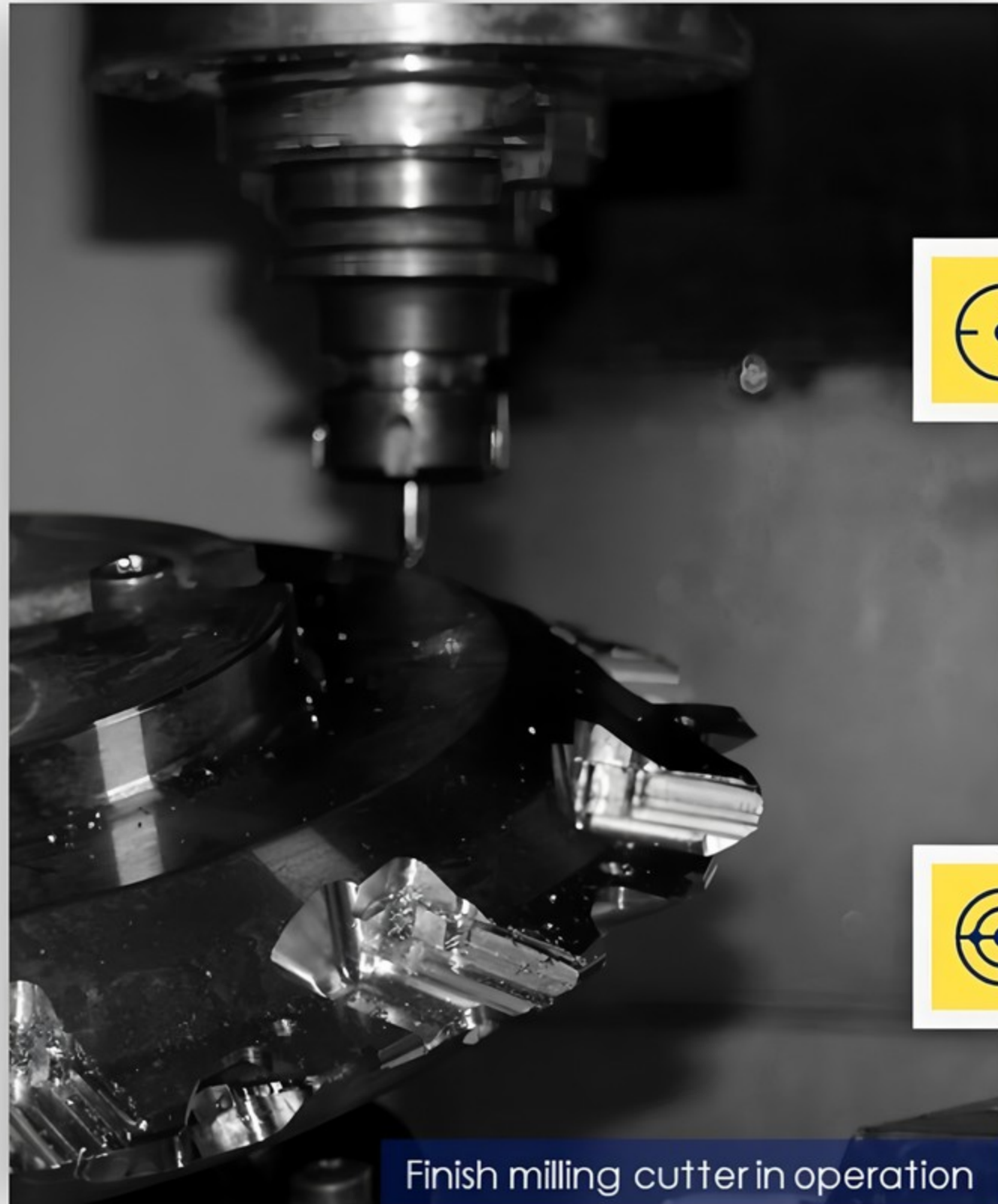
Brand of machine: Yichang Changjiang Machine
Technology

Power consumption : 45kw



Gear finish milling cutter

Wind power generators, construction machines
(Slewing bearing gear milling)



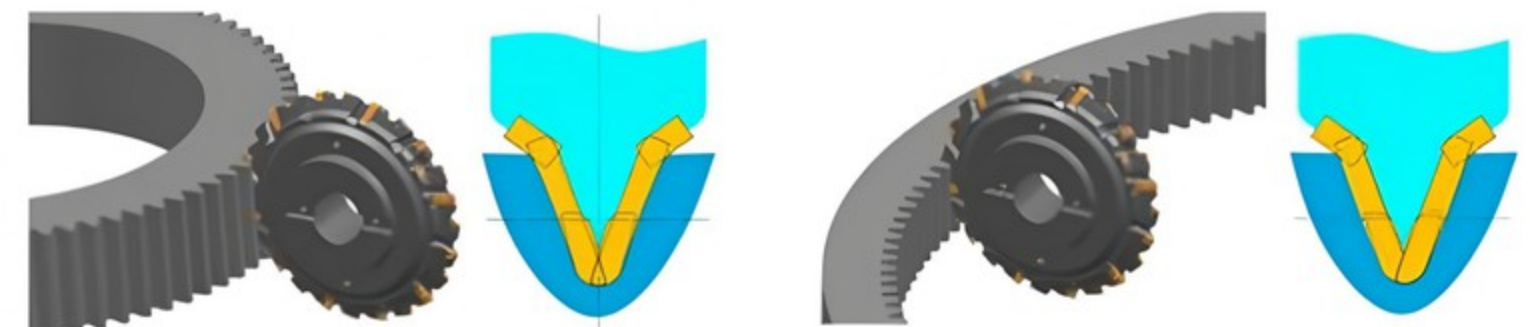
Finish milling cutter in operation



Gear finish milling cutter

Gear finish milling cutter includes top inserts, side inserts and chamfering inserts. Top inserts are to get rid of root Volute edge are adopted on side inserts to reach surface smoothness $Ra0.4$. Chamfering inserts at the rear is to chamfer the sides of the groove, make path for further machining. By combination of these inserts, the utmost life-span, surface smoothness and efficiency will be achieved.

