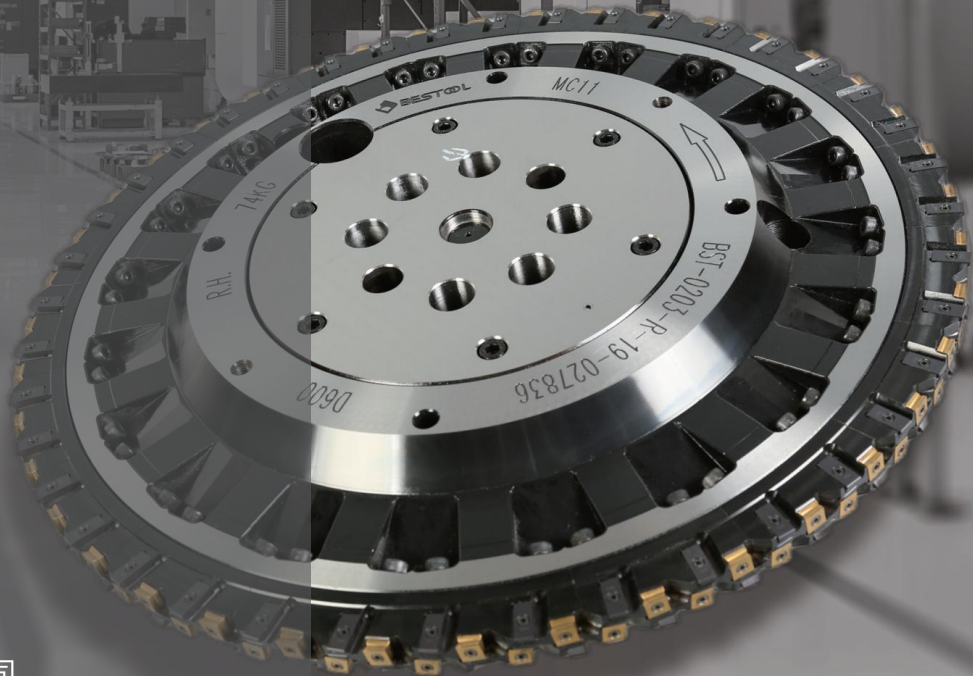


曲轴刀具

CRANKSHAFT
CUTTER



百斯图工具制造有限公司
SOFTOOL MANUFACTURING CO., LTD.

2023 - V1

百斯图工具制造有限公司

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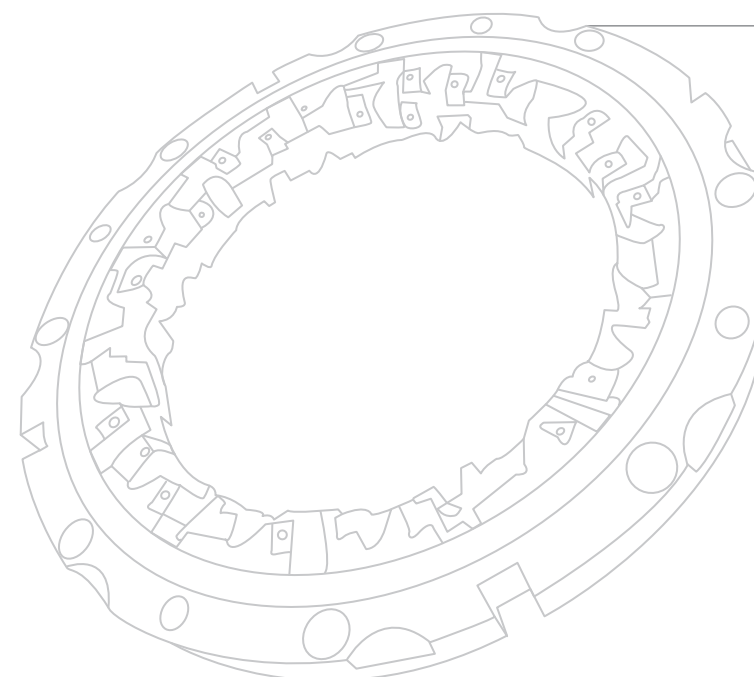
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曲轴刀具

Crankshaft Cutter



公司简介

COMPANY PROFILE

百斯图工具制造有限公司位于天津京滨工业园区，隶属于厦门钨业股份有限公司，新厂进行现代规模化投资并于2020年底投入使用，新厂配有多条自动化标准品产线，配备全套进口热处理、表面处理设备线，年产能达60万件。是一家专注于金属切削刀体的高新技术企业。

As a member of Xiamen Tungsten Co., Ltd., SofTool Manufacturing Co., Ltd. is located at Jingbin industrial park in Tianjin. With modern scale investment, the new plant has been put into use at the end of 2020. With multiple automated production lines, a full set of advanced heat treatment, surface processing equipment lines, the annual production capacity is expected to reach 600 thousand pieces, we are a high-tech enterprise focusing on metal cutting tool bodies.

集产品研发、工艺设计、生产制造、OEM/ODM代工、产品销售为一体的钢制品制造企业，为全球客户专业提供PSC产品、铣刀体、钻杆、镗刀、液压刀柄、热装刀柄、曲轴、型线刀具等产品及个性化专属解决方案，产品应用覆盖了风（核）能发电、模具制造、汽车、工程机械、铁路、石油化工等各个领域。

As a steel product manufacturing enterprise integrating product research and development, process design, manufacturing, OEM/ODM, and product sales, we provide professional cutter tools and personalized and exclusive solutions for PSC product, milling tool bodies, drilling stem, boring tools, shrink-fit chuck, hydraulic chuck, crank shaft for global customers. Our products are applied in wind (nuclear) power generation, mold manufacturing, automobiles, construction machinery, railways, petrochemicals and other fields.





