NACHI

The next generation solid carbide drill

AQUA Drill EX Series

AQUA Drill EX Series

AQDEX AQDEXR AQDEXOH3D AQDEXOH5D AQDEXOH8D AQDEXOH3F3D AQDEXOH3F5D

Realize stable, high efficiency drilling in wide area,
from medium and low speed up to high speed

AQUA Drill EX Series

AQDEX AQDEXR AQDEXOH3D AQDEXOH5D AQDEXOH8D AQDEXOH3F3D AQDEXOH3F5D

- High-speed & high-efficiency drilling
- Applicable to wide range of material
- High performance, even on small machine

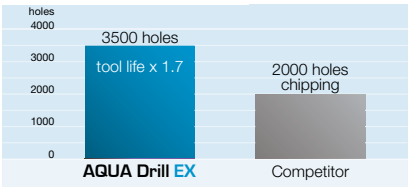

Oil hole


Dry drilling

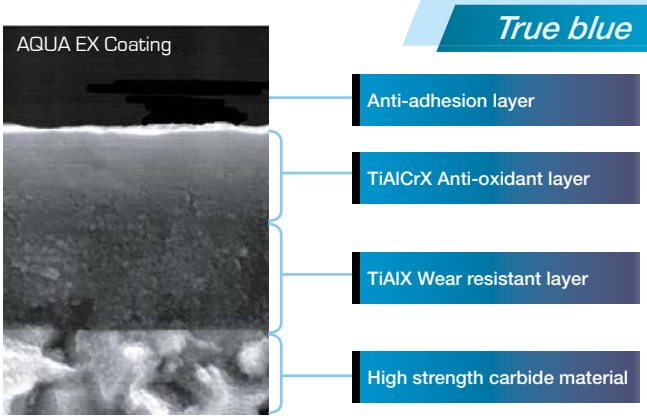

Wet drilling

High speed drilling

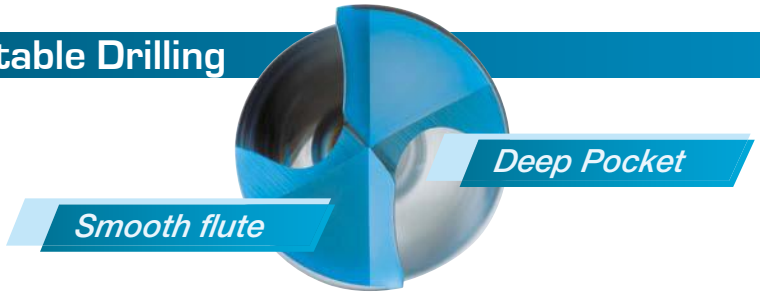
Comparison



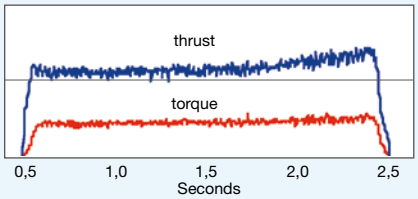
Cutting Condition	
Tool:	L9602 AQDEXR 8.0
Speed:	120 m/min
Feed:	0.25 mm/rev. (1,200 mm/min)
Cutting depth:	32 mm
Work material:	C50
Cutting fluid:	Water soluble



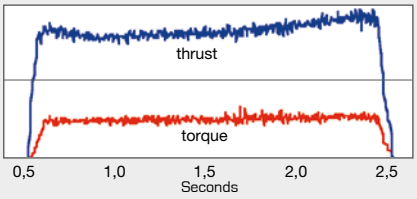
High Stable Drilling



AQUA Drill EX



Competitor

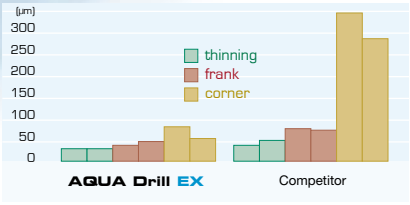


Long Tool Life Example No. 1

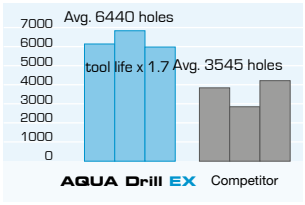
Low Cutting Force

Flowing curve

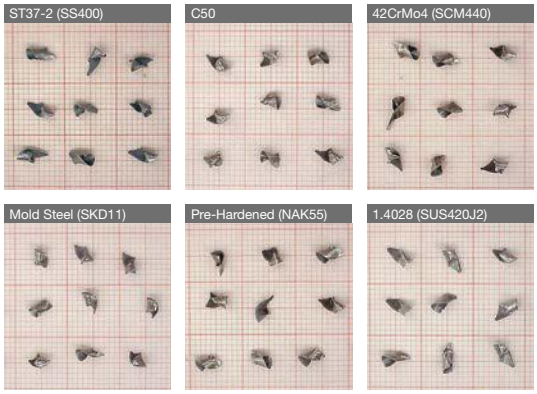
Durability comparison (after 3653 holes)



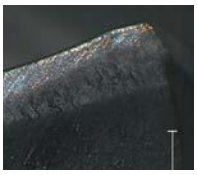
Tool life comparison



Good chip shape created by AQUA Drill EX



AQUA Drill EX



Competitor

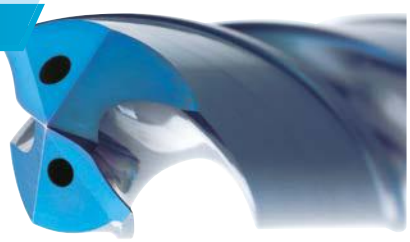
Cutting Condition	
Tool:	L9602 AQDEXR 6.0
Speed:	100 m/min
Feed:	0.18 mm/rev. (960 mm/min)
Cutting depth:	21 mm
Work material:	C50
Cutting fluid:	Water soluble