Profile of internal & external gear finishing

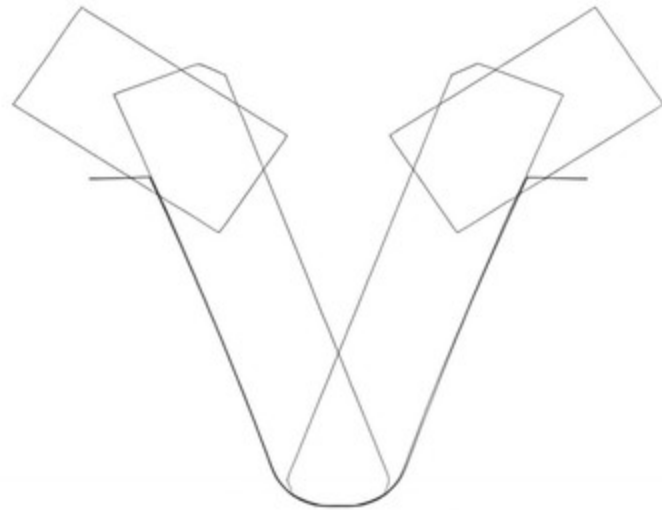


External gear finishing

Internal gear finishing

Types and Features of Gear Finish Milling Cutters

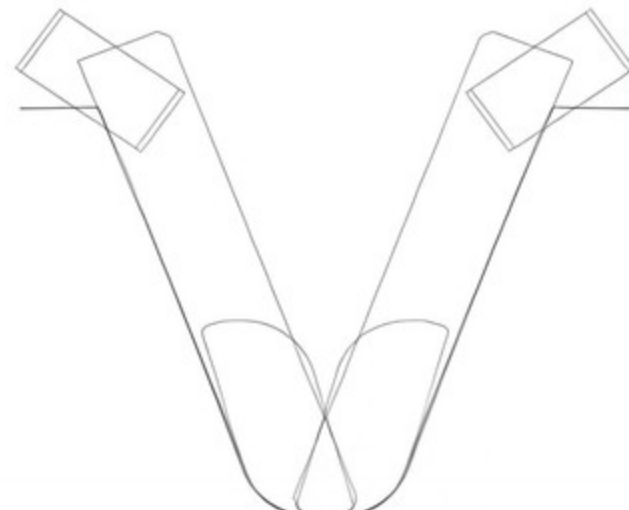
MGDJA Type



**Full-pitch single-sided
double-blades
(Full side-pitch structure)**

Characteristics: Classic structure. Good strength & precision. Maximum effective pitch can be achieved, higher feeding speed. While the disadvantage is high cost

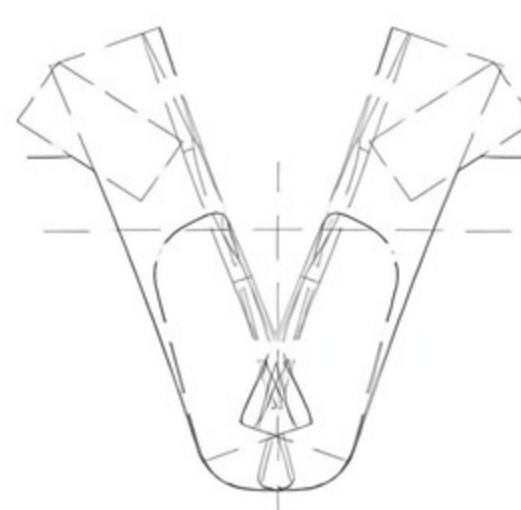
MGDJ Type



**Full-pitch single-sided
double-blades
(Top-sided pitch structure)**

Characteristics: good precision and cost-effective. Higher number of effective pitch and feeding speed can be achieved.

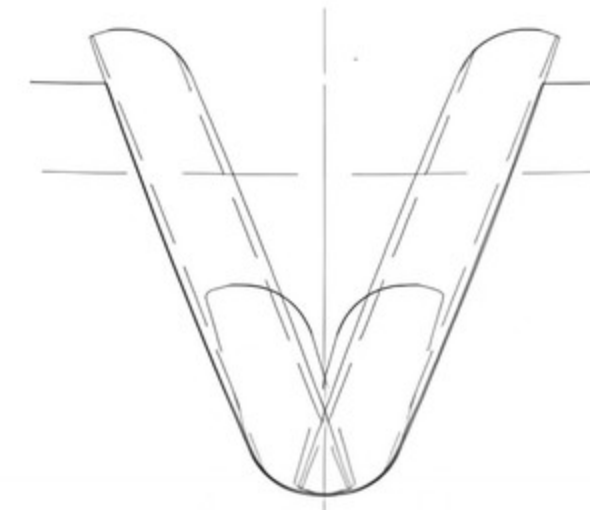
MGDJB Type



**Half-pitch double-sided
four-blades
(Top-sided pitch structure)**

Characteristics: lower cost. Only lower effective pitch number can be achieved. Longer life-span using front angles.

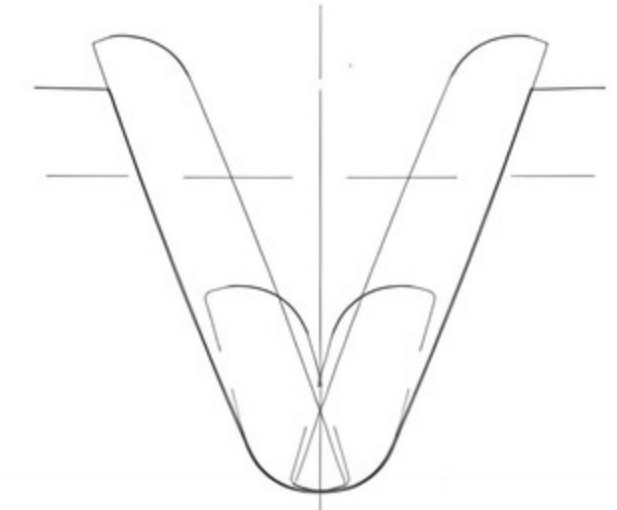
MGDJC Type



**Full-pitch double-sided
four-blades
(Top-sided pitch structure)**

Characteristics: good precision and life-span; cost effective. Higher effective pitches can be achieved on a single cutter. Designed with location slot to install multiple-sized profiles, realizing higher efficiency.

MGDJD Type



**Full-pitch double-sided
Four blades - 1
(Top-sided pitch structure)**

Characteristics: long life-span, cost effective. Higher effective pitch number can be achieved.

Sharing-programme

In the case of pitches with the same module and pressure angle, the cutter body can be kept while changing inserts only to save cost with our "Full-pitch double-sided four-blades" design.

In the case of gear with same modules and similar profiles, same inserts can be used to save cost if the precision and tolerance are allowed.

Range of Module of Gear Finish Milling Cutters (m5-m40)
Range of Module s of Gear Finish Milling Cutters (Φ200-Φ500)

