

50 YEARS

NACHI

NACHI EUROPE GmbH

OUR SYNERGY
YOUR PERFORMANCE

AQUA DRILL EX FLAT SERIES

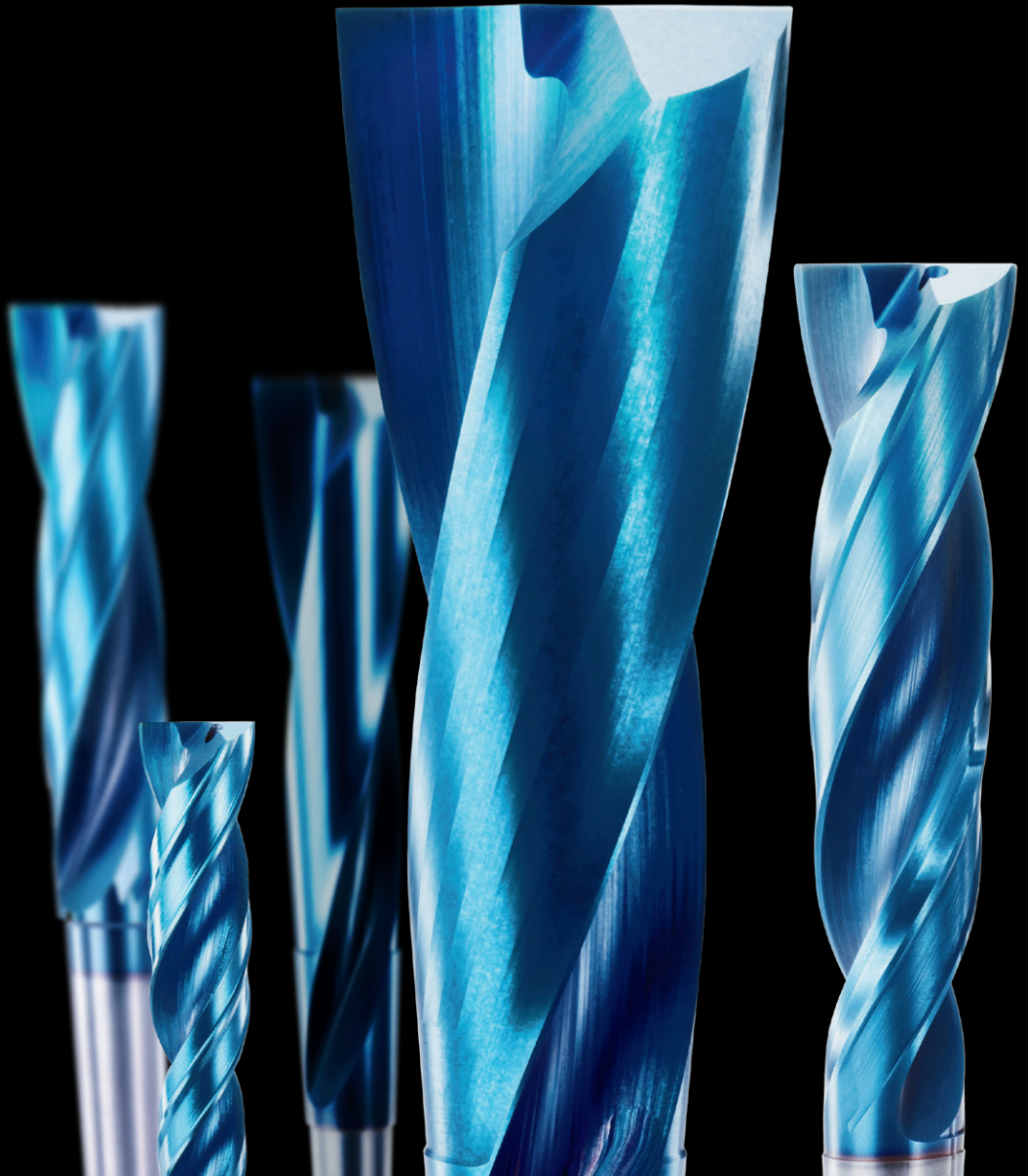
NEW DRILLING TECHNOLOGY



CELEBRATE THE POLE POSITION

**NEW
AQUA EX
COATING**

long tool life,
by improved heat
and wear resistance



AQUA Drill EX FLAT Series

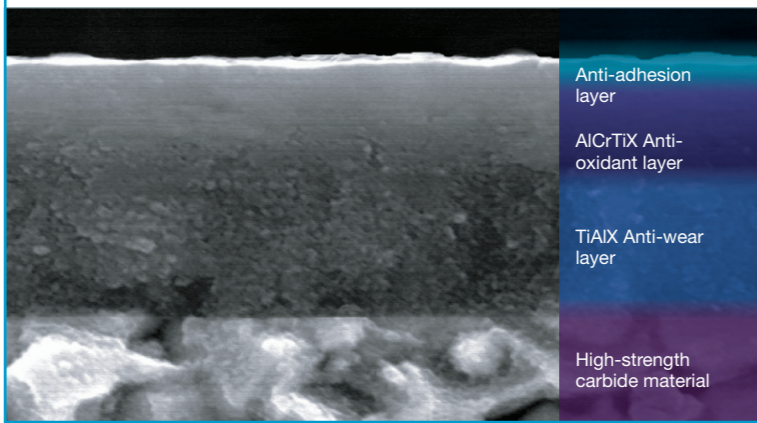
AQUA Drill EX FLAT, Regular, Long Shank, Oil hole, Radius

