50 YEARS

NACHI

NACHI EUROPE GmbH

OUR SYNERGY
YOUR PERFORMANCE

AQUA DRILL
EX FLAT SERIES

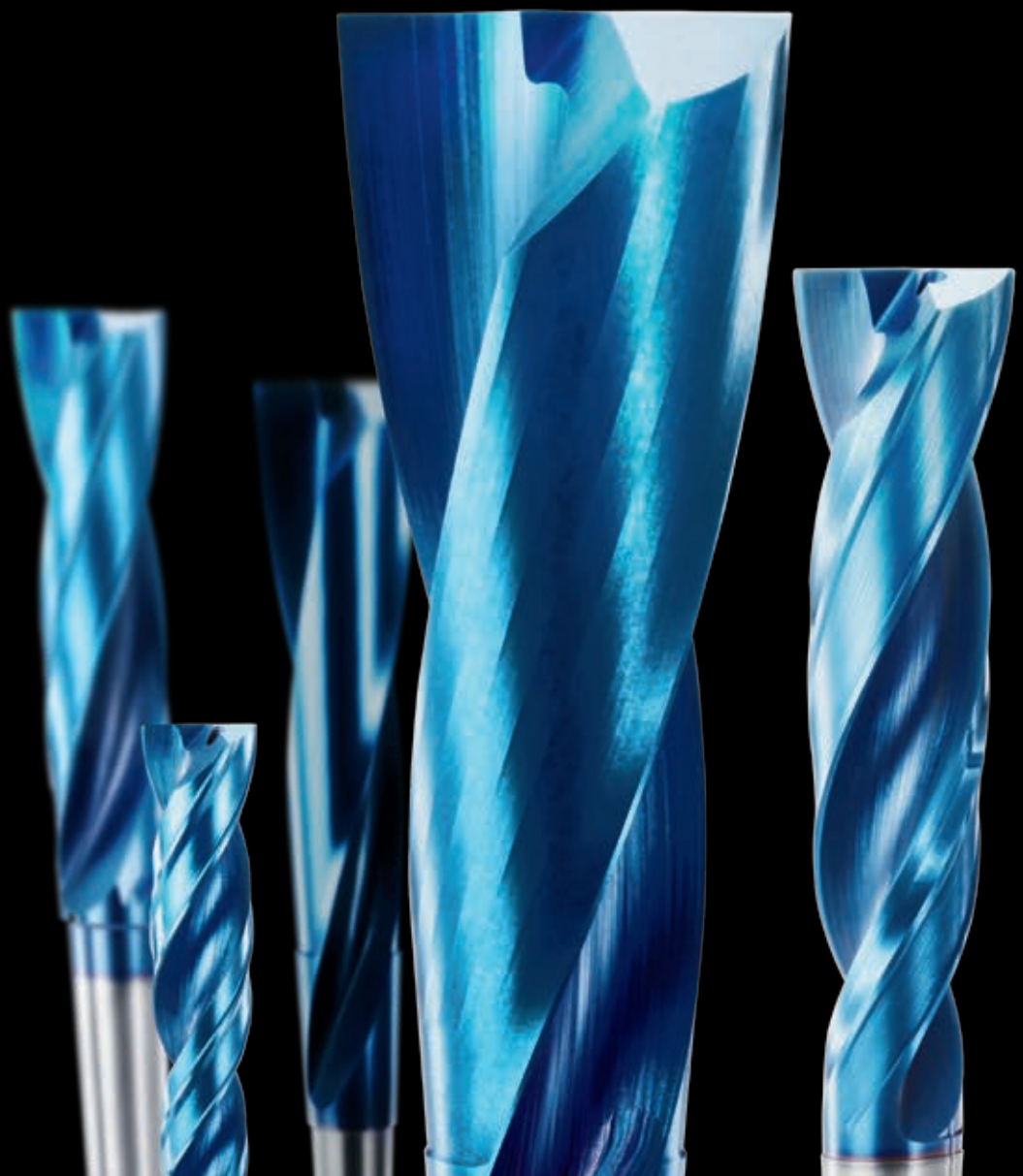
NEW DRILLING TECHNOLOGY



CELEBRATE THE POLE POSITION

NEW
AQUA EX
COATING

long tool life,
by improved heat
and wear resistance



AQUA Drill EX FLAT Series

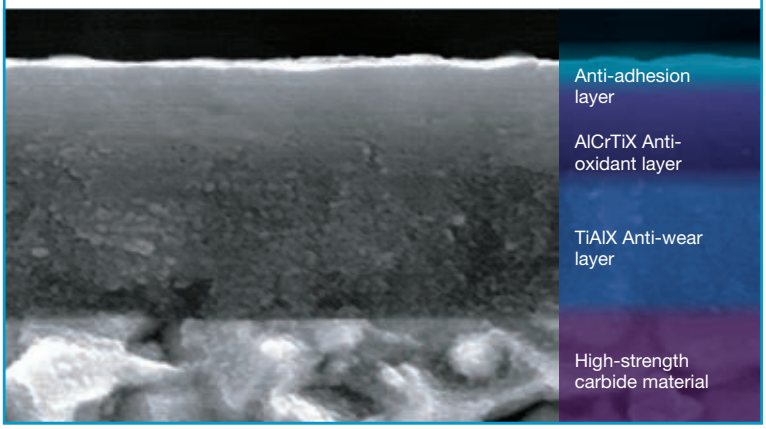


AQUA Drill EX FLAT, Regular, Long Shank, Oil hole, Radius

- 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



Flat bottom

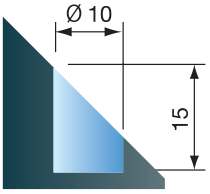
2Flute end mill



Bottom is not flat

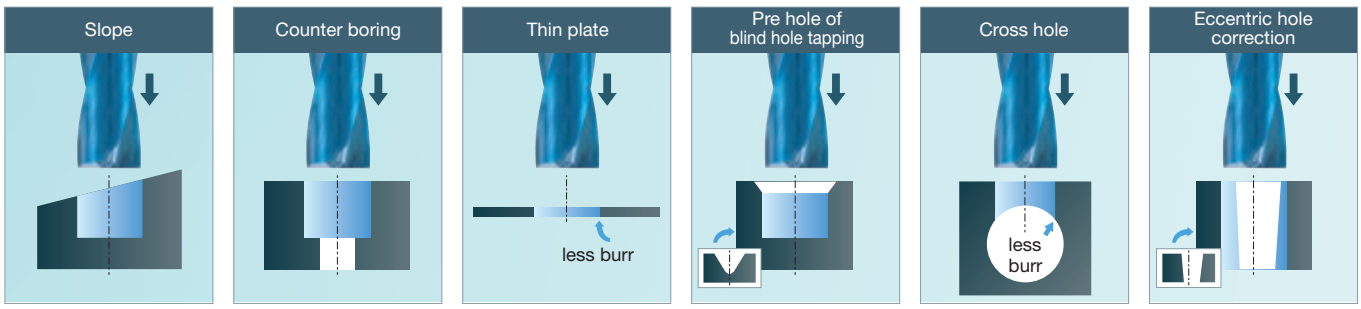
Cutting conditions

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