Long Tool Life Example No. 2 Oil hole drill

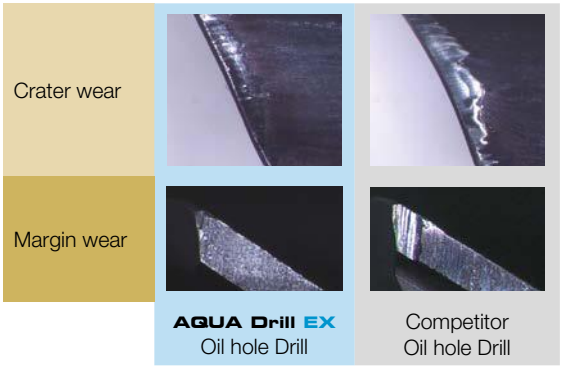
Small wear

Delicate cut

Tough heart

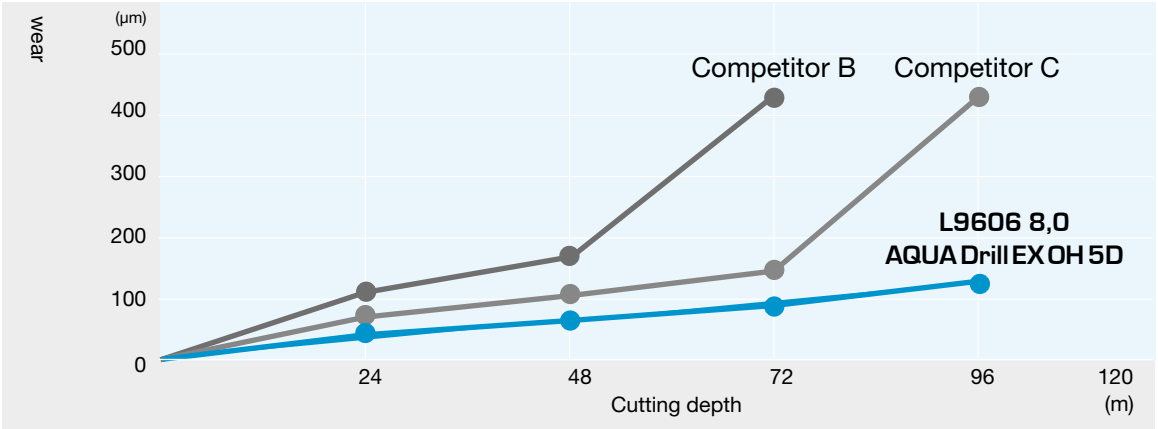


Wear comparison (after 625 hole)



Cutting Condition			
Tool:	L9608 Oli Hole 8D 8.0	**Cutting depth:**	64 mm Blind hole
Speed:	80 m/min	**Work material:**	C50 (180 HB)
Feed:	640 mm/min	**Cutting fluid:**	Water soluble (Internal Coolant

Comparison of wear on 1.4301 Stainless Steel (SUS304)



Cutting Condition			
Tool:	L9608 8.0	**Cutting depth:**	40 mm
Speed:	80 m/min	**Work material:**	1.4301
Feed:	640 mm/min	**Cutting fluid:**	Water soluble

AQDEX

Selection Chart

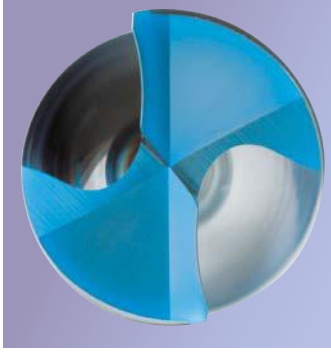
List No.	Type	Cutting Fluid	Structural Steels SS400	Carbon Steels S45C S50C	Pre-Hardened Steels Alloy Steels SCR NAK	Hardened Steels Mold Steels 25 ~ 40 HRC	Hardened Steels 40 ~ 50 HRC	Hardened Steels 50 ~ 65 HRC	Stainless Steels SUS304 SUS316	Stainless Steels SUS420	Titanium Alloys Nickel Alloys	Cast Iron FCD FC
L9600	AQUA Drill EX Stub	Wet & Dry[1]	■	■	■	■	■		❍[2]	❍		❍
L9602	AQUA Drill EX Regular	Wet & Dry[1]	■	■	■	■	■		❍[2]	❍		❍
L9604	AQUA Drill EX Oil Hole 3D	Wet & MQL	■	■	■	■	■		❍[2]	❍	❍	■
L9606	AQUA Drill EX Oil Hole 5D	Wet & MQL	■	■	■	■	■		❍[2]	❍	❍	■
L9608	AQUA Drill EX Oil Hole 8D	Wet & MQL	■	■	■	■	■		❍[2]	❍	❍	■
L9826	AQUA Drill EX Oil Hole 3 Flutes 3D	Wet	■	■	■	■	■		❍	❍		❍
L9820	AQUA Drill EX Oil Hole 3 Flutes 5D	Wet	■	■	■	■	■		❍	❍		❍
L9544	AQUA Microdrill	Wet & Dry[1]	■	■	■	■	■		■[2]	■	❍	❍
L9546	AQUA 3Flute	Wet & Dry[1]	■	■	■	■	■			❍		❍
L9548	AQUA Hard	Wet & Dry[1]						■				

