建議切削條件
Standard cutting conditions

AQUA EX 飛速鑽 2D PF2D
AQUA Drills EX Power Feed 2D

被削材 Workpiece material	結構鋼・炭素鋼・灰鑄鐵 Structural steel Carbon steel Gray cast iron SS400 S50C FC250		合金鋼・調質鋼 Alloy steel Heat-treated steel SCM440 NAK		模具鋼・預硬鋼 Mold steel Pre-hardened steel SKD61 NAK HPM		高硬度鋼 High hardness steel		球墨鑄鐵 Ductile iron FCD400	
	～200HB		20～30HRC		30～40HRC		40～50HRC			
Diameter (mm)	Rotation (min⁻¹)	Feed (mm/min)	Rotation (min⁻¹)	Feed (mm/min)	Rotation (min⁻¹)	Feed (mm/min)	Rotation (min⁻¹)	Feed (mm/min)	Rotation (min⁻¹)	Feed (mm/min)
2	12700	660～1540	10500	520～1140	5600	220～460	4000	140～280	9500	500～1170
3	8500		7000		3700		2650		6400	
5	5100		4200		2200		1600		3800	
8	3200		2600		1400		1000		2400	
10	2550		2100		1100		800		1900	

AQUA EX 飛速鑽 4D PF4D
AQUA Drills EX Power Feed 4D

被削材 Workpiece material	結構鋼・炭素鋼・灰鑄鐵 Structural steel Carbon steel Gray cast iron SS400 S50C FC250		合金鋼・調質鋼 Alloy steel Heat-treated steel SCM440 NAK		模具鋼・預硬鋼 Mold steel Pre-hardened steel SKD61 NAK HPM		高硬度鋼 High hardness steel		球墨鑄鐵 Ductile iron FCD400	
	～200HB		20～30HRC		30～40HRC		40～50HRC			
Diameter (mm)	Rotation (min⁻¹)	Feed (mm/min)	Rotation (min⁻¹)	Feed (mm/min)	Rotation (min⁻¹)	Feed (mm/min)	Rotation (min⁻¹)	Feed (mm/min)	Rotation (min⁻¹)	Feed (mm/min)
2	12700	590～1270	10500	460～930	5600	200～400	4000	115～230	9500	440～950
3	8500		7000		3700		2650		6400	
5	5100		4200		2200		1600		3800	
8	3200		2600		1400		1000		2400	
10	2550		2100		1100		800		1900	

切削條件計算式
Cutting conditions of the calculator

$$\text{切削速度(Vc) Cutting speed} = \frac{\text{刀具直徑(Dc)} \times \text{圓週率}(\pi) \times \text{回轉數(n)}}{\text{Tool diameter} \times \pi \times \text{Rotation}\ \ 1{,}000} \quad (\text{m/min})$$

$$\text{進給量(f) Feed amount} = \frac{\text{進給速度(Vf) Feed speed}}{\text{回轉數(n) Rotation}} \quad (\text{mm/rev})$$

$$\text{進給率 Feed rate} = \frac{\text{進給量(f) Feed amount}}{\text{刀具直徑(Dc) Tool diameter}} \quad (\%)$$

Example **PF4D** Workpiece material:S50C Diameter:ϕ5mm Rotation:5,100min⁻¹ Feed:590mm/min

$$\text{Cutting speed[Vc]} = \frac{5.0 \times \pi \times 5100}{1000} = \mathbf{80m/min}$$

$$\text{Feed amount[f]} = \frac{590}{5100} = \mathbf{0.116mm/rev}$$

$$\text{Feed rate} = \frac{0.116}{5} = \mathbf{2.3\%}$$

一般加工條件的比較
General recommendations of the processing conditions

被削材 Workpiece material	切削速度 Cutting speed (mm/min)	一般進給率 General feed rate (%/Dc)	高進給鑽進給率 Feed rate of Power Feed (%/Dc)
結構鋼・炭素鋼・灰鑄鐵	80	2.0～2.5	2.0～6.0
合金鋼・調質鋼	65	2.0～2.5	2.0～5.5
模具鋼・預硬鋼	35	1.5～2.0	1.5～4.0
高硬度鋼	25	1.3～1.8	1.3～3.5
球墨鑄鐵	60	2.0～2.5	2.0～6.0