V 愿景 ision

构建全球刀具行业的协助平台，
成为世界具有影响力的刀具企业。

To build a global synergistic platform
for the cutting tools,
to be one of the influential tool body
manufacturing companies.

M 使命 ission

引领刀体行业的健康发展；
助力刀具企业的产业升级。

Leading the healthy development for
the tool body industry;
expediting the industrial upgrades
for the tooling companies.

C 核心价值观 ore Value

以品质铸就企业，
以利益回馈客户，
以价值成就员工。

To build the company with quality,
to reward customers with benefits,
to cultivate employees with value.

S 品牌标语 logan

是刀具更是艺术。

Tooling also arts.

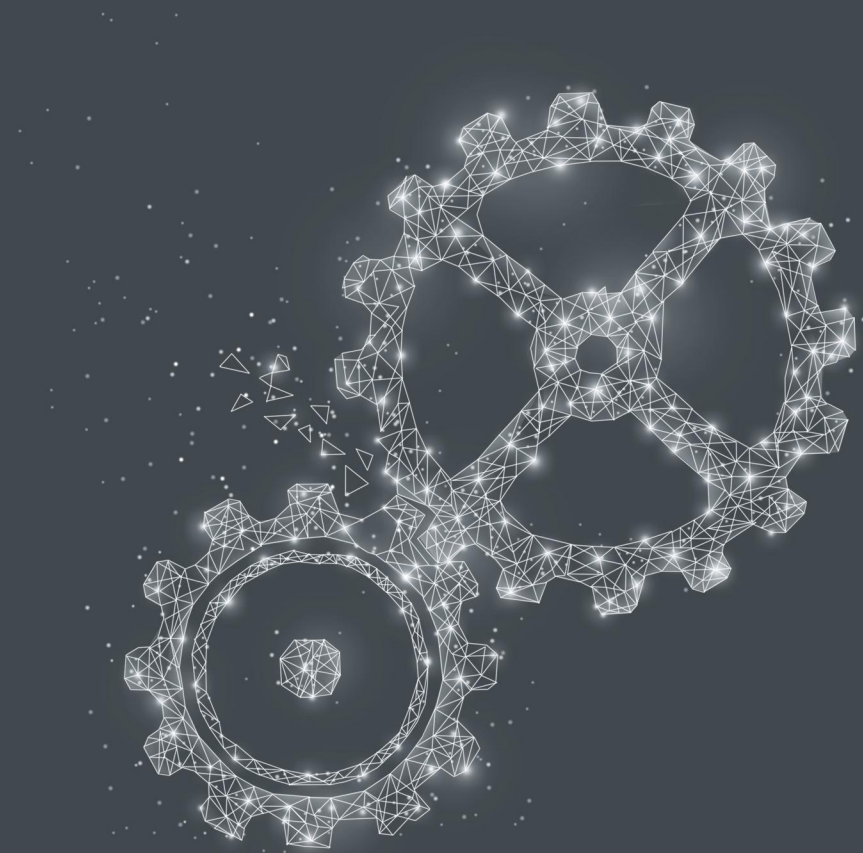


SUPERIOR SERVICE
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优质服务 SUPERIOR SERVICE

恪守“品质优先 客户至上”的服务宗旨，利用技术、产能和规模优势，为客户提供质量稳定的产品和交付快捷的服务。

Adhering to the service tenet of quality-oriented, customer first, we take advantage of technology, capacity and scale to provide customers with stable quality products and fast delivery services.



ADVANCED TECHNOLOGY
ADVANCED TECHNOLOGY

精湛技术

ADVANCED TECHNOLOGY

经验丰富的技术人才、先进设计仿真平台、先进工艺流程、国际进口数控设备、系统信息化管理,为客户攻坚克难,提供刀体解决方案。

In order to provide cutting tools solution and overcome difficulties for customers, experienced technical talents, high-tech design simulation platform, advanced controlling process, CNC equipment, as well as system information management are integrated.



LARGE SCALE
LARGE SCALE

更大规模

LARGE SCALE

自动化生产线、国际进口热处理、表面处理加工设备线、投资10亿、年产能60万件，满足客户对产品的多种工艺需求。

Providing customers with various processing skills, such as automated production line, advanced heat treatment, surface processing equipment line with 1 billion investment and 600 thousand capacity to meet multiple demands.



以专业技能应对客户加工需求

COPING WITH CUSTOMER PROCESSING NEEDS WITH PROFESSIONAL SKILLS.

曲轴是内燃机的核心部件，围绕在我们生活的各个方面，摩托车、轿车、卡车、轮船以及燃料发电机组等均不可或缺。

百斯图曲轴刀具集技术、经验、能力于一身，我们拥有超过100份的曲轴加工案例，专业的研发、生产、制造是百斯图曲轴刀具在行业立足的根本，可提供刀盘、刀夹、刀片、配件及周边产品的全套加工解决方案。着眼未来，百斯图用专业与您携手共进，合作共赢。

The crankshaft is the core component of the internal combustion engine. It is applied in every aspect of our life and indispensable in motorcycle, car, truck, ship and fuel generator set. SofTool crankshaft milling tool integrates technology, experience and capacity.

