

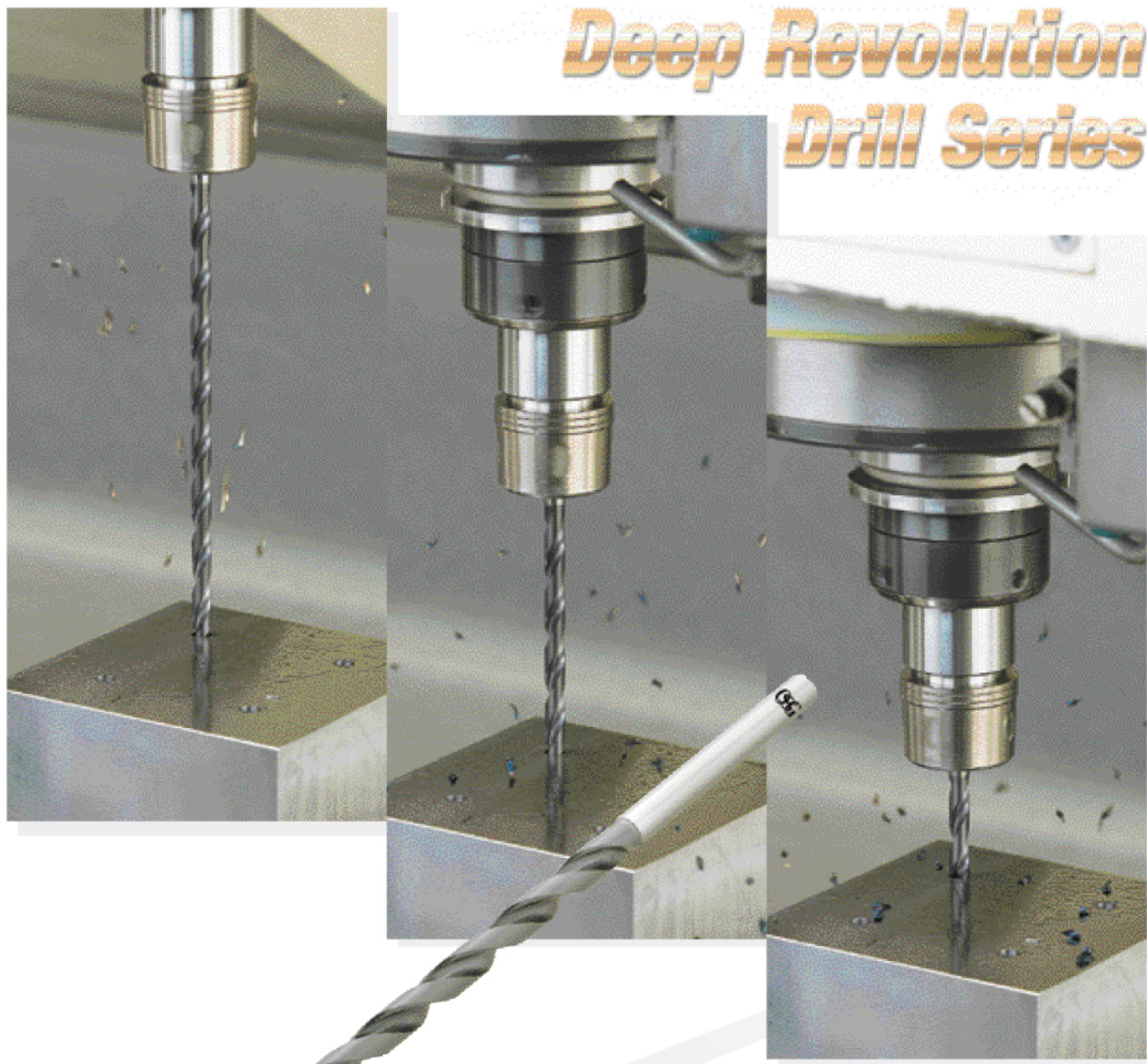


硬质合金

内冷油孔模具加工用超长钻头

Carbide Extra Long Drill with Oil Hole for Molds FTO-M-GDXL PAT.
FTO-PLT

*Deep Revolution
Drill Series*



模具孔加工的救世主!

A savior for drilling holes in dies!

模具深孔加工的稳定·高效化!

Stable and highly efficient boring of deep holes in molds!



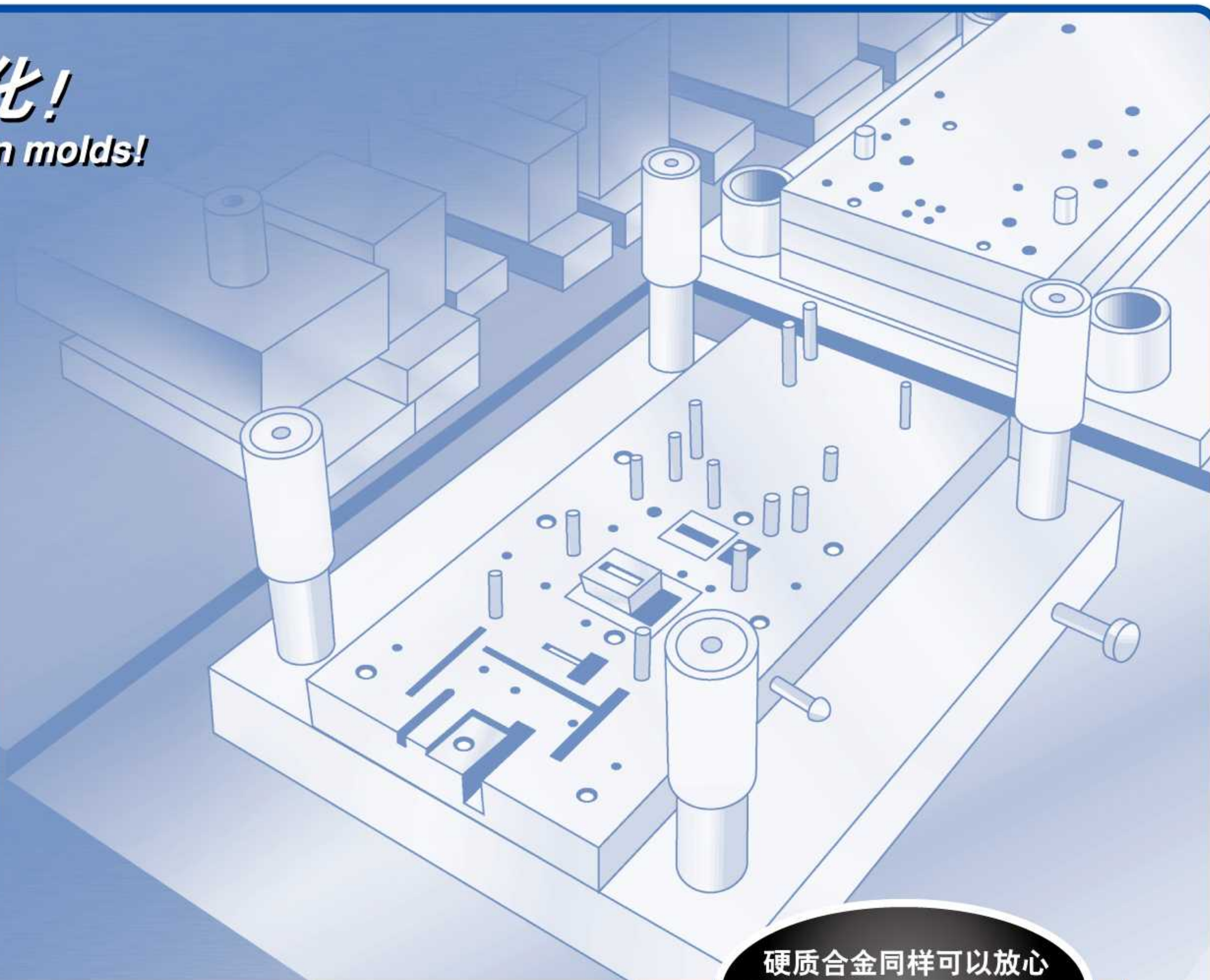
用户的心声 Voices of users

以前使用高速钢钻头和枪钻加工
Drilling problems with previous HSS drills and gun drills

虽然标准
Safe, but

花费时间长...
It takes a long time

工具寿命短...
Short tool life



硬质合金同样可以放心
Safe even though it's a
carbide drill!

排屑性出众的钻头面世! 不易崩刃! 不易折损!

Superior chip evacuation form provides resistance against breakage and chipping!

• 深孔加工条件UP!

Improved conditions in deep hole drilling

• 稳定加工

Stable drilling

• 高精度加工

High precision drilling

模具用硬质合金超长钻头的特点 Features

独创的排屑槽设计 Unique flute form

■ 使用不易崩刃, 折损的超微粒子硬质合金!

Made of ultra fine grain carbide which resists chipping and breakage.

■ 双刃带设计, 加工稳定!

心厚增大, 刚性高!

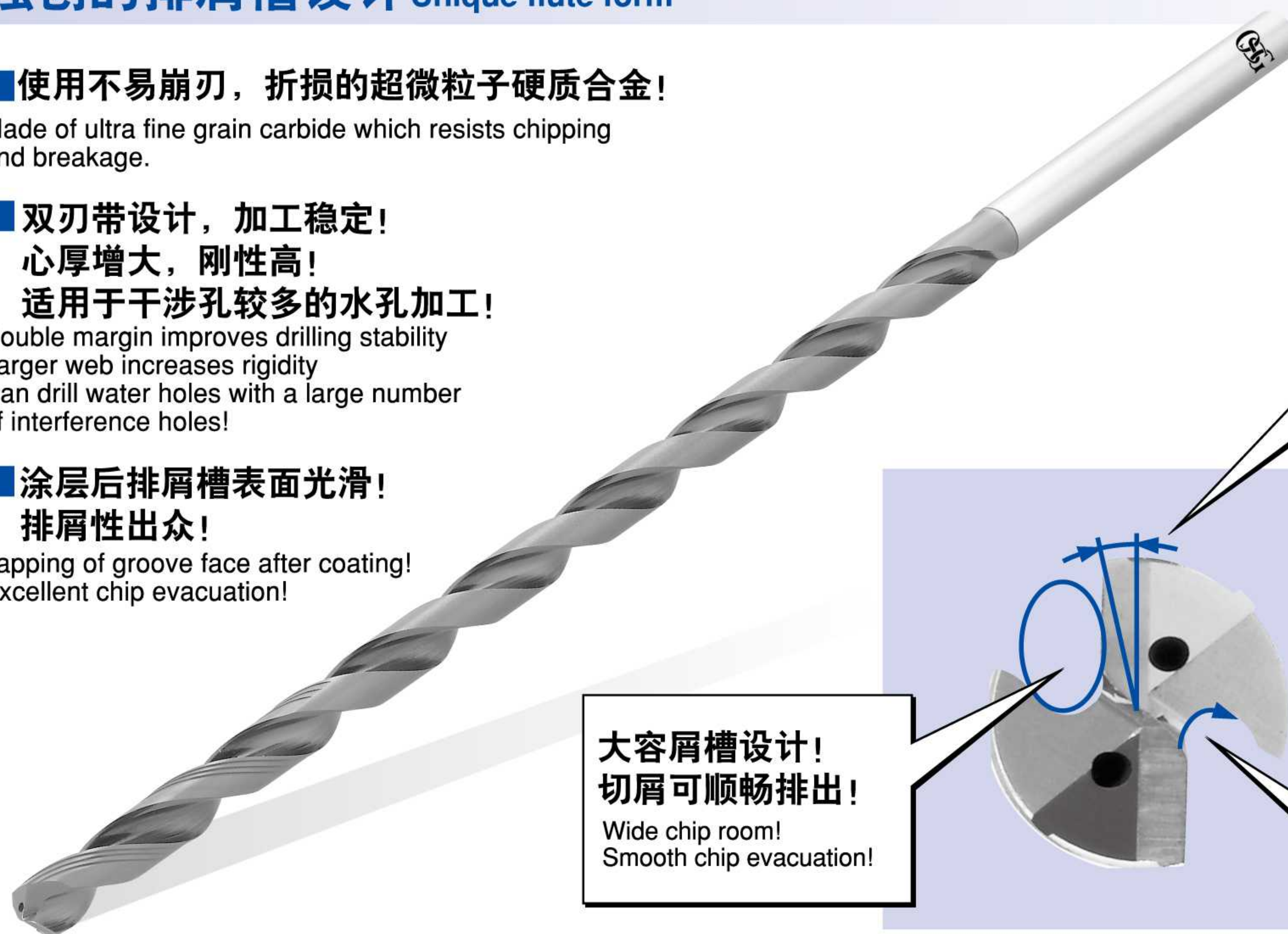
适用于干涉孔较多的水孔加工!