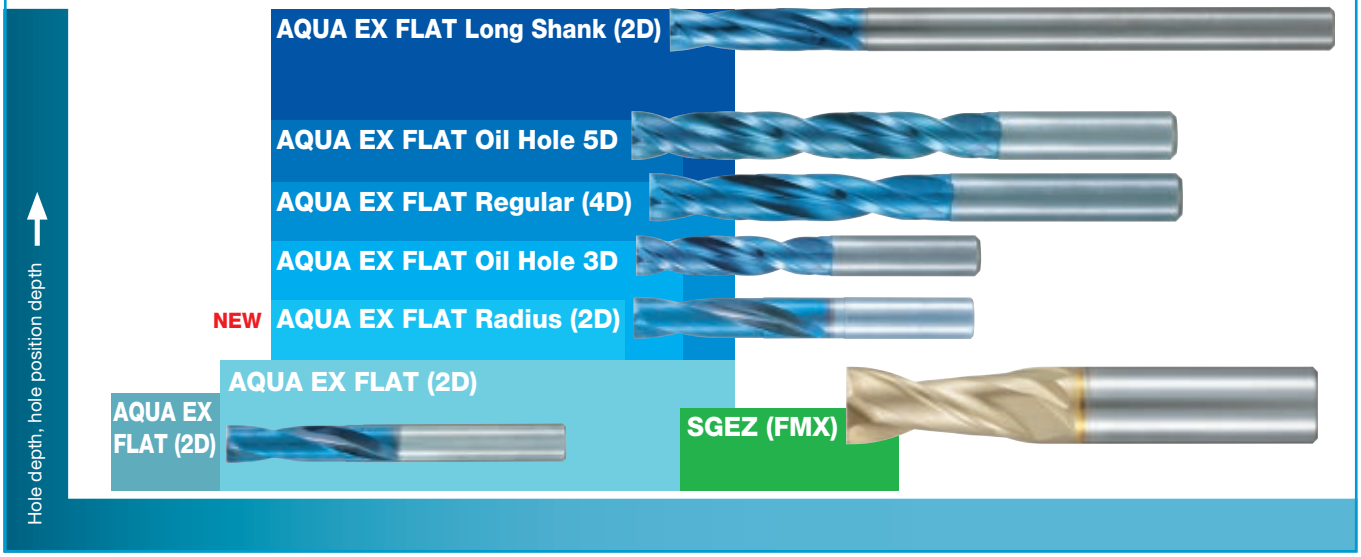


New Drilling Technology

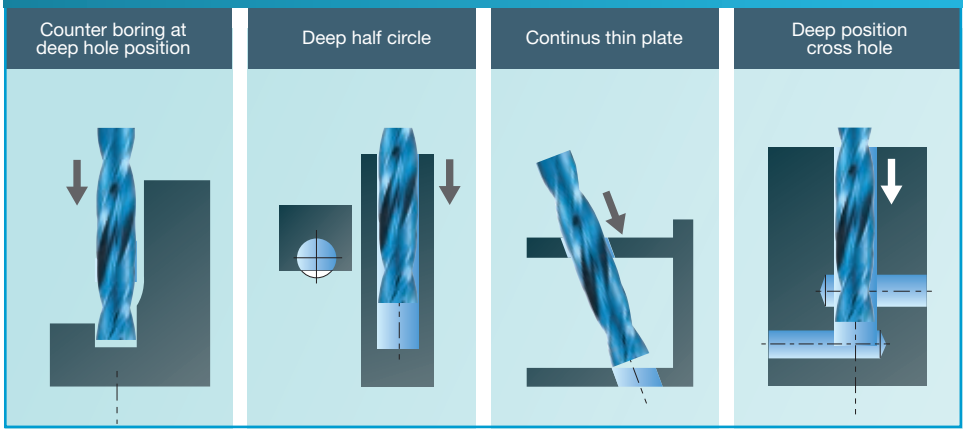
Slope, Counter Boring, Thin Plate, Cross Hole, Hole correction in one drill.



New Aqua Drill EX FLAT lineup

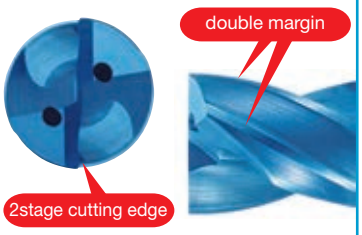


New capable application



Reduction of hole enlargement

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



Hole enlargement.

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 necessairy

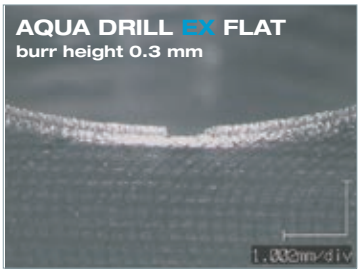
Applicable work materials

Tool	Structual 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

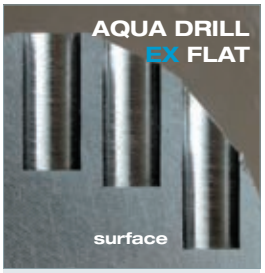
Excellent cutting edge, tool life, precision and efficiency.