[1] Use in Wet condition when drill size is under 1 mm

[2] Dry & MQL drilling not recommended

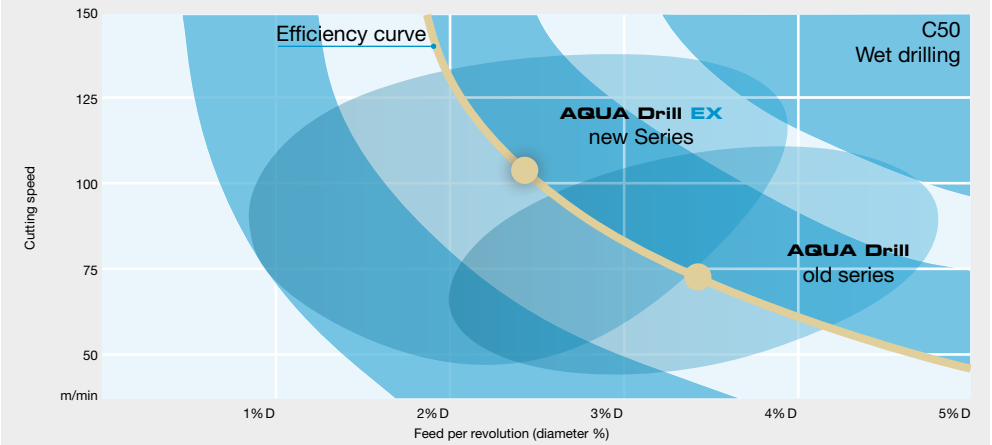
■ Excellent ❍ Good

AQUA Drill EX



- Flute geometry which realizes low cutting resistance and high speed drilling
- Stable drilling even on low rigidity machines such as small M/C
- Smooth chip evacuation on low carbon steels
- Wide area of cutting speed

Features of AQUA Drill and AQUA Drill EX



AQUA Drill EX covers a wide range of area.

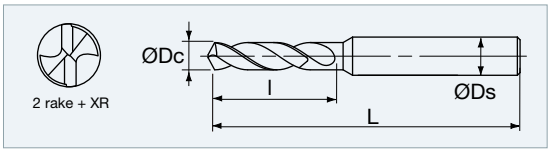
Various cutting conditions are applicable.

Both dry and wet drilling are possible.

AQDEXS

VHM | AQ EX | h8 | 135° | 30° | h6

AQUA Drill EX Stub



LIST9600			Unit: mm
Dc	l	L	Ds
2.0	8	45	3
2.1	10	45	3
2.2	10	45	3
2.3	10	45	3
2.4	10	45	3
2.5	10	45	3
2.6	13	45	3
2.7	13	45	3
2.8	13	45	3
2.9	13	45	3
3.0	13	45	3
3.1	19	54	4
3.2	19	54	4
3.3	19	54	4
3.4	19	54	4
3.5	19	54	4
3.6	21	54	4
3.7	21	54	4
3.8	21	54	4
3.9	21	54	4
4.0	21	54	4
4.1	23	61	5
4.2	23	61	5
4.3	23	61	5
4.4	23	61	5
4.5	23	61	5
4.6	25	61	5
4.7	25	61	5
4.8	25	61	5
4.9	25	61	5
5.0	25	61	5
5.1	25	65	6
5.2	25	65	6
5.3	25	65	6
5.4	25	65	6
5.5	25	65	6

LIST9600			Unit: mm
Dc	l	L	Ds
5.6	27	65	6
5.7	27	65	6
5.8	27	65	6
5.9	27	65	6
6.0	27	65	6
6.1	31	73	7
6.2	31	73	7
6.3	31	73	7
6.4	31	73	7
6.5	31	73	7
6.6	33	73	7
6.7	33	73	7
6.8	33	73	7
6.9	33	73	7
7.0	33	73	7
7.1	33	78	8
7.2	33	78	8
7.3	33	78	8
7.4	33	78	8
7.5	33	78	8
7.6	36	78	8
7.7	36	78	8
7.8	36	78	8
7.9	36	78	8
8.0	36	78	8
8.1	36	82	9
8.2	36	82	9
8.3	36	82	9
8.4	36	82	9
8.5	36	82	9
8.6	38	82	9
8.7	38	82	9
8.8	38	82	9
8.9	38	82	9
9.0	38	82	9
9.1	38	87	10

LIST9600			Unit: mm
Dc	l	L	Ds
9.2	38	87	10
9.3	38	87	10
9.4	38	87	10
9.5	38	87	10
9.6	41	87	10
9.7	41	87	10
9.8	41	87	10
9.9	41	87	10
10.0	41	87	10
10.1	41	93	11
10.2	41	93	11
10.3	41	93	11
10.4	41	93	11
10.5	41	93	11
10.6	45	93	11
10.7	45	93	11
10.8	45	93	11
10.9	45	93	11
11.0	45	93	11
11.1	45	100	12
11.2	45	100	12
11.3	45	100	12
11.4	45	100	12
11.5	45	100	12
11.6	47	100	12
11.7	47	100	12
11.8	47	100	12
11.9	47	100	12
12.0	47	100	12
12.1	47	100	13
12.2	47	100	13
12.3	47	100	13
12.4	47	100	13
12.5	47	100	13
12.6	49	100	13
12.7	49	100	13