Double margin improves drilling stability
Larger web increases rigidity
Can drill water holes with a large number of interference holes!

■ 涂层后排屑槽表面光滑!

排屑性出众!

Lapping of groove face after coating!
Excellent chip evacuation!



大容屑槽设计!
切屑可顺畅排出!

Wide chip room!
Smooth chip evacuation!

切屑刃强度增大!
不易崩刃!
不易折损!

Stronger cutting edge!
Resists chipping!
Resists breaking!

特殊槽底设计!
断屑性良好!

The heel sweeps inward
to curl the chips!
Excellent chip breakage!

■ 模具用硬质合金超长钻头

Carbide Extra Long Drill for Molds

FTO-M-GDXL

- 材 质

Tool Material

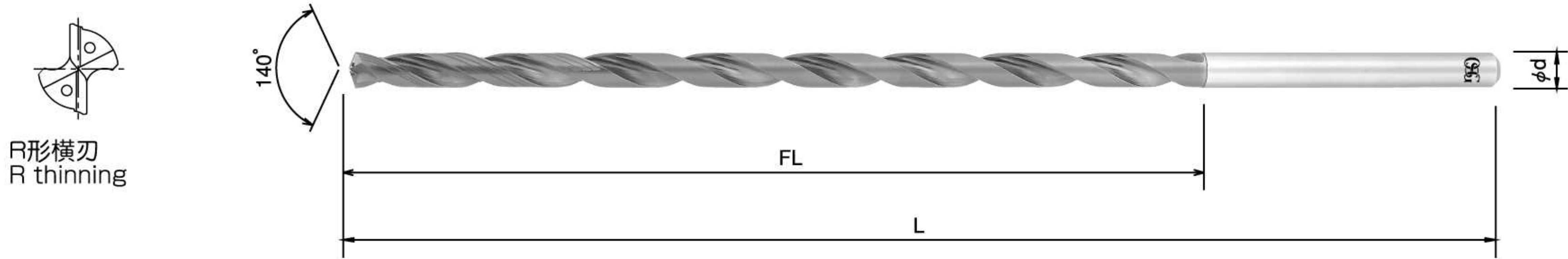
超微粒子硬质合金

Micro Grain Carbide
- 表面处理

Surface Treatment

FX(TiAlN系)复合涂层

FX (composite multi-layered TiAlN) coating



单位:mm Unit:mm					
EDP NO.	D	槽长 FL	全长 L	柄径 d	库存 Stock
8568540	4×20D	90	140	4	●
8568550	5×20D	115	165	5	●
8568560	6×20D	140	190	6	●

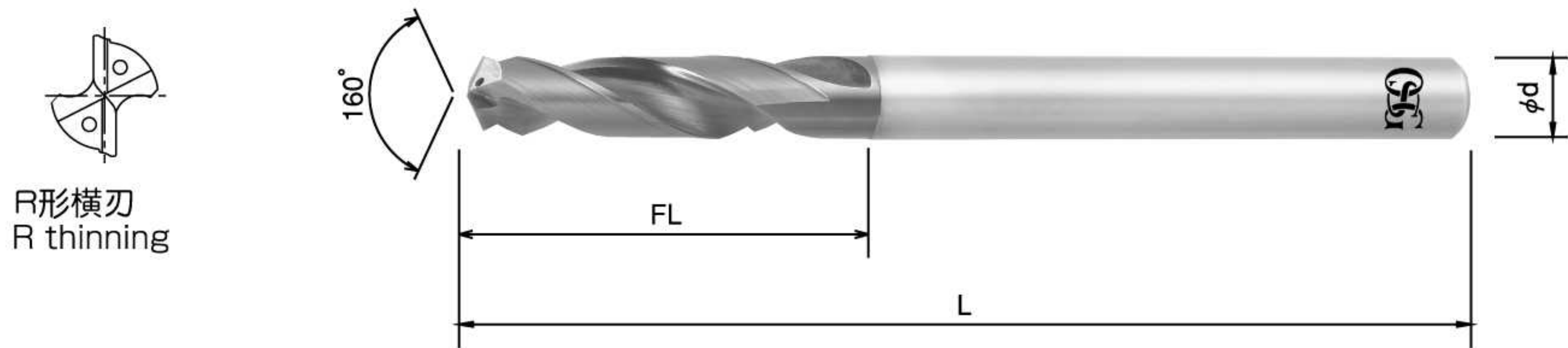
单位:mm Unit:mm					
EDP NO.	D	槽长 FL	全长 L	柄径 d	库存 Stock
8568580	8×20D	180	230	8	●
8568600	10×20D	230	280	10	●

●=标准库存品 ●=Standard stock item.

■ 超长钻头用导向孔钻头

Pilot Drill for Extra Long Drill

FTO-PLT



单位:mm Unit:mm					
EDP NO.	D	槽长 FL	全长 L	柄径 d	库存 Stock
8568904	4.03	20	70	4	●
8568905	5.03	25	75	5	●
8568906	6.03	30	80	6	●

单位:mm Unit:mm					
EDP NO.	D	槽长 FL	全长 L	柄径 d	库存 Stock
8568908	8.03	40	90	8	●
8568910	10.03	50	100	10	●

●=标准库存品 ●=Standard stock item.

■ 切削油剂的油压不同来比较切削的抵抗 Comparison of cutting resistance with different coolant pressures

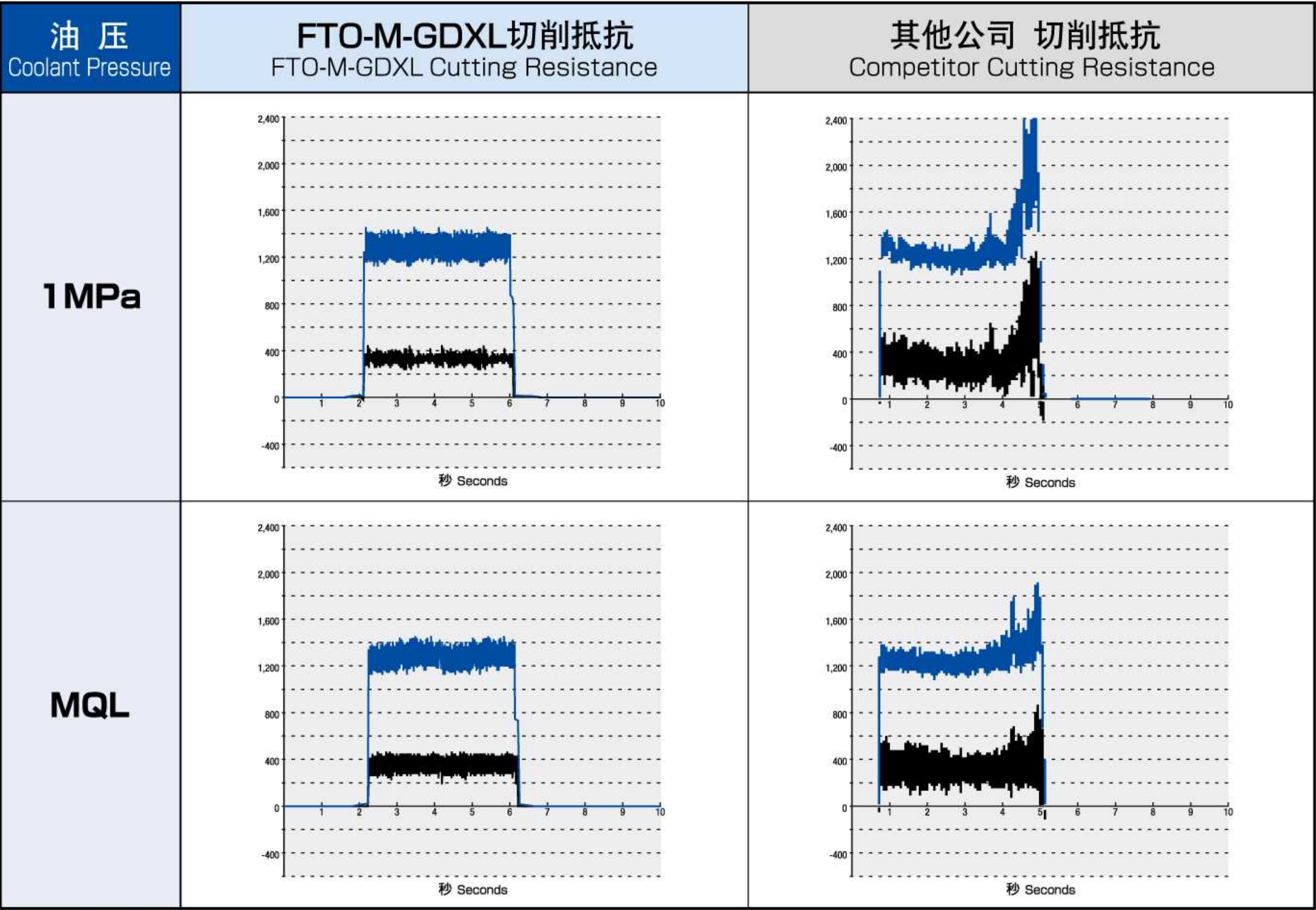
使用工具 Tool	FTO-M-GDXL $\phi 6$	其他公司 $\phi 6$ Competitor
加工材质 Work Material	S50C DIN CK50, AISI 1049	
切削速度 Drilling Speed	80m/min (4,246min ⁻¹)	
进给速度 Feed	1,274mm/min (0.3mm/rev) 无停顿式 Non-pecking	
孔深 Depth of Holes	120mm (20D) 盲孔 Blind Hole	
使用设备 Machine	立式加工中心 Vertical Machining Center	

导向孔加工钻头 Drill for pilot hole

使用工具 Tool	FTO-PLT $\phi 6.03$		
加工材质 Drilling Speed	80m/min	进给量 Feed Rate	0.2mm/rev
孔深 Depth of Holes	6mm		

上表中其他公司的钻头排屑不顺畅，切削抵抗从切屑堵塞开始急剧上升，切削抵抗波形的振幅也非常不稳定。另外，内孔变形弯曲使钻头与孔内壁接触，造成切削抵抗的振幅紊乱。但是，FTO-M-GDXL在油压较低或非雾式加工下切屑也不会堵塞，可以稳定地加工。

The drill made by another company is unable to eject chips smoothly, and the cutting resistance increases suddenly when it starts to become clogged with chips. This causes a significant amplitude disturbance in cutting resistance. However, the FTO-M-GDXL is able to drill holes in a stable manner without ever becoming clogged with chips even when the coolant pressure is low or working with MQL (minimal quantity lubrication).