We have more than 100 successful crankshaft processing cases. With the ability of professional design and development, manufacturing and technical support, we can provide a full range of machining solutions for milling cutters, cartridges, inserts, accessories and associated products. Focusing on the future, SofTool will work with you hand in hand with professionalism to achieve win-win cooperation.

产品加工及交付能力

PRODUCT MACHINING AND DELIVERY CAPACITY

在曲轴加工领域可提供车拉、整体/模块式曲轴内铣刀盘、模块化曲轴外铣刀盘、法兰端铣刀等产品。

刀盘直径可高达 $\phi 1000\text{mm}$ ，端跳与径跳可控制在 0.03mm 以内。

产品交付时间一般在4-8周，根据客户需求我们还能灵活调整交货时间。

In the field of crankshaft processing, we can provide products such as Tbroaching, integral /modular crankshaft internal milling cutter, modular crankshaft external milling cutter, flange end milling cutter and other products.

The maximum diameter of the cutter can be up to $\phi 1000\text{mm}$, axial and radial runout can be controlled within 0.03mm .

Delivery time is usually 4-8 weeks, and we can also flexibly adjust the delivery time according to the customer needs.

技术特长

TECHNICAL SPECIALITY

我们在刀具基体及刀夹的热处理、表面硬化和刀体精度上均有严格要求。

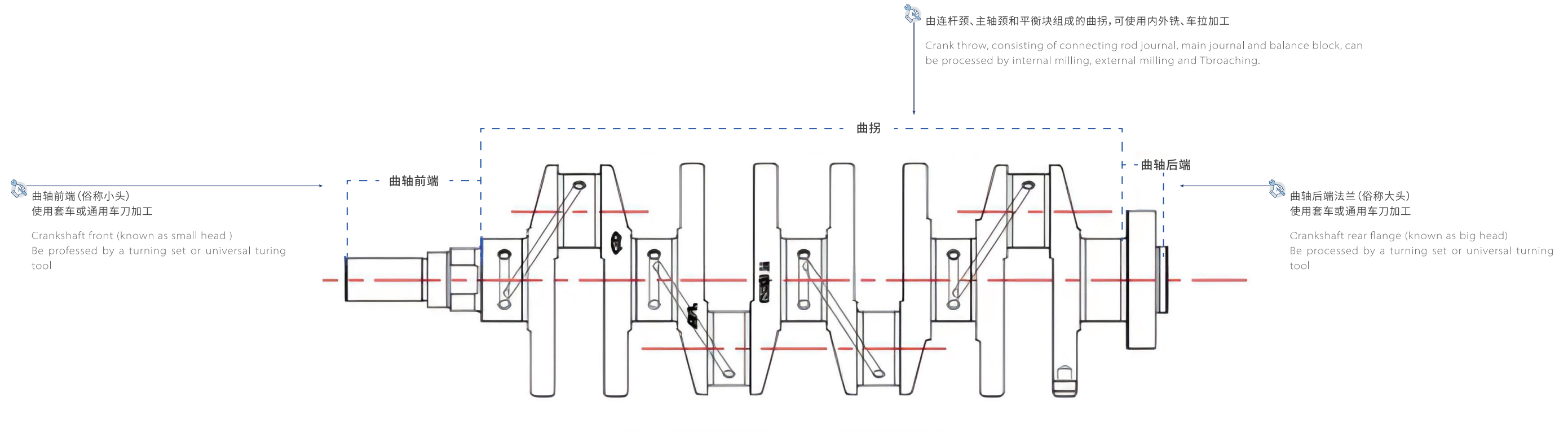
首先刀体必须具有足够的刚性来保证连接强度，防止压溃变形；其次，在刀片附近的刀体表面做了硬化处理，防止铁屑将刀体磨损失效。

We have strict requirements on heat treatment, surface hardening and precision of the tool substrate and cartridge.

First of all, the cutter body must have enough rigidity to ensure the connection strength and prevent crushing and deformation; Secondly, the surface of the cutter body near the insert is hardened to prevent the iron filings from wearing out the cutter body.

曲轴解析

►► CRANKSHAFT ANALYSIS



曲轴粗加工工艺, 从设备出现的先后顺序经历了单刀车、多刀成型车、外铣、内铣、车拉、高速随动外铣、复合加工等。

由于外铣、内铣、车拉、车车拉、高速随动外铣是多个刀片交替进行加工, 以碎小切屑为主, 产生较小的径向切削力, 有效的减小了粗加工的切削变形, 故变形量大的多刀成型车逐渐淘汰。

一般情况下: 曲轴长度在700mm以下时多采用车车拉、外铣;

曲轴长度在700mm以上时多采用外铣或内铣主轴颈和连杆颈。

According to the processing sequence, crankshaft roughing proceeds a single turning, multi-cutter profile turning, external milling, internal milling, Tbroaching, high-speed follow-up external milling, compound machining, etc.

Since external milling, internal milling, Tbroaching, T-Tbroaching and high-speed follow-up external milling are alternately processed by multiple inserts with mainly minor cutting, it results smaller radial cutting force and effectively reduces the cutting deformation of rough machining.

In general: When crankshaft length is below 700mm, Tbroaching and external milling are mostly performed;

When crankshaft length is above 700mm, external milling or internal milling of the main journal and connecting rod journal is mostly performed.