LIST9600			Unit: mm
Dc	l	L	Ds
12.8	49	100	13
12.9	49	100	13
13.0	49	100	13
13.1	50	105	14
13.2	50	105	14
13.3	50	105	14
13.4	50	105	14
13.5	50	105	14
13.6	52	105	14
13.7	52	105	14
13.8	52	105	14
13.9	52	105	14
14.0	52	105	14
14.1	52	108	15
14.2	52	108	15
14.3	52	108	15
14.4	52	108	15
14.5	52	108	15
14.6	53	108	15
14.7	53	108	15
14.8	53	108	15
14.9	53	108	15
15.0	53	108	15
15.1	53	112	16
15.2	53	112	16
15.3	53	112	16
15.4	53	112	16
15.5	53	112	16
15.6	55	112	16
15.7	55	112	16
15.8	55	112	16
15.9	55	112	16
16.0	55	112	16

Standard Drilling Conditions

Work material		Structural steel & carbon steel gray cast iron		Alloy steel		Die steel Heat treated steel		High hardness steel		Ductile cast iron		Stainless steel	
		SS SC FC		SCM NAK HPM		SKD (30-40HRC)		(40-50HRC)		FCD		SUS	
	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
Conventional Condition	2	12700	600	10500	480	5600	230	4000	140	9500	450	4800	140
	3	8500	660	7000	540	3700	260	2650	160	6400	500	3200	150
	5	5100	660	4100	540	2200	260	1600	160	3800	500	1900	150
	8	3200	660	2600	540	1400	260	1000	160	2400	500	1200	150
	10	2550	630	2100	510	1100	250	800	150	1900	470	950	140
	12	2100	600	1700	480	950	230	650	140	1600	440	800	130
	16	1600	550	1300	440	700	210	500	130	1200	410	600	120
High Speed Condition	2	19100	900	15900	750	8000	330	6400	230	14000	670	Use under normal conditions.	
	3	12700	1000	10500	830	5300	370	4250	260	9500	750		
	5	7600	1000	6400	830	3200	370	2550	260	5700	750		
	8	4800	1000	4000	830	2000	370	1600	260	3600	750		
	10	3800	940	3200	790	1600	350	1250	240	2900	710		
	12	3200	890	2650	750	1300	330	1050	230	2400	670		
	16	2400	820	2000	690	1000	300	800	210	1800	620		

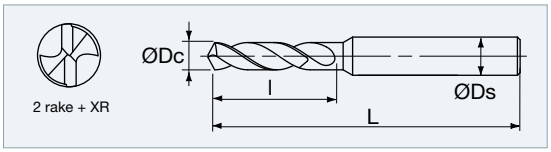
Attention on using the drilling condition tables

1. Utilize the standard drilling condition shown in the catalogs just as the general guide, when starting operation.
2. Adjust drilling condition when unusual vibration, different sound occur by cutting.
3. When using low speed machines, use the maximum speed and adjust the feed rate.
4. For drilling with water soluble cutting fluid.
5. Drilling of Aluminum Alloys & other light metals is not recommended.
6. Drilling the step feed in stainless steels when hole depth more than 2×D deep, step feed interval is about 0.5×D.
7. Use water soluble cutting fluid for the high speed condition.
8. Use air blow for cooling and the chips exclusion in dry drilling.

AQDEXR

VHM AQ EX h8 135° 30° h6

AQUA Drill EX Regular



LIST9602			Unit: mm
Dc	l	L	Ds
2.0	15	49	3
2.1	17	49	3
2.2	17	49	3
2.3	17	49	3
2.4	17	49	3
2.5	17	49	3
2.6	19	49	3
2.7	19	49	3
2.8	19	49	3
2.9	19	49	3
3.0	19	49	3
3.1	24	60	4
3.2	24	60	4
3.3	24	60	4
3.4	24	60	4
3.5	24	60	4
3.6	27	60	4
3.7	27	60	4
3.8	27	60	4
3.9	27	60	4
4.0	27	60	4
4.1	31	76	5
4.2	31	76	5
4.3	31	76	5
4.4	31	76	5
4.5	31	76	5
4.6	38	76	5
4.7	38	76	5
4.8	38	76	5
4.9	38	76	5
5.0	38	76	5
5.1	39	81	6
5.2	39	81	6
5.3	39	81	6
5.4	39	81	6
5.5	39	81	6

LIST9602			Unit: mm
Dc	l	L	Ds
5.6	41	81	6
5.7	41	81	6
5.8	41	81	6
5.9	41	81	6
6.0	41	81	6
6.1	42	83	7
6.2	42	83	7
6.3	42	83	7
6.4	42	83	7
6.5	42	83	7
6.6	43	83	7
6.7	43	83	7
6.8	43	83	7
6.9	43	83	7
7.0	43	83	7
7.1	45	90	8
7.2	45	90	8
7.3	45	90	8
7.4	45	90	8
7.5	45	90	8
7.6	48	90	8
7.7	48	90	8
7.8	48	90	8
7.9	48	90	8
8.0	48	90	8
8.1	53	98	9
8.2	53	98	9
8.3	53	98	9
8.4	53	98	9
8.5	53	98	9
8.6	55	98	9
8.7	55	98	9
8.8	55	98	9
8.9	55	98	9
9.0	55	98	9
9.1	58	105	10