■ 多种切削条件下的加工 Drilling holes in a wide range of cutting conditions

使用工具 Tool	FTO-M-GDXL $\phi 6$		
加工材质 Work Material	S50C DIN CK50, AISI 1049		
孔深 Depth of Holes	120mm (20D) 盲孔 Blind Hole		
使用设备 Machine	立式加工中心 (HSK63A) Vertical Machining Center		

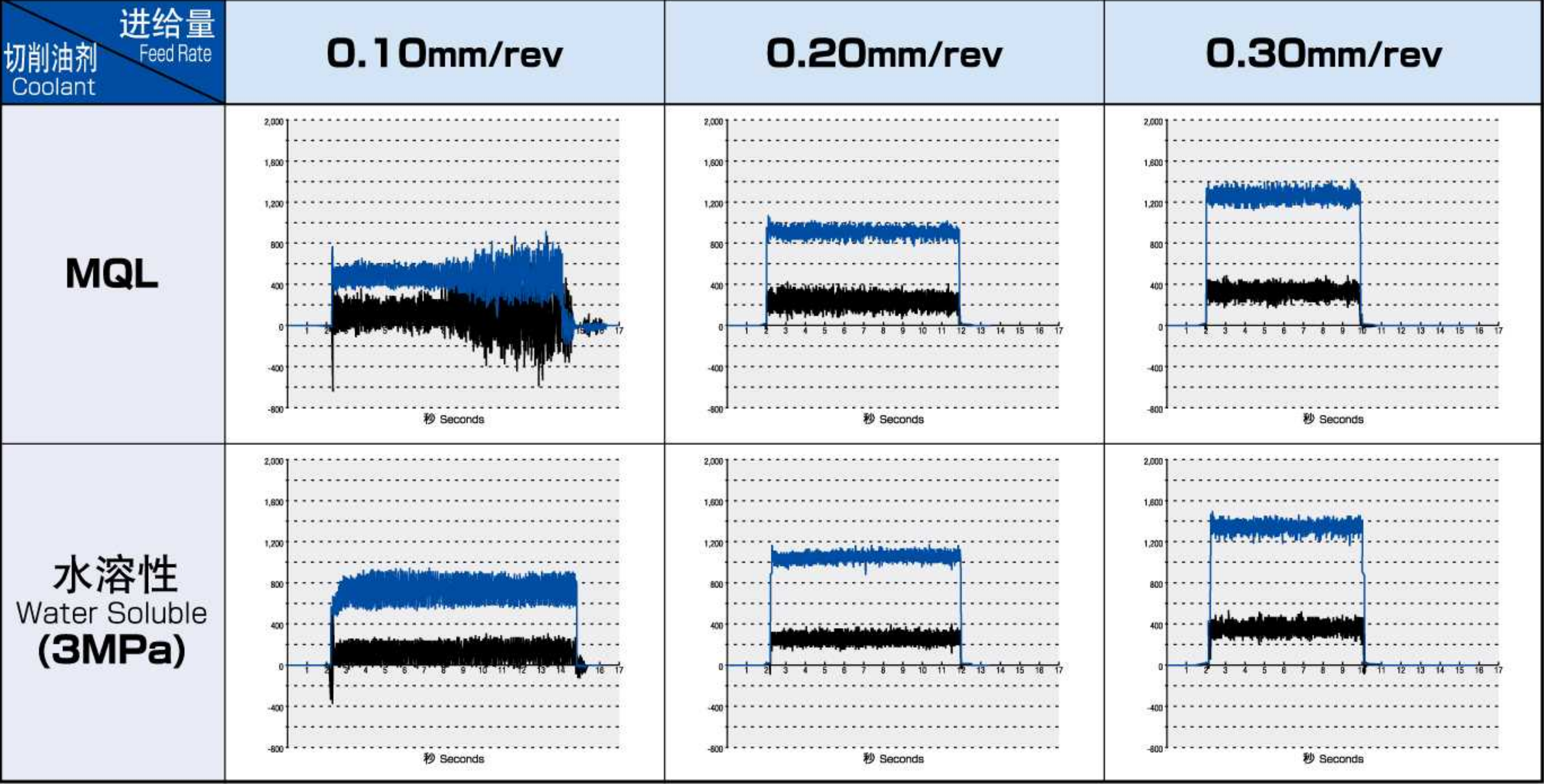
导向孔加工钻头 Drill for pilot hole

使用工具 Tool	FTO-PLT $\phi 6.03$		
切削速度 Drilling Speed	80m/min	进给量 Feed Rate	0.2mm/rev
孔深 Depth of Holes	6mm		

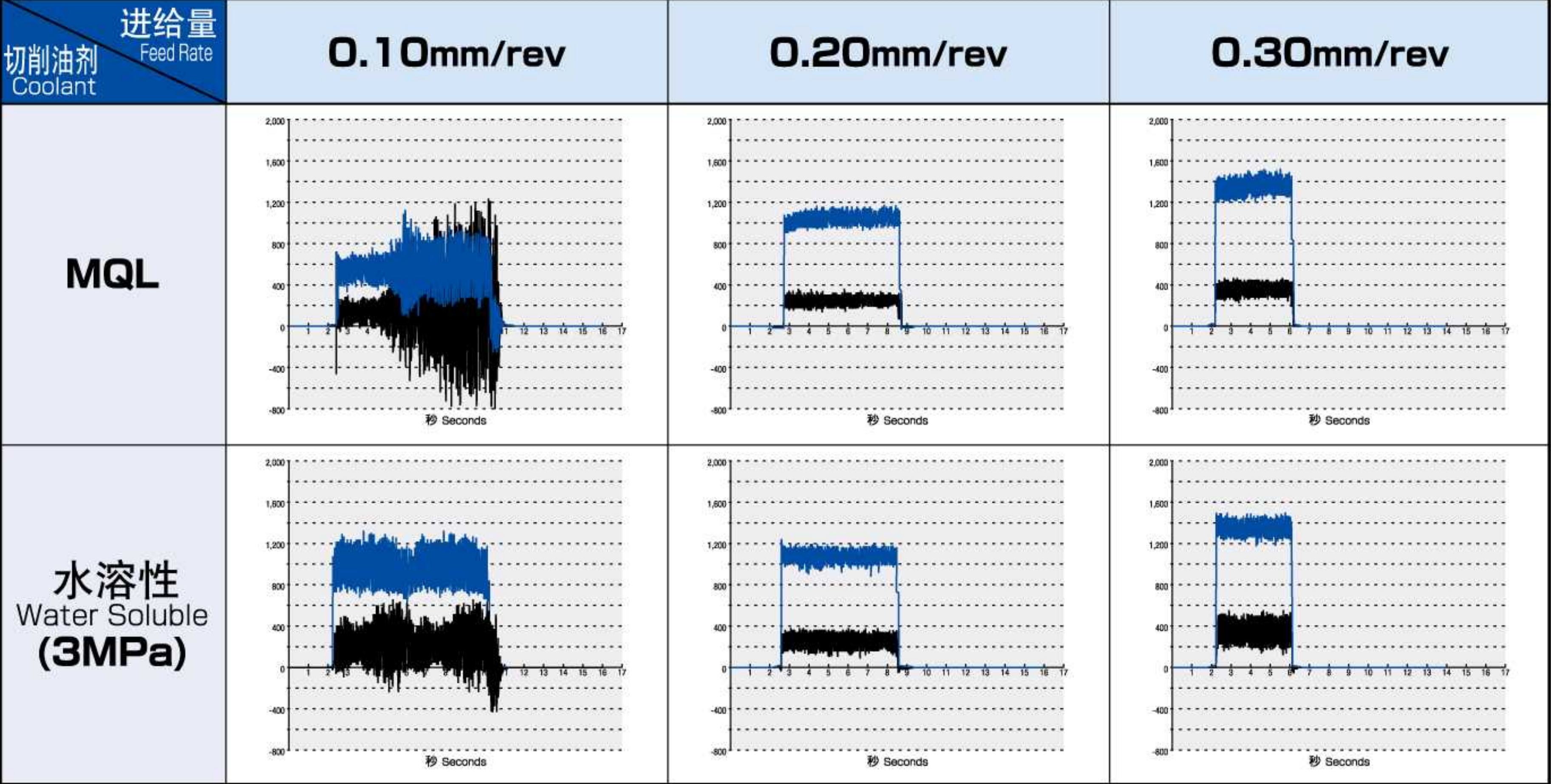
FTO-M-GDXL可在广泛的切削条件下进行加工，即使将进给量调整到0.20~0.30mm/rev 也可进行无积屑的稳定加工，进给量在0.10mm/rev时虽可加工，但切屑形状不佳，切削抵抗不稳定，故不作推荐。

The FTO-M-GDXL can be used in a wide range of cutting conditions. It can be drill holes in a reliable manner without ever becoming clogged with chips even if the feed rate is increased to as much as 0.20 to 0.30mm/rev. Although it can drill holes even at a feed rate of 0.10mm/rev, this is not recommended, because it negatively affects the chip shape and causes the cutting resistance to fluctuate considerably.