M14 Finish Milling Cutter



M16 Finish Milling Cutter



M24 Finish Milling Cutter



Recommended Parameters of D420 High-speed Finish Milling

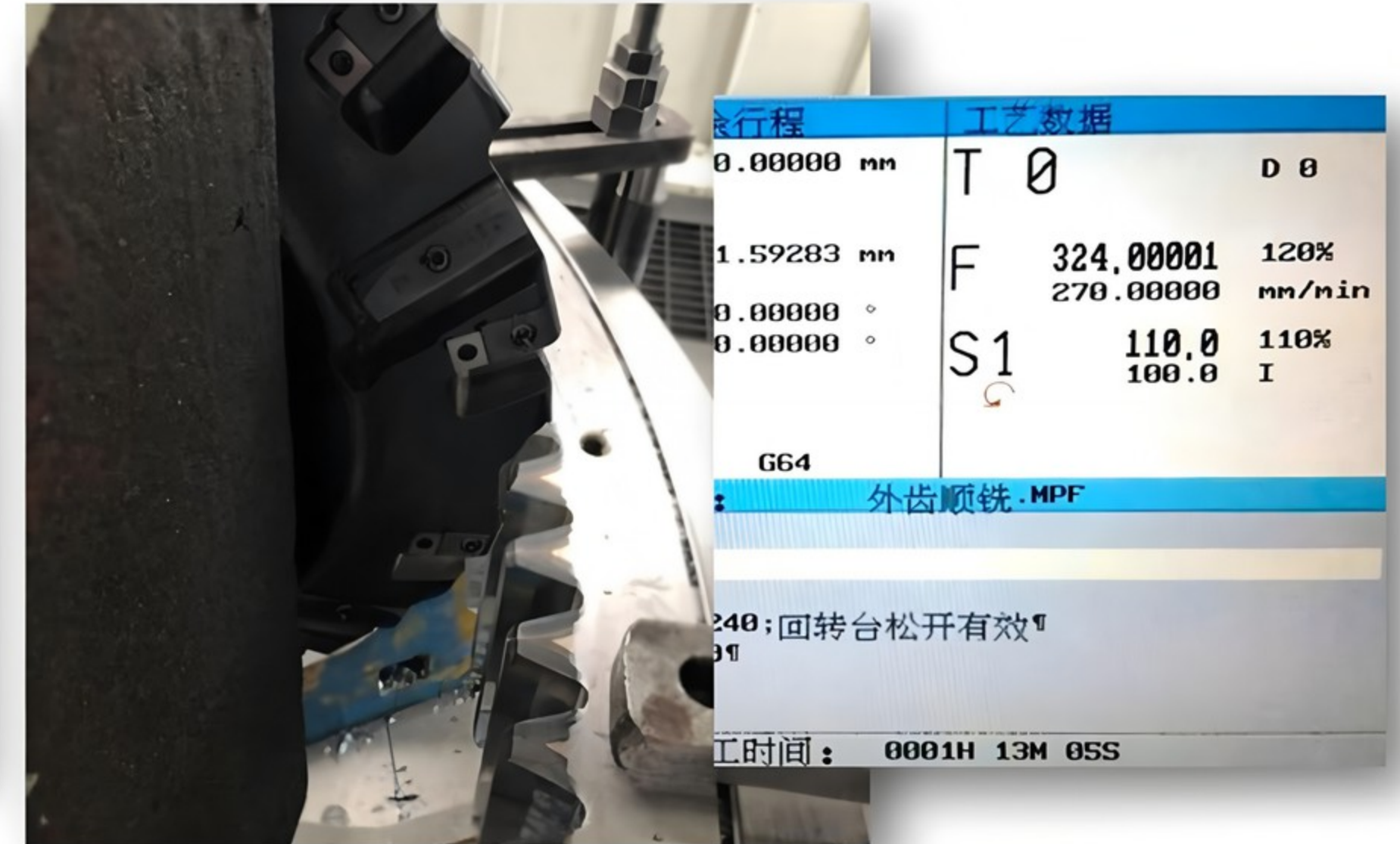
Pitch					Depth of cut			
Module	Addendum coefficient	Dedendum coefficient	Addendum modification coefficient	Standard pitch depth	a1	a2	a3	a4
M10	1	1.25	0	22.5	21	22.5		
M12	1	1.25	0	27	25.5	27		
M14	1	1.25	0	31.5	30	31.5		
M16	1	1.25	0	36	34.5	36		
M18	1	1.25	0	40.5	35	39	40.5	
M20	1	1.25	0	45	39	43.5	45	
M22	1	1.25	0	49.5	40	48	49.5	
M24	1	1.25	0	54	40	50	53	54
M25	1	1.25	0	56.25	40	50	55	56.25

Maching method				M10/12	M14	M16	M18	M20	M22	M24/25
High-speed milling pitch	Internal and external pitch	Finish milling cutter rotaion speed 110	a1	F360	F360	F360	F360	F320	F320	F320
			a2			F500	F500	F500	F400	F400

Example of finish milling application



M24 Z139 External gear finish milling operation and parameters



M30 Z83 Internal gear finish milling operation and parameters

Warranty on life-span

Life-span of single insert

M16 High-speed gear finish milling

Side pitch: 200 m

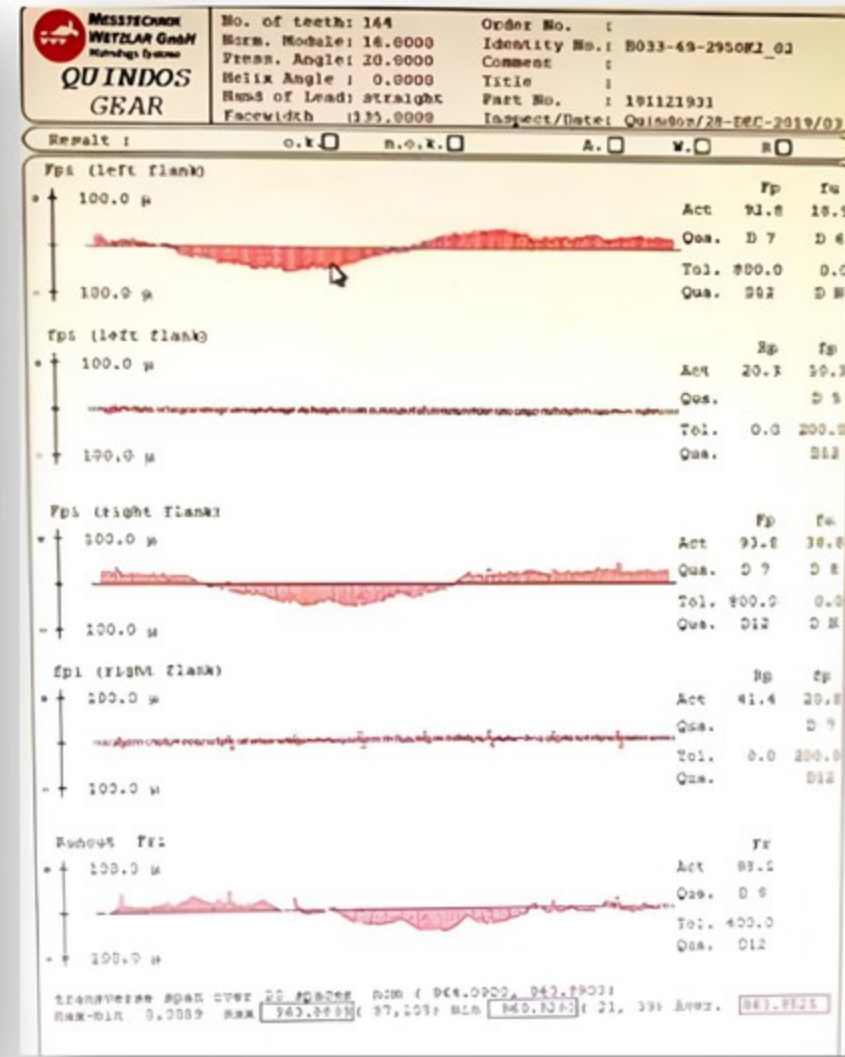
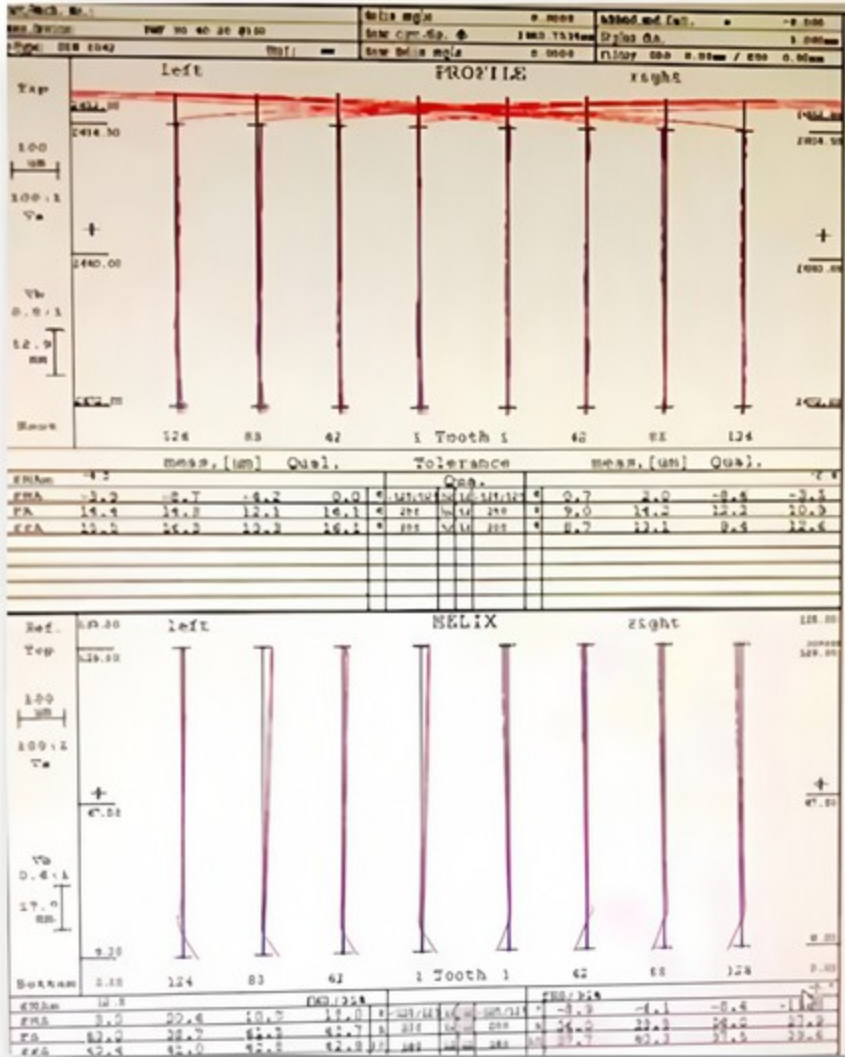
Top pitch: 150m