LIST9602			Unit: mm
Dc	l	L	Ds
9.2	58	105	10
9.3	58	105	10
9.4	58	105	10
9.5	58	105	10
9.6	60	105	10
9.7	60	105	10
9.8	60	105	10
9.9	60	105	10
10.0	60	105	10
10.1	66	114	11
10.2	66	114	11
10.3	66	114	11
10.4	66	114	11
10.5	66	114	11
10.6	68	114	11
10.7	68	114	11
10.8	68	114	11
10.9	68	114	11
11.0	68	114	11
11.1	71	121	12
11.2	71	121	12
11.3	71	121	12
11.4	71	121	12
11.5	71	121	12
11.6	73	121	12
11.7	73	121	12
11.8	73	121	12
11.9	73	121	12
12.0	73	121	12
12.1	76	137	13
12.2	76	137	13
12.3	76	137	13
12.4	76	137	13
12.5	76	137	13
12.6	78	137	13
12.7	78	137	13

LIST9602			Unit: mm
Dc	l	L	Ds
12.8	78	137	13
12.9	78	137	13
13.0	78	137	13
13.1	84	147	14
13.2	84	147	14
13.3	84	147	14
13.4	84	147	14
13.5	84	147	14
13.6	86	147	14
13.7	86	147	14
13.8	86	147	14
13.9	86	147	14
14.0	86	147	14
14.1	89	153	15
14.2	89	153	15
14.3	89	153	15
14.4	89	153	15
14.5	89	153	15
14.6	91	153	15
14.7	91	153	15
14.8	91	153	15
14.9	91	153	15
15.0	91	153	15
15.1	94	160	16
15.2	94	160	16
15.3	94	160	16
15.4	94	160	16
15.5	94	160	16
15.6	96	160	16
15.7	96	160	16
15.8	96	160	16
15.9	96	160	16
16.0	96	160	16

Standard Drilling Conditions

Work material		Structural steel & carbon steel gray cast iron		Alloy steel		Die steel heat treated steel		High hardness steel		Ductile cast iron		Stainless steel	
		SS SC FC		SCM NAK HPM		SKD (30-40HRC)		(40-50HRC)		FCD		SUS	
	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
Conventional Condition	2	12700	530	10500	430	5600	200	4000	130	9500	400	4800	130
	3	8500	590	7000	480	3700	220	2650	140	6400	440	3200	140
	5	5100	590	4100	480	2200	220	1600	140	3800	440	1900	140
	8	3200	590	2600	480	1400	220	1000	140	2400	440	1200	140
	10	2550	560	2100	460	1100	210	800	140	1900	420	950	130
	12	2100	530	1700	430	950	200	650	130	1600	400	800	120
	16	1600	490	1300	390	700	180	500	120	1200	370	600	110
High Speed Condition	2	19100	790	15900	660	8000	290	6400	210	14000	590	Use under normal conditions.	
	3	12700	880	10500	730	5300	320	4250	230	9500	660		
	5	7600	880	6400	730	3200	320	2550	230	5700	660		
	8	4800	880	4000	730	2000	320	1600	230	3600	660		
	10	3800	840	3200	700	1600	300	1250	220	2900	630		
	12	3200	790	2650	660	1300	280	1050	210	2400	600		
	16	2400	730	2000	610	1000	260	800	190	1800	550		

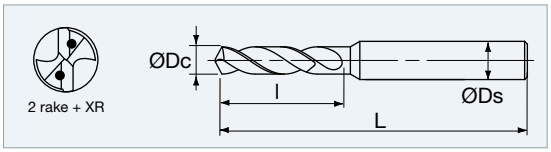
Attention on using the drilling condition tables

1. Utilize the standard drilling condition shown in the catalogs just as the general guide, when starting operation.
2. Adjust drilling condition when unusual vibration, different sound occur by cutting.
3. When using low speed machines, use the maximum speed and adjust the feed rate.
4. For drilling with water soluble cutting fluid.
5. Drilling Aluminum Alloys,Light Metals are not recommended.
6. Drilling the step feed in stainless steels when hole depth more then 2×D deep, step feed interval is about 0.5×D.
7. Use water soluble cutting fluid for the high speed condition.
8. Use air blow for cooling and the chips exclusion in dry drilling.

AQDEXOH3D

VHM AQ EX h7 135° N h6

AQUA Drill EX Oil-Hole 3D



LIST9604			Unit: mm
Dc	l	L	Ds
3.0	17	68	3
3.1	20	72	4
3.2	20	72	4
3.3	20	72	4
3.4	20	72	4
3.5	20	72	4
3.6	22	72	4
3.7	22	72	4
3.8	22	72	4
3.9	22	72	4
4.0	22	72	4
4.1	25	80	5
4.2	25	80	5
4.3	25	80	5
4.4	25	80	5
4.5	25	80	5
4.6	27	80	5
4.7	27	80	5
4.8	27	80	5
4.9	27	80	5
5.0	27	80	5
5.1	27	82	6
5.2	27	82	6
5.3	27	82	6
5.4	27	82	6
5.5	27	82	6
5.6	30	82	6
5.7	30	82	6
5.8	30	82	6
5.9	30	82	6
6.0	30	82	6
6.1	32	88	7
6.2	32	88	7
6.3	32	88	7
6.4	32	88	7