● 切削速度 Drilling Speed 40m/min



● 切削速度 Drilling Speed 80m/min

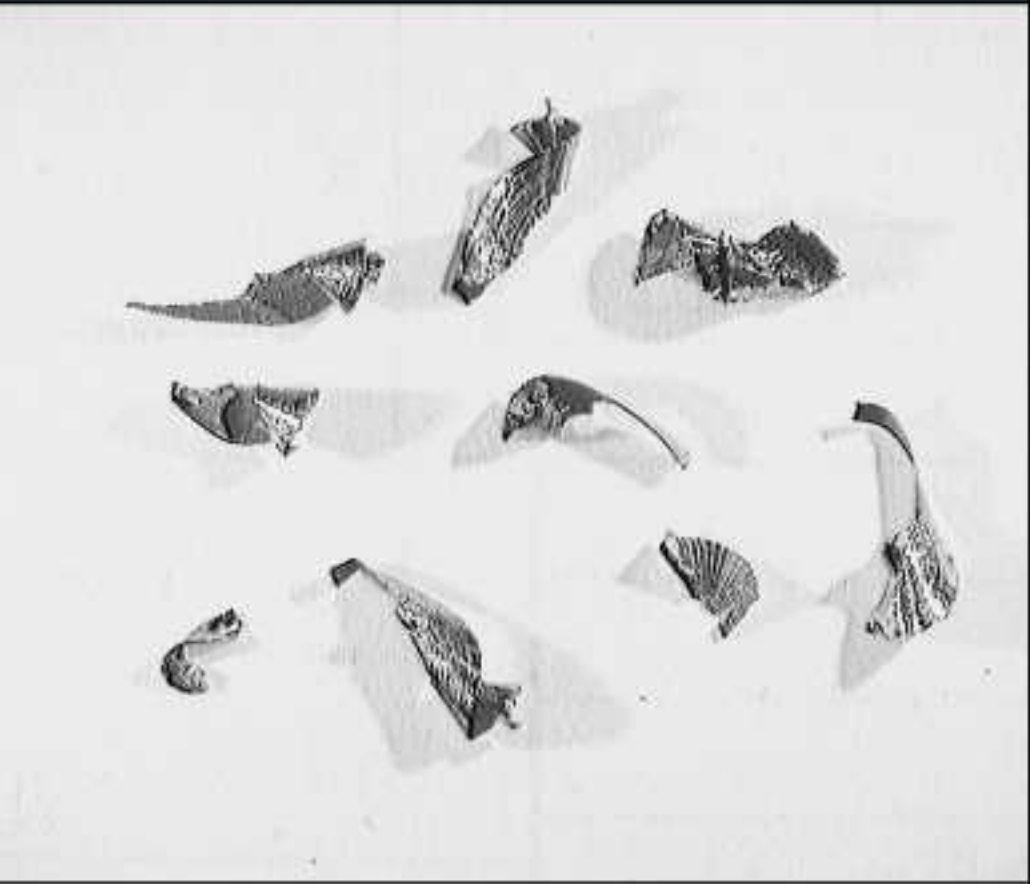


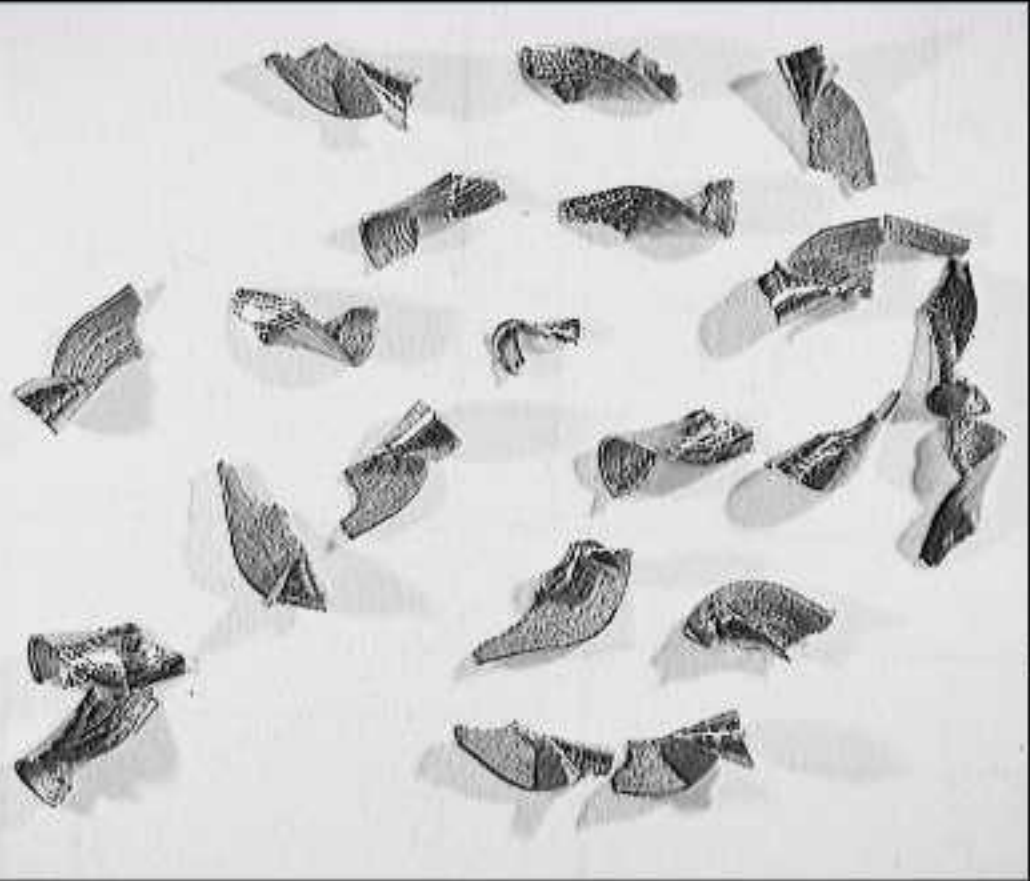
不同的进给量下的切屑形状 Chip shapes with different feed rates

使用工具 Tool	FTO-M-GDXL $\phi 6$
加工材质 Work Material	S50C DIN CK50, AISI 1049
切削速度 Drilling Speed	80m/min (4,246min ⁻¹)
孔深 Depth of Holes	120mm (20D) 盲孔 Blind Hole
使用设备 Machine	立式加工中心 Vertical Machining Center

导向孔加工钻头 Drill for pilot hole

使用工具 Tool	FTO-PLT φ6.03		
切削速度 Drilling Speed	80m/min	进给量 Feed Rate	0.2mm/rev
孔深 Depth of Holes	6mm		

进给量 Feed Rate	0.07mm/rev	0.09mm/rev	0.14mm/rev
切屑 Chip			
判定 Criterion	×	×	△

送进量 Feed Rate	0.15mm/rev	0.20mm/rev	0.50mm/rev
切屑 Chip			
判定 Criterion	○	○	○

进给量在0.1mm/rev以下时，切屑呈连续卷曲的蛇腹状，在深孔加工中引起切屑堵塞，可能导致钻头折损。因此推荐在切削排出形状良好状态下的加工条件进行加工。

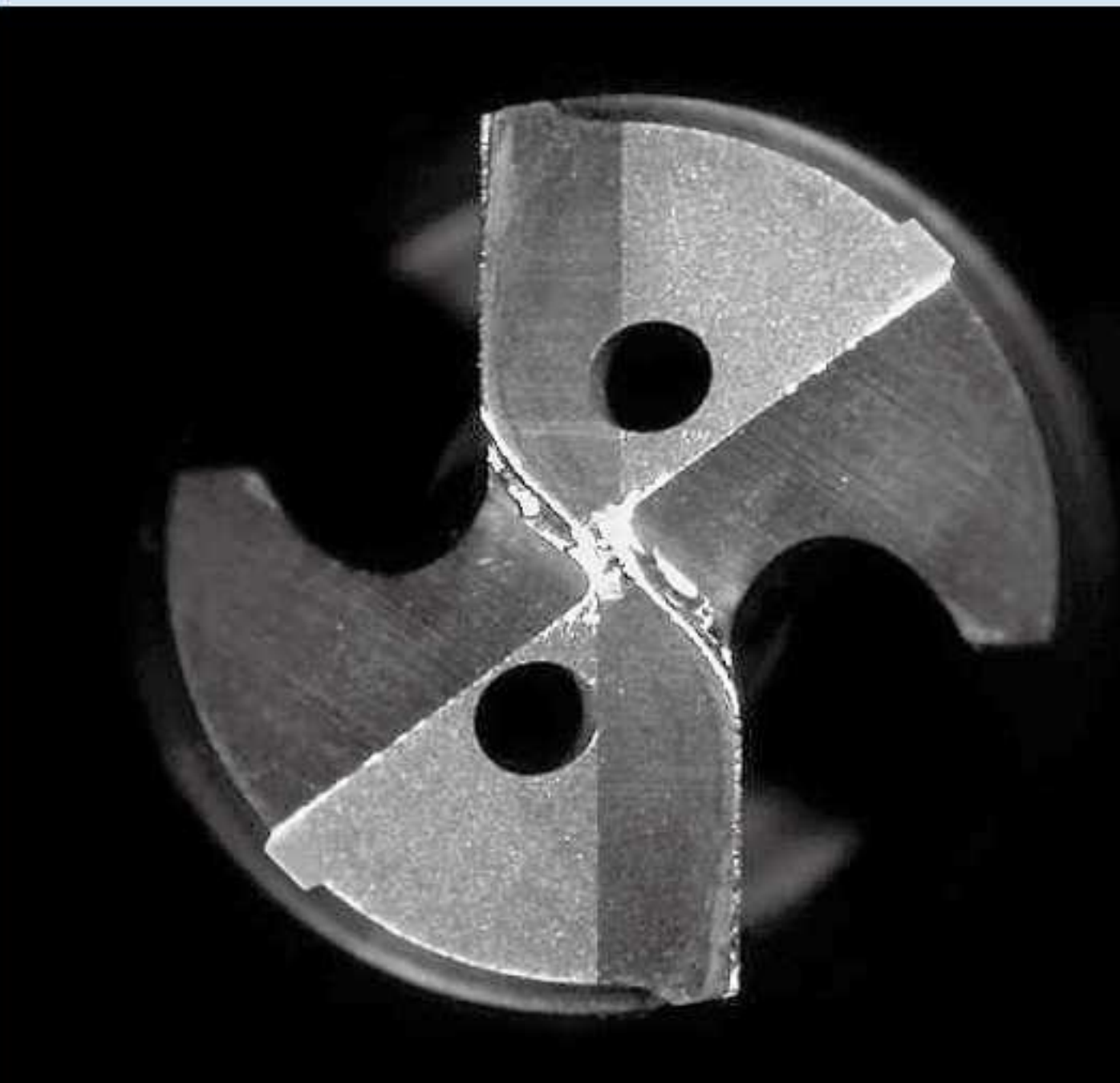
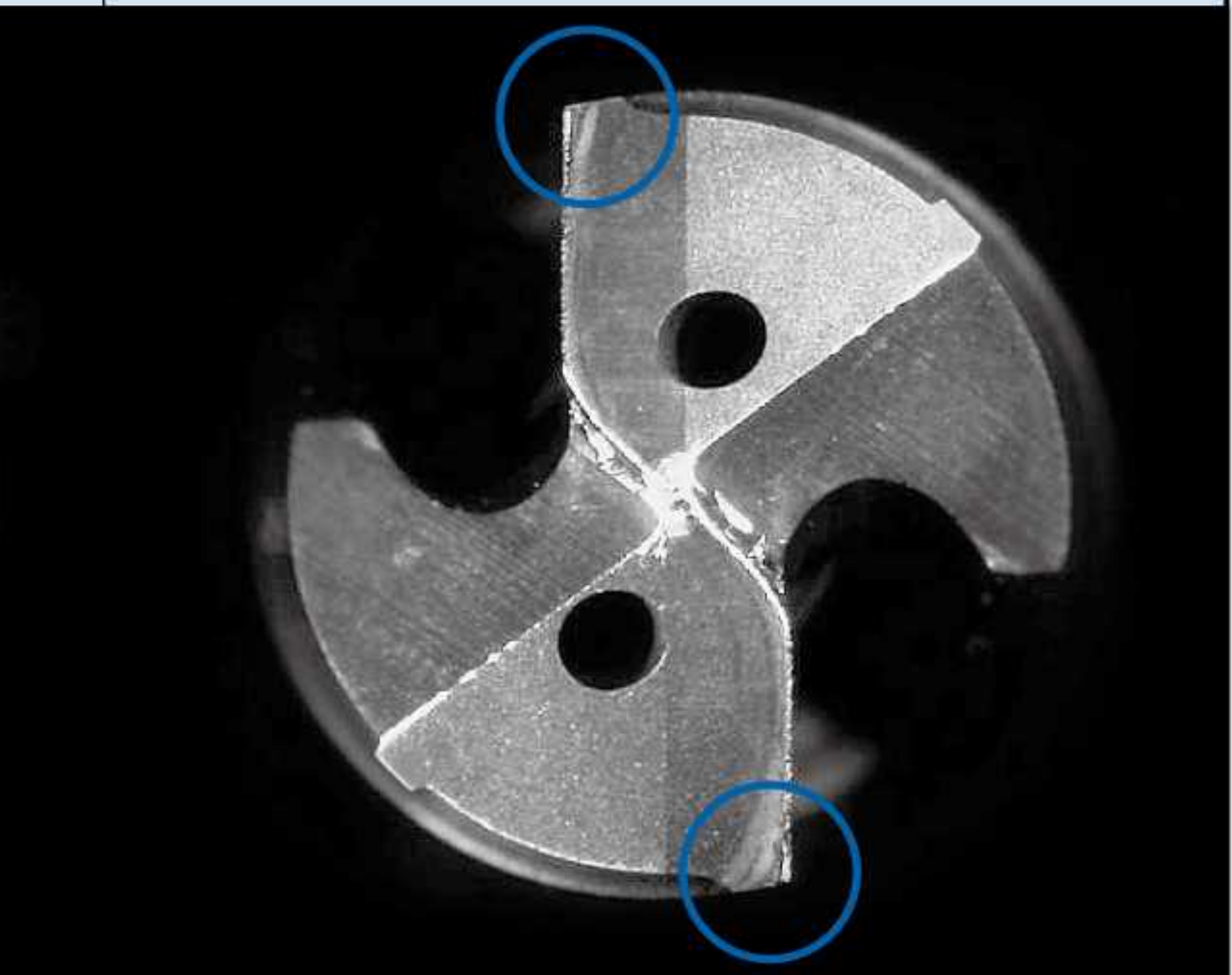
A feed rate below 0.10mm/rev will negatively affect the chip shape, creating chips that are long or form a bellowed shape. While drilling a deep hole, improperly shaped chips will cause the drill to become clogged with chips, which could cause the drill to break. Therefore, we recommend that you use the drills in a range that creates optimal chip shapes.

