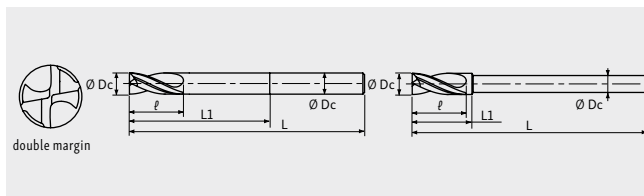


AQUA Drill EX FLAT Long Shank 2D



MATERIAL

POINT ANGLE HELIX ANGLE

L9816

Dc	ℓ	L	L1	Ds	Stock
3.0	14	100	30	6	•
3.1	15	100	31	6	•
3.2	15	100	32	6	•
3.3	15	100	33	6	•
3.4	16	100	34	6	•
3.5	16	100	35	6	•
3.6	16	100	36	6	•
3.7	18	100	37	6	•
3.8	18	100	38	6	•
3.9	18	100	39	6	•
4.0	18	100	40	6	•
4.1	19	100	41	6	•
4.2	19	100	42	6	•
4.3	19	100	43	6	•
4.4	21	100	44	6	•
4.5	21	100	45	6	•
4.6	21	100	46	6	•
4.7	22	100	47	6	•
4.8	22	100	48	6	•
4.9	22	100	49	6	•
5.0	23	110	50	6	•
5.1	24	110	51	6	•
5.2	24	110	52	6	•
5.3	24	110	53	6	•
5.4	25	110	54	6	•
5.5	25	110	55	6	•
5.6	25	110	56	6	•
5.7	27	110	57	6	•
5.8	27	110	58	6	•
5.9	27	110	59	6	•
6.0	27	120	60	6	•
6.1	28	120	30	6	•
6.2	28	120	30	6	•
6.3	28	120	30	6	•
6.4	30	120	32	6	•
6.5	30	120	32	6	•
6.6	30	120	32	6	•
6.7	31	120	33	6	•
6.8	31	120	33	6	•
6.9	31	120	33	6	•
7.0	32	120	34	6	•
7.1	33	120	35	6	•
7.2	33	120	35	6	•
7.3	33	120	35	6	•
7.4	34	120	36	6	•
7.5	34	120	36	6	•
7.6	34	120	36	6	•
7.7	36	120	38	6	•
7.8	36	120	38	6	•
7.9	36	120	38	6	•
8.0	36	130	80	8	•
8.1	37	130	39	8	•
8.2	37	130	39	8	•
8.3	37	130	39	8	•
8.4	39	130	41	8	•
8.5	39	130	41	8	•
8.6	39	130	41	8	•
8.7	40	130	42	8	•

Dc	ℓ	L	L1	Ds	Stock
8.8	40	130	42	8	•
8.9	40	130	42	8	•
9.0	41	130	43	8	•
9.1	42	130	44	8	•
9.2	42	130	44	8	•
9.3	42	130	44	8	•
9.4	43	130	45	8	•
9.5	43	130	45	8	•
9.6	43	130	45	8	•
9.7	45	130	47	8	•
9.8	45	130	47	8	•
9.9	45	130	47	8	•
10.0	45	150	100	10	•
10.1	46	150	48	10	•
10.2	46	150	48	10	•
10.3	46	150	48	10	•
10.4	48	150	50	10	•
10.5	48	150	50	10	•
10.6	48	150	50	10	•
10.7	49	150	51	10	•
10.8	49	150	51	10	•
10.9	49	150	51	10	•
11.0	50	150	52	10	•
11.1	51	150	53	10	•
11.2	51	150	53	10	•
11.3	51	150	53	10	•
11.4	52	150	54	10	•
11.5	52	150	54	10	•
11.6	52	150	54	10	•
11.7	54	150	56	10	•
11.8	54	150	56	10	•
11.9	54	150	56	10	•
12.0	54	170	120	12	•
12.5	57	170	59	12	•
13.0	59	180	61	12	•
13.5	61	180	63	12	•
14.0	63	190	65	12	•
14.5	66	190	68	12	•
15.0	67	200	69	12	•
15.5	70	200	72	12	•
16.0	72	220	160	16	•
16.5	75	220	77	16	•
17.0	77	220	79	16	•
17.5	79	220	81	16	•
18.0	81	240	83	16	•
18.5	84	240	86	16	•
19.0	86	250	88	16	•
19.5	88	250	90	16	•
20.0	90	250	200	20	•