Wearing status:

Below photos show the wearing status of insert (M16 Z135 h=100) after running two rounds.



Warranty on Machining Quality



Inspection report on three-coordinate pitch profiles

FHa: left: 6 right: 6

Fa: left: 6 right: 5

FFa: left: 6 right: 6

Fp: left: 92.8 right: 93.8

fp: left: 10.3 right: 20.8

Roughness of profile surface

The surface roughness can meet $Ra < 0.8 \mu m$

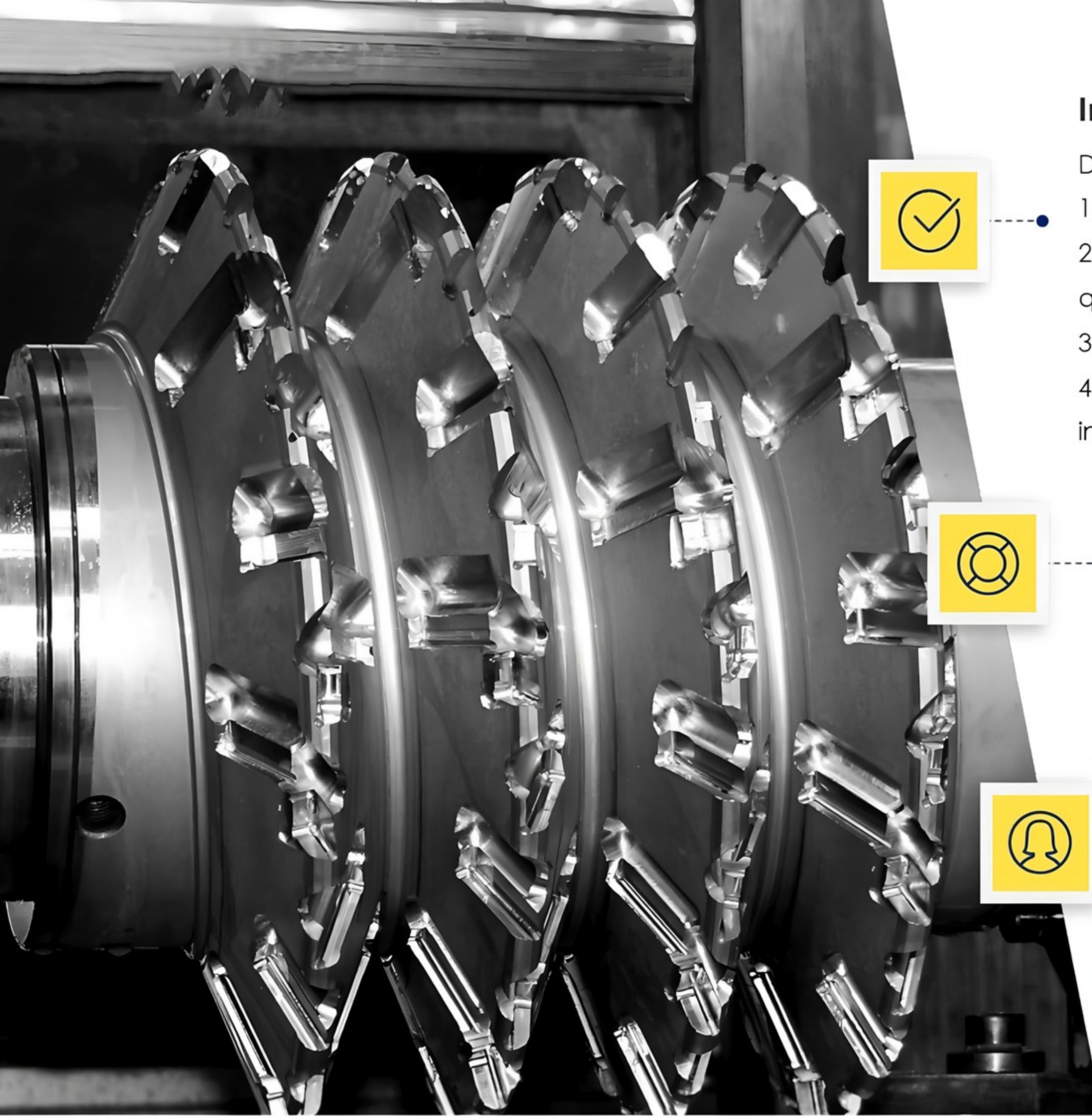
Exterior of pitch profile

exterior looks smooth, even and bright



High-speed gear milling hobs

Pre grinding hob | Gear hob



Insert

Designed with slanted holes. Advantages:

- 1. easy to change inserts .
- 2. to avoid inserts being installed backwards, resulting in quality accidents .
- 3. Slanted holes ensures accurate positioning and installation.
- 4. longer slanted holes create stronger locking force and fix inserts more securely .



Body

Made of first-class forged steel, with excellent strength and hardness; shock resistant.