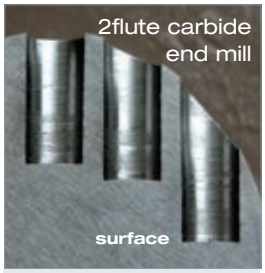
Smaller burrs at the exit of hole on thin plate drilling:





High-efficiency. Direct drilling without pilot hole:





Cutting conditions

Tool:	AQUA EX Flat Ø 10	Work Material:	SS400 structure steel
Speed:	75 m/min.	Cutting fluid:	water soluble
Feed:	420 mm/min. (0.18 mm/rev)		

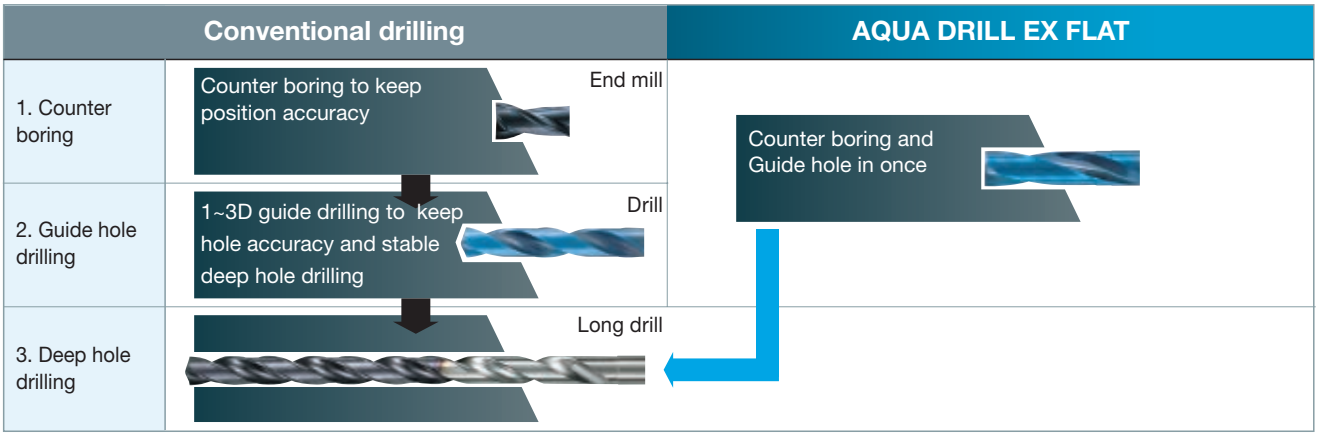
Drilling time

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

32 sec.
5 mm-step drilling

Applications

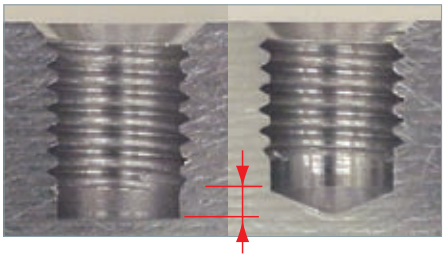
Guide holes.



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

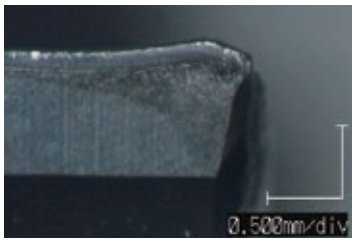
AQUA DRILL EX FLAT — after drilling



L9814 AQUA EX Flat Oil Hole 5D performance

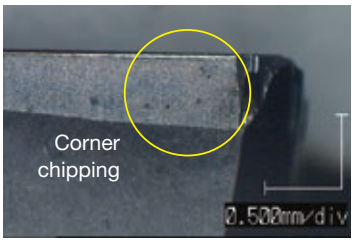
After drilling 720 holes.

AQUA EX Flat Oil Hole 5D





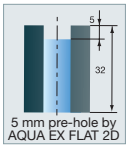
Competitor

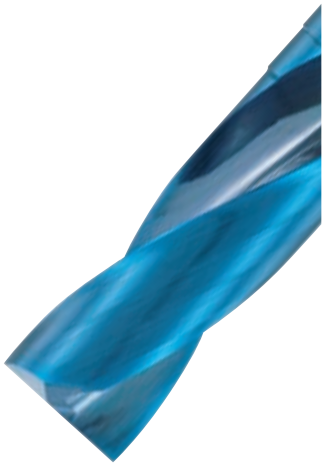




Cutting conditions

Tool:	Ø 10 mm	Depth:	32 mm (Through hole)
Speed:	60 m/min.	Guide hole:	10.5 mm
Feed:	285 mm/min. (0.15 mm/rev)	Work Material:	C50 Carbon steel
		Cutting fluid:	Water Soluble



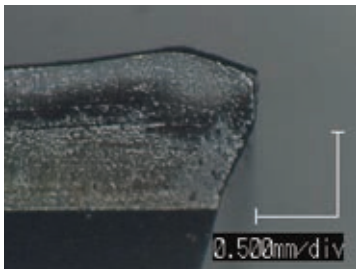


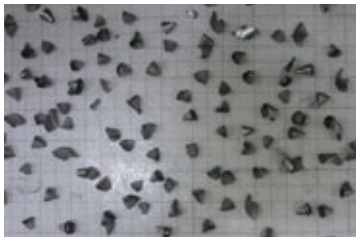


L9816 AQUA EX FLAT Long Shank Performance

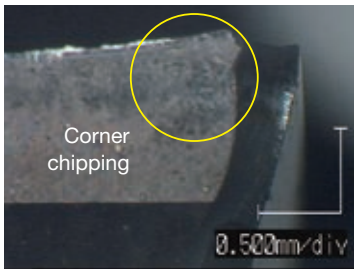
Comparison tool life.

