

50 YEARS

NACHI

NACHI EUROPE GmbH

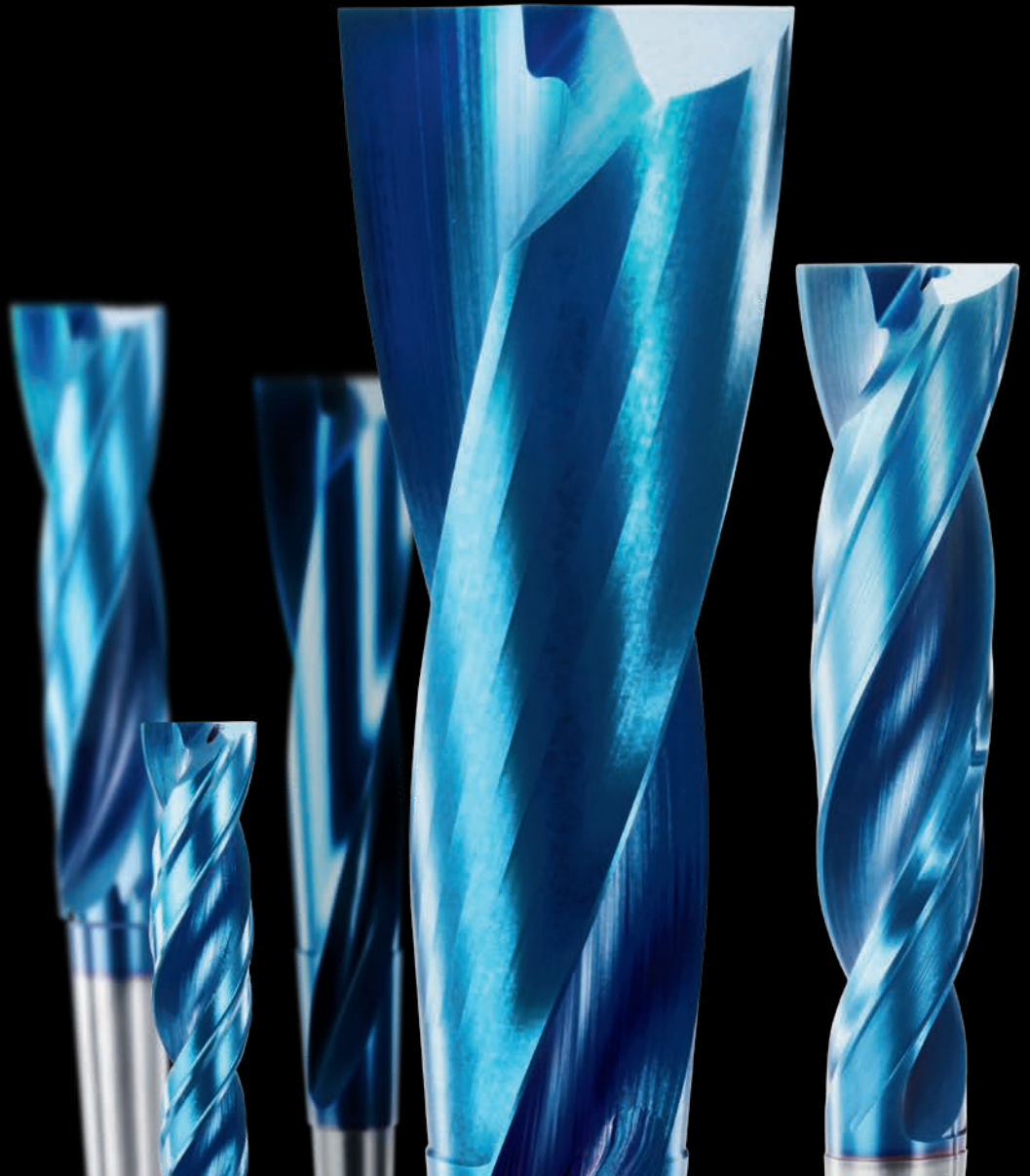
OUR SYNERGY
YOUR PERFORMANCE

AQUA DRILL EX FLAT SERIES

NEW DRILLING TECHNOLOGY



CELEBRATE THE POLE POSITION



**TOP
QUALITY
LEADER**

Exact centering
in inclined holes

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

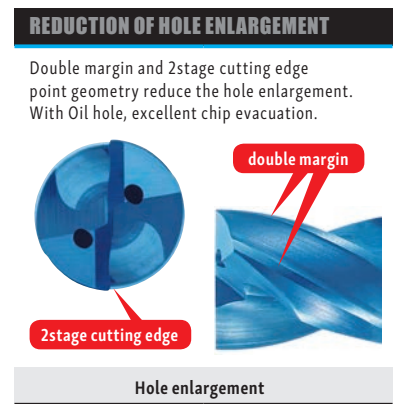