• German Stock

Standard Drilling Conditions

STANDARD DRILLING CONDITIONS AQUA DRILL EX FLAT LONG SHANK 2D												
Work material	Structural Steel, Carbon Steel, Grey Cast Iron St37-2, C45E, C50E		Alloy Steel. Pre-Hardened 42CrMo4		Mold Steel 1.2344		Hardened Steel		Ductile Cast Iron GG/GGG		Aluminium Alloy A7075	
	~200HB		20-30HRC		30-40HRC		40-50HRC					
mm	min ⁻¹	mm/min	min ⁻¹	mm/min	min ⁻¹	mm/min	min ⁻¹	mm/min	min ⁻¹	mm/min	min ⁻¹	mm/min
3	10600	790	9500	570	7400	330	5300	240	9500	430	12700	950
4	7900	790	7100	570	5550	330	3980	240	7100	430	9500	950
5	6300	790	5700	570	4450	330	3180	240	5700	430	7600	950
6	5300	790	4750	570	3700	330	2650	240	4750	430	6400	950
8	3950	790	3550	570	2790	330	1990	240	3550	430	4780	950
10	3150	790	2860	570	2230	330	1590	240	2860	430	3800	950
12	2650	790	2390	570	1860	330	1300	240	2390	430	3180	950
16	1990	790	1790	570	1390	330	990	240	1790	430	2390	950
20	1590	790	1430	570	1110	330	800	240	1430	430	1910	950

Warnings on using the drilling condition tables:

- 1) Adjust drilling condition according to the rigidity of machine or work clamp state.
- 2) These table values are for drilling with water-soluble cutting fluid. When using non-water-soluble cutting fluid, reduce the RPM and feed speeds by 20%.
- 3) Use the table values for drilling depths under 2xD.
- 4) Drilling stainless steel (SS304, 316, etc.) are not recommend. Recommend the Aqua Drill EX Flat OH3D5D.
- 5) When for hole on flat surfaces.
1: centering hole larger than the diameter or
2: same diameter guide hole.
(Recommend the AG Starting Drill for centering holes.)
- 6) Guide holes are not necessary when for hole on surfaces angled between 5 and 15°. reduce the RPM by under 60%, the feed by under 40%.
- 7) Side milling is not possible.

STANDARD DRILLING CONDITIONS AQUA DRILL EX FLAT OIL-HOLE 3D														
Work material	Structural Steel, Carbon Steel, Grey Cast Iron St37-2, C45E, C50E		Alloy Steel. Pre-Hardened 42CrMo4		Mold Steel 1.2344		Hardened Steel		Ductile Cast Iron GG/GGG		Stainless Steel 1.4301		Aluminium Alloy A7075	
	~200HB		20-30HRC		30-40HRC		40-50HRC				38-45HRC			
mm	min ⁻¹	mm/min	min ⁻¹	mm/min	min ⁻¹	mm/min	min ⁻¹	mm/min	min ⁻¹	mm/min	min ⁻¹	mm/min	min ⁻¹	mm/min
1.0	15900	130	12700	80	9550	45	7960	40	12700	60	9550	20	22300	210
1.5	10600	130	8490	80	6370	45	5320	40	8490	60	6370	20	14900	210
2.0	9550	160	7960	100	5570	55	4790	50	7960	75	6370	40	12700	240
2.5	11500	470	9600	315	9500	230	5750	140	9560	240	8900	250	13300	660
2.9	13000	950	10900	635	7600	330	6600	285	11000	480	11000	635	15350	1330
3	12700	950	10600	635	7400	330	6370	285	10600	480	10600	635	14800	1330
4	9500	950	7900	635	5550	330	4780	285	7900	480	7900	635	11100	1330
5	7600	950	6300	635	4450	330	3820	285	6300	480	6300	635	8900	1330
6	6370	950	5300	635	3700	330	3180	285	5300	480	5300	635	7400	1330
8	4780	950	3950	635	2790	330	2390	285	3950	480	3950	635	5570	1330
10	3820	950	3150	635	2230	330	1900	285	3150	480	3150	635	4460	1330
12	3180	950	2650	635	1860	330	1590	285	2650	480	2650	635	3710	1330
16	2390	950	1990	635	1390	330	1190	285	1990	480	1990	635	2790	1330

Warnings on using the drilling condition tables:

- 1) Adjust drilling condition according to the rigidity of machine or work clamp state.
- 2) These table values are for drilling with water-soluble cutting fluid. When using non-water-soluble cutting fluid, reduce the RPM and feed speeds by 20%.
- 3) Use the table values for drilling depths under 3xD.
- 4) Guide holes are not necessary when for hole on surfaces angled between 5 and 15°. reduce the RPM by under 50%, the feed by under 40%.
- 5) Side milling is not possible.