根据摩耗量判断寿命 Determining tool life by the amount of wear

使用工具 Tool	FTO-M-GDXL $\phi 6$
加工材质 Work Material	S50C DIN CK50, AISI 1049
切削速度 Drilling Speed	80m/min (4,246min ⁻¹)
进给量 Feed	849mm/min (0.2mm/rev)
孔深 Depth of Holes	120mm (20D) 盲孔 Blind Hole
使用设备 Machine	立式加工中心 Vertical Machining Center

导向孔加工钻头 Drill for pilot hole

使用工具 Tool	FTO-PLT φ6.03		
切削速度 Drilling Speed	80m/min	进给量 Feed Rate	0.2mm/rev
孔深 Depth of Holes	6mm		

加工孔数 Holes	740孔 Holes	814孔 Holes
切屑 Drill		
摩耗量 Wear Amount	0.214mm	0.296mm
判定 Criterion	○	STOP

切削刃后刀面的摩耗量达到0.2~0.3mm为止，可安心进行加工，(超过以上界限时，可能产生崩刃，请停止使用。)

Use a drill until its lip relief wear is approximately 0.2 to 0.3mm (stop using it if the drill becomes chipped before that).

■ 加工SKD61时的性能 Performance of FTO-M-GDXL in SKD61

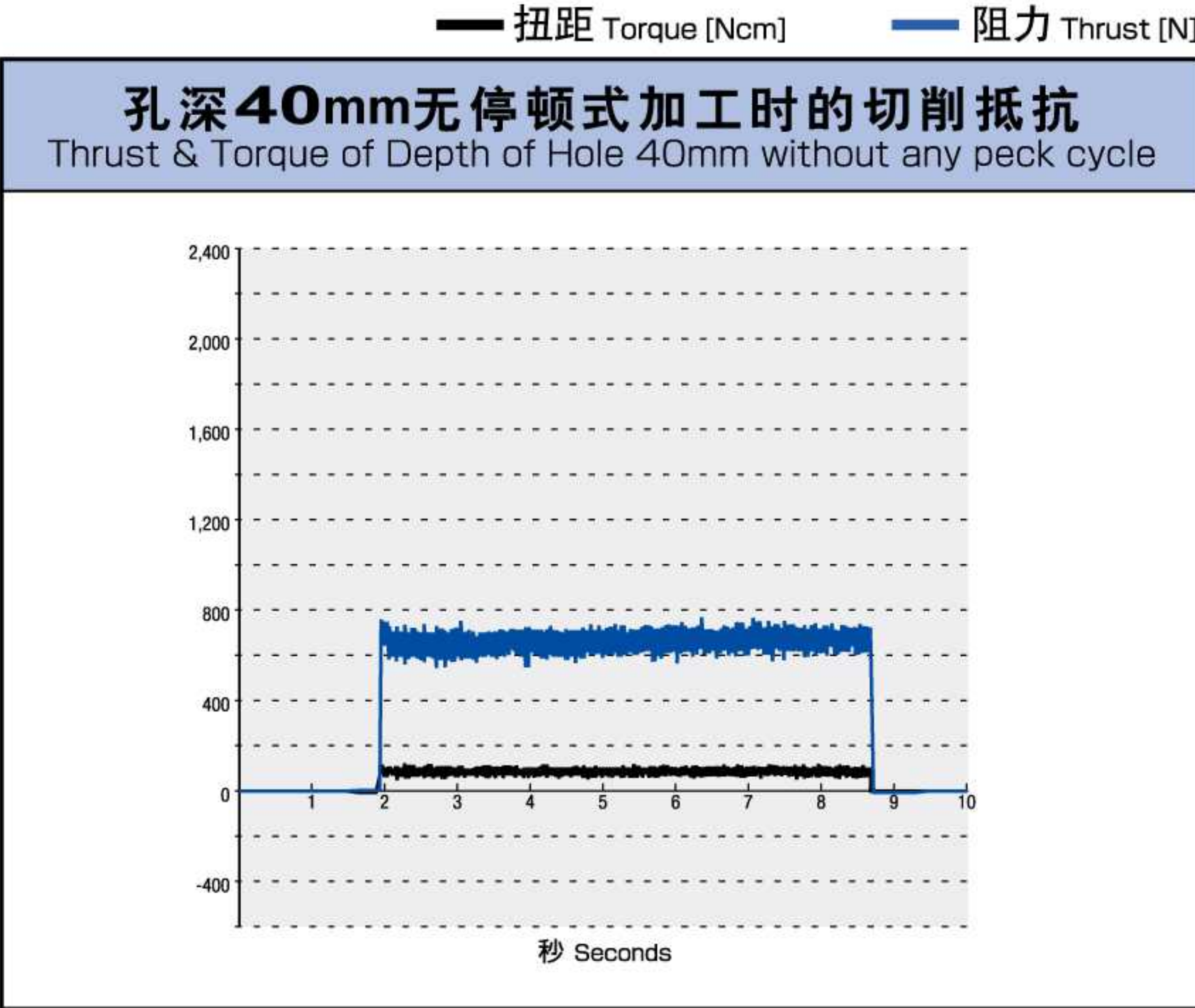
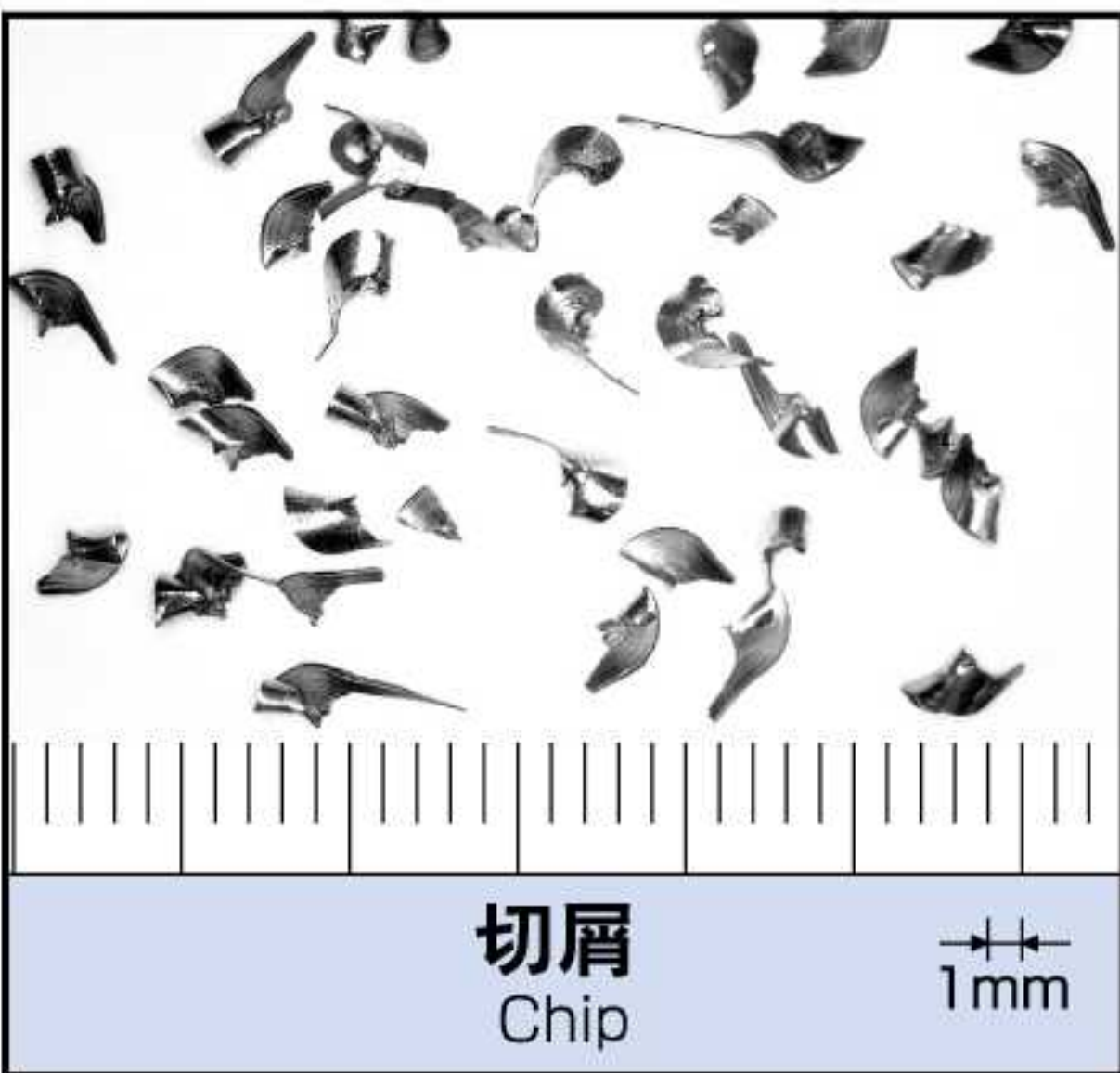
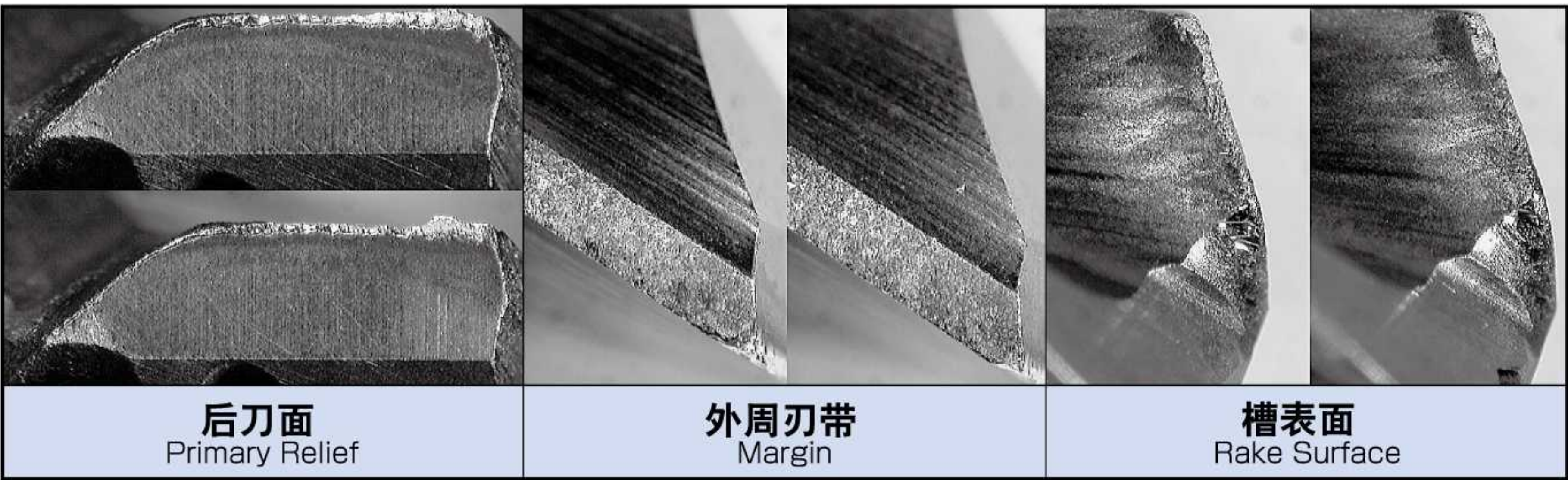
使用工具 Tool	FTO-M-GDXL φ4
加工材质 Work Material	SKD61 (40HRC) DIN X40CrMoV51,ASTM H13
切削速度 Drilling Speed	40m/min (3,183min ⁻¹)
进给速度 Feed	318mm/min (0.1mm/rev) 1D 停顿量 1D Pecking
孔深 Depth of Holes	80mm (20D) 盲孔 Blind Hole
切削油剂 Coolant	水溶性切削油 (7MPa) Water Soluble
使用设备 Machine	卧式加工中心 Horizontal Machining Center