Lower cost, higher cutting speed and longer life-span minimize downtime.



Services

With decades' experience and practices, we have a unique understanding about the structure and design of cutting tools, delivering best performance and efficiency to our clients.





CONTENT

Pre grinding hob

STRATEGY

Wind power generators & construction machinery
(gearbox, sun gear & planetary gear rough milling)



Pre-grinding hobs in operation

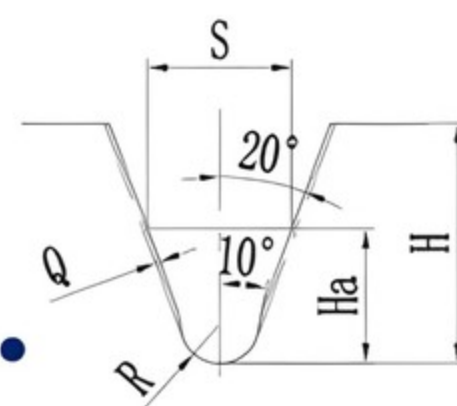


Pre-grinding hobs

Applied in M5-M38 gear rough milling to achieve higher cutting speed and reliable production.

To meet clients' demands, hobs of various tangential pitch structures (integral and modular) are supplied.

Recommended Parameters of Pre-grinding hobs, 20° Angles of Pressure



$$S = \pi \cdot M / 2$$

$$H_a = 1.4 \cdot M + q / (\sin 20^\circ)$$

$$R = 0.4 \cdot M$$

q: 预留磨削余量
q: stock for grinding

Modules	S	Q	R	Ha	H
6	9.43	*	2.4	8.85	16
7	11	*	4.8	10.3	19
8	12.57	*	3.2	11.73	22
9	14.14	*	3.6	13.17	24
10	15.7	*	4	14.61	26
12	18.85	*	4.8	17.52	33
14	22	*	5.6	20.45	38
16	25.13	*	6.4	23.37	43
18	28.27	*	7.2	26.3	49
20	31.42	*	8	29.23	58

Introduction to pre grinding hob (M5-M38)