STANDARD DRILLING CONDITIONS AQUA DRILL EX FLAT OIL-HOLE 5D														
Work material	Structural Steel, Carbon Steel, Grey Cast Iron St37-2, C45E, C50E		Alloy Steel. Pre-Hardened 42CrMo4		Mold Steel 1.2344		Hardened Steel		Ductile Cast Iron GG/GGG		Stainless Steel 1.4301		Aluminium Alloy A7075	
	~200HB		20-30HRC		30-40HRC		40-50HRC				38-45HRC			
mm	min ⁻¹	mm/min	min ⁻¹	mm/min	min ⁻¹	mm/min	min ⁻¹	mm/min	min ⁻¹	mm/min	min ⁻¹	mm/min	min ⁻¹	mm/min
1.0	19100	190	15900	105	11100	55	9550	50	15900	80	12730	65	25500	255
1.5	12700	190	10600	105	7430	55	6370	50	10600	80	8490	65	17000	255
2.0	11100	330	9550	190	6700	100	5570	80	9550	140	7960	130	14300	430
2.5	13500	760	10200	380	7130	200	5740	160	10200	270	9500	330	15900	890
2.9	15300	1340	11000	635	7660	330	6590	285	10900	480	10900	635	17600	1530
3	14800	1340	10600	635	7400	330	6370	285	10500	480	10500	635	17000	1530
4	11100	1340	7900	635	5550	330	4780	285	7900	480	7900	635	13700	1530
5	8900	1340	6300	635	4450	330	3820	285	6300	480	6300	635	10200	1530
6	7400	1340	5300	635	3700	330	3180	285	5300	480	5300	635	9500	1530
8	5570	1340	3950	635	2790	330	2390	285	3950	480	3950	635	6370	1530
10	4460	1340	3150	635	2230	330	1900	285	3150	480	3150	635	5100	1530
12	3700	1340	2650	635	1860	330	1590	285	2650	480	2650	635	4240	1530
16	2790	1340	1990	635	1390	330	1190	285	1990	480	1990	635	3180	1530

Warnings on using the drilling condition tables:

- 1) Adjust drilling condition according to the rigidity of machine or work clamp state.
- 2) These table values are for drilling with water-soluble cutting fluid. When using non-water-soluble cutting fluid, reduce the RPM and feed speeds by 20%.
- 3) Use the table values for drilling depths under 5xD.
- 4) Drilling requires.
1: a centering hole larger than the diameter or
2: a guide hole of the same diameter.
(1: AG Starting Drill is recommended for centering holes, and 2: Aqua Drill EX Flat is recommended for guide holes. For drilling stainless steel, Aqua Drill EX Flat EXOH3D is recommended.)
- 5) Side milling is not possible.

AQUA Drill EX FLAT Series

AQUA Drill EX FLAT. Regular. Long Shank. Oil Hole. Radius

- ▶ New Drilling Technology
- ▶ Expanded the AQUA Flat drill series to 7 type 1028 sizes
- ▶ AQUA EX coating realize long tool life. by improved heat and wear resistance
- ▶ Adoption of double margin provides stable drilling and improves hole accuracy



AQUA EX COATING

Excellent drilling performance

- Anti-adhesion layer
- AlCrTiX Anti-oxidant layer
- TiAlX Anti-wear layer
- High-strength carbide material



CUTTING CONDITIONS

Tool	AQUA EX Flat Ø10
Cutting Speed	75m/min
Feed Speed	240mm/min
Work Material	C50 carbon steel
Cutting Fluid	Water-soluble