AQUA EX FLAT Long Shank





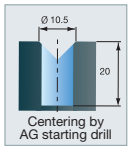
Competitor





Cutting conditions

Tool:	Ø 10 mm	Depth:	20 mm (blind hole)
Speed:	60 m/min.	Guide hole:	10.5 mm
Feed:	285 mm/min. (0.15 mm/rev)	Work Material:	C50 Carbon steel
		Cutting fluid:	Water Soluble

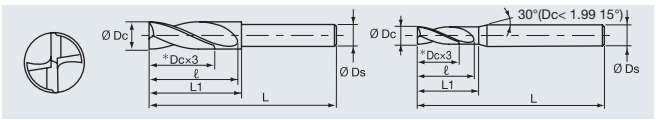


AQUA Drill EX FLAT 2D

VHM AQ h7 180° 20° h6

* Dc < 1.99 : Dc x 2.3





L9610

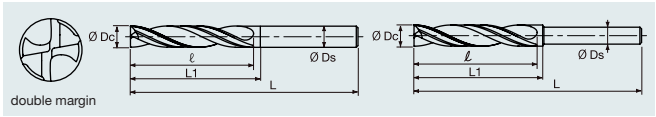
Dc	ℓ	L	L1	Ds	Stock
0,2	0,66	47	0,98	3	●
0,25	0,82	47	1,17	3	●
0,3	0,99	47	1,36	3	●
0,35	1,16	47	1,46	3	●
0,4	1,32	47	1,65	3	●
0,45	1,48	47	1,84	3	●
0,5	1,65	47	2,03	3	●
0,55	1,81	47	2,13	3	●
0,6	1,98	47	2,32	3	●
0,65	2,14	47	2,51	3	●
0,7	2,31	47	2,71	3	●
0,75	2,47	47	2,8	3	●
0,8	2,64	47	2,99	3	●
0,85	2,8	47	3,19	3	●
0,9	2,97	47	3,28	3	●
0,95	3,13	47	3,47	3	●
1.0	3.3	47	3.6	3	●
1.1	3.5	47	3.9	3	●
1.2	3.9	47	4.2	3	●
1.3	4.2	47	4.5	3	●
1.4	4.6	47	4.9	3	●
1.5	4.9	47	5.2	3	●
1.6	5.2	47	5.5	3	●
1.7	5.5	47	5.8	3	●
1.8	5.8	47	6.1	3	●
1.9	6.2	47	6.5	3	●
2.0	9	50	9.8	4	●
2.1	11	50	11.4	4	●
2.2	11	50	11.4	4	●
2.3	11	50	11.5	4	●
2.4	12	50	12.6	4	●
2.5	12	50	12.7	4	●
2.6	12	50	12.8	4	●
2.7	14	50	14.9	4	●
2.8	14	50	15.0	4	●
2.9	14	50	15.0	4	●
3.0	14	50	14.4	6	●
3.1	15	50	15.5	6	●
3.2	15	50	15.6	6	●
3.3	15	50	15.7	6	●
3.4	16	50	16.2	6	●
3.5	16	50	16.3	6	●
3.6	16	50	16.4	6	●
3.7	18	50	18.0	6	●
3.8	18	50	18.1	6	●
3.9	18	50	18.2	6	●
4.0	18	50	18.3	6	●
4.1	19	60	20.4	6	●
4.2	19	60	20.4	6	●
4.3	19	60	20.5	6	●
4.4	21	60	22.6	6	●
4.5	21	60	22.7	6	●
4.6	21	60	22.8	6	●
4.7	22	60	22.9	6	●
4.8	22	60	23.0	6	●
4.9	22	60	23.0	6	●
5.0	23	60	23.1	6	●
5.1	24	60	26.2	6	●
5.2	24	60	26.3	6	●
5.3	24	60	26.4	6	●
5.4	25	60	27.5	6	●
5.5	25	60	27.6	6	●
5.6	25	60	27.7	6	●
5.7	27	60	29.7	6	●
5.8	27	60	29.8	6	●
5.9	27	60	29.9	6	●
6.0	27	60	30	6	●
6.1	28	70	31	6	●
6.2	28	70	31	6	●
6.3	28	70	31	6	●
6.4	30	70	33	6	●
6.5	30	70	33	6	●
6.6	30	70	33	6	●
6.7	31	70	33	6	●
6.8	31	70	33	6	●
6.9	31	70	33	6	●
7.0	32	70	33	6	●
7.1	33	70	36	6	●
7.2	33	70	36	6	●
7.3	33	70	36	6	●
7.4	34	70	36	6	●
7.5	34	70	36	6	●
7.6	34	70	36	6	●
7.7	36	70	39	6	●
7.8	36	70	39	6	●
7.9	36	70	39	6	●
8.0	36	70	39	8	●
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8.5	39	80	42	8	●
8.6	39	80	42	8	●
8.7	40	80	42	8	●
8.8	40	80	42	8	●
8.9	40	80	42	8	●
9.0	41	80	42	8	●
9.1	42	80	45	8	●
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9.3	42	80	45	8	●
9.4	43	80	45	8	●
9.5	43	80	45	8	●
9.6	43	80	45	8	●
9.7	45	80	48	8	●
9.8	45	80	48	8	●
9.9	45	80	48	8	●
10.0	45	80	48	10	●
10.1	46	90	49	10	●
10.2	46	90	49	10	●
10.3	46	90	49	10	●
10.4	48	90	51	10	●
10.5	48	90	51	10	●
10.6	48	90	51	10	●
10.7	49	90	51	10	●
10.8	49	90	51	10	●
10.9	49	90	51	10	●
11.0	50	90	51	10	●
11.1	51	90	54	10	●
11.2	51	90	54	10	●
11.3	51	90	54	10	●
11.4	52	90	54	10	●
11.5	52	90	54	10	●
11.6	52	90	54	10	●
11.7	54	90	57	10	●
11.8	54	90	57	10	●
11.9	54	90	57	10	●
12.0	54	90	57	12	●
12,1	55	100	58	12	●
12,2	55	100	58	12	●
12,3	55	100	58	12	●
12,4	57	100	60	12	●
12,5	57	100	60	12	●
12,6	57	100	60	12	●
12,7	58	100	60	12	●
12,8	58	100	60	12	●
12,9	58	100	60	12	●
13,0	59	100	60	12	●
13,1	60	100	63	12	●
13,2	60	100	63	12	●
13,3	60	100	63	12	●
13,4	61	100	63	12	●
13,5	61	100	63	12	●
13,6	61	100	63	12	●
13,7	63	100	66	12	●
13,8	63	100	66	12	●
13,9	63	100	66	12	●
14,0	63	100	66	12	●
14,1	64	105	67	12	●
14,2	64	105	67	12	●
14,3	64	105	67	12	●
14,4	66	105	69	12	●
14,5	66	105	69	12	●
14,6	66	105	69	12	●
14,7	67	105	69	12	●
14,8	67	105	69	12	●
14,9	67	105	69	12	●
15,0	68	105	69	12	●
15,1	69	115	72	12	●
15,2	69	115	72	12	●
15,3	69	115	72	12	●
15,4	70	115	72	12	●
15,5	70	115	72	12	●
15,6	70	115	72	12	●
15,7	72	115	75	12	●
15,8	72	115	75	12	●
15,9	72	115	75	12	●
16,0	72	115	75	16	●
16,5	75	115	78	16	●
17,0	77	125	79	16	●
17,5	79	125	81	16	●
18,0	81	125	84	16	●
18,5	84	135	87	16	●
19,0	86	135	87	16	●
19,5	88	145	91	16	●
20,0	90	145	93	20	●