切削條件之注意事項

(1)請依機械剛性,工件夾持,加工部形狀等狀況, 適度調整切削條件。
(2)上記切削條件為水溶性切削液狀況,使用非水溶性切削液時 請將回轉數&進給速 調降20%。
(3)不適用在 鋁合金, 輕金屬, 不鏽鋼 加工上。
(4)切削條件表中 PF2D適用於鑽孔深2Dc以下, PF4D適用於鑽孔深4Dc以下。
依被削材基礎的 加工條件下,有可能有切屑排出性不良的狀況,
此時,如尚未達到目標孔深,也請加入STEP的排屑條件。
(5)STEP的排屑條件,請退出至孔的上面。
(6)STEP的進給量,請以0.5～1Dc為基礎。
(7)鑽頭偏擺量請控制在0.02mm以下, 高速進給時 請控制在0.01mm以下。
(8)鑽頭再研磨量請以1Dc為基準, 超過1Dc時 切屑排出性有可能變差。
(9)請交由本公司進行鑽頭再研磨, 再研磨刀型不同的狀況下,有無法發揮性能的狀況。

Cutting conditions of the note

(1) Please adjust the cutting conditions according to the mechanical rigidity and the workpiece holder and the shape of the machining place.
(2) This table shows the cutting conditions under which water-soluble cutting oil is used. If using non-water-soluble cutting oil, reduce the speed and feed rate by 20%.
(3) Less suitable for processing aluminum, light metal, stainless steel.
(4) This cutting condition table,"PF2D "is only applicable to 2Dc of hole depth. "PF4D" is only suitable for 4Dc below of hole depth. In addition, according to the workpiece material and processing conditions, there is a possibility that the performance of discharging chips may be deteriorated. When such a situation, even within the scope of machining hole depth, please use the step-feed machining
(5) Retraction of the step feed is to be returned to the top of the hole.
(6) Step feed is recommended to 0.5Dc to 1Dc.
(7) Please use the fixture to control the amplitude of the drill bit below 0.02mm, high-speed cutting control amplitude of the drill bit 0.01mm or less.
(8) **The re-grinding amount of the tip of the drill bit is recommended to be 1 Dc.** If more than 1 Dc, the performance of chip discharge may be worse.
(9) Please contact us about re-grinding the drill bit. **Depending on the shape, the properties may be different after regrinding.**

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2016.11.V.MD-SANWA

NACHI

打破傳統觀念!

Break down the barrier of convention!

可降低切削阻力,
大幅提升切屑排出性,
刃型 & 溝型 設計。

容易切屑阻塞的車床鑽孔 、
或超高速進給的銑床鑽孔 、
實現突破傳統的
高精度 & 長壽命的性能。

Adopt the optimized cutting edge and flue geometry to improve the reduction of cutting resistance and chip evacuation drastically.
Realize high accuracy and longer tool life in ultra high speed drilling in machining center or turning machine where chip jamming is easy to occur.

NEW

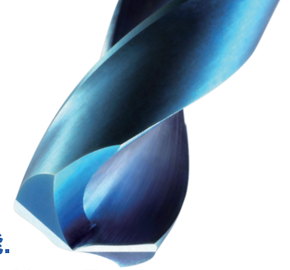
AQUA EX 飛速鑽 (高速進給鑽頭)

AQUA Drills EX Power Feed

AQUA EX 飛速鑽（高速進給鑽頭）

AQUA Drills EX Power Feed

PF2D / PF4D



無論是在切屑容易阻塞的車床鑽孔加工，
或是需要超高速進給的銑床鑽孔加工上，都發揮了高精度及長壽命的效能.