180° FLAT DRILL

Realize high accurate counter bore surface in once

AQUA DRILL EX FLAT	2Flute end mill
Flat bottom	Bottom is not flat

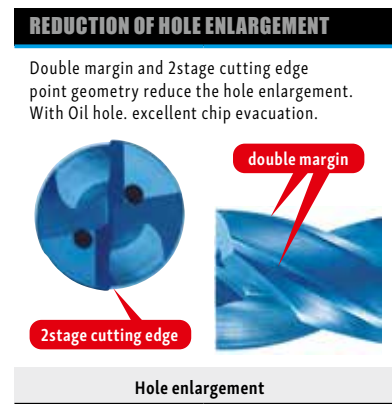
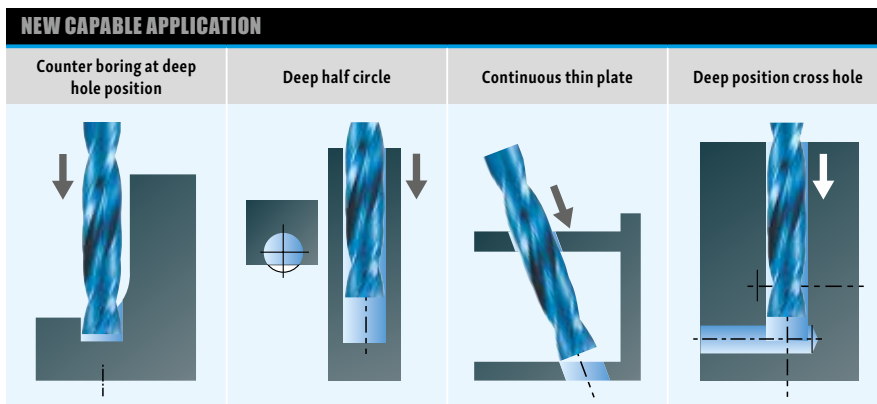
NEW DRILLING TECHNOLOGY

Slope. Counter Boring. Thin Plate. Cross Hole. Hole correction in one drill

Slope	Counter boring	Thin plate	Pre hole of blind hole tapping	Cross hole	Eccentric hole correction

NEW AQUA DRILL EX FLAT LINEUP			
Hole depth, hole position depth ↑	AQUA EX FLAT Long Shank 2D		•
	AQUA EX FLAT Oil Hole 5D		•
	AQUA EX FLAT Regular 4D		•
	AQUA EX FLAT Oil Hole 3D	NEW	•
	AQUA EX FLAT Radius 2D		•
	AQUA EX FLAT 2D		•
	AQUA EX FLAT SHORT*		○
	SGEZ, SG Flat (FMX)		•

○: Japan Stock | ●: German Stock | *On request: Available in extra short version over Japan Stock.



FEATURES AND SPECIFICATIONS									
Tool	Depth	Feature					Drill Feature		
		Deep position	Efficiency	Slope	Hole accuracy	Corner radius	Guide hole	Double margin	Internal coolant
AQUA FLAT 2D	2D		•	•			no		
AQUA FLAT 2D Radius	2D		•	•		•	no		
AQUA FLAT 4D	4D	•					need*	○	
AQUA FLAT Long Shank	deep position (2D)	•					need*	○	
AQUA FLAT Oil Hole 3D	3D		•	•	•		no need	○	○
AQUA FLAT Oil Hole 5D	5D	•	○		○		need	○	○
SG FLAT 1D	1D			•			no need		

● Excellent | ○ Good | X Not Applicable | * Depending on the part. material. condition. guide may not be necessary

APPLICABLE WORK MATERIALS												
Tool	Structural Steels	Carbon Steels	Pre-Hardened Steels Alloy Steels	Hardened Steels Mold Steels	Hardened Steels		Stainless Steels		Titanium Alloys Nickel Alloys	Cast Irons	Aluminium Alloys	Copper Alloys
	St37-2	C45E	42CrMo4	30-40HRC	40-50 HRC	50-60 HRC	1.4301/ 1.4401	1.4021		GG/GGG	AC/ADC	Cu
AQUA FLAT 2D												
AQUA FLAT 2D Radius												
AQUA FLAT 4D	•	•	•	•	○			•			○	○
AQUA FLAT Long Shank												
AQUA FLAT Oil Hole 3D	•	•	•	•	○		○	•		•	•	•
AQUA FLAT Oil Hole 5D	•	•	•	•	○		○	•		•	•	•
SG FLAT 1D	•	•	•	○	x	x	○	○	○	•	•	•