M14 A25
Pre-grinding hobs

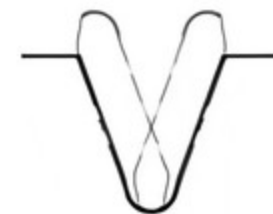


M16 A22.5
pre-grinding hobs
of variable angle of pressure



M20 A25
Pre-grinding hobs

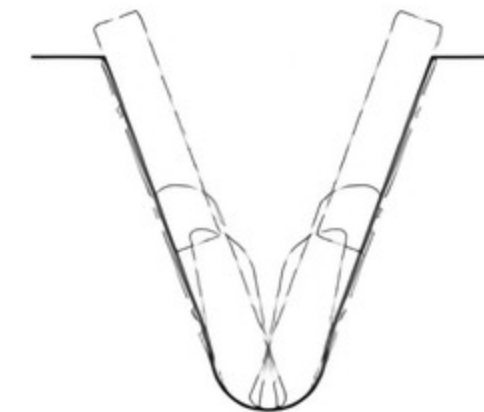
Arrangements of pre-grinding hobs



M6-7



M8-16



M18-24

Application example of gear hobbing before grinding



**M18 Pre-grinding hobs running
in sun gear machining**

Parameters of machine

Depth of cut : 35mm

Rotating speed : S110

Feed : F3.5

Machine brand : Gleason

Power consumption :7.5HP



**M18 pre-grinding hobs running
in planetary gear machining**

Parameters of machine

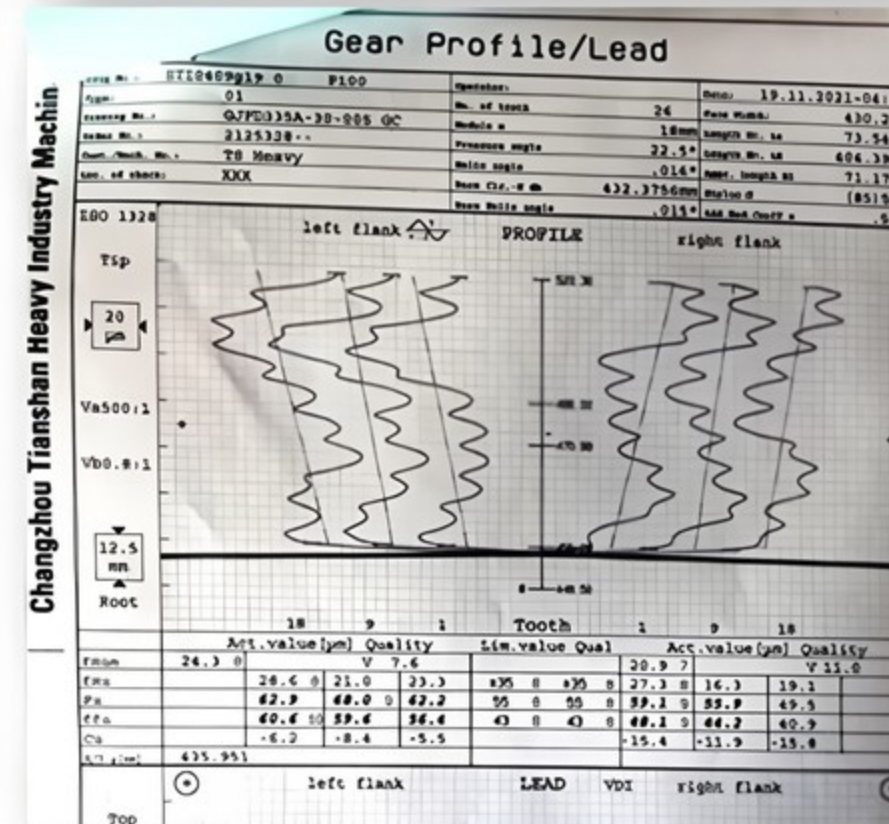
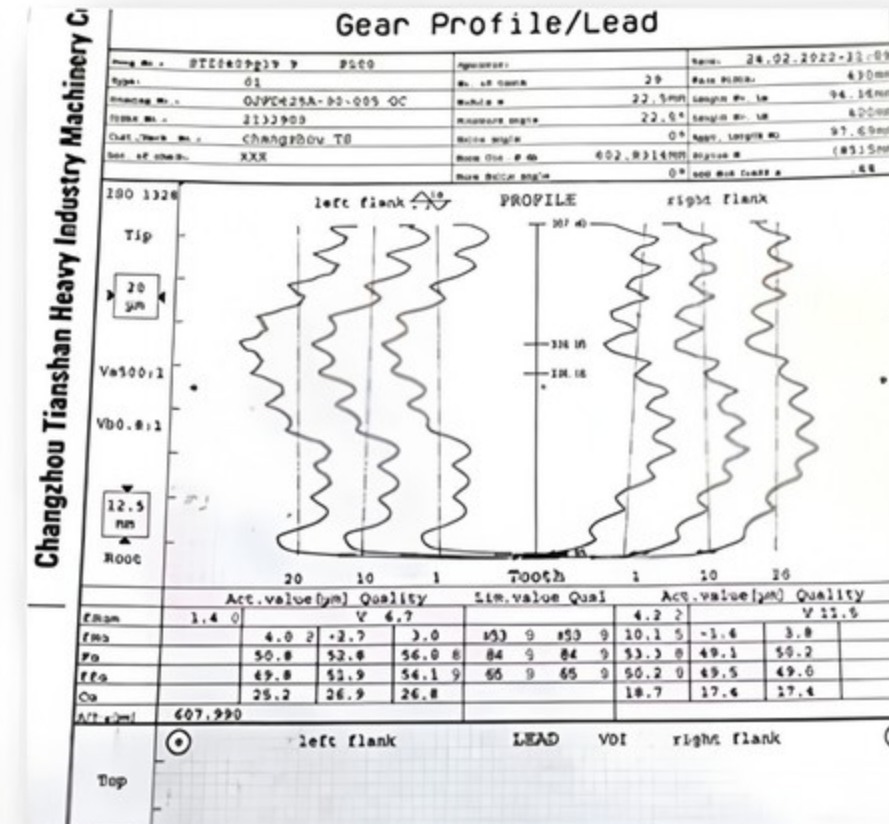
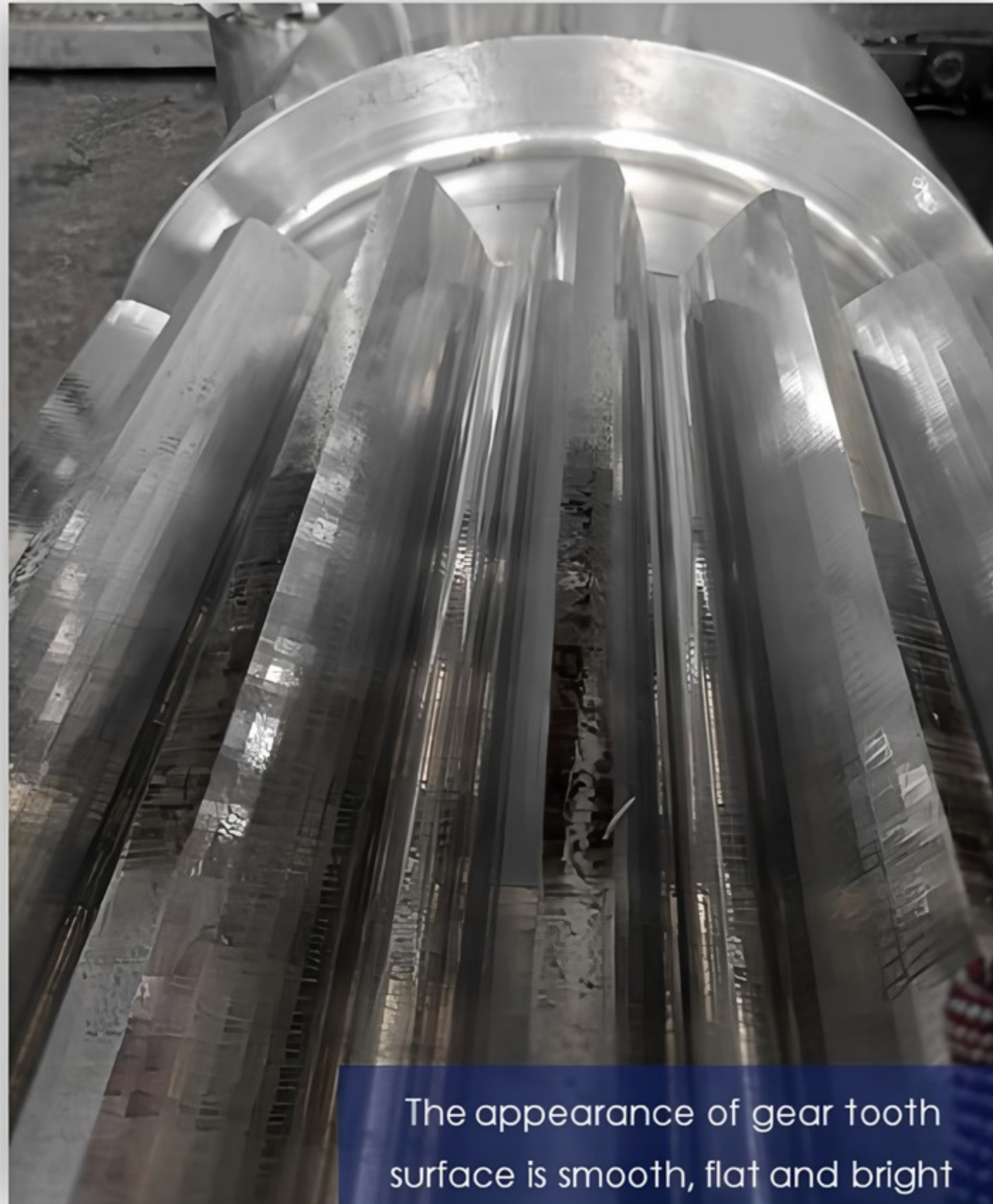
Depth of cut : 40.5mm