- 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.



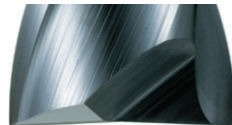
180° Flat Drill

Realize high accurate counter bore surface in once.

AQUA DRILL EX FLAT

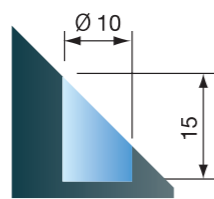


2Flute end mill



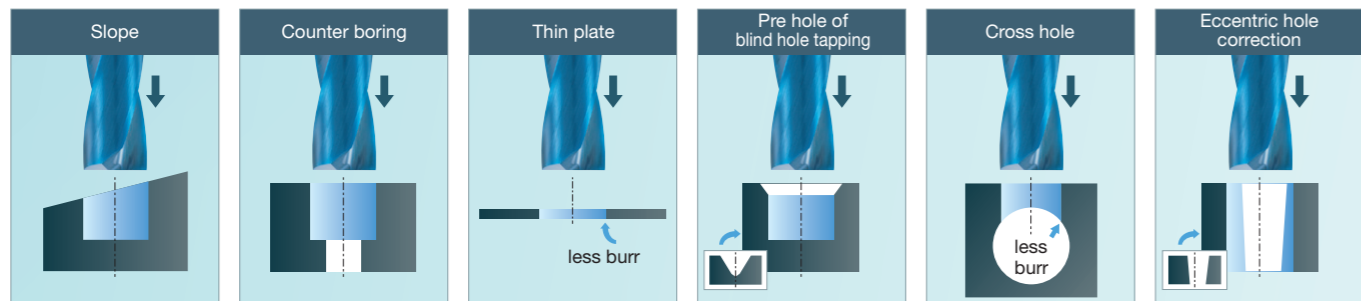
Cutting conditions

Tool: AQUA EX Flat Ø 10
Speed: 75 m/min.
Feed: 240 mm/min.
Work Material: C50 carbon steel
Cutting fluid: water soluble