毛坯余量大小也是选择铣削或车拉的重要依据:

- 毛坯余量大且粗糙, 通常 $\geq 5\text{mm}$ (单边余量), 常采用外铣或内铣;
- 毛坯余量小且均匀, 余量 $\leq 3\text{mm}$ (单边余量), 常采用车拉、车车拉。

曲轴粗加工也可以先进行内铣或外铣主轴颈和连杆颈, 去除大部分余量, 释放应力后再进行车拉主轴颈和连杆颈, 这样更利减小曲轴的加工变形。

经过加工后, 曲轴可获得较好的轴向尺寸和径向尺寸。

Blank allowance is also an important basis for choose milling or Tbroaching:

- If allowance is rough and large, allowance $\geq 5\text{mm}$ (one-side), external milling or internal milling is generally applied;
- If allowance is even and small, allowance $\leq 3\text{mm}$ (one-side), Tbroaching and T-Tbroaching is generally applied;

Crankshaft roughing can also be performed by internal milling or external milling of the main journal and connecting rod journal to remove most of the allowance, after releasing stress, then Tbroaching of the main journal and connecting rod journal, which is more beneficial to reduce the processing deformation of the crankshaft.

After the machining, the crankshaft can obtain better axial and radial dimensions.

曲轴的选择

序号	工艺名称	优点	缺点	适用范围
1	单刀车	机床简单，可用普通车床； 投资少； 刀具简单、便宜。	加工效率低；曲轴变形大； 自动化程度低； 加工精度低。	单件、小批量生产 (产品试制打样)
2	多刀成型车	机床较简单； 投资较少； 刀具简单、便宜；加工效率较高。	曲轴变形较大； 自动化程度较低； 加工精度较低。	成批、大批量生产 (传统、低附加值曲轴)
3	外铣	较高的切削速度，Vc=300rn/min 较短的切削时间；切削力较小； 尽可能多的刀片；提高效率； 刀具寿命长；加工精度高。	设备投资中等； 刀具为专用刀具，价格较高。	适合曲轴长度在700mm以下成批 大批量生产(乘用车居多)
4	内铣	刀片数量较少； 可承受较大负荷； 单件刀片成本低，刀具寿命可达外 铣2倍左右；	不易对刀； 非切削时间较长，加工工序时间比 铣多30%~50%； 设备投资高； 刀具为专用刀具，价格高。	适合曲轴长度在700mm以上余量 较大成批、大批量生产(商用车、工 程车居多)
5	车拉	曲轴变形小，加工质量高，可代替 粗磨； 近似标准车刀片消耗品成本较低。	效率比铣削低； 设备投资高； 刀片消耗较大。	适合曲轴长度700mm以下成批、 大批量生产(乘用车曲轴)
6	高速随动外铣	对平衡块侧面需加工的曲轴，生产 率相对较高； 具有较高柔性； 加工质量高；	设备投资高； 加工效率较低； 自动化程度高。	适合曲轴长度在700mm以下单件 或大批量生产(乘用车曲轴)
7	复合加工	一次装夹完成曲轴加工； 具有较高柔性； 加工质量高；	设备投资高； 加工效率低； 自动化程度高。	适合各类曲轴单件、小批量生产 (船用、大型工程机械用曲轴)

Choice of crankshaft

S.N.	Process	Advantage	Disadvantage	Application
1	Single turning tool	Simple machine , applicable for common lathe; Less investment; Easy and cheap.	Low efficiency; large crankshaft deformation; Low automation; Low accuracy.	Single piece and small scale production (sample trial production)
2	Multi-cutter profile turning	Simple machine ; Less investment; Easy and cheap; Higher processing efficiency.	Large crankshaft deformation; Low automation; Low accuracy.	Bulk and mass production (Traditional crankshaft with low additional value)
3	External milling	Higher cutting speed,Vc=300rn/min Shorter cutting time; less cutting force; As more inserts as possible; higher efficiency; Long life of the tool; high machining precision.	Medium equipment investment; Special cutter, higher price.	Suitable for bulk and mass production of crankshaft with length below 700mm (Most passenger cars)
4	Internal milling	Fewer inserts; Withstand a large load; Low cost of single insert; The tool life can reach about 2 times of the external milling;	Hard for tool setting Longer non-cutting time, process- ing time is longer than milling by 30% ~ 50%; High equipment investment; Special cutter, high price.	Suitable for bulk and mass production of crankshaft with length above 700mm (Most commercial and engineering vehicles)
5	Tbroaching	Small crankshaft deformation, high processing quality, can replace rough grinding; Similar to standard turning inserts, low cost.	Efficiency lower than milling; High equipment investment; More inserts consumption.	Suitable for crankshaft length below 700mm in batches and production. (Passenger car crankshaft)
6	High-speed follow-up external milling	The productivity is relatively high for the crankshaft on the side of the balance block; With a high flexibility; High processing quality;	High equipment investment; Lower processing efficiency; High automation.	Suitable for crankshaft length below 700mm single piece or mass production. (Passenger car crankshaft)
7	Compound machining	Crankshaft machining in one clamping; With a high flexibility; High processing quality;	High equipment investment; Low processing efficiency; High automation.	Suitable for all kinds of crankshaft single-piece, small-batch production. (Crankshaft for marine, large construc- tion machinery)

适用范围

►► Application

外铣 | External milling



轮廓直径可高达Dc1000mm，
端跳径跳可控致在0.03mm以内

Maximum contour diameter Dc1000mm,
axial and radial runout within 0.03mm

内铣 | Internal milling



轮廓直径可高达Dc1000mm，
可提供整体式与模块式刀盘

Maximum contour diameter Dc1000mm,
provide integrated and modular cutter

套车 | Back turning



根据图纸要求，
可提供7:24、HSK等接口的复合套车刀

According to the drawings, composite back
turning coupling with 7:24, HSK, etc. can be
provided.