导向孔加工钻头 Drill for pilot hole

使用工具 Tool	FTO-PLT φ4.03		
切削速度 Drilling Speed	39m/min	进给量 Feed Rate	0.1mm/rev
孔深 Depth of Holes	8mm		

切屑被细小地切断。无切屑堵塞，切削抵抗稳定，可连续加工196个孔。
This drill made 196 holes without any overload and chip packing, and was still in good shape.

● 196 孔加工后 After 196 Holes



■ 加工HPM38时的性能 Performance of FTO-M-GDXL in HPM38

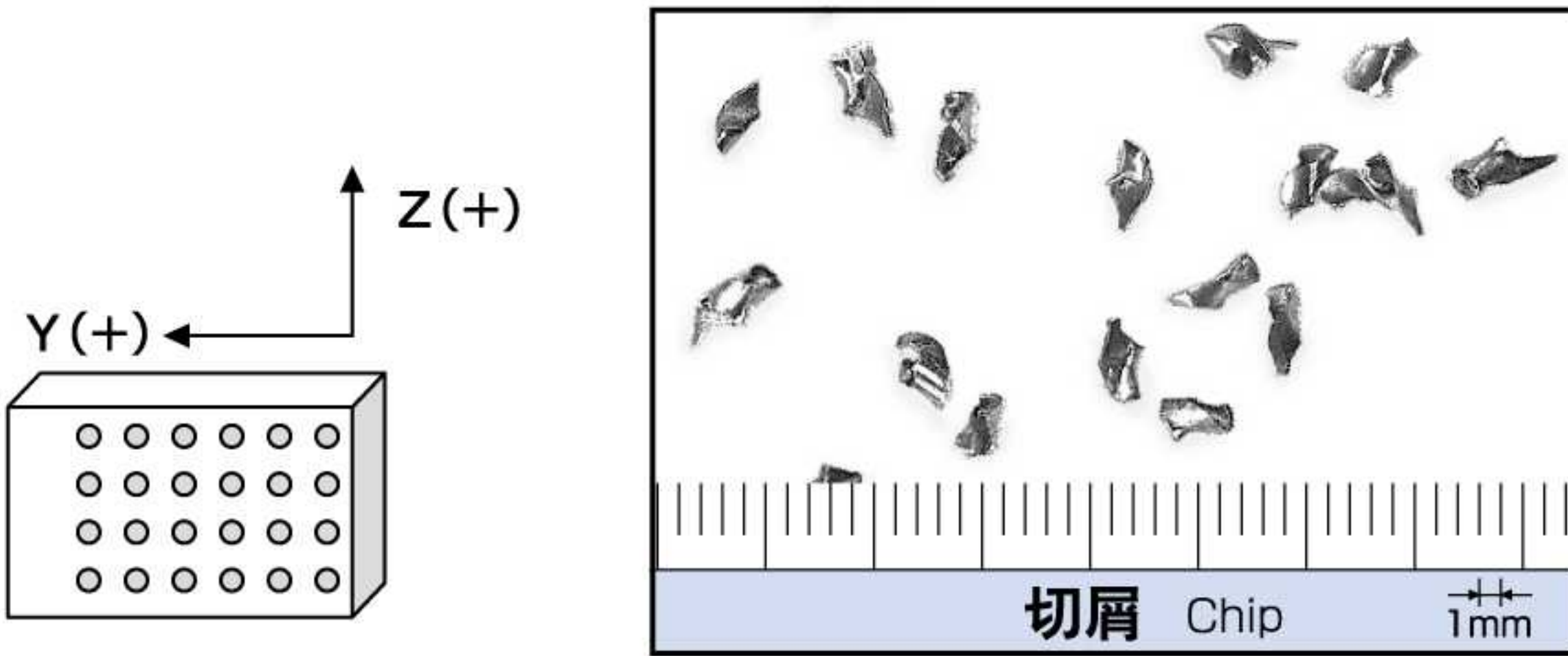
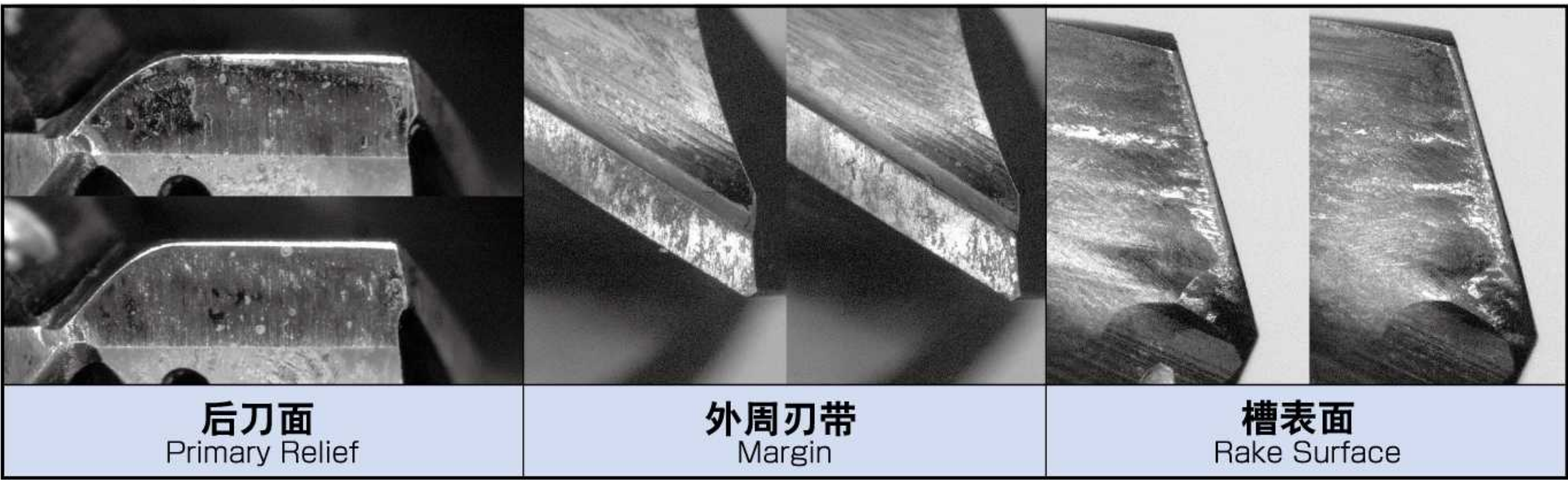
使用工具 Tool	FTO-M-GDXL φ4
加工材质 Work Material	HPM38 (40HRC)
切削速度 Drilling Speed	30m/min (2,387min ⁻¹)
进给速度 Feed	239mm/min (0.1mm/rev) 1D 停顿量 1D Pecking
孔深 Depth of Holes	75mm (18.75D) 通孔 Through Hole
切削油剂 Coolant	油性切削油 (7MPa) Emulsion
使用设备 Machine	立式加工中心 Vertical Machining Center

导向孔加工钻头 Drill for pilot hole

使用工具 Tool	FTO-PLT φ4.03		
切削速度 Drilling Speed	39m/min	进给量 Feed Rate	0.1mm/rev
孔深 Depth of Holes	8mm		

切层被细小地切断，可连续加工168个孔。孔的弯曲可以控制在0.036mm以内，可进行精度高的孔加工。
After 168 holes, this drill was still capable of drilling more holes. Also, the amount of hole offset was no bigger than 0.036mm.