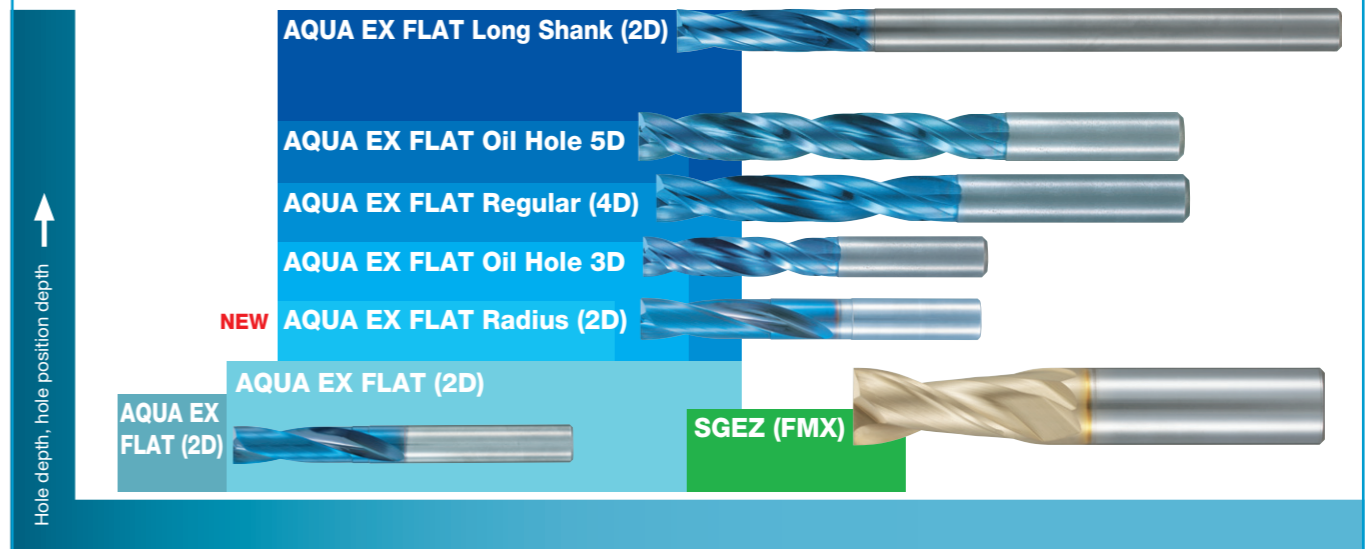


New Drilling Technology

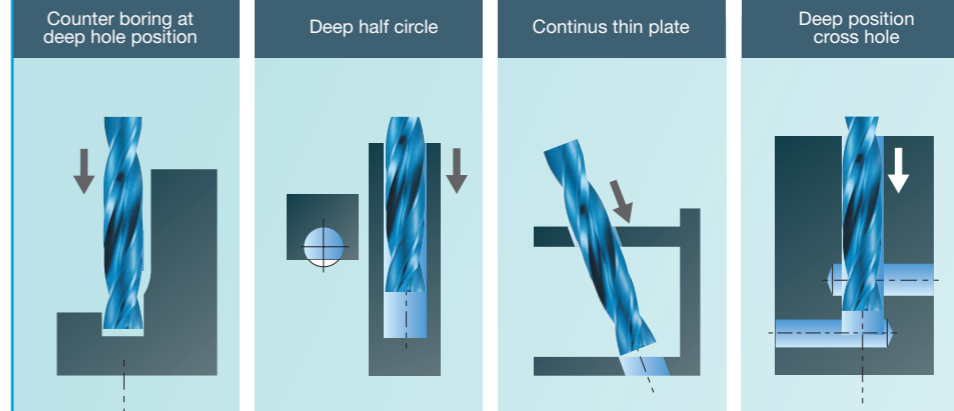
Slope, Counter Boring, Thin Plate, Cross Hole, Hole correction in one drill.



New Aqua Drill EX FLAT lineup

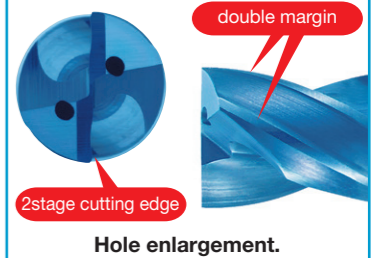


New capable application



Reduction of hole enlargement

Double margin and 2stage cutting edge point geometry reduce the hole enlargement. With Oil hole, excellent chip evacuation.



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		

* depending on the part, material, condition, guide may not be necessary

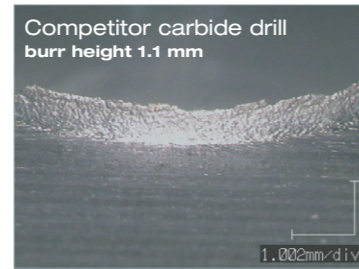
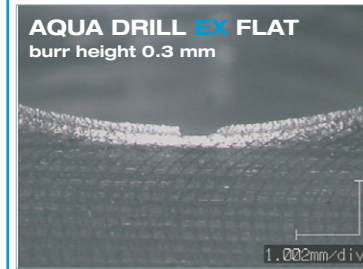
Applicable work materials