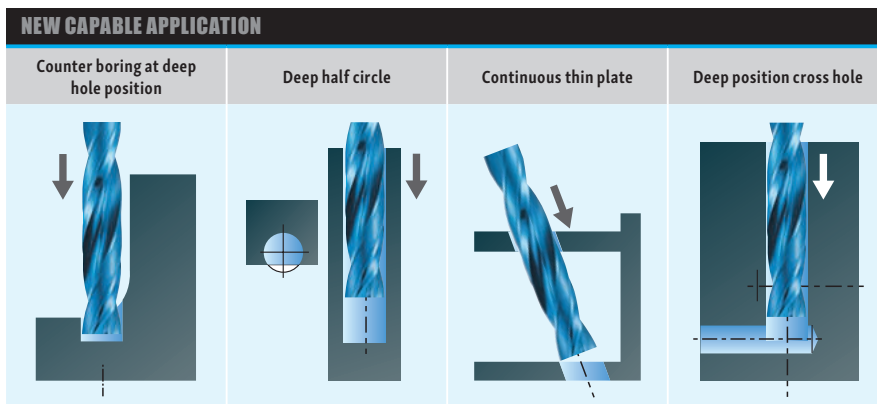
NEW DRILLING TECHNOLOGY

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		•
	AQUA EX FLAT Radius 2D		•
	AQUA EX FLAT 2D		•
	AQUA EX FLAT SHORT*	NEW	○
SGEZ (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
	SS400	S45C	SCM/NAK	30-40HRC	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	•	•	•	○	X	X	○	○	○	•	•	•