- 採用可降低軸向應力與優異切屑分斷性的 刃型與溝型設計，即使是傳統進給3倍的超高速進給時,也可以穩定的加工.
- 提升切屑分斷性，即使在切屑排出困難的車床工件旋轉加工上，也有出色的切屑排出表現.
- 在令人驚異的超高速進給時，也有高精度 長壽命的表現.

Realize high accuracy and longer tool life in ultra high speed drilling in machining center or turning machine where chip jamming is easy to occur.

- Even the traditional 3 times higher feed can also be stable processing, by adopting good geometry of cutting edge and flutes for reducing thrust cutting force, chip breaking and evacuation.
- Improved chip breaking performance, and realized outstanding chip evacuation in work rotation turning machine as well.
- Even if it is stunning ultra-high-speed feed, but also can achieve long processing life, high-precision machining.

大幅降低軸向應力

Significantly reduced thrust

大幅降低加工時的軸向應力，傳統進給3倍的超高速進給加工下，也有優異的切屑排出性能.

Thrust is greatly reduced, so even in the 3x ultra-high-speed feed, chip removal is also very good

2D長高進給鑽的切削阻力
Cutting resistance of Power feed 2D

約一般進給的3倍
Is about 3x the normal feed

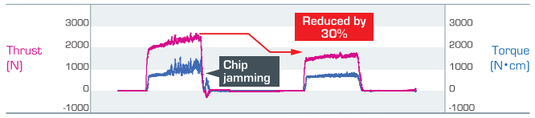
Feed amount:0.56mm/rev [Feed amount/Tool Diameter=7%]

Cutting conditon			
	Diameter:ϕ8mm	Cutting speed:80m/min	Machine center
	Workpiece material:S50C	Hole depth:16mm	Water-soluble cutting oil

4D長高進給鑽的切削阻力
Cutting resistance of Power feed 4D

約一般進給的2倍
Is 2x the normal feed

Feed amount:0.4mm/rev [Feed amount/Tool Diameter=5%]



Cutting conditon			
	Diameter:ϕ8mm	Cutting speed:80m/min	Machine center
	Workpiece material:S50C	Hole depth:32mm	Water-soluble cutting oil

超高速進給加工時也有長壽命

Ultra-high-speed feed also has a long tool life

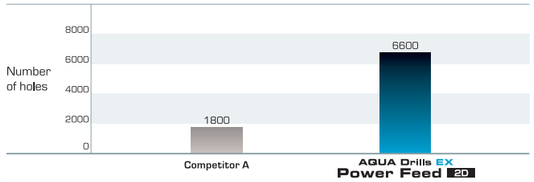
在銑床的超高速進給加工時,較他牌產品有壓倒性長壽命. 在切屑容易阻塞的車床加工時,也有穩定的長壽命表現.

When using a machining center for ultra-high-speed feed processing, Power feed drills have an overwhelming tool life. In addition, there is a stable performance in lathe machine which is liable to cause chip clogging.

銑床加工的壽命比較
Compare the tool life of using machining center

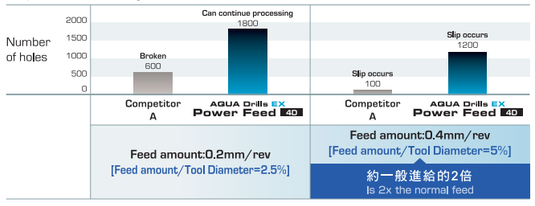
約一般進給的3倍
Is about 3x the normal feed

Feed amount:0.56mm/rev [Feed amount/Tool Diameter=7%]



Cutting conditon			
	Diameter:ϕ8mm	Cutting speed:80m/min	Machine center
	Workpiece material:S50C	Hole depth:16mm	Water-soluble cutting oil