Tool	Structural Steels	Carbon Steels	Pre-Hardened Steels Alloy Steels	Hardened Steels Mold Steels	Hardened Steels		Stainless Steels		Titanium Alloys Nickel Alloys	Cast Irons	Aluminum Alloys	Copper Alloys
	SS400	S45C	SCM/NAK	30-40 HRC	40-50 HRC	50-60 HRC	SUS304/SUS316	SUS420		FC/FCD	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	○	○	○	○	×	×	○	○	○	○	○	○

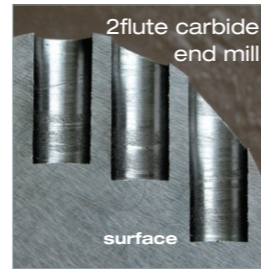
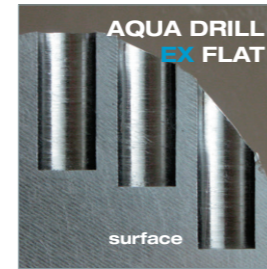
Comparison of performance

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
Speed: 75 m/min.
Feed: 420 mm/min.
(0.18 mm/rev)

Work Material: SS400 structure steel
Cutting fluid: water soluble

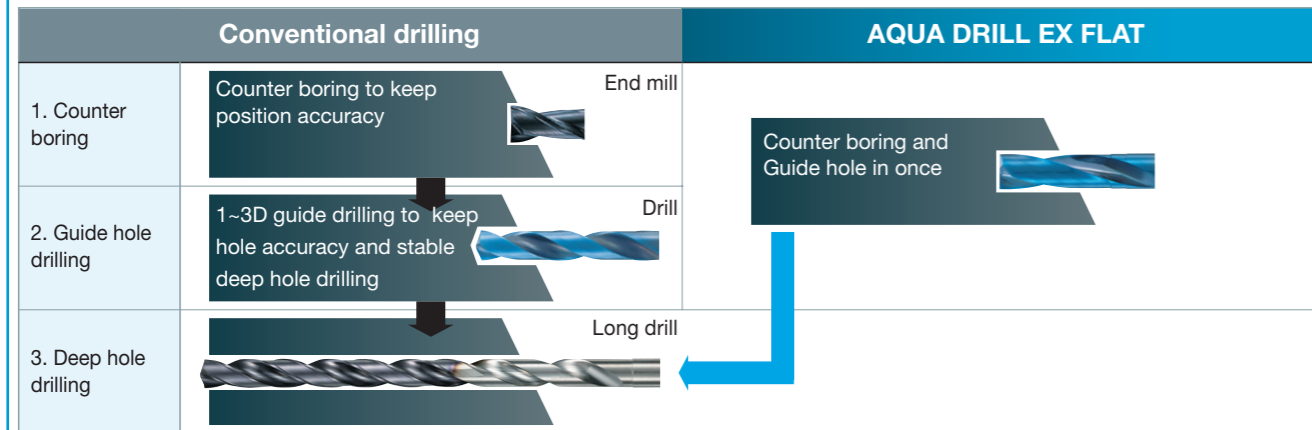
Drilling time

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

32 sec.
5 mm-step drilling

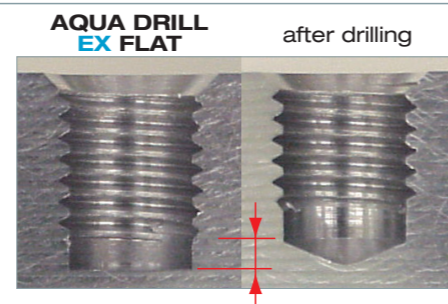
Applications

Guide holes.



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

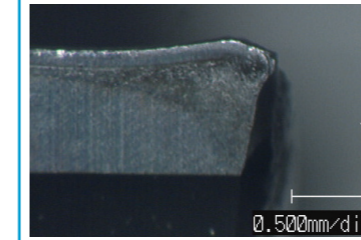
Thin wall tapping
maximum effective
screw length



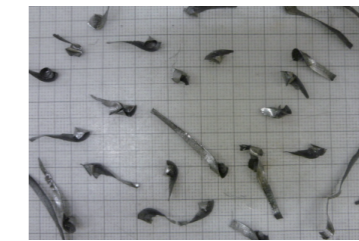
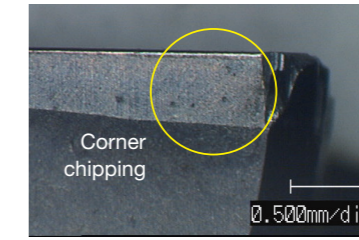
L9814 AQUA EX Flat Oil Hole 5D performance

After drilling 720 holes.