LIST9604			Unit: mm
Dc	l	L	Ds
6.5	32	88	7
6.6	35	88	7
6.7	35	88	7
6.8	35	88	7
6.9	35	88	7
7.0	35	88	7
7.1	37	94	8
7.2	37	94	8
7.3	37	94	8
7.4	37	94	8
7.5	37	94	8
7.6	40	94	8
7.7	40	94	8
7.8	40	94	8
7.9	40	94	8
8.0	40	94	8
8.1	42	100	9
8.2	42	100	9
8.3	42	100	9
8.4	42	100	9
8.5	42	100	9
8.6	45	100	9
8.7	45	100	9
8.8	45	100	9
8.9	45	100	9
9.0	45	100	9
9.1	47	106	10
9.2	47	106	10
9.3	47	106	10
9.4	47	106	10
9.5	47	106	10
9.6	50	106	10
9.7	50	106	10
9.8	50	106	10
9.9	50	106	10

LIST9604			Unit: mm
Dc	l	L	Ds
10.0	50	106	10
10.1	52	116	11
10.2	52	116	11
10.3	52	116	11
10.4	52	116	11
10.5	52	116	11
10.6	55	116	11
10.7	55	116	11
10.8	55	116	11
10.9	55	116	11
11.0	55	116	11
11.1	57	122	12
11.2	57	122	12
11.3	57	122	12
11.4	57	122	12
11.5	57	122	12
11.6	60	122	12
11.7	60	122	12
11.8	60	122	12
11.9	60	122	12
12.0	60	122	12
12.1	62	128	13
12.2	62	128	13
12.3	62	128	13
12.4	62	128	13
12.5	62	128	13
12.6	65	128	13
12.7	65	128	13
12.8	65	128	13
12.9	65	128	13
13.0	65	128	13
13.1	67	134	14
13.2	67	134	14
13.3	67	134	14
13.4	67	134	14

LIST9604			Unit: mm
Dc	l	L	Ds
13.5	67	134	14
13.6	70	134	14
13.7	70	134	14
13.8	70	134	14
13.9	70	134	14
14.0	70	134	14
14.1	72	140	15
14.2	72	140	15
14.3	72	140	15
14.4	72	140	15
14.5	72	140	15
14.6	75	140	15
14.7	75	140	15
14.8	75	140	15
14.9	75	140	15
15.0	75	140	15
15.1	77	146	16
15.2	77	146	16
15.3	77	146	16
15.4	77	146	16
15.5	77	146	16
15.6	80	146	16
15.7	80	146	16
15.8	80	146	16
15.9	80	146	16
16.0	80	146	16

Standard Drilling Conditions

Work material		Structural steel & carbon steel gray cast iron		Alloy steel		Die steel heat treated steel		High hardness steel		Ductile cast iron		Stainless steel	
		SS SC FC		SCM NAK HPM		SKD (30–40HRC)		(40–50HRC)		FCD		SUS	
	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
Wet Condition	3	12700	1150	10600	950	8500	760	5300	400	10600	950	8500	680
	4	9600	1150	8000	950	6400	760	4000	330	8000	950	6400	680
	6	6400	1070	5300	950	4200	710	2700	320	5300	950	4200	660
	8	4800	1070	4000	880	3200	710	2000	320	4000	880	3200	620
	10	3800	960	3200	790	2500	640	1600	290	3200	790	2500	540
	12	3200	800	2700	670	2100	540	1300	290	2700	670	2100	500
	14	2700	760	2300	650	1800	510	1100	270	2300	650	1800	500
MQL Condition	16	2400	730	2000	620	1600	480	1000	260	2000	620	1600	480
	3	8500	710	7400	520	6400	540	3200	210	7400	620		
	4	6400	710	5600	520	4800	540	2400	190	5600	620		
	6	4200	710	3700	520	3200	540	1600	180	3700	620		
	8	3200	660	2800	490	2400	500	1200	170	2800	580		
	10	2500	590	2200	440	1900	440	960	160	2200	500		
	12	2100	510	1900	370	1600	380	800	150	1900	460		
	14	1800	480	1600	350	1400	360	680	150	1600	430		
	16	1600	460	1400	330	1200	340	600	140	1400	400		

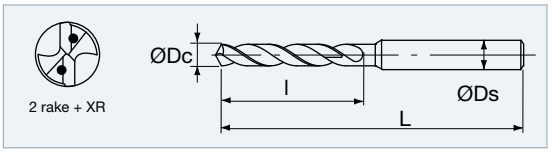
Attention on using the drilling condition tables

1. Adjust drilling condition according to the rigidity of machine or work clamp state.
2. Wet condition are for drilling with water soluble cutting fl uid.
3. In non water soluble cutting fl uid, reduce the rotation and feed by 20%.
4. Use on internal coolant.
5. In step feed, return to the entrance hole.
6. Step feed interval is about 0.2–1×D.

AQDEXOH5D

VHM | AQ EX | h7 | 135° | N | h6

AQUA Drill EX Oil-Hole 5D



LIST9606 Unit: mm

Dc	l	L	Ds
3.0	28	78	3
3.1	32	86	4
3.2	32	86	4
3.3	32	86	4
3.4	32	86	4
3.5	32	86	4
3.6	36	86	4
3.7	36	86	4
3.8	36	86	4
3.9	36	86	4
4.0	36	86	4
4.1	40	98	5
4.2	40	98	5
4.3	40	98	5
4.4	40	98	5
4.5	40	98	5
4.6	44	98	5
4.7	44	98	5
4.8	44	98	5
4.9	44	98	5
5.0	44	98	5
5.1	44	100	6
5.2	44	100	6
5.3	44	100	6
5.4	44	100	6
5.5	44	100	6
5.6	48	100	6
5.7	48	100	6
5.8	48	100	6
5.9	48	100	6
6.0	48	100	6
6.1	52	109	7
6.2	52	109	7
6.3	52	109	7
6.4	52	109	7