● Excellent | ○ Good | X Not Applicable

AQUA DRILL EX FLAT SERIES

COMPARISON OF PERFORMANCE

Excellent cutting edge. tool life. precision and efficiency

Smaller burrs at the exit of hole on thin plate drilling:

High-efficiency. Direct drilling without pilot hole:



Cutting Conditions

Tool AQUA EX Flat Ø 10
 Cutting Speed 75m/min
 Feed Speed 420mm/min
 Feed 0.18mm/rev
 Work Material SS400 structure steel
 Cutting Fluid Water-soluble

Drilling time

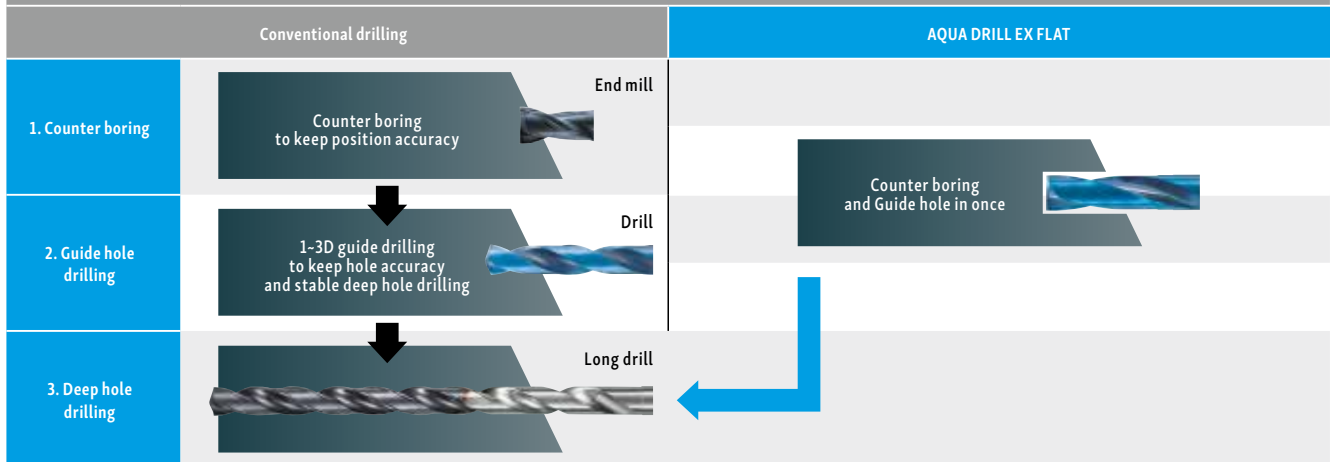
19sec.
 Non-step drilling
 only 19sec to drill
 2D depth slope
 40% efficiency

Drilling time

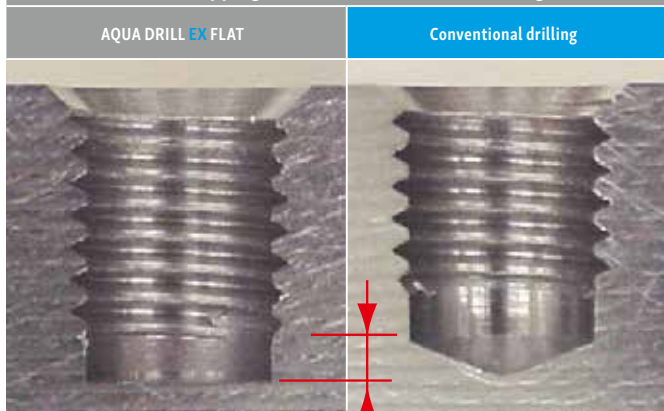
32sec.
 5mm-step drilling

APPLICATIONS

Guide holes



Thin wall tapping maximum effective screw length



Suitable for tap pre-hole too.
 Blind hole in thin wall. effective thread length is kept that eliminates post-processing.