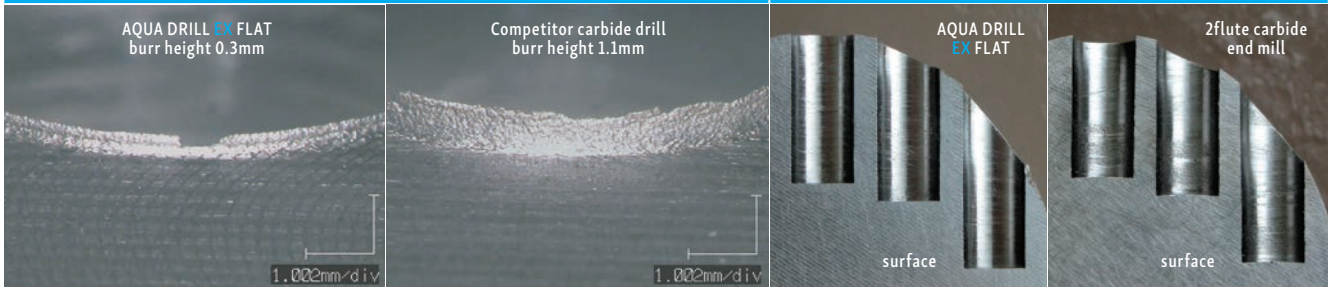
● Excellent | ○ Good | X Not Applicable

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

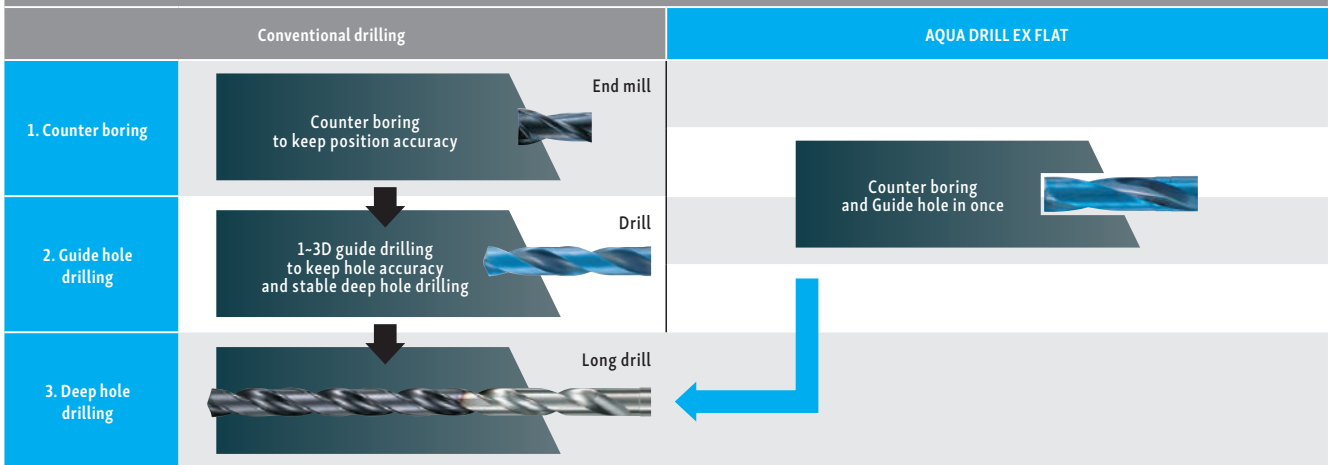
19sec.
 Non-step drilling
 only 19sec to drill
 2D depth slope
 40% efficiency

Drilling time

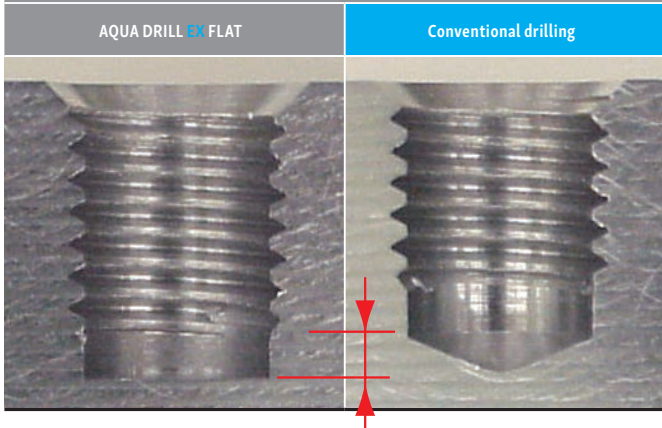
32sec.
 5mm-step drilling

APPLICATIONS

Guide holes



Thin wall tapping maximum effective screw length

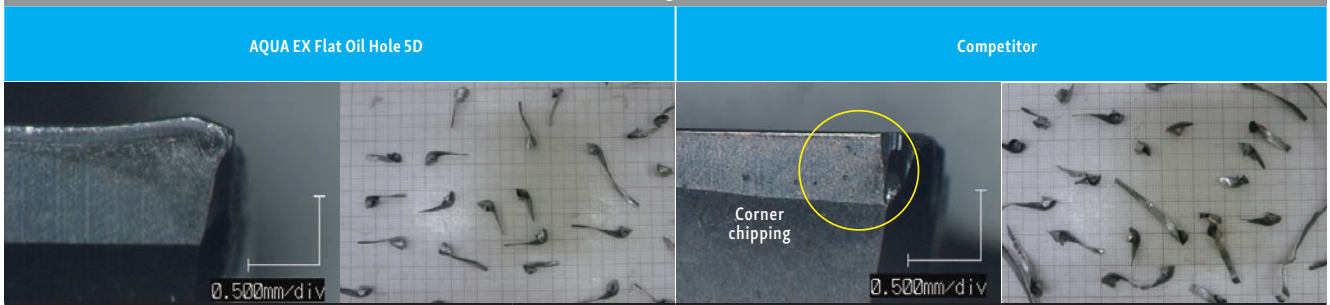


Suitable for tap pre-hole too.

Blind hole in thin wall, effective thread length is kept that eliminates post-processing.