AQUA EX Flat Oil Hole 5D



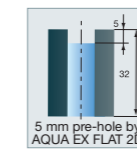
Competitor



Cutting conditions

Tool: Ø 10 mm
Speed: 60 m/min.
Feed: 285 mm/min.
(0.15 mm/rev)

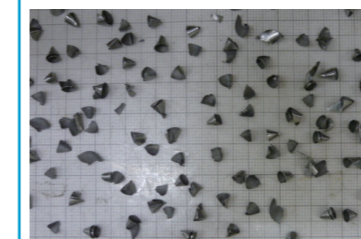
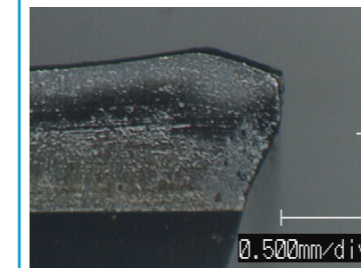
Depth: 32 mm (Through hole)
Guide hole: 10.5 mm
Work Material: C50 Carbon steel
Cutting fluid: Water Soluble



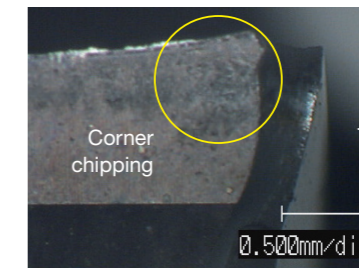
L9816 AQUA EX FLAT Long Shank Performance

Comparison tool life.

AQUA EX FLAT Long Shank



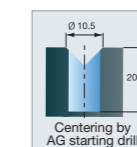
Competitor



Cutting conditions

Tool: Ø 10 mm
Speed: 60 m/min.
Feed: 285 mm/min.
(0.15 mm/rev)

Depth: 20 mm (blind hole)
Guide hole: 10.5 mm
Work Material: C50 Carbon steel
Cutting fluid: Water Soluble

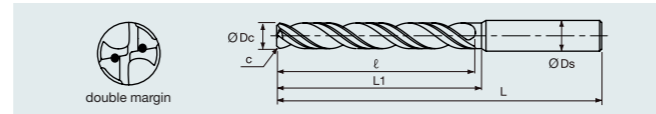


AQUA Drill EX FLAT Oil-Hole 5D



L9814

Dc	ℓ	L	L1	Ds	Stock
1,0	6,3	57	6,6	3	●
1,1	6,9	60	7,2	3	●
1,2	7,6	60	7,9	3	●
1,3	8,2	60	8,5	3	●
1,4	8,8	60	9,1	3	●
1,5	9,5	60	9,8	3	●
1,6	10,1	60	10,4	3	●
1,7	10,7	60	11,0	3	●
1,8	11,3	60	11,6	3	●
1,9	12,0	60	12,3	3	●
2,0	12,6	60	12,9	3	●
2,1	13,2	64	13,5	3	●
2,2	13,9	64	14,2	3	●
2,3	14,5	64	14,8	3	●
2,4	15,1	64	15,4	3	●
2,5	15,8	64	16,1	3	●
2,6	16,4	74	16,7	3	●
2,7	17,0	74	17,3	3	●
2,8	17,6	74	17,9	3	●
2,9	18,3	74	18,6	3	●
3,0	20	74	21	3	●
3,1	22	80	25	4	●
3,2	22	80	25	4	●
3,3	22	80	25	4	●
3,4	24	80	25	4	●
3,5	24	80	26	4	●
3,6	24	80	27	4	●
3,7	24	80	27	4	●
3,8	26	80	27	4	●
3,9	26	80	27	4	●
4,0	26	80	27	4	●
4,1	28	90	30	5	●
4,2	28	90	30	5	●
4,3	28	90	30	5	●
4,4	29	90	30	5	●
4,5	29	90	31	5	●
4,6	29	90	34	5	●
4,7	32	90	34	5	●
4,8	32	90	34	5	●
4,9	32	90	34	5	●
5,0	33	90	34	5	●
5,1	35	94	38	6	●
5,2	35	94	38	6	●
5,3	35	94	38	6	●
5,4	37	94	38	6	●
5,5	37	94	39	6	●
5,6	37	94	40	6	●
5,7	39	94	40	6	●
5,8	39	94	40	6	●
5,9	39	94	40	6	●
6,0	39	94	40	6	●
6,1	41	101	44	7	●
6,2	41	101	44	7	●
6,3	41	101	44	7	●
6,4	43	101	44	7	●
6,5	43	101	45	7	●
6,6	43	101	46	7	●
6,7	45	101	46	7	●
6,8	45	101	46	7	●
6,9	45	101	46	7	●
7,0	46	101	46	7	●
7,1	48	110	51	8	●
7,2	48	110	51	8	●
7,3	48	110	51	8	●
7,4	50	110	51	8	●
7,5	50	110	52	8	●