● 168孔加工后 After 168 Holes



● 孔形弯曲度测定 Evaluation of hole straightness

测定孔 Measurement Hole	①		②		③		④		⑤		⑥	
	入口 Entrance	出口 Exit	入口 Entrance	出口 Exit	入口 Entrance	出口 Exit	入口 Entrance	出口 Exit	入口 Entrance	出口 Exit	入口 Entrance	出口 Exit
孔径 Hole Dia.	4.012	4.008	4.006	4.004	4.006	4.007	4.009	4.001	4.011	4.005	4.009	4.005
同心圆度 Circularity	0.004	0.001	0.001	0.001	0.001	0.001	0.002	0.001	0.002	0.002	0.002	0.002
Y座标偏差 Y-axis misalignment	-0.001		0.020		-0.008		0.015		-0.025		-0.006	
Z座标偏差 Z-axis misalignment	0.015		-0.014		-0.018		-0.008		-0.016		0.036	
孔弯曲度 Hole offset	0.015		0.024		0.020		0.017		0.030		0.036	

测定位置：入口：端面起12mm， 出口：端面起2mm
Measurement Point: 12mm from entrance side Exit: 2mm from exit side

■ 加工HPM38时的性能比较

Performance comparison in HPM38

使用工具 Tool	FTO-M-GDXL	
尺寸 Size	φ4 (特殊品) (Special order)	全长=165mm Overall length
	槽长=115mm Flute length	柄径=φ4 Shank
加工材质 Work Material	HPM38	
切削速度 Drilling Speed	50m/min (3,980min ⁻¹)	
进给速度 Feed	478mm/min (0.12mm/rev) 1D 停顿量 1D Pecking	
孔深 Depth of Holes	100mm (25D) 盲孔 Blind Hole	
使用设备 Machine	立式加工中心 Vertical Machining Center	

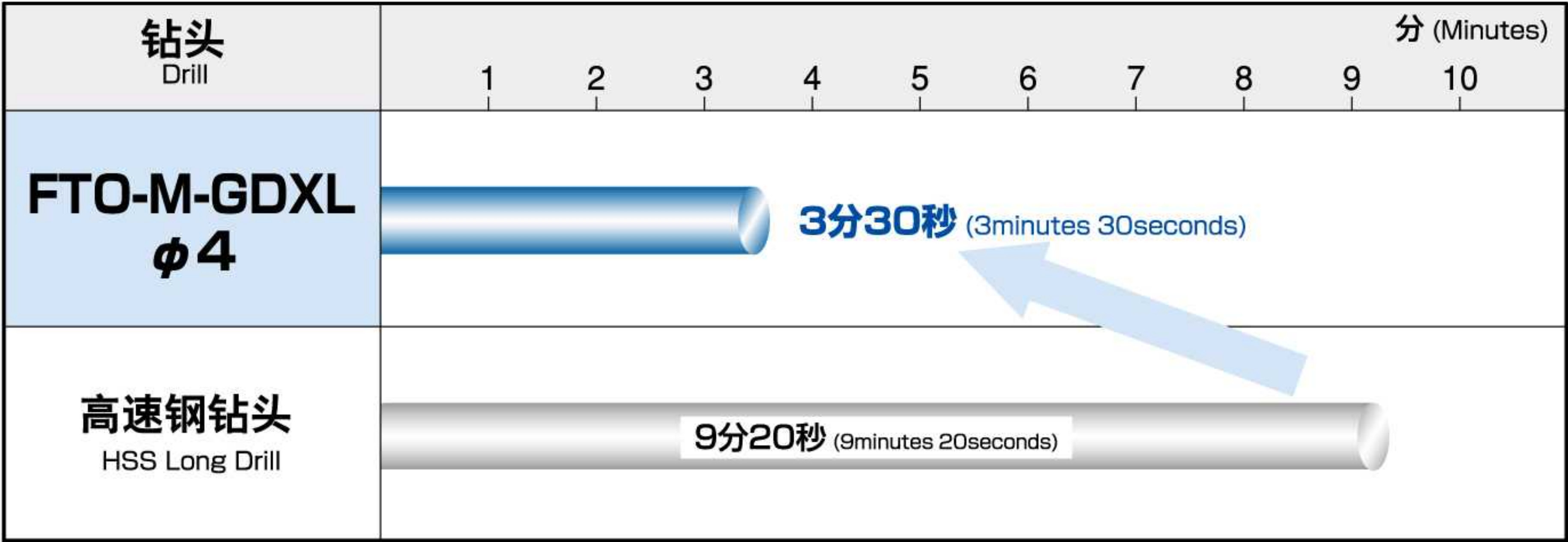
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Drill for pilot hole

使用工具 Tool	FTO-PLT φ4.03	
切削速度 Drilling Speed	50m/min	进给量 Feed Rate 0.12mm/rev
孔深 Depth of Holes	8mm	

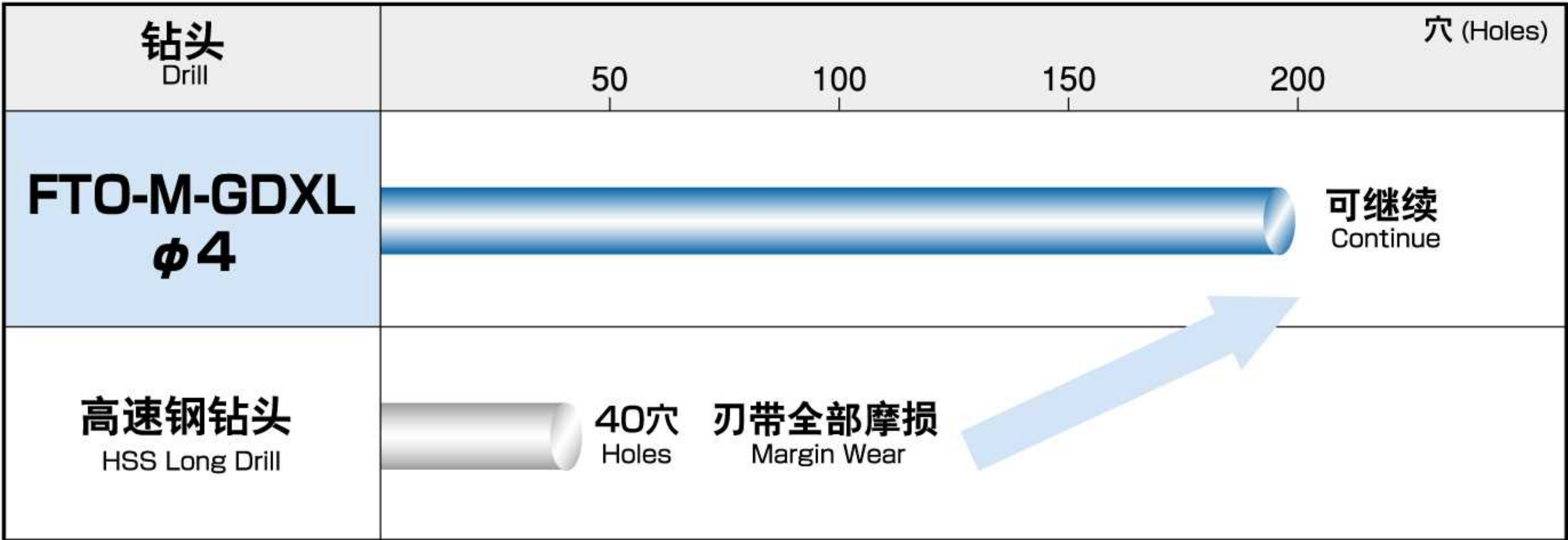
●加工1个孔的时间比较

Drilling Time Per Hole



●寿命性能比较

Dulability



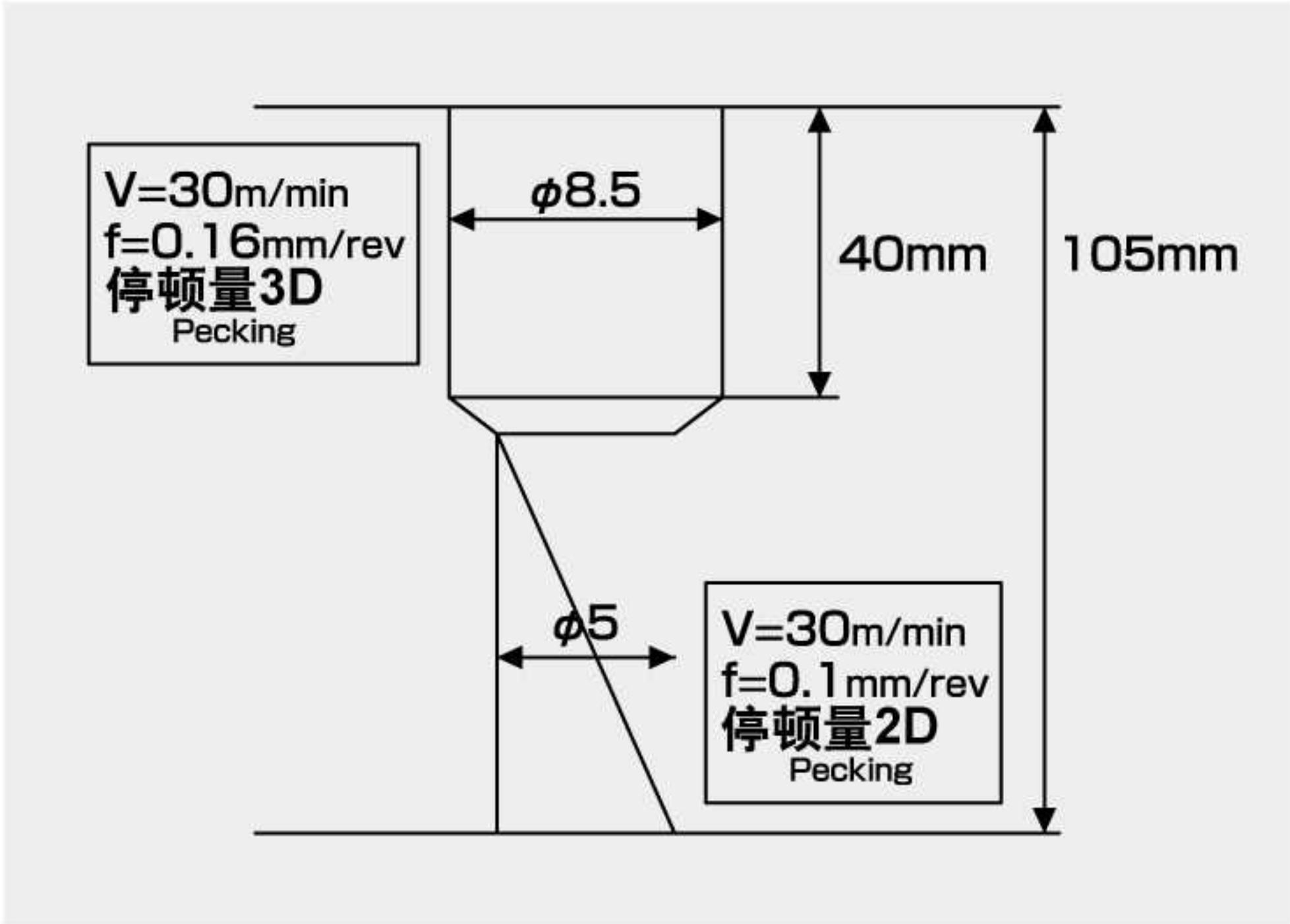
高速钢钻头与高速钢钻头比较，加工时间约为其2/5,寿命为5倍以上。

A comparison with an HSS long drill revealed that the FTO-M-GDXL drill shortened the drilling time to about 2/5 and tool life was increased more than 5 times.