車床加工的壽命比較
Compare the tool life of using lathe



Cutting conditon			
	Diameter:ϕ8mm	Cutting speed:64m/min	Automatic lathes
	Workpiece material:S45C	Hole depth:32mm	Oily cutting oil

超高速進給加工時也有高精度

Ultra-high-speed feed machining is also highly accurate

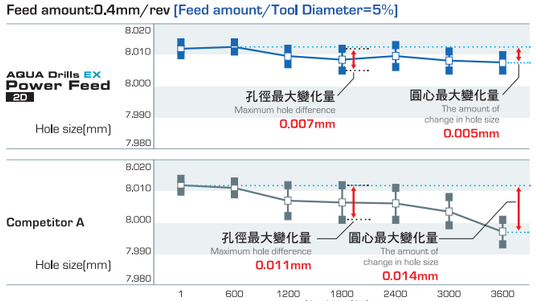
即使在超高速進給加工時,孔徑變化小 同時有良好加工面.

Even in the case of high feed processing, the variation of the hole expansion amount is small, and a high-quality work surface can be obtained

車床加工時的孔精度比較
Compare the hole accuracy of using lathe

約一般進給的2倍
Is 2x the normal feed

Feed amount:0.4mm/rev [Feed amount/Tool Diameter=5%]

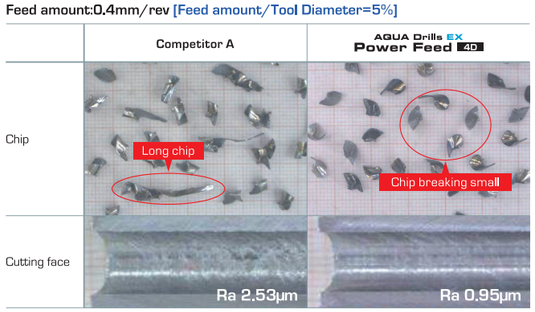


Cutting conditon			
	Diameter:ϕ8mm	Cutting speed:64m/min	Automatic lathes
	Workpiece material:S45C	Hole depth:16mm	Oily cutting oil

車床加工時的切屑，加工面比較
Compare chip, machining surface of using lathe

約一般進給的2倍
Is 2x the normal feed

Feed amount:0.4mm/rev [Feed amount/Tool Diameter=5%]



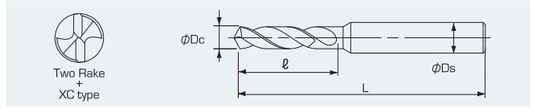
Cutting conditon			
	Diameter:ϕ8mm	Cutting speed:64m/min	Automatic lathes
	Workpiece material:S45C	Hole depth:32mm	Oily cutting oil

CARBIDE TOOL MATERIAL | AQ EX COATING | h8 DIAMETER TOLERANCE | 135° TOOL TIP ANGLE | 30° TWIST ANGLE | h6 SHANK DIAMETER TOLERANCE | 2.0-10.0 DIAMETER RANGE