Dc	ℓ	L	L1	Ds	Stock
7,6	50	110	53	8	●
7,7	52	110	53	8	●
7,8	52	110	53	8	●
7,9	52	110	53	8	●
8,0	52	110	53	8	●
8,1	54	117	57	9	●
8,2	54	117	57	9	●
8,3	54	117	57	9	●
8,4	56	117	57	9	●
8,5	56	117	58	9	●
8,6	56	117	59	9	●
8,7	58	117	59	9	●
8,8	58	117	59	9	●
8,9	58	117	59	9	●
9,0	59	117	59	9	●
9,1	61	126	64	10	●
9,2	61	126	64	10	●
9,3	61	126	64	10	●
9,4	63	126	64	10	●
9,5	63	126	65	10	●
9,6	63	126	66	10	●
9,7	65	126	66	10	●
9,8	65	126	66	10	●
9,9	65	126	66	10	●
10,0	65	126	66	10	●
10,1	67	138	70	11	●
10,2	67	138	70	11	●
10,3	67	138	70	11	●
10,4	69	138	70	11	●
10,5	69	138	71	11	●
10,6	69	138	71	11	●
10,7	72	138	73	11	●
10,8	72	138	73	11	●
10,9	72	138	73	11	●
11,0	73	138	73	11	●
11,1	74	146	77	12	●
11,2	74	146	77	12	●
11,3	74	146	77	12	●
11,4	76	146	77	12	●
11,5	76	146	78	12	●
11,6	76	146	79	12	●
11,7	78	146	79	12	●
11,8	78	146	79	12	●
11,9	78	146	79	12	●
12,0	78	146	79	12	●
12,5	82	153	84	13	●
13,0	86	153	86	13	●
13,5	89	162	91	14	●
14,0	91	162	92	14	●
14,5	95	169	97	15	●
15,0	98	169	98	15	●
15,5	102	178	104	16	●
16,0	104	178	105	16	●

● German Stock
 = New Sizes

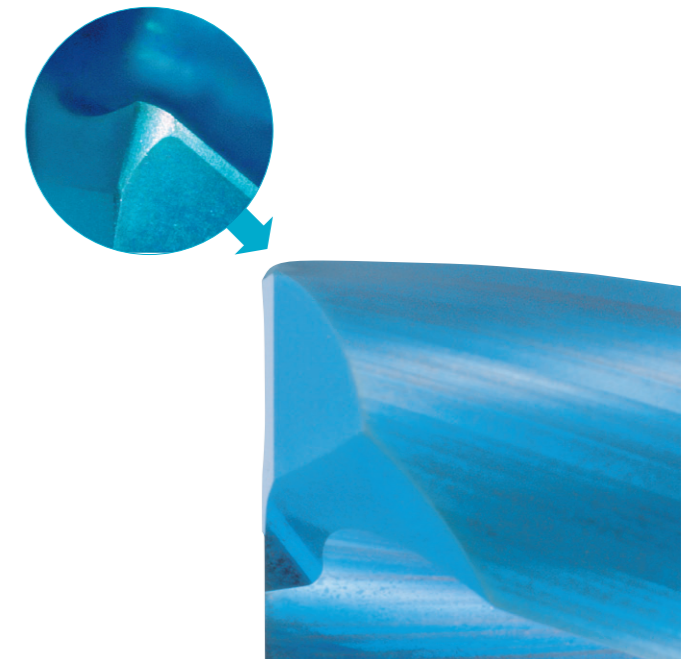
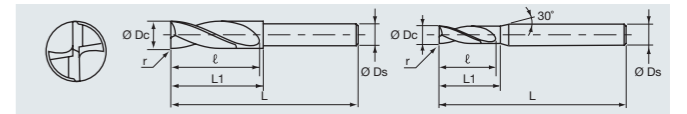
AQUA Drill EX FLAT 2D Radius