LIST9606 Unit: mm

Dc	l	L	Ds
6.5	52	109	7
6.6	56	109	7
6.7	56	109	7
6.8	56	109	7
6.9	56	109	7
7.0	56	109	7
7.1	60	118	8
7.2	60	118	8
7.3	60	118	8
7.4	60	118	8
7.5	60	118	8
7.6	64	118	8
7.7	64	118	8
7.8	64	118	8
7.9	64	118	8
8.0	64	118	8
8.1	68	127	9
8.2	68	127	9
8.3	68	127	9
8.4	68	127	9
8.5	68	127	9
8.6	72	127	9
8.7	72	127	9
8.8	72	127	9
8.9	72	127	9
9.0	72	127	9
9.1	76	136	10
9.2	76	136	10
9.3	76	136	10
9.4	76	136	10
9.5	76	136	10
9.6	80	136	10
9.7	80	136	10
9.8	80	136	10
9.9	80	136	10

LIST9606 Unit: mm

Dc	l	L	Ds
10.0	80	136	10
10.1	84	149	11
10.2	84	149	11
10.3	84	149	11
10.4	84	149	11
10.5	84	149	11
10.6	88	149	11
10.7	88	149	11
10.8	88	149	11
10.9	88	149	11
11.0	88	149	11
11.1	92	158	12
11.2	92	158	12
11.3	92	158	12
11.4	92	158	12
11.5	92	158	12
11.6	96	158	12
11.7	96	158	12
11.8	96	158	12
11.9	96	158	12
12.0	96	158	12
12.1	100	167	13
12.2	100	167	13
12.3	100	167	13
12.4	100	167	13
12.5	100	167	13
12.6	104	167	13
12.7	104	167	13
12.8	104	167	13
12.9	104	167	13
13.0	104	167	13
13.1	108	176	14
13.2	108	176	14
13.3	108	176	14
13.4	108	176	14

LIST9606 Unit: mm

Dc	l	L	Ds
13.5	108	176	14
13.6	112	176	14
13.7	112	176	14
13.8	112	176	14
13.9	112	176	14
14.0	112	176	14
14.1	116	185	15
14.2	116	185	15
14.3	116	185	15
14.4	116	185	15
14.5	116	185	15
14.6	120	185	15
14.7	120	185	15
14.8	120	185	15
14.9	120	185	15
15.0	120	185	15
15.1	124	194	16
15.2	124	194	16
15.3	124	194	16
15.4	124	194	16
15.5	124	194	16
15.6	128	194	16
15.7	128	194	16
15.8	128	194	16
15.9	128	194	16
16.0	128	194	16

Standard Drilling Conditions

Work material		Structural steel & carbon steel gray cast iron		Alloy steel		Die steel heat treated steel		High hardness steel		Ductile cast iron		Stainless steel	
		SS SC FC		SCM NAK HPM		SKD (30–40HRC)		(40–50HRC)		FCD		SUS	
	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
Wet Condition	3	12700	1150	10600	950	8500	760	5300	400	10600	950	8500	680
	4	9600	1150	8000	950	6400	760	4000	330	8000	950	6400	680
	6	6400	1070	5300	950	4200	710	2700	320	5300	950	4200	660
	8	4800	1070	4000	880	3200	710	2000	320	4000	880	3200	620
	10	3800	960	3200	790	2500	640	1600	290	3200	790	2500	540
	12	3200	800	2700	670	2100	540	1300	290	2700	670	2100	500
	14	2700	760	2300	650	1800	510	1100	270	2300	650	1800	500
MQL Condition	16	2400	730	2000	620	1600	480	1000	260	2000	620	1600	480
	3	8500	710	7400	520	6400	540	3200	210	7400	620		
	4	6400	710	5600	520	4800	540	2400	190	5600	620		
	6	4200	710	3700	520	3200	540	1600	180	3700	620		
	8	3200	660	2800	490	2400	500	1200	170	2800	580		
	10	2500	590	2200	440	1900	440	960	160	2200	500		
	12	2100	510	1900	370	1600	380	800	150	1900	460		
	14	1800	480	1600	350	1400	360	680	150	1600	430		
	16	1600	460	1400	330	1200	340	600	140	1400	400		

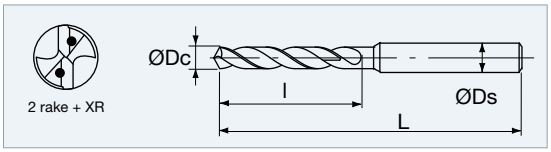
Attention on using the drilling condition tables

1. Adjust drilling condition according to the rigidity of machine or work clamp state.
2. Wet condition are for drilling with water soluble cutting fluid.
3. In non water soluble cutting fluid, reduce the rotation and feed by 20%.
4. Use on internal coolant.
5. When for hole depth more then 5×D deep, add step seeding. However, a work material and drilling condition to Chip removal may be worse. In that case, add A even if drilling depth 5×D is as follows.
6. In step feed, return to the entrance hole.
7. Step feed interval is about 0.2–1×D.