车拉 | Tbroaching

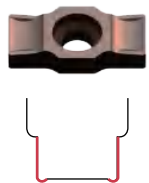
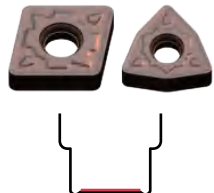
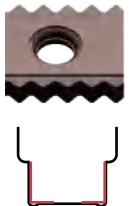
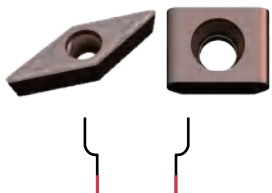


轮廓直径可高达Dc1000mm，
可覆盖12-45工位范围

Maximum contour diameter Dc1000mm,
cover 12-45 stations

车车拉刀片

▶▶ T-TBROACHING INSERT

图示 Diagram	特点 Features
	<p>大容屑槽设计, 有效保证粗加工稳定性, 实现快速去除余量。</p> <p>The design of large chip flute effectively ensures the stability of rough machining and realizes rapid excess removal.</p>
	<p>通用型槽型设计, 兼容锻钢及球铁曲轴不同的加工特性。</p> <p>Universal groove design, compatible with different processing characteristics of forged steel and spherical iron crankshaft.</p>
	<p>多齿设计, 保证锻钢曲轴精车的良好切屑处理, 减少加工表面划伤。</p> <p>Multi-tooth design to ensure better chip handling of forged steel crankshaft finishing, and reduce workpiece surface scratches.</p>
	<p>高强度刃口设计, 实现沉割槽稳定加工, 防止崩刀及过快磨损。</p> <p>High strength cutting edge design, to achieve stable machining of sink groove and prevent the edge from breaking and excessive wearing.</p>

内外铣刀片

▶▶ INTERNAL AND EXTERNAL MILLING INSERT

图示 Diagram	产品型号 Model	适用范围 Application
	<p>BCS1</p> <p>系列 series</p>	<p>用于柴油机曲轴加工。</p> <p>特点: 刀尖强度高、加工安全性好, 用于大余量粗铣加工对机床功率和曲轴档宽要求较高。</p> <p>Used for diesel engine crankshaft processing. With the features of high cutter tip strength and good machining safety, it can be used in rough milling with large allowance, which has higher requirements on machine power and crankshaft gear width.</p>
	<p>BCS2-M</p> <p>系列 series</p>	<p>用于汽油机曲轴及小型柴油机曲轴加工。</p> <p>特点: 刃口较锋利、切削阻力低、振动小。</p> <p>Used for gasoline engine crankshaft and small diesel engine crankshaft processing. The feature is sharper cutting edge, lower cutting force resistance and small vibration.</p>
	<p>BCS2-E</p> <p>系列 series</p>	<p>用于汽油机曲轴及小型柴油机曲轴加工。</p> <p>特点: 刃口锋利、切削阻力低、振动小。</p> <p>Used for gasoline engine crankshaft and small diesel engine crankshaft processing. The feature is sharper cutting edge, lower cutting force resistance and small vibration.</p>
	<p>BCS3</p> <p>系列 series</p>	<p>用于汽油机曲轴加工。</p> <p>特点: 多功能加工, 仅需1-2款刀片即可完成全部轴颈加工。</p> <p>Used for gasoline engine crankshaft processing. The feature is multi-functional machining. It takes 1-2 insert to complete all of journal machining.</p>

合作伙伴

▶▶ PARTNERS



本公司刀具已成功应用在这些机床上，相关信息可咨询本公司销售工程师。
Our cutters have been applied to these machine tools successfully.
Please consult our sales engineers for relevant information.