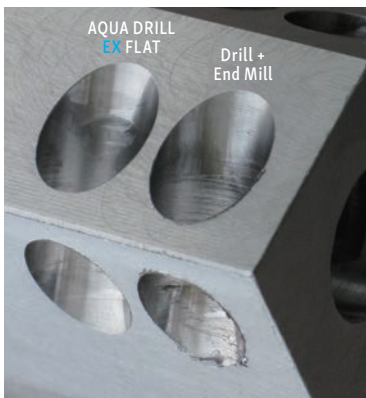
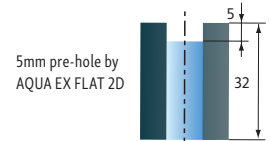
L9814 AQUA EX FLAT OIL HOLE 5D PERFORMANCE

After drilling 720 holes



Cutting Conditions

Tool	Ø 10mm	Hole Depth	32mm - Through hole
Cutting Speed	60m/min	Guide hole	10.5mm
Feed Speed	285mm/min	Work Material	C50 Carbon steel
Feed	0.15mm/rev	Cutting Fluid	Water-soluble



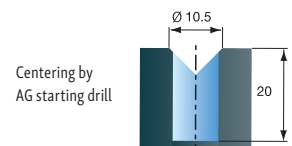
L9816 AQUA EX FLAT LONG SHANK PERFORMANCE

Comparison tool life



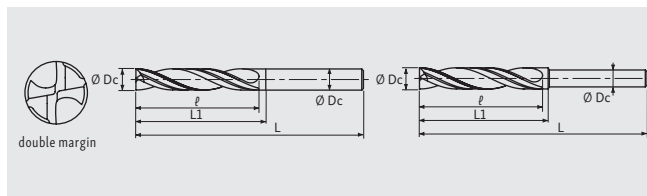
Cutting Conditions

Tool	Ø 10mm	Hole Depth	20mm - Blind hole
Cutting Speed	60m/min	Guide hole	10.5mm
Feed Speed	285mm/min	Work Material	C50 Carbon steel
Feed	0.15mm/rev	Cutting Fluid	Water-soluble



AQUA Drill EX

FLAT Regular 4D



MATERIAL

POINT ANGLE HELIX ANGLE

L9818

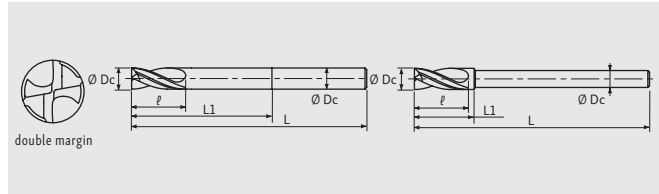
Dc	ℓ	L	L1	Ds	Stock
3.0	19	60	20	6	●
3.1	21	60	23	6	●
3.2	21	60	23	6	●
3.3	21	60	24	6	●
3.4	23	60	24	6	●
3.5	23	60	24	6	●
3.6	23	60	26	6	●
3.7	25	60	25	6	●
3.8	25	60	25	6	●
3.9	25	60	25	6	●
4.0	25	60	25	6	●
4.1	27	70	29	6	●
4.2	27	70	29	6	●
4.3	27	70	30	6	●
4.4	29	70	32	6	●
4.5	29	70	32	6	●
4.6	29	70	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	●

Dc	ℓ	L	L1	Ds	Stock
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	●

Dc	ℓ	L	L1	Ds	Stock
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



MATERIAL

POINT ANGLE

HELIX ANGLE

L9816

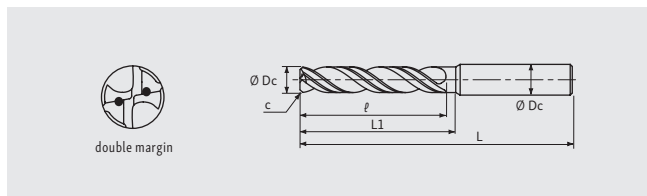
Dc	l	L	L1	Ds	Stock
3.0	14	100	30	6	•
3.1	15	100	31	6	•
3.2	15	100	32	6	•
3.3	15	100	33	6	•
3.4	16	100	34	6	•
3.5	16	100	35	6	•
3.6	16	100	36	6	•
3.7	18	100	37	6	•
3.8	18	100	38	6	•
3.9	18	100	39	6	•
4.0	18	100	40	6	•
4.1	19	100	41	6	•
4.2	19	100	42	6	•
4.3	19	100	43	6	•
4.4	21	100	44	6	•
4.5	21	100	45	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	•