L9830

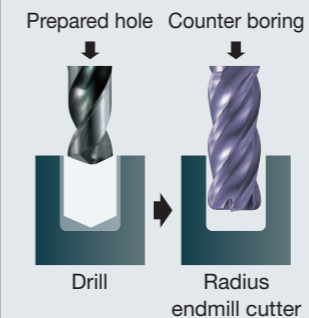
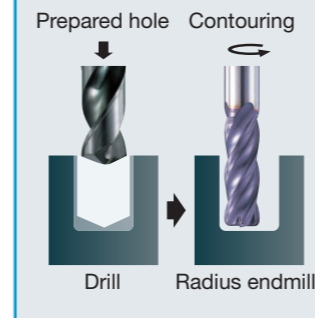
Dc	r	ℓ	L	L1	Ds	Stock
3,0	0,3	14	50	14,4	6	○
3,3	0,3	15	50	15,7	6	○
3,5	0,3	16	50	16,3	6	○
4,0	0,3	18	50	18,3	6	○
4,2	0,3	19	60	20,4	6	○
4,5	0,3	21	60	22,7	6	○
5,0	0,3	23	60	23,1	6	○
5,3	0,3	24	60	26,4	6	○
5,5	0,3	25	60	27,6	6	○
6,0	0,4	27	60	30	6	○
6,5	0,4	30	70	33	6	○
6,8	0,4	31	70	33	6	○
7,0	0,4	32	70	33	6	○
7,5	0,4	34	70	36	6	○
8,0	0,4	36	70	39	8	○
8,5	0,4	39	80	42	8	○
8,8	0,4	40	80	42	8	○
9,0	0,4	41	80	42	8	○
9,5	0,4	43	80	45	8	○
10,0	0,5	45	80	48	10	○
10,3	0,5	46	90	49	10	○
10,5	0,5	48	90	51	10	○
10,8	0,5	49	90	51	10	○
11,0	0,5	50	90	51	10	○
11,5	0,5	52	90	54	10	○
12,0	0,5	54	90	57	12	○

○ Japan Stock
 German Stock from September 2015



Radius blind hole, one operation drilling with no prepared hole

Conventional



AQUA Drill EX FLAT 2D Radius



To reduce the stress at the bottom of the blind hole, corner radius might be required. Conventional process was to use radius end mill after drilling or special cutter with radius. But with AQUA Drill EX Flat Corner Radius, 1shot drilling is possible.

Standard Drilling Conditions

Standard Drilling Conditions AQUA Drill EX FLAT Oil-Hole 3D

Work material	Structural Steel, Carbon Steel, Grey Cast Iron SS400 S55C FC250		Alloy Steel, Pre-Hardened SCM SKT SKS SKD		Mold Steel SKT SKD NAK55 HPM1		Hardened Steel		Ductile Cast Iron FCD400		Stainless Steel SUS304		Aluminum 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
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:

- Adjust drilling condition according to the rigidity of machine or work clamp state.
- This 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 %.
- Use the table values for drilling depths under 3xD.
- Guide holes is not necessary when for hole on surfaces angled between 5 and 15°, reduce the RPM by under 50 %, the feed by under 40 %.
- Side milling is not possible.

Standard Drilling Conditions AQUA Drill EX FLAT Oil-Hole 5D

Work material	Structural Steel, Carbon Steel, Grey Cast Iron SS400 S55C FC250		Alloy Steel, Pre-Hardened SCM SKT SKS SKD		Mold Steel SKT SKD NAK55 HPM1		Hardened Steel		Ductile Cast Iron FCD400		Stainless Steel SUS304		Aluminum 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
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:

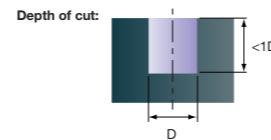
- Adjust drilling condition according to the rigidity of machine or work clamp state.
- This table values are for drilling with water soluble cutting fluid. When using non-water soluble cutting fluid, reduce the RPM and feed speeds by 20 %.
- Use the table values for drilling depths under 5xD.
- Drilling 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.)
- Side milling is not possible.