● German Stock
= New Sizes

AQUA Drill EX FLAT Regular 4D

VHM AQ 20° h7 180° h6





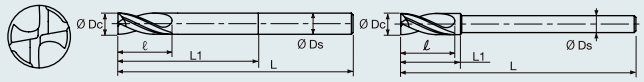
L9818

Dc	ℓ	L	L1	Ds	Stock
3.0	19	60	20	6	●
3.1	21	60	23	6	●
3.2	21	60	23	6	●
3.3	21	60	24	6	●
3.4	23	60	24	6	●
3.5	23	60	24	6	●
3.6	23	60	26	6	●
3.7	25	60	25	6	●
3.8	25	60	25	6	●
3.9	25	60	25	6	●
4.0	25	60	25	6	●
4.1	27	70	29	6	●
4.2	27	70	29	6	●
4.3	27	70	30	6	●
4.4	29	70	32	6	●
4.5	29	70	32	6	●
4.6	29	70	32	6	●
4.7	31	70	33	6	●
4.8	31	70	33	6	●
4.9	31	70	32	6	●
5.0	32	70	32	6	●
5.1	34	70	36	6	●
5.2	34	70	36	6	●
5.3	34	70	36	6	●
5.4	36	70	37	6	●
5.5	36	70	37	6	●
5.6	36	70	39	6	●
5.7	38	70	39	6	●
5.8	38	70	39	6	●
5.9	38	70	39	6	●
6.0	38	70	39	6	●
6.1	40	85	41	6	●
6.2	40	85	41	6	●
6.3	40	85	41	6	●
6.4	42	85	43	6	●
6.5	42	85	43	6	●
6.6	42	85	43	6	●
6.7	44	85	45	6	●
6.8	44	85	45	6	●
6.9	44	85	45	6	●
7.0	46	90	47	6	●
7.1	46	90	47	6	●
7.2	46	90	47	6	●
7.3	46	90	47	6	●
7.4	48	90	49	6	●
7.5	48	90	49	6	●
7.6	48	90	49	6	●
7.7	51	90	52	6	●
7.8	51	90	52	6	●
7.9	51	90	52	6	●
8.0	51	100	53	8	●
8.1	52	100	53	8	●
8.2	52	100	53	8	●
8.3	52	100	53	8	●
8.4	54	100	55	8	●
8.5	54	100	55	8	●
8.6	54	100	55	8	●
8.7	56	100	57	8	●
8.8	56	100	57	8	●
8.9	56	100	57	8	●
9.0	58	100	59	8	●
9.1	59	100	60	8	●
9.2	59	100	60	8	●
9.3	59	100	60	8	●
9.4	61	100	62	8	●
9.5	61	100	62	8	●
9.6	61	100	62	8	●
9.7	63	100	64	8	●
9.8	63	100	64	8	●
9.9	63	100	64	8	●
10.0	63	110	65	10	●
10.1	65	110	66	10	●
10.2	65	110	66	10	●
10.3	65	110	66	10	●
10.4	67	110	68	10	●
10.5	67	110	68	10	●
10.6	67	110	68	10	●
10.7	69	110	70	10	●
10.8	69	110	70	10	●
10.9	69	110	70	10	●
11.0	70	115	71	10	●
11.1	71	115	72	10	●
11.2	71	115	72	10	●
11.3	71	115	72	10	●
11.4	73	115	74	10	●
11.5	73	115	74	10	●
11.6	73	115	74	10	●
11.7	76	115	77	10	●
11.8	76	115	77	10	●
11.9	76	115	77	10	●
12.0	76	125	78	12	●
12,1	78	125	79	12	●
12,2	78	125	79	12	●
12,3	78	125	79	12	●
12,4	80	125	81	12	●
12,5	80	125	81	12	●
12,6	80	125	81	12	●
12,7	81	125	82	12	●
12,8	81	125	82	12	●
12,9	81	125	82	12	●
13,0	82	130	83	12	●
13,1	84	130	85	12	●
13,2	84	130	85	12	●
13,3	84	130	85	12	●
13,4	86	130	87	12	●
13,5	86	130	87	12	●
13,6	86	130	87	12	●
13,7	88	130	89	12	●
13,8	88	130	89	12	●
13,9	88	130	89	12	●
14,0	88	135	89	12	●
14,1	90	135	91	12	●
14,2	90	135	91	12	●
14,3	90	135	91	12	●
14,4	92	135	93	12	●
14,5	92	135	93	12	●
14,6	92	135	93	12	●
14,7	94	135	95	12	●
14,8	94	135	95	12	●
14,9	94	135	95	12	●
15,0	95	145	96	12	●
15,1	97	145	98	12	●
15,2	97	145	98	12	●
15,3	97	145	98	12	●
15,4	98	145	99	12	●
15,5	98	145	99	12	●
15,6	98	145	99	12	●
15,7	101	145	102	12	●
15,8	101	145	102	12	●
15,9	101	145	102	12	●
16,0	101	160	104	16	●
16,5	105	160	106	16	●
17,0	108	165	109	16	●
17,5	111	165	112	16	●
18,0	113	175	114	16	●
18,5	118	175	119	16	●
19,0	120	185	121	16	●
19,5	124	185	125	16	●
20,0	126	195	129	20	●

● German Stock
= New Sizes

AQUA Drill EX FLAT Long Shank 2D





double margin

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	●
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	●