Web-Video

WEB VIDEO
 Product
 introduction

AQUA DRILL EX FLAT

2Flute end mill

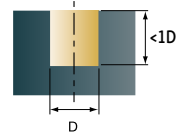
Standard Drilling Conditions

STANDARD DRILLING CONDITIONS SG DRILL FOR LARGE DIAMETERS														
Work material	Structural Steel, Carbon Steel St37-2, C50E		Alloy Steel, Pre-Hardened 42CrMo4		Mold Steel 1.2344		Stainless Steel 1.4301, 1.4401		Ductile Cast Iron GG/GGG		Aluminium Alloy Copper Alloy A5052 C1100		Titanium Alloys, Nickel Alloys	
	-200HB		20-30HRC		30-40HRC									
mm	min ⁻¹	mm/min	min ⁻¹	mm/min	min ⁻¹	mm/min	min ⁻¹	mm/min	min ⁻¹	mm/min	min ⁻¹	mm/min	min ⁻¹	mm/min
20	400	80	320	65	240	38	160	32	400	100	480	100	80	13
22	360	80	290	65	220	38	140	32	360	100	440	100	70	13
24	330	80	265	65	200	38	130	32	330	100	400	100	70	13
26	300	80	245	65	185	38	120	32	300	100	370	100	60	13
28	280	70	230	55	170	33	110	28	280	80	340	90	60	11
30	260	70	210	55	160	33	100	28	260	80	320	90	50	11
32	250	70	200	55	150	33	100	28	250	80	300	90	50	11

Warnings on using the drilling condition tables:

- Adjust cutting conditions according to the rigidity of machine, work clamp and work shape. In case of no rigid machines, pre-drilling hole is required.
- This cutting condition is for drilling with water-soluble cutting fluid.
- Provide sufficient cutting fluid to the cutting point and in the flute.
- This cutting condition table is applied for hole depth 1D or less.
- Cutting chip may scatter. The covering is required. When the chip grows, add step feed and break into cutting chip.
- Side milling is not possible.

Depth of cut:



User Guide

PREVENTION OF HOLE ENLARGEMENT AND VIBRATION BY AQUA EX FLAT(2D) AND OIL HOLE 3D

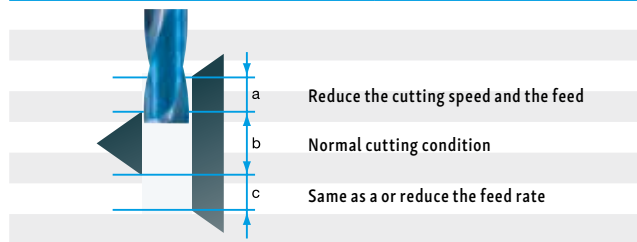
- For flat surface, maintain the guide hole by small steps (G73)
- For slope surface, reduce the feed rate AQUA EX FLAT Long Shank (2D)



Please make the chamfer 1st when the hole is larger than drill diameter such as tap holes



CUTTING CONDITION OF SLOPE DRILLING



AQUA EX FLAT REGULAR(4D). LONG SHANK(2D). OIL HOLE 5D DRILLING

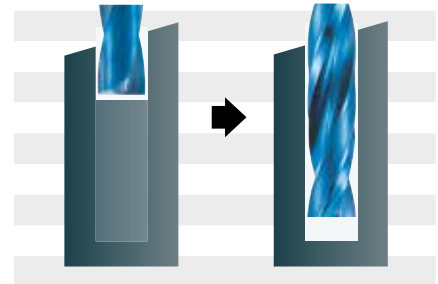
Please make a guide hole with AQUA EX Flat 2D (In case of stainless steel, please use AQUA EX Flat Oil Hole 3D)



Chamfering with AG Starting drill

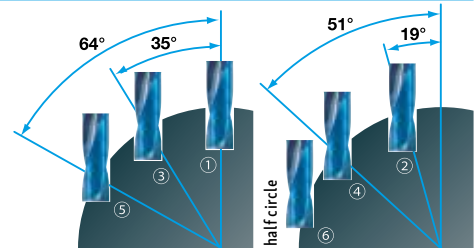


Please make a guide hole with AQUA EX Flat 2D (In case of stainless steel, please use AQUA EX Flat Oil Hole 3D)



CUTTING CONDITION COMPARISON ON SLOPE DRILLING

No.	Position	Cutting Speed			Feed			
		angle	mm/min	min ⁻¹	ratio	mm/min	mm/rev	ratio
1	0		75	2400	100%	420	0.18	100%
2	19°					210	0.09	50%
3	35°					120	0.07	40%
4	51°		52	1650	70%	120	0.07	40%
5	64°					90	0.06	33%
6	half circle					60	0.04	20%



Cutting Conditions Tool AQUA EX Flat Drill Ø 10 Hole Depth 15mm Cutting Fluid Water-soluble Work Material C45 Carbon steel