Rotating speed : S110

Feed : F7

Machine brand : Gleason

Power consumption :7.5HP



Inspection Report on three-coordinate Tooth Profiles

FHA:left : 9 right : 9

FA:left : 8 right : 9

FFA:left : 9 right : 9

Inspection Report on three-coordinate Tooth Profiles

FHA: left : 8 right : 8

FA:left : 9 right : 9

FFA:left : 9 right : 9

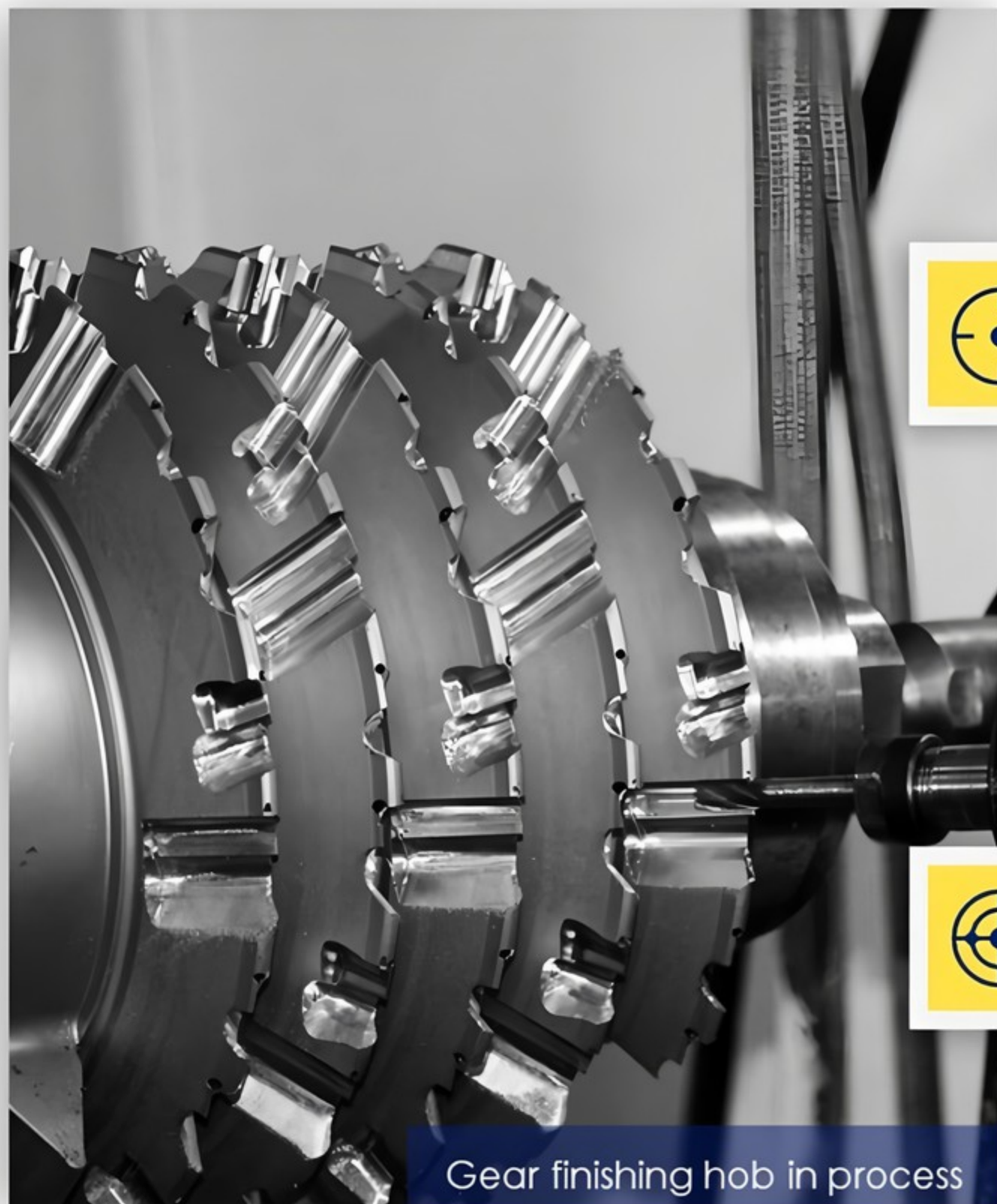


CONTENT

Gear finish hobs

STRATEGY

Wind power generators & construction machinery
(Slewing bearing finishing)



Gear finishing hob in process

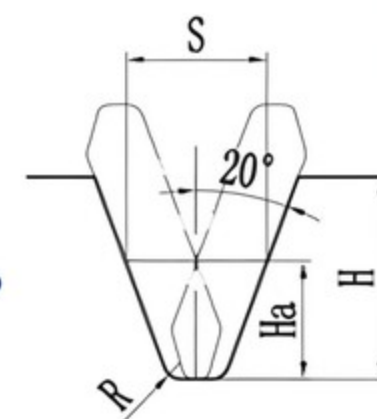


Gear finish hobs

Applied in M4-M40 gear finish milling to achieve higher cutting speed and reliable production.

To meet clients' demands, hobs of various tangential pitch structures (integral and modular) are supplied.

Recommended Parameters of gear finish hobs, 20° Angles of Pressure



$$S = \pi \cdot M / 2$$

$$H_a = 1.25 \cdot M$$

$$R = 0.2 \cdot M$$

Modules	S	R	Ha	H
6	9.43	1.2	7.5	14
7	11	1.4	8.75	19
8	12.57	1.6	10	23
9	14.14	1.8	11.25	24
10	15.7	2	12.5	29
12	18.85	2.4	15	32
14	22	2.8	17.5	38
16	25.13	3.2	20	42
18	28.27	3.6	22.5	49
20	31.42	4	25	58

Introduction to gear finish hobs (M4-M40)



M10 A20
double head finish hob



M16 A20
Single head finish hob

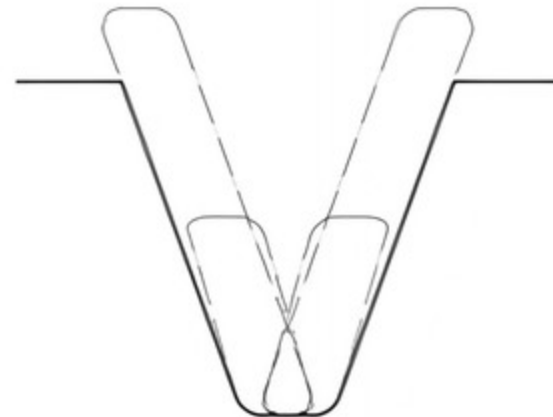


M22 A20
Single head finish hob

**Arrangements of inserts
on gear finish hobs**

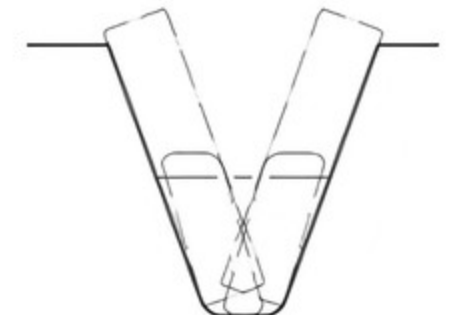


M6-10



M12-24

**Arrangements of inserts on
gear finish hobs**



M10-24

Warranty on life-span

Life-span of single insert

M16 gear finish hob

Side pitch: 200 m

Top pitch: 150m

Wearing status:

Below photos show the wearing status of insert (M16 Z26 h=430) after running 20 rounds.