曲轴内铣案例-1

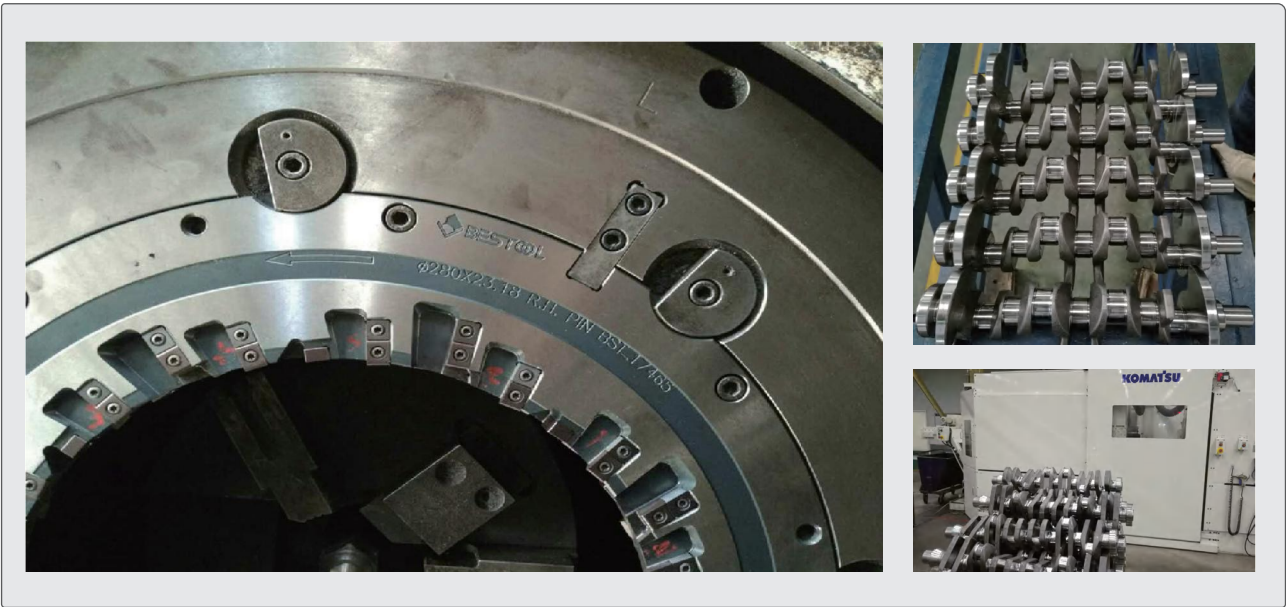
▶▶ CRANKSHAFT INTERNAL MILLING CASE-1



工况简介	Description
机床类型：日本KOMATSU 内铣	Machine tool type: Japanese KOMATSU internal milling
在用刀具：S品牌	Cutter in use: Brand S
工件名称：六缸曲轴	Workpiece name: six-cylinder crankshaft
工件材质：SAE1548 (HB260-280)	Workpiece material: SAE1548(HB260-280)
加工要求：每刃连续加工85支	Machining requirement: continuous processing of 85 pieces per effective tooth
切削参数：Vc=135-165m/min fz=0.25mm ap=1.5-2mm	Cutting parameter: Vc=135-165m/min fz=0.25mm ap=1.5-2mm
测试结果：百斯图通过优化刀盘结构，选用更为合理的刀片材质，与某日系品牌在同等切削参数下，切削寿命提高20%，综合成本下降35%。	Result: By optimizing the structure of the cutter more reasonable insert material is selected. Comparing with a Japanese brand in the same cutting parameters, the cutting life increased by 20% and the comprehensive cost decreased by 35%.

曲轴内铣案例-2

▶▶ CRANKSHAFT INTERNAL MILLING CASE-2



工况简介	Description
机床类型：日本KOMATSU内铣	Machine tool type: internal milling in KOMATSU, Japan
在用刀具：K品牌	Cutter in use: Brand K
工件名称：1.5T四缸曲轴	Workpiece name: 1.5T four-cylinder crankshaft
工件材质：38MnV（HB265-278）	Workpiece material: 38MnV (HB265-278)
加工要求：每刃连续加工1200支	Machining requirement: continous processing of 1200 pieces per effective tooth
切削参数：Vc=155-180m/min fz=0.25-0.28mm ap=1.5-2mm	Cutting parameter: Vc=155-180m/min fz=0.25-0.28mm ap=1.5-2mm
测试结果：测试结果优于客户在用刀具。	Result: SofTool cutter is superior to the cutter in use.

曲轴外铣案例-1

▶▶ CRANKSHAFT EXTERNAL MILLING CASE-1



工况简介	Description
机床类型：德国HELLER外铣	Machine tool type: German HELLER external milling
在用刀具：W品牌	Cutter in use: Brand W
工件名称：1.5T四缸曲轴	Workpiece name: 1.5T four-cylinder crankshaft
工件材质：QT800-2（HB295-310）	Workpiece material: QT800-2 (HB295-310)
加工要求：每刃连续加工1200支	Machining requirement: continous processing of 1200 pieces per effective tooth
切削参数：Vc=182-200m/min fz=0.28mm ap=1.5-2mm	Cutting parameter: Vc=182-200m/min fz=0.28mm ap=1.5-2mm
测试结果：刀盘与刀夹测试结果完全满足客户的图纸要求，客户再次下单。（轮廓直径D700）	Result: the cutter and cartridge fully meet customer's drawing requirements contour (Diameter is D700), and ordered again.

曲轴外铣案例-2

▶▶ CRANKSHAFT EXTERNAL MILLING CASE-2



工况简介	Description
机床类型：湖北伟翔外铣	Machine tool type: Hubei Weixiang external milling
在用刀具：无，交钥匙	Cutter in use: none, turnkey
工件名称：4缸、6缸曲轴	Workpiece name: 4-cylinder and 6-cylinder crankshaft
工件特点：从圆棒料开始加工出成品曲轴	Workpiece features: Be professed from rod material to finished crankshaft
刀具特点：外径760mm 开档尺16mm（很薄）30个刀夹 无刀垫 端跳≤0.04mm	Cutter features: External diameter 760mm opening size 16mm (very thin) with 30 cartridges, no shim and runout ≤ 0.04mm
使用结果：调机后一次实验成功。	Result: the experiment succeeded after only one-time adjusting the machine