PF2D

AQUA EX 飛速鑽 2D

AQUA Drills EX Power Feed 2D



LIST 9850 Order Code Unit:mm

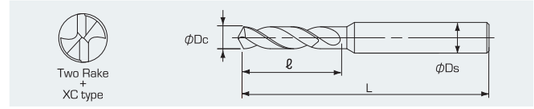
Code	Diameter Dc	Groove length ℓ	Full length L	Shank diameter Ds
PF2D0200	2.0	6.0	45	3
PF2D0210	2.1	8.0	45	3
PF2D0220	2.2	8.0	45	3
PF2D0230	2.3	8.0	45	3
PF2D0240	2.4	8.0	45	3
PF2D0250	2.5	8.0	45	3
PF2D0260	2.6	10.0	45	3
PF2D0270	2.7	10.0	45	3
PF2D0280	2.8	10.0	45	3
PF2D0290	2.9	10.0	45	3
PF2D0300	3.0	10.0	45	3
PF2D0310	3.1	16.0	54	4
PF2D0320	3.2	16.0	54	4
PF2D0330	3.3	16.0	54	4
PF2D0340	3.4	16.0	54	4
PF2D0350	3.5	16.0	54	4
PF2D0360	3.6	17.0	54	4
PF2D0370	3.7	17.0	54	4
PF2D0380	3.8	17.0	54	4
PF2D0390	3.9	17.0	54	4
PF2D0400	4.0	17.0	54	4
PF2D0410	4.1	19.0	61	5
PF2D0420	4.2	19.0	61	5
PF2D0430	4.3	19.0	61	5
PF2D0440	4.4	19.0	61	5
PF2D0450	4.5	19.0	61	5
PF2D0460	4.6	20.0	61	5
PF2D0470	4.7	20.0	61	5
PF2D0480	4.8	20.0	61	5
PF2D0490	4.9	20.0	61	5
PF2D0500	5.0	20.0	61	5
PF2D0510	5.1	20.0	65	6
PF2D0520	5.2	20.0	65	6
PF2D0530	5.3	20.0	65	6
PF2D0540	5.4	20.0	65	6
PF2D0550	5.5	20.0	65	6
PF2D0560	5.6	21.0	65	6
PF2D0570	5.7	21.0	65	6
PF2D0580	5.8	21.0	65	6
PF2D0590	5.9	21.0	65	6
PF2D0600	6.0	21.0	65	6
PF2D0610	6.1	25.0	73	7
PF2D0620	6.2	25.0	73	7
PF2D0630	6.3	25.0	73	7
PF2D0640	6.4	25.0	73	7
PF2D0650	6.5	25.0	73	7
PF2D0660	6.6	26.0	73	7
PF2D0670	6.7	26.0	73	7
PF2D0680	6.8	26.0	73	7
PF2D0690	6.9	26.0	73	7
PF2D0700	7.0	26.0	73	7
PF2D0710	7.1	26.0	78	8
PF2D0720	7.2	26.0	78	8
PF2D0730	7.3	26.0	78	8
PF2D0740	7.4	26.0	78	8
PF2D0750	7.5	26.0	78	8
PF2D0760	7.6	28.0	78	8
PF2D0770	7.7	28.0	78	8
PF2D0780	7.8	28.0	78	8
PF2D0790	7.9	28.0	78	8
PF2D0800	8.0	28.0	78	8
PF2D0810	8.1	28.0	82	9
PF2D0820	8.2	28.0	82	9
PF2D0830	8.3	28.0	82	9
PF2D0840	8.4	28.0	82	9
PF2D0850	8.5	28.0	82	9
PF2D0860	8.6	29.0	82	9
PF2D0870	8.7	29.0	82	9
PF2D0880	8.8	29.0	82	9
PF2D0890	8.9	29.0	82	9
PF2D0900	9.0	29.0	82	9
PF2D0910	9.1	29.0	87	10
PF2D0920	9.2	29.0	87	10
PF2D0930	9.3	29.0	87	10
PF2D0940	9.4	29.0	87	10
PF2D0950	9.5	29.0	87	10
PF2D0960	9.6	31.0	87	10
PF2D0970	9.7	31.0	87	10
PF2D0980	9.8	31.0	87	10
PF2D0990	9.9	31.0	87	10
PF2D1000	10.0	31.0	87	10

CARBIDE TOOL MATERIAL | AQ EX COATING | h8 DIAMETER TOLERANCE | 135° TOOL TIP ANGLE | 30° TWIST ANGLE | h6 SHANK DIAMETER TOLERANCE | 2.0-10.0 DIAMETER RANGE