Example of gear finish hob Application

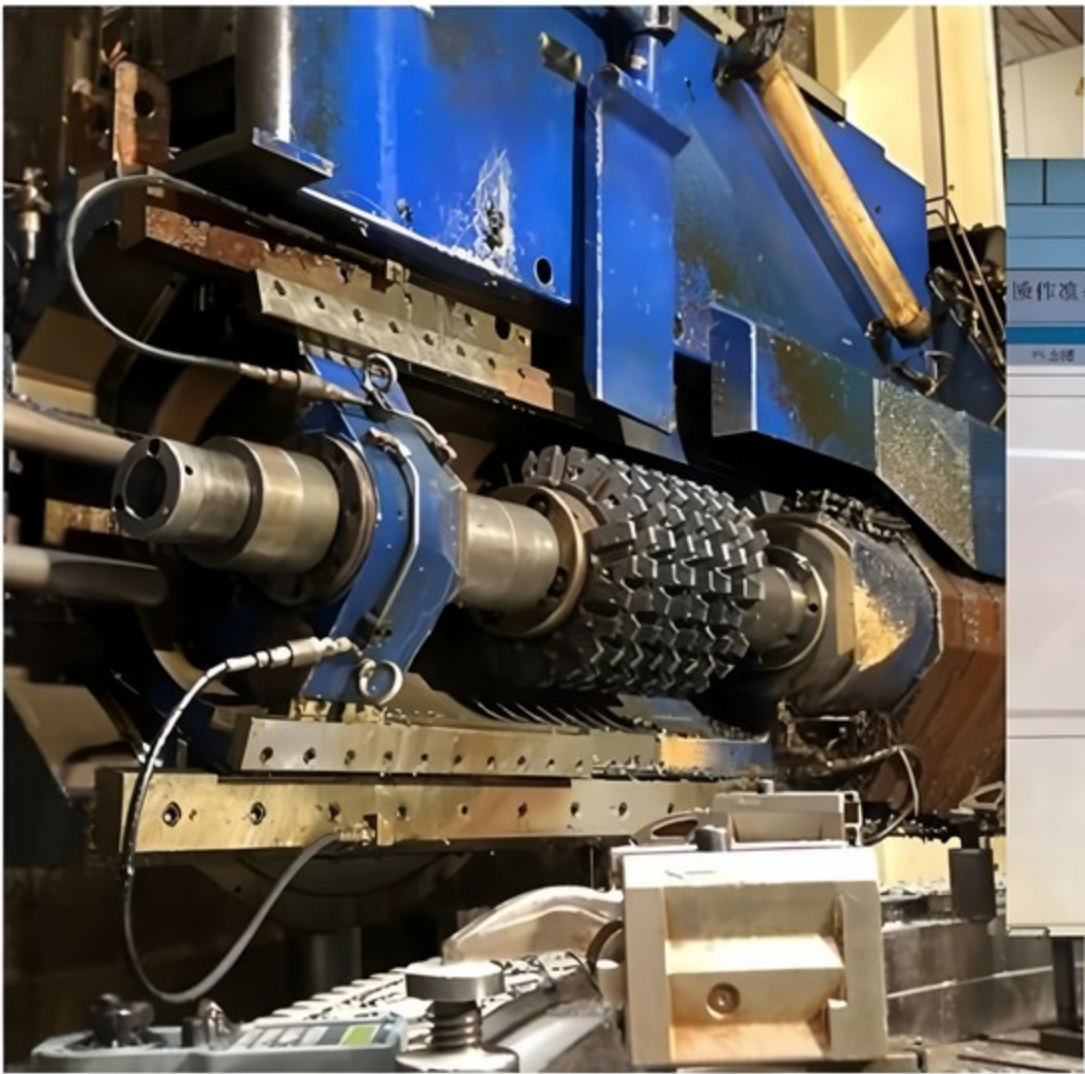


M16 Single head finishing hob milling

IPY: 2	MODE	WORK: 001/001_DIALOG_0400.MPF	DATE: 2016.08.21
程序名	001/001_DIALOG_0400.MPF	程序名	001/001_DIALOG_0400.MPF
↓ Etched gap : 0.1	number of teeth : 39	ROV	
坐标	位置	余程	主坐标
609.550	mm	0.000	实际 121.014 mm
117.299	mm	442.426	设定 109.889 rpm
0.000	deg	0.000	位置 0 度
358.913	deg	0.000	功率 110.0 %
157.560	deg	0.000	功率 19%
程序段	CEAL903.SPF	进给率 [mm/min]	
R147		实际 315.000 90.0 %	
		设定 350.000	
		刀具	
		铣齿刀具	
		G02	G40

Data on M16 Single head finish hob milling

Rotating speed :120
Feed:3



M10 Double head finish hob milling

AUTO	MODE	WORK: 001/001_DIALOG_0400.MPF	DATE: 2016.08.21
程序名	001/001_DIALOG_0400.MPF	程序名	001/001_DIALOG_0400.MPF
↓ Etched gap : 0.1	number of teeth : 39	ROV	
坐标	位置	余程	主坐标
609.550	mm	0.000	实际 121.014 mm
117.299	mm	442.426	设定 109.889 rpm
0.000	deg	0.000	位置 0 度
358.913	deg	0.000	功率 110.0 %
157.560	deg	0.000	功率 19%
程序段	CEAL903.SPF	进给率 [mm/min]	
R147		实际 315.000 90.0 %	
		设定 350.000	
		刀具	
		铣齿刀具	
		G02	G40

Data on M10 Double head finish hob milling

Rotating speed :105
Feed:5.5

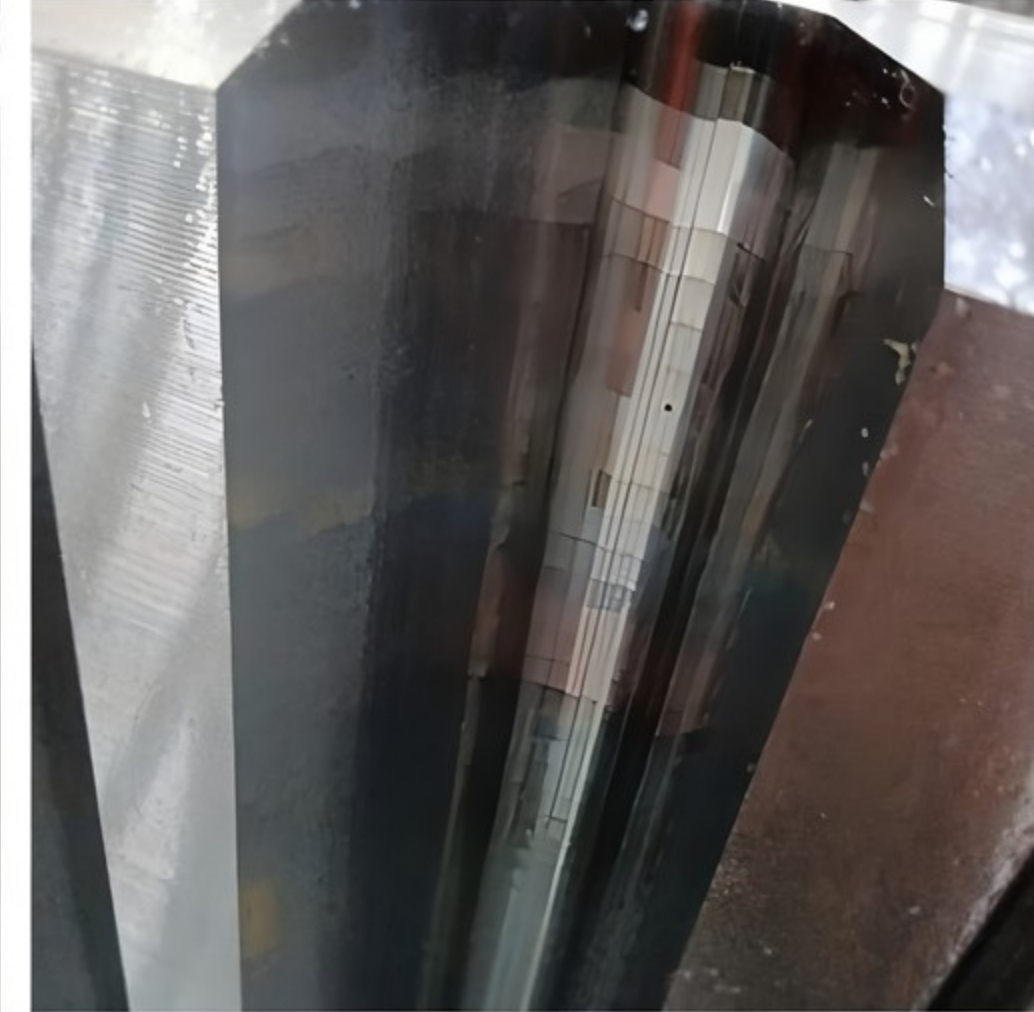
Warranty on Machining Quality



Exterior of pitch profile, M20 Single head finish hobs

Uniform texture of milling traces on the pitch surface

Even and smooth surface



Exterior of pitch root, M20 Single head finish hobs

Uniform texture of milling traces on the pitch root

No sign of overlap on the pitch root