曲轴车车拉案例-1

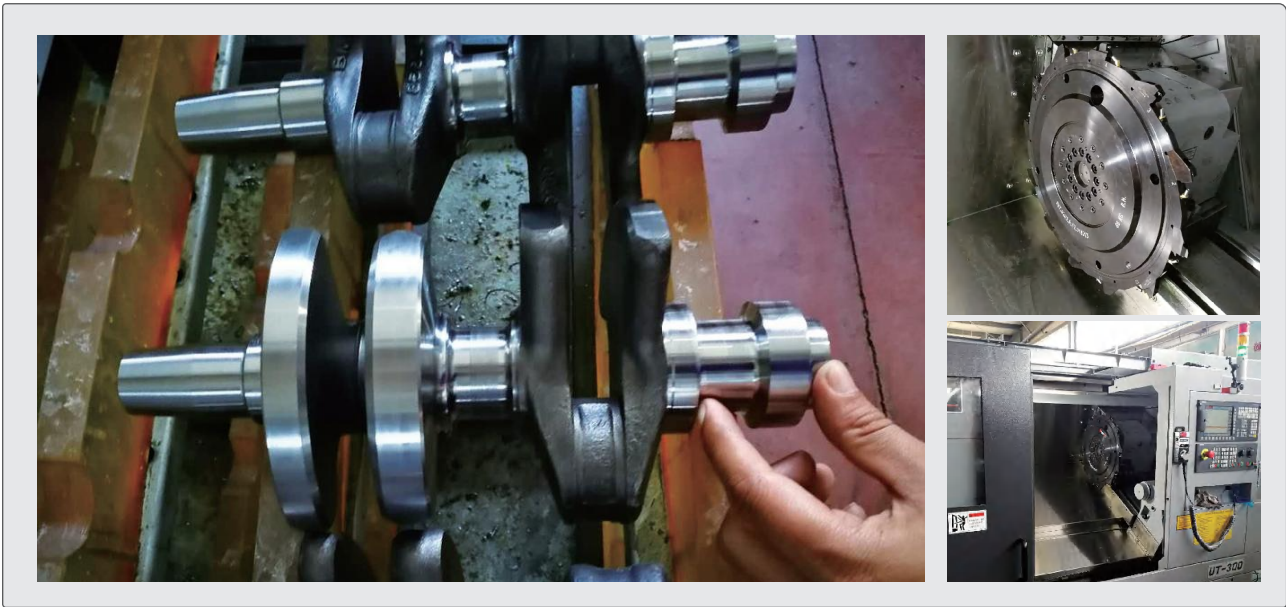
▶▶ CRANKSHAFT T-TBROACHING CASE-1



工况简介	Description
使用设备：德国NILES-SIMMONS	Equipment in use: German NILES-SIMMONS
原有刀具：I品牌	Original cutter: Brand I
加工产品：6缸曲轴	Machining product: 6-cylinder crankshaft
项目内容：曲轴生产线项目改造，原有刀盘不能满足使用要求，百斯图承接车车拉与曲轴内铣全套刀盘。	Project content: modification of crankshaft production line project, original cutter can't meet utilization requirements. SofTool undertaked the whole project of T-Tbroaching and crankshaft internal milling.

曲轴车车拉案例-2

▶▶ CRANKSHAFT T-TBROACHING CASE-2



工况简介	Description
机床类型：台湾ACCUWAY 车车拉	Machine tool type: Taiwan ACCUWAY T-Tbroaching
在用刀具：无，交钥匙	Cutter using: none, turnkey
工件名称：摩托车双缸曲轴	Workpiece name: two-cylinder crankshaft for motorcycle
工件材质：QT700（HB283-314）	Workpiece material: QT700 (HB283-314)
加工特点：毛坯尺寸不均匀	Machining features: uneven blank size
测试结果：根据客户要求，为其新的车车拉机床进行交钥匙配刀。按照客户需求结合我司经验，给客户设计12工位车车拉刀盘（轮廓直径D550）。	Result: On customer's requirement combined with our experience, we made turnkey tooling for their new T-Tbroaching machine and designed 12-station T-Tbroaching cutter (contour diameter is D550).