AQDEXOH8D

VHM AQ EX h7 135° N h6

AQUA Drill EX Oil-Hole 8D



LIST9608 Unit: mm

Dc	l	L	Ds
3.0	33	81	3
3.1	38	92	4
3.2	38	92	4
3.3	38	92	4
3.4	38	92	4
3.5	38	92	4
3.6	44	92	4
3.7	44	92	4
3.8	44	92	4
3.9	44	92	4
4.0	44	92	4
4.1	49	105	5
4.2	49	105	5
4.3	49	105	5
4.4	49	105	5
4.5	49	105	5
4.6	55	105	5
4.7	55	105	5
4.8	55	105	5
4.9	55	105	5
5.0	55	105	5
5.1	60	118	6
5.2	60	118	6
5.3	60	118	6
5.4	60	118	6
5.5	60	118	6
5.6	66	118	6
5.7	66	118	6
5.8	66	118	6
5.9	66	118	6
6.0	66	118	6
6.1	71	130	7
6.2	71	130	7
6.3	71	130	7
6.4	71	130	7

LIST9608 Unit: mm

Dc	l	L	Ds
6.5	71	130	7
6.6	77	130	7
6.7	77	130	7
6.8	77	130	7
6.9	77	130	7
7.0	77	130	7
7.1	82	142	8
7.2	82	142	8
7.3	82	142	8
7.4	82	142	8
7.5	82	142	8
7.6	88	142	8
7.7	88	142	8
7.8	88	142	8
7.9	88	142	8
8.0	88	142	8
8.1	93	154	9
8.2	93	154	9
8.3	93	154	9
8.4	93	154	9
8.5	93	154	9
8.6	99	154	9
8.7	99	154	9
8.8	99	154	9
8.9	99	154	9
9.0	99	154	9
9.1	104	166	10
9.2	104	166	10
9.3	104	166	10
9.4	104	166	10
9.5	104	166	10
9.6	110	166	10
9.7	110	166	10
9.8	110	166	10
9.9	110	166	10

LIST9608 Unit: mm

Dc	l	L	Ds
10.0	110	166	10
10.1	115	182	11
10.2	115	182	11
10.3	115	182	11
10.4	115	182	11
10.5	115	182	11
10.6	121	182	11
10.7	121	182	11
10.8	121	182	11
10.9	121	182	11
11.0	121	182	11
11.1	126	194	12
11.2	126	194	12
11.3	126	194	12
11.4	126	194	12
11.5	126	194	12
11.6	132	194	12
11.7	132	194	12
11.8	132	194	12
11.9	132	194	12
12.0	132	194	12
12.1	137	206	13
12.2	137	206	13
12.3	137	206	13
12.4	137	206	13
12.5	137	206	13
12.6	143	206	13
12.7	143	206	13
12.8	143	206	13
12.9	143	206	13
13.0	143	206	13
13.1	148	218	14
13.2	148	218	14
13.3	148	218	14
13.4	148	218	14

LIST9608 Unit: mm

Dc	l	L	Ds
13.5	148	218	14
13.6	154	218	14
13.7	154	218	14
13.8	154	218	14
13.9	154	218	14
14.0	154	218	14
14.1	159	230	15
14.2	159	230	15
14.3	159	230	15
14.4	159	230	15
14.5	159	230	15
14.6	165	230	15
14.7	165	230	15
14.8	165	230	15
14.9	165	230	15
15.0	165	230	15
15.1	170	242	16
15.2	170	242	16
15.3	170	242	16
15.4	170	242	16
15.5	170	242	16
15.6	176	242	16
15.7	176	242	16
15.8	176	242	16
15.9	176	242	16
16.0	176	242	16

Standard Drilling Conditions

Work material		Structural steel & carbon steel gray cast iron		Alloy steel		Die steel heat treated steel		High hardness steel		Ductile cast iron		Stainless steel	
		SS SC FC		SCM NAK HPM		SKD (30-40HRC)		(40-50HRC)		FCD		SUS	
	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
Wet Condition	3	12700	950	10600	840	8500	630	5300	320	10600	800	8500	630
	4	9600	950	8000	840	6400	630	4000	320	8000	800	6400	630
	6	6400	890	5300	840	4200	600	2700	300	5300	740	4200	600
	8	4800	890	4000	800	3200	590	2000	300	4000	740	3200	570
	10	3800	790	3200	710	2500	530	1600	290	3200	680	2500	510
	12	3200	730	2700	640	2100	480	1300	270	2700	630	2100	490
	14	2700	690	2300	600	1800	460	1100	270	2300	590	1800	490
MQL Condition	16	2400	650	2000	580	1600	440	1000	260	2000	550	1600	470
	3	8500	560	7400	450	6400	400	3200	180	7400	500		
	4	6400	560	5600	450	4800	400	2400	180	5600	500		
	6	4200	540	3700	450	3200	370	1600	170	3700	470		
	8	3200	540	2800	430	2400	370	1200	170	2800	470		
	10	2600	510	2200	400	1900	340	1000	150	2200	440		
	12	2100	480	1900	350	1600	340	800	150	1900	430		
	14	1800	430	1600	330	1400	340	700	140	1600	390		
	16	1600	410	1400	310	1200	330	600	140	1400	360		

Attention on using the drilling condition tables

1. Adjust drilling condition according to the rigidity of machine or work clamp state.
2. Wet condition are for drilling with water soluble cutting fluid.
3. In non water soluble cutting fluid, reduce the rotation and feed by 20%.
4. Use on internal coolant.
5. When for hole depth more then 5×D deep, add step seeding. However, a work material and drilling condition to Chip removal may be worse. In that case, add A even if drilling depth 5×D is as follows.
6. In step feed, return to the entrance hole.
7. Step feed interval is about 0.2–1×D.

Internal oil hole and three flutes provide high precision and great performance

AQUA Drill EX Series

Oil Hole