Dc	l	L	L1	Ds	Stock
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



MATERIAL

POINT ANGLE

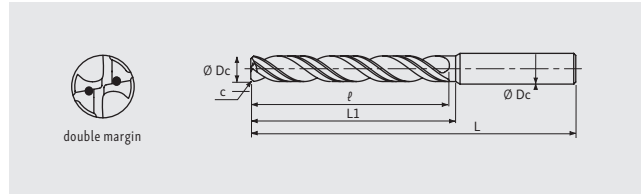
L9812 | L9812D

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	●

Dc	l	L	L1	Ds	Stock
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	●
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 | *L9812D

AQUA Drill EX FLAT Oil-Hole 5D



MATERIAL

POINT ANGLE

L9814

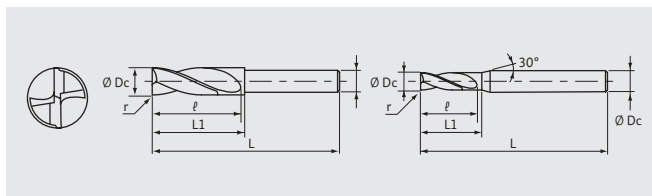
Dc	ℓ	L	L1	Ds	Stock
1.0	6.3	57	6.6	3	●
1.1	6.9	60	7.2	3	●
1.2	7.6	60	7.9	3	●
1.3	8.2	60	8.5	3	●
1.4	8.8	60	9.1	3	●
1.5	9.5	60	9.8	3	●
1.6	10.1	60	10.4	3	●
1.7	10.7	60	11.0	3	●
1.8	11.3	60	11.6	3	●
1.9	12.0	60	12.3	3	●
2.0	12.6	60	12.9	3	●
2.1	13.2	64	13.5	3	●
2.2	13.9	64	14.2	3	●
2.3	14.5	64	14.8	3	●
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	●