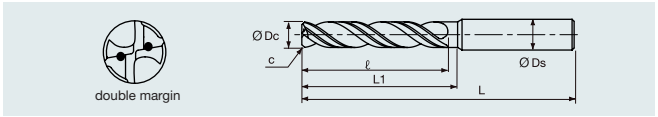
● German Stock

AQUA Drill EX FLAT Oil-Hole 3D

VHM AQ N h7 180° h6



L9812



Dc	ℓ	L	L1	Ds	Stock
1,0	4,3	55	4,6	3	●
1,1	4,7	58	5,0	3	●
1,2	5,2	58	5,5	3	●
1,3	5,6	58	5,9	3	●
1,4	6,0	58	6,3	3	●
1,5	6,5	58	6,8	3	●
1,6	6,9	58	7,2	3	●
1,7	7,3	58	7,6	3	●
1,8	7,7	58	8,0	3	●
1,9	8,2	58	8,5	3	●
2,0	8,6	58	8,9	3	●
2,1	9,0	62	9,3	3	●
2,2	9,5	62	9,8	3	●
2,3	9,9	62	10,2	3	●
2,4	10,3	62	10,6	3	●
2,5	10,8	62	11,1	3	●
2,6	11,2	68	11,5	3	●
2,7	11,6	68	11,9	3	●
2,8	12,0	68	12,3	3	●
2,9	12,5	68	12,9	3	●
3.0	14	68	15	3	●
3.1	15	72	17	4	●
3.2	15	72	17	4	●
3.3	15	72	17	4	●
3.4	16	72	17	4	●
3.5	16	72	18	4	●
3.6	16	72	19	4	●
3.7	18	72	19	4	●
3.8	18	72	19	4	●
3.9	18	72	19	4	●
4.0	18	72	19	4	●
4.1	19	80	22	5	●
4.2	19	80	22	5	●
4.3	19	80	22	5	●
4.4	21	80	22	5	●
4.5	21	80	23	5	●
4.6	21	80	24	5	●
4.7	22	80	24	5	●
4.8	22	80	24	5	●
4.9	22	80	24	5	●
5.0	23	80	24	5	●
5.0	23	80	24	6	●
5.1	24	82	26	6	●
5.2	24	82	26	6	●
5.3	24	82	26	6	●
5.4	25	82	26	6	●
5.5	25	82	27	6	●
5.6	25	82	28	6	●
5.7	27	82	28	6	●
5.8	27	82	28	6	●
5.9	27	82	28	6	●
6.0	27	82	28	6	●
6.1	28	88	31	7	●
6.2	28	88	31	7	●
6.3	28	88	31	7	●
6.4	30	88	31	7	●
6.5	30	88	32	7	●
6.5	30	88	32	8	●
6.6	30	88	33	7	●
6.7	31	88	33	7	●
6.8	31	88	33	7	●
6.8	31	88	33	8	●
6.9	31	88	33	7	●
7.0	32	88	33	7	●
7.1	33	94	35	8	●
7.2	33	94	35	8	●

Dc	ℓ	L	L1	Ds	Stock
7.3	33	94	35	8	●
7.4	34	94	35	8	●
7.5	34	94	36	8	●
7.6	34	94	37	8	●
7.7	36	94	37	8	●
7.8	36	94	37	8	●
7.9	36	94	37	8	●
8.0	36	94	37	8	●
8.1	37	100	40	9	●
8.2	37	100	40	9	●
8.3	37	100	40	9	●
8.4	39	100	40	9	●
8.5	39	100	41	9	●
8.5	39	100	41	10	●
8.6	39	100	42	9	●
8.7	40	100	42	9	●
8.8	40	100	42	9	●
8.9	40	100	42	9	●
9.0	41	100	42	9	●
9.0	41	100	42	10	●
9.1	42	106	44	10	●
9.2	42	106	44	10	●
9.3	42	106	44	10	●
9.4	43	106	44	10	●
9.5	43	106	45	10	●
9.6	43	106	46	10	●
9.7	45	106	46	10	●
9.8	45	106	46	10	●
9.9	45	106	46	10	●
10.0	45	106	46	10	●
10.3	46	116	49	11	●
10.4	48	116	49	11	●
10.5	48	116	50	11	●
10.5	48	116	50	12	●
10.8	49	116	51	11	●
11.0	50	116	51	11	●
11.0	50	116	51	12	●
11.5	52	122	54	12	●
12.0	54	122	55	12	●
12.5	57	128	59	13	●
13.0	59	128	60	13	●
13.0	59	128	60	14	●
13.5	61	134	63	14	●
14.0	63	134	64	14	●
14.5	66	140	68	15	●
15.0	68	140	69	15	●
15.0	68	140	69	16	●
15.5	70	146	72	16	●
16.0	72	146	73	16	●

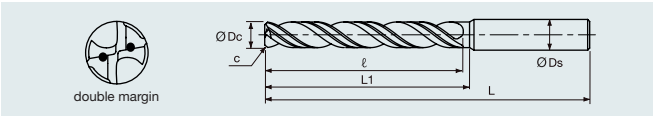
● German Stock
= New Sizes

AQUA Drill EX FLAT Oil-Hole 5D

VHM AQ N h7 180° h6



L9814

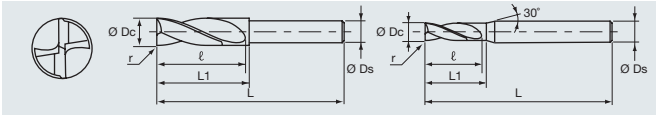


Dc	ℓ	L	L1	Ds	Stock
1,0	6,3	57	6,6	3	●
1,1	6,9	60	7,2	3	●
1,2	7,6	60	7,9	3	●
1,3	8,2	60	8,5	3	●
1,4	8,8	60	9,1	3	●
1,5	9,5	60	9,8	3	●
1,6	10,1	60	10,4	3	●
1,7	10,7	60	11,0	3	●
1,8	11,3	60	11,6	3	●
1,9	12,0	60	12,3	3	●
2,0	12,6	60	12,9	3	●
2,1	13,2	64	13,5	3	●
2,2	13,9	64	14,2	3	●
2,3	14,5	64	14,8	3	●
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	●
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