PF4D

AQUA EX 飛速鑽 4D

AQUA Drills EX Power Feed 4D



LIST 9852 Order Code Unit:mm

Code	Diameter Dc	Groove length ℓ	Full length L	Shank diameter Ds
PF4D0200	2.0	15.0	49	3
PF4D0210	2.1	17.0	49	3
PF4D0220	2.2	17.0	49	3
PF4D0230	2.3	17.0	49	3
PF4D0240	2.4	17.0	49	3
PF4D0250	2.5	17.0	49	3
PF4D0260	2.6	19.0	49	3
PF4D0270	2.7	19.0	49	3
PF4D0280	2.8	19.0	49	3
PF4D0290	2.9	19.0	49	3
PF4D0300	3.0	19.0	49	3
PF4D0310	3.1	24.0	60	4
PF4D0320	3.2	24.0	60	4
PF4D0330	3.3	24.0	60	4
PF4D0340	3.4	24.0	60	4
PF4D0350	3.5	24.0	60	4
PF4D0360	3.6	27.0	60	4
PF4D0370	3.7	27.0	60	4
PF4D0380	3.8	27.0	60	4
PF4D0390	3.9	27.0	60	4
PF4D0400	4.0	27.0	60	4
PF4D0410	4.1	31.0	76	5
PF4D0420	4.2	31.0	76	5
PF4D0430	4.3	31.0	76	5
PF4D0440	4.4	31.0	76	5
PF4D0450	4.5	31.0	76	5
PF4D0460	4.6	38.0	76	5
PF4D0470	4.7	38.0	76	5
PF4D0480	4.8	38.0	76	5
PF4D0490	4.9	38.0	76	5
PF4D0500	5.0	38.0	76	5
PF4D0510	5.1	39.0	81	6
PF4D0520	5.2	39.0	81	6
PF4D0530	5.3	39.0	81	6
PF4D0540	5.4	39.0	81	6
PF4D0550	5.5	39.0	81	6
PF4D0560	5.6	41.0	81	6
PF4D0570	5.7	41.0	81	6
PF4D0580	5.8	41.0	81	6
PF4D0590	5.9	41.0	81	6
PF4D0600	6.0	41.0	81	6
PF4D0610	6.1	42.0	83	7
PF4D0620	6.2	42.0	83	7
PF4D0630	6.3	42.0	83	7
PF4D0640	6.4	42.0	83	7
PF4D0650	6.5	42.0	83	7
PF4D0660	6.6	43.0	83	7
PF4D0670	6.7	43.0	83	7
PF4D0680	6.8	43.0	83	7
PF4D0690	6.9	43.0	83	7
PF4D0700	7.0	43.0	83	7
PF4D0710	7.1	45.0	90	8
PF4D0720	7.2	45.0	90	8
PF4D0730	7.3	45.0	90	8
PF4D0740	7.4	45.0	90	8
PF4D0750	7.5	45.0	90	8
PF4D0760	7.6	48.0	90	8
PF4D0770	7.7	48.0	90	8
PF4D0780	7.8	48.0	90	8
PF4D0790	7.9	48.0	90	8
PF4D0800	8.0	48.0	90	8
PF4D0810	8.1	53.0	98	9
PF4D0820	8.2	53.0	98	9
PF4D0830	8.3	53.0	98	9
PF4D0840	8.4	53.0	98	9
PF4D0850	8.5	53.0	98	9
PF4D0860	8.6	55.0	98	9
PF4D0870	8.7	55.0	98	9
PF4D0880	8.8	55.0	98	9
PF4D0890	8.9	55.0	98	9
PF4D0900	9.0	55.0	98	9
PF4D0910	9.1	58.0	105	10
PF4D0920	9.2	58.0	105	10
PF4D0930	9.3	58.0	105	10
PF4D0940	9.4	58.0	105	10
PF4D0950	9.5	58.0	105	10
PF4D0960	9.6	60.0	105	10
PF4D0970	9.7	60.0	105	10
PF4D0980	9.8	60.0	105	10
PF4D0990	9.9	60.0	105	10
PF4D1000	10.0	60.0	105	10