Dc	ℓ	L	L1	Ds	Stock
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	●

Dc	ℓ	L	L1	Ds	Stock
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

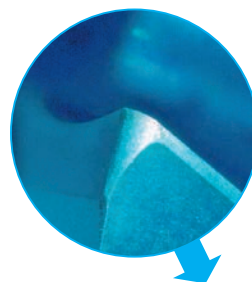


VHM AQ h7 180° 20° h6
 MATERIAL POINT ANGLE HELIX ANGLE

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	•

•: German Stock



RADIUS BLIND HOLE, ONE OPERATION DRILLING WITH NO PREPARED HOLE

Conventional

Prepared hole → Drill → Contouring → Radius endmill

AQUA Drill EX FLAT 2D Radius

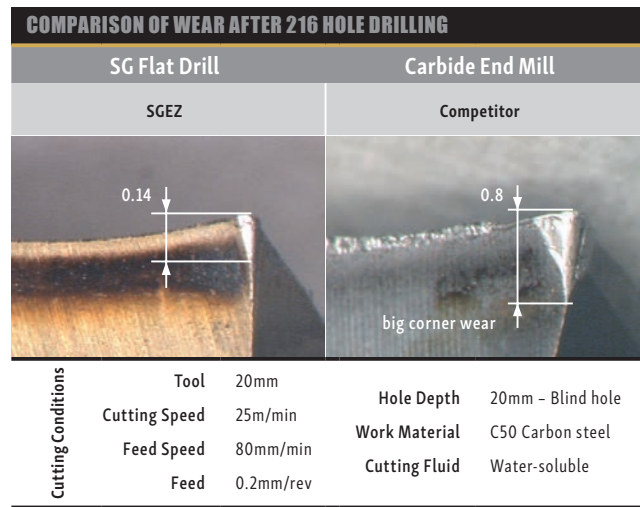
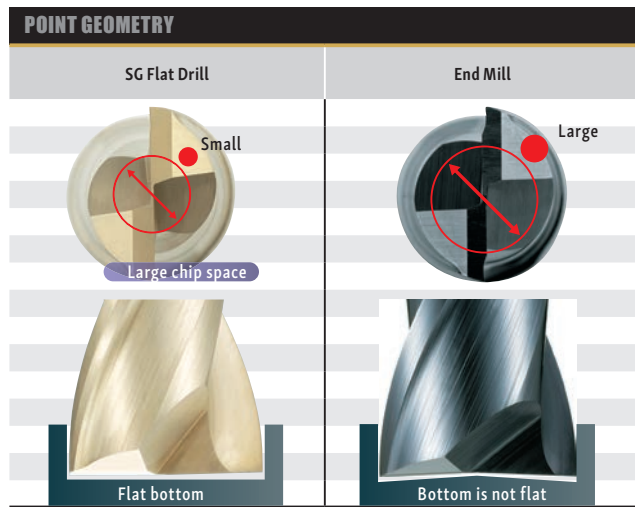
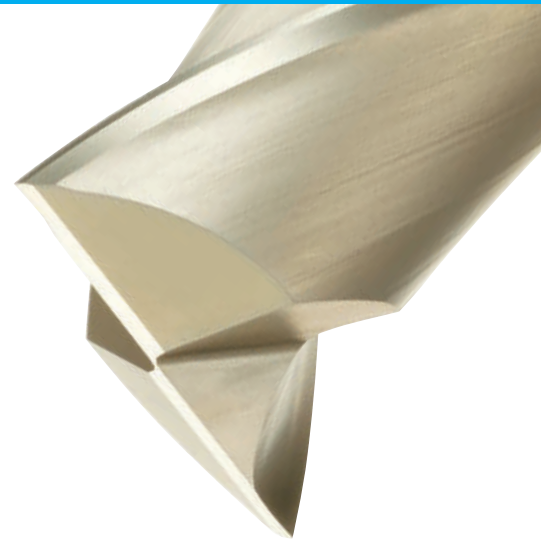
No prepared hole → Counter boring

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

SG Flat drill is a multifunctional drill for large diameter

- ▶ 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.



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	Aluminium Alloys	Copper Alloys
SS400	S45C/S50C	SCM/NAK	30-40HRC	40-50 HRC	50-65 HRC	SUS304/ SUS316	SUS420		FCD/FC	AC/ADC	Cu
●	●	●	●	X	X	○	○	○	●	○	○

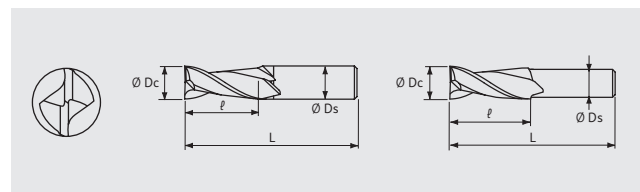
● Excellent | ○ Good | X Not Applicable

SG Drill for large diameters



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	●



Dc	ℓ	L	Ds	Stock
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.

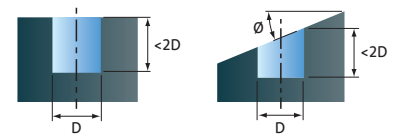
Standard Drilling Conditions

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		Aluminium Alloy A7075		Cast Aluminium 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
0.2	32000	40	29000	35	16000	20	14000	10	16000	10	29000	25	60000	120	56000	100
0.3	30000	60	25000	45	15000	30	12000	15	15000	15	25000	35	60000	180	50000	130
0.4	28000	70	23000	55	14000	35	11000	20	14000	20	23000	45	60000	240	47000	170
0.5	25500	80	21000	65	12500	40	10000	20	12500	20	21000	50	60000	300	45000	200
0.6	24000	120	19000	90	11500	60	9000	25	11500	25	19000	70	53000	350	40000	250
0.7	22000	150	18000	125	11000	75	8000	30	11000	30	18000	100	48000	450	36000	300
0.8	21000	200	17000	160	10500	80	7500	30	10500	35	17000	130	45000	550	33000	350
0.9	20000	250	16500	200	10000	100	7000	35	10000	40	16500	160	42000	650	31000	400
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:

- Adjust drilling condition according to the rigidity of machine or work clamp state.
- For drilling removed forging surfaces.
- 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%.
- For drilling depths of 2D or less. Drilling over 2D is not recommended.
- For drilling stainless steel (SS304, 316, etc.), use it as 1.9mm or less.
- 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.
- 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		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	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:

- Adjust drilling condition according to the rigidity of machine or work clamp state.
- 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%.
- Use the table values for drilling depths under 4xD.
- Drilling stainless steel (SS304, 316, etc.) is not recommended. We recommend the Aqua Drill EX Flat OH3D5D.
- 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.)
- Side milling is not possible.

Standard Drilling Conditions

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		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 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		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 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		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.

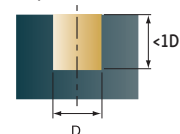
Standard Drilling Conditions

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		Aluminium 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

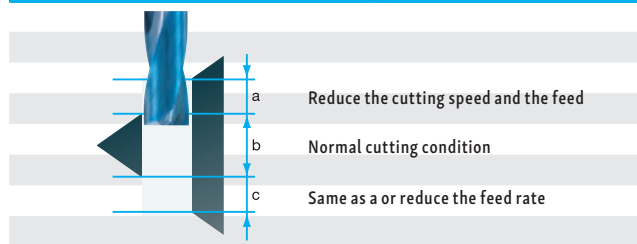
- For flat surface, maintain the guide hole by small steps (G73)
- For slope surface, reduce the feed rate AQUA EX FLAT Long Shank (2D)



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

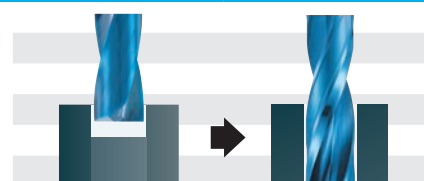


CUTTING CONDITION OF SLOPE DRILLING



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

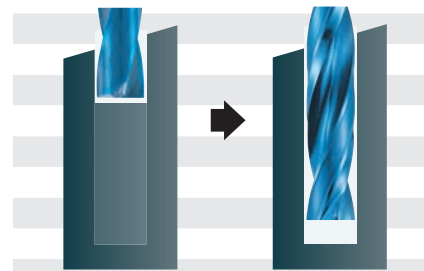
Please make a guide hole with AQUA EX Flat 2D (In case of stainless steel, please use AQUA EX Flat Oil Hole 3D)



Chamfering with AG Starting drill

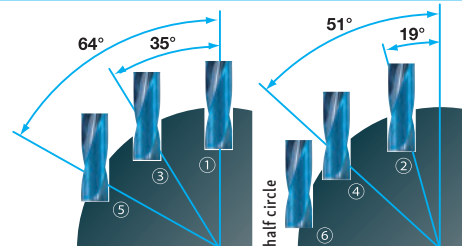


Please make a guide hole with AQUA EX Flat 2D (In case of stainless steel, please use AQUA EX Flat Oil Hole 3D)



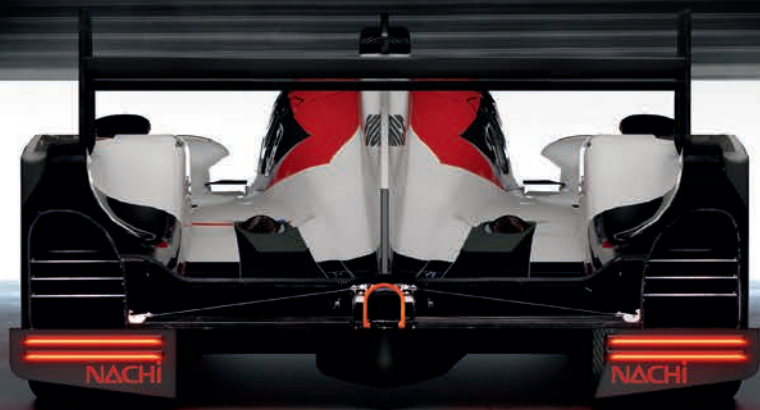
CUTTING CONDITION COMPARISON ON SLOPE DRILLING

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

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