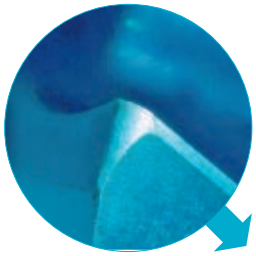


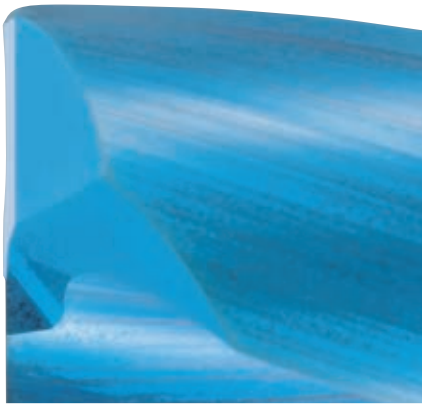


L9830

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	○

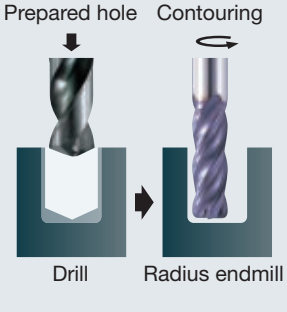
○ Japan Stock
German Stock from September 2015

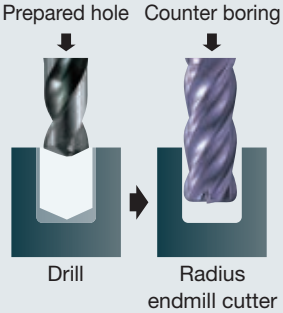




Radius blind hole, one operation drilling with no prepared hole

Conventional





AQUA Drill EX FLAT 2D Radius



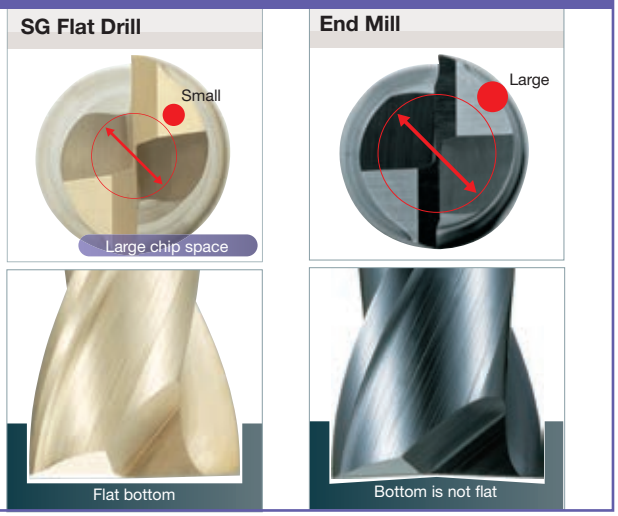
To reduce the stress at the bottom of the blind hole, corner radius might be required. Conventional process was to use radius end mill after drilling or special cutter with radius.But with AQUA Drill EX Flat Corner Radius, 1shot drilling is possible.

SG Flat drill is a multifunctional drill for large diameter

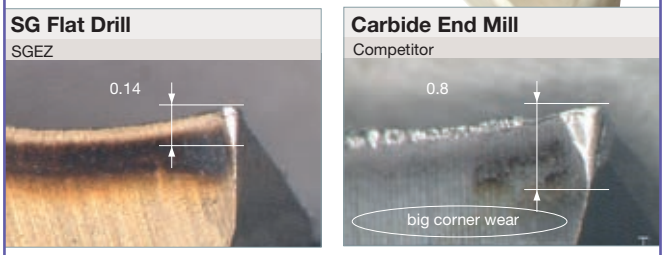
SG Flat Drill

- Large diameter in NACHI flat drill series.
- NACHI original FMX material, superior to conventional HSS.
- High wear resistance SG Coating realize long tool life.
- Well balanced flute geometry between high rigidity and smooth chip evacuation.

Point Geometry



Comparison of wear after 216 hole drilling



Cutting conditions

Tool: 20 mm
Cutting speed: 25 m/min
Feed: 80 mm/min (0.2 mm/rev)

Depth: 20 mm (blind hole)
Work material: C50 Carbon steel
Cutting fluid: Water soluble

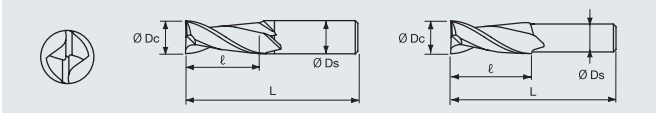
Work Material

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/S50C	SCM/NAK	30~40HRC	40~50HRC	50~65HRC	SUS304/ SUS316	SUS420		FCD/FC	AC/ADC	Cu
◎	◎	◎	◎	X	X	○	○	○	◎	○	○

SG Drill for large diameters

FMX SG h7 180° 30° h7





L6544

Dc	ℓ	L	Ds	Stock
20.0	44	113	20	●
21.0	44	113	20	●
22.0	44	113	20	●
23.0	49	120	20	●
24.0	49	120	20	●
25.0	54	134	25	●
26.0	54	134	25	●
26.5	54	134	25	●
27.0	54	134	25	●
28.0	58	142	25	●
29.0	58	142	25	●
29.5	63	147	25	●
30.0	63	147	25	●
31.0	63	147	25	●
32.0	68	158	32	●

● German Stock

Please use adjusting screw in case of counter boring without pilot hole in large diameter.

Standard Drilling Conditions

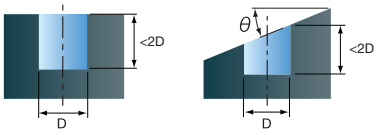
Standard Drilling Conditions AQUA Drill EX FLAT 2D and 2D Radius

Work material	Structural Steel, Carbon Steel, Grey Cast Iron SS SC FC		Alloy Steel, Pre-Hardened SCM NAK HPM		Mold Steel SKD		Hardened Steel		Stainless Steel SUS304		Ductile Cast Iron FCD		Aluminum Alloy A7075		Cast Aluminum AC ADC	
	~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	min^{-1}	mm/min	min^{-1}	mm/min
1	19100	290	15900	240	9550	110	6400	40	9550	50	15900	190	40000	720	28600	460
1,9	11700	360	10100	310	5900	160	4200	70	5030	50	10100	250	24300	830	17600	540
2	11100	360	9550	310	5550	160	3980	70	-	-	9550	250	23100	830	16700	530
3	7950	420	6900	360	3700	170	2650	80	-	-	6900	310	17000	1020	12500	660
4	5950	420	5150	360	2800	170	2000	80	-	-	5150	310	12500	1020	9550	660
5	4800	420	4150	360	2200	170	1600	80	-	-	4150	310	10000	1020	7650	660
6	4000	420	3450	360	1800	170	1300	80	-	-	3450	310	8500	1020	6400	660
8	3000	420	2600	360	1400	170	1000	80	-	-	2600	310	6350	1020	4750	660
10	2400	420	2050	360	1100	170	800	80	-	-	2050	310	5100	1020	3800	660
12	2000	420	1700	360	950	170	650	80	-	-	1700	310	4250	1020	3200	660
16	1500	420	1300	360	700	170	500	80	-	-	1300	310	3200	1020	2400	660
20	1200	420	1050	360	550	170	400	80	-	-	1050	310	2550	1020	1900	660

Warnings on using the drilling condition tables:

1. Adjust drilling condition according to the rigidity of machine or work clamp state.
2. For drilling removed forging surfaces.
3. 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 %.
4. For drilling depths of 2D or less. Drilling over 2D is not recommended.
5. For drilling stainless steel (SS304, 316, etc.), use it as 1.9 mm or less.
6. For slope drilling, adjust according to inclined angle(θ). For inclined angle under 30°, reduce the feed to 50 %. When drilling on inclined surface over 30°, reduce the rotation to 70 % or less and cutting speed to 30 % or less.
7. Side milling is not possible.

Depth of cut:



Standard Drilling Conditions AQUA Drill EX FLAT Regular 4D

Work material	Structural Steel, Carbon Steel, Grey Cast Iron SS400 S55C FC250		Alloy Steel, Pre-Hardened SCM SKT SKS SKD		Mold Steel SKD		Hardened Steel		Ductile Cast Iron FCD400		Aluminum 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	630	9500	430	7400	330	5300	240	9500	430	12700	760
4	7900	630	7100	430	5550	330	3980	240	7100	430	9500	760
5	6300	630	5700	430	4450	330	3180	240	5700	430	7600	760
6	5300	630	4750	430	3700	330	2650	240	4750	430	6400	760
8	3950	630	3550	430	2790	330	1990	240	3550	430	4780	760
10	3150	630	2860	430	2230	330	1590	240	2860	430	3800	760
12	2650	630	2390	430	1860	330	1300	240	2390	430	3180	760
16	1990	630	1790	430	1390	330	990	240	1790	430	2390	760
20	1590	630	1430	430	1110	330	800	240	1430	430	1910	760

Warnings on using the drilling condition tables:

1. Adjust drilling condition according to the rigidity of machine or work clamp state.
2. 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 %.
3. Use the table values for drilling depths under 4×D.
4. Drilling stainless steel (SS304, 316, etc.) are not recommend. We recommend the Aqua Drill EX Flat OH3D5D.
5. When for hole drilling require, 1:centering hole larger than the diameter or 2:same diameter guide hole. (1:Recommend the AG Starting Drill for centering holes, 2:Recommend the Aqua Drill EX Flat for guide holes.)
6. Side milling is not possible.

Standard Drilling Conditions AQUA Drill EX FLAT Long Shank 2D

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		Aluminum 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. 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 %.
3. Use the table values for drilling depths under 2×D.
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 is 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

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}	mm/min
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. 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 %.
3. Use the table values for drilling depths under 3×D.
4. 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 %.
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 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}	mm/min
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. 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 %.
3. Use the table values for drilling depths under 5×D.
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.

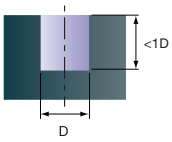
Standard Drilling Conditions SG Drill for large diameters

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}	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:

1. 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.
2. This cutting condition is for drilling with water soluble cutting fluid.
3. Provide sufficient cutting fluid to the cutting point and in the flute.
4. This cutting condition table is applied for hole depth 1D or less.
5. Cutting chip may scatter. The covering is required. When the chip grows, add step feed and break into cutting chip.
6. 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

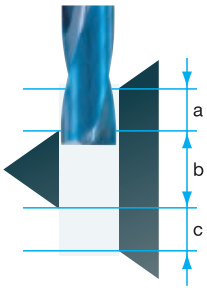


- For flat surface, maintain the guide hole by small steps (G73)
- For slope surface, reduce the feed rate



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

Cutting condition of slope drilling



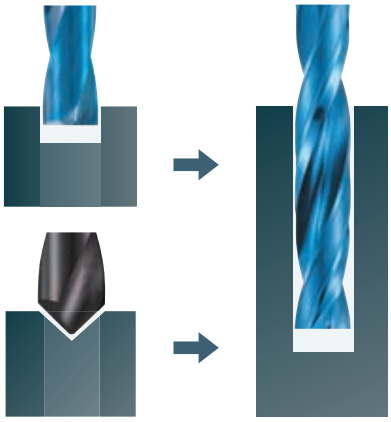
Reduce the cutting speed and the feed

Normal cutting condition

Same as a or reduce the feed rate

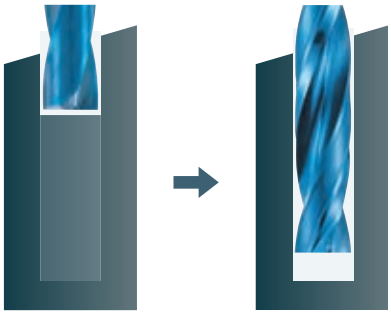
AQUA EX Flat Regular(4D), Long Shank(2D), Oil Hole 5D drilling

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

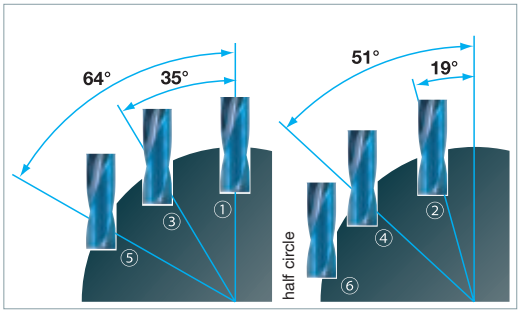
Please make a guide hole with AQUA EX Flat 2D (Incase of stainless steel, please use AQUA EX Flat Oil Hole 3D)



Cutting condition comparison on slope drilling

Position		Cutting Speed			Feed		
No.	angle	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°	52	1650	70%	120	0.07	40%
④	51°				120	0.07	40%
⑤	64°				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.

50 YEARS

NACHI

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