Standard Drilling Conditions SG Drill for large diameters

Work material	Structural Steel, Carbon Steel SS400 S50C		Alloy Steel, Pre-Hardened SCM440 NAK HPM		Mold Steel SK61 NAK HPM		Stainless Steel SUS304 SUS316		Ductile Cast Iron FC250 FCD400		Aluminum 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
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.



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



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

Cutting condition of slope drilling



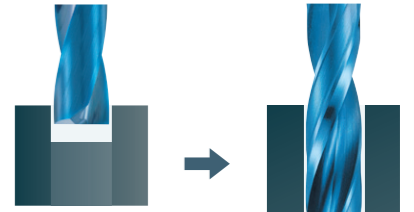
Reduce the cutting speed and the feed

Normal cutting condition

Same as a or reduce the feed rate

AQUA EX Flat Regular(4D), Long Shank(2D), Oil Hole 5D drilling

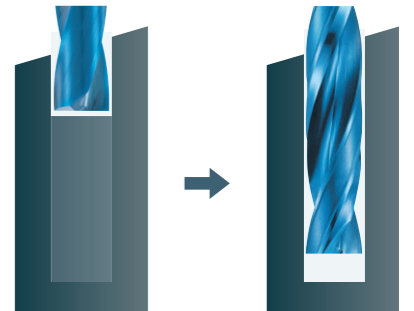
Please make a guide hole with AQUA EX Flat 2D (Incase of stainless steel, please use AQUA EX Flat Oil Hole 3D)



Chamfering with AG Starting drill

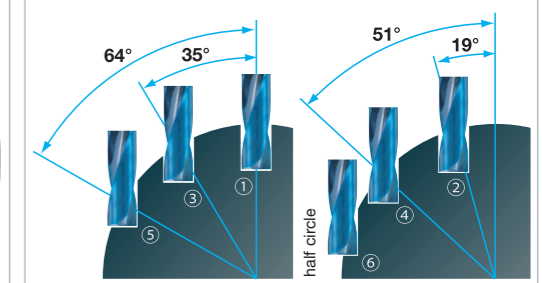
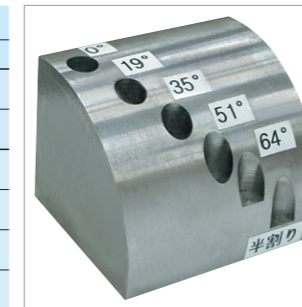


Please make a guide hole with AQUA EX Flat 2D (Incase of stainless steel, please use AQUA EX Flat Oil Hole 3D)



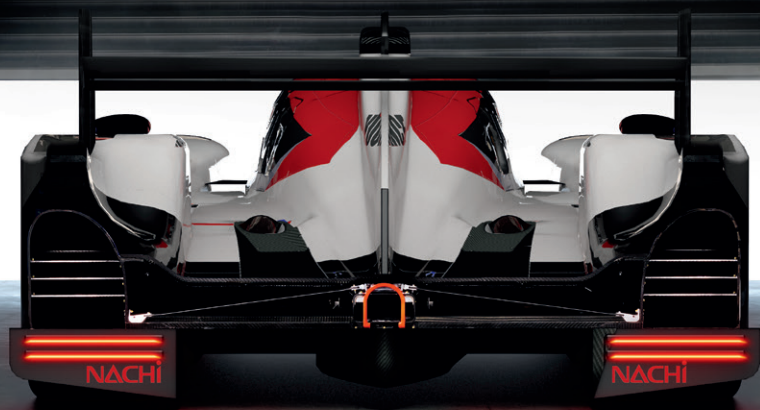
Cutting condition comparison on slope drilling

Position	No.	angle	Cutting Speed			Feed		
			m/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°					120	0.07	40%
⑤	64°		52	1650	70%	90	0.06	33%
⑥	half circle					60	0.04	20%



AQUA EX Flat Drill Ø 10 / Material C45 carbon steel / Cutting depth 15 mm / Water soluble.

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