■ 加工DAC55时的性能比较

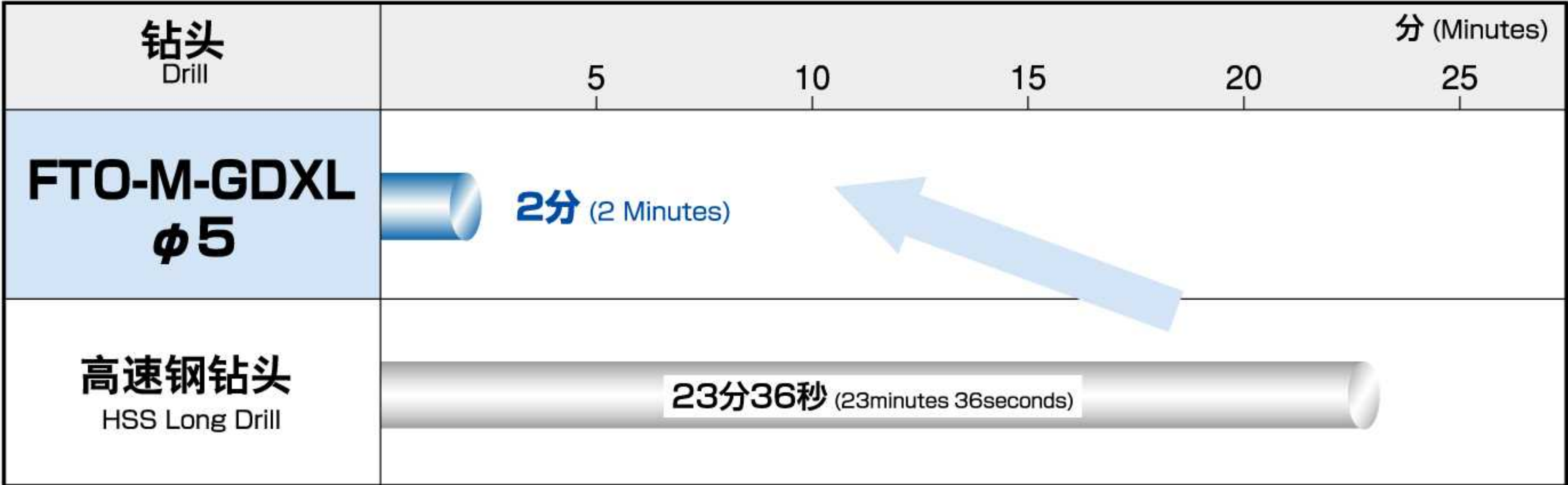
Performance comparison in DAC55

使用工具 Tool	FTO-M-GDXL φ5	
加工材质 Work Material	DAC55(45~48HRC)	
切削速度 Drilling Speed	30m/min (1,910min ⁻¹)	
进给速度 Feed	191mm/min (0.1mm/rev)	
孔深 Depth of Holes	105mm	
切削油剂 Coolant	水溶性切削油剂(2.5MPa) Water Soluble	
使用设备 Machine	立式加工中心 Vertical Machining Center	



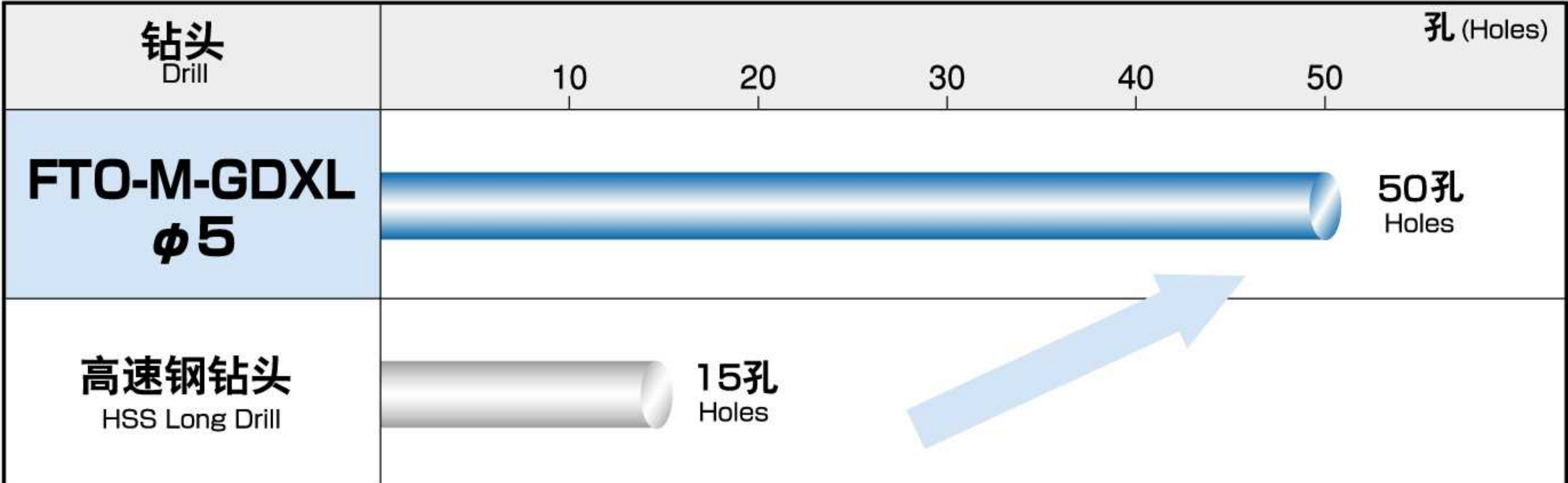
●加工1个孔的时间比较

Drilling Time Per Hole



●寿命性能比较

Dulability



与高速钢钻头比较，加工时间约为其1/12,寿命为3倍以上。

A comparison with an HSS long drill revealed that the FTO-M-GDXL drill shortened the drilling time to about 1/12 and tool life was increased more than 3 times.

切削条件表 Recommended Drilling Condition

加工材质 WORK MATERIAL	炭素钢 CARBON STEELS S50C		合金钢・预硬钢 ALLOY STEELS (C $\geq$ 0.3%)・ PRE-HARDENED STEELS SCM440 28~34HRC		特殊钢・调质钢 预硬钢 SKD61 (非调质) SPECIAL ALLOY STEELS・ HARDENED STEELS・ PRE-HARDEND STEELS SKD61 (unquenched) 34~44HRC		特殊钢・调质钢 预硬钢 SKD61 (非调质) SPECIAL ALLOY STEELS・ HARDENED STEELS・ PRE-HARDEND STEELS SKD61 (unquenched) 44~46HRC	
切削速度 DRILLING SPEED	70~90m/min		50~70m/min		40~60m/min		30~40m/min	
直径 DRILL DIA. (mm)	转速 SPEED(min ⁻¹)	进给量 FEED(mm/rev)	转速 SPEED(min ⁻¹)	进给量 FEED(mm/rev)	转速 SPEED(min ⁻¹)	进给量 FEED(mm/rev)	转速 SPEED(min ⁻¹)	进给量 FEED(mm/rev)
4	6,300	0.10~0.15	4,700	0.10~0.15	3,900	0.10~0.15	2,700	0.08~0.13
5	5,000	0.12~0.18	3,800	0.12~0.18	3,100	0.12~0.18	2,200	0.10~0.15
6	4,200	0.14~0.20	3,100	0.14~0.20	2,600	0.14~0.20	1,800	0.12~0.18
8	3,100	0.16~0.24	2,300	0.16~0.24	1,900	0.16~0.24	1,400	0.14~0.22
10	2,500	0.18~0.27	1,900	0.18~0.27	1,500	0.18~0.27	1,100	0.15~0.25

1. 此切削条件基准表是使用水溶性切削油或50ml/h左右的雾式加工下的值
 2. 水溶性切削油在使用时请稀释至20~30倍
 3. 使用非水溶性切削油时，请将切削速度调整至左表对应值中最低值的70%
 4. 请按照“FTO-M-GDXL的推荐加工方法”进行导向孔的加工
 5. 低炭素钢、炭素钢、合金钢加工时，进给量为直径×0.08时必须满足以下条件
 - 机床刚性高
 - 固定状态良好
 - 无干涉孔
 - 油压高
 6. 高硬度材料加工时，请以1D~2D的停顿式加工进行
 7. 断续加工如遇斜面・曲面时，请将转速设置为0.05~0.10mm/rev
1. The indicated speeds and feeds are for drilling with water-soluble oil or mist (approx. 50ml/hour).
 2. The most suitable cutting fluid is water-soluble oil (20-30 times dilution).
 3. When using non-water soluble oil, set the drilling speed between 70-100% of the lowest limit.
 4. Make a pilot hole before using FTO-M-GDXL in accordance with recommended operation shown below.
 5. A feed rate of 8% of drill diameter is obtainable in Low Carbon Steels, Carbon Steels and Alloy Steels under the following conditions:
 - A machine with high rigidity
 - Stable, rigid clamping
 - No interrupting holes
 - High pressure coolant supply
 6. 1D~2D step feeding is required for drilling high hardened steels.
 7. When coming through to an inclined or curved surface, set to the feed to 0.05~0.10mm/rev at the time of perforation.

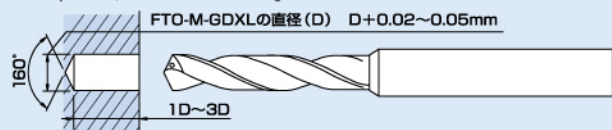
FTO-M-GDXL的推荐加工方法 Recommended operation for using FTO-M-GDXL

①使用FTO-PLT进行导向孔加工

Make a pilot hole.

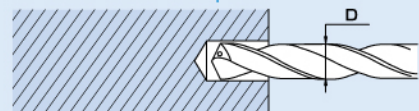
- 导向孔的尺寸请以加工直径(D)+0.02~0.05mm的基准选定。推荐在加工时将导向孔尽量加深。

For a pilot hole, select 0.02~0.05mm larger size drill than FTO-M-GDXL.



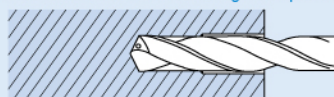
②以静止或低转速状态下将FTO-M-GDXL插入

Insert the FTO-M-GDXL into a pilot hole with zero or low revolution.



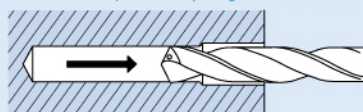
③以预设的转速加速后进行加工

Increase the revolution to the designated speed and start drilling.



④加工后退刀时钻头离开孔底后，请放慢转速拔出。

After drilling, move the drill away from the bottom of the hole; then reduce its speed while pulling it out of the hole.



※加工时请务必使用内部供油方式

Make sure to use an internal coolant supply when drilling.

安全须知

- 工具使用时有破损的危险，请务必使用保护罩、保护镜、安全靴等。
- 手不要直接碰刀刃。
- 请不要用手接触碎屑。
- 刀具的刀刃不良时请停止使用。
- 如发生异常声音及振动时请立刻停止使用。
- 请不要擅自修改工具。
- 加工前请确认工具尺寸。

Safe use of cutting tools

- Use safety cover, safety glasses and safety shoes during operation.
- Do not touch cutting edges with bare hands.
- Do not touch cutting chips with bare hands. Chips will be hot after cutting.
- Stop cutting when the tool becomes dull.
- Stop cutting operation immediately if you hear any strange cutting sounds.
- Do not modify tools.
- Please use correct tools for the operation. Check dimensions to ensure proper selection.

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