曲轴刀夹案例-1

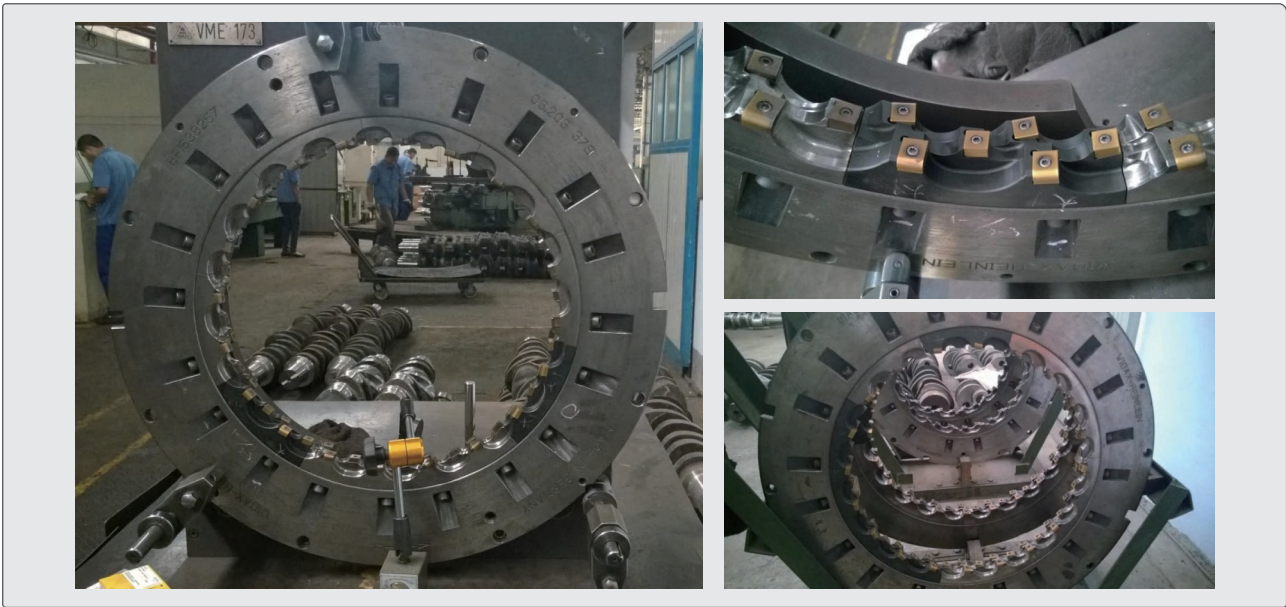
▶▶ CRANKSHAFT CARTRIDGE CASE -1



工况简介	Description
机床类型：德国MAG-BOEHRINGER外铣	Machine tool type: German MAG-BOEHRINGER external milling
在用刀具：I品牌	Cutter in use: Brand I
我司产品：刀夹全部替代	SofTool product: full substitution of cartridge
使用结果：使用原品牌刀盘，应客户需求百斯图进行刀夹国产化，完全满足客户使用要求。	Result: Following customer's request, SofTool cartridges are assembled to original Brand-I cutter, which fully meets customer's requirements request for utilization.

曲轴刀夹案例-2

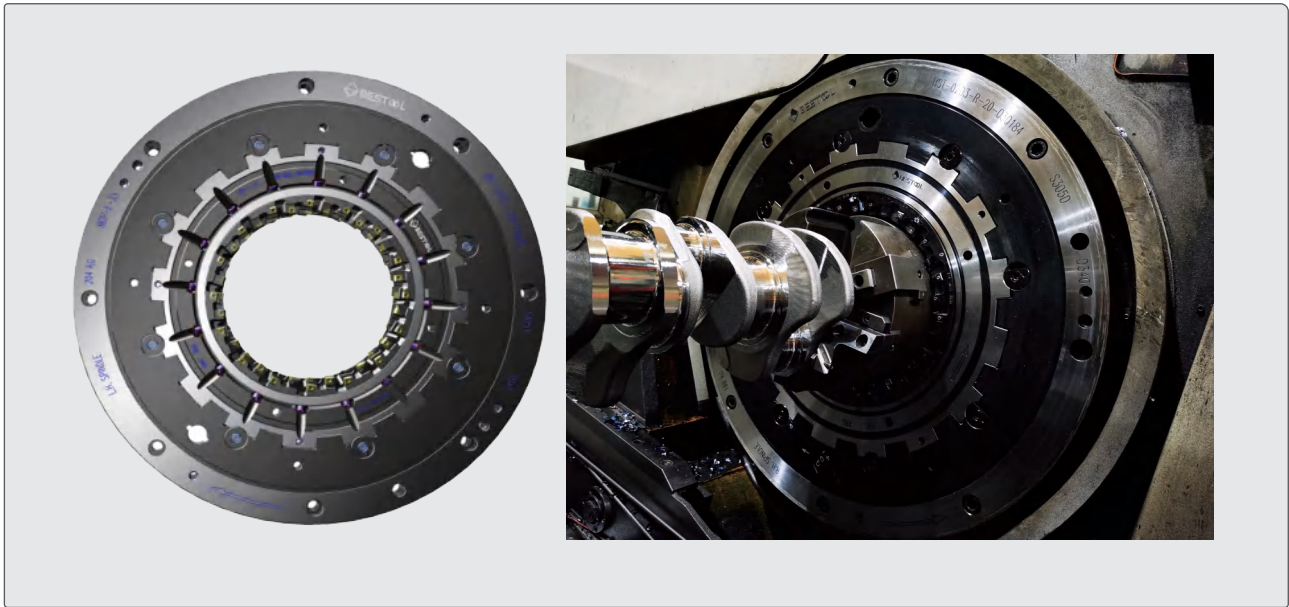
▶▶ CRANKSHAFT CARTRIDGE CASE -2



工况简介	Description
机床类型：德国HELLER 重型内铣	Machine tool type: German HELLER heavy internal milling
在用刀具：W 品牌	Cutter in use: Brand W
我司产品：为客户进行内铣刀夹替代，与原品牌对比，无明显差异，为客户直接降低采购成本。	SofTool product: Internal milling cartridge replacement for customers, compared with the original brand, there is no obvious difference, to directly reduce the purchase cost for customers.

曲轴内铣加工案例（榫卯结构）

▶▶ CRANKSHAFT INTERNAL MILLING CASE (MORTISE AND TENON STRUCTURE)



工况简介	Description
工件名称：康明斯Z14曲轴	Workpiece name: Cummins Z14 crankshaft
机床品牌：沈阳PMC18250C	Machine tool brand: Shenyang PMC18250C
工件材料：42CrMoA	Workpiece material: 42CrMoA
刀盘切削直径：Ø940mm	Cutter diameter: Ø940mm
其他产品在用刀具：某德系品牌	Other cutter in use: a German brand
切削参数：Vc= 160 m/min 余量3-4mm	Cutting parameter: Vc= 160 m/min margin 3-4mm
刀片寿命：150件/每刃	Insert life: 150pcs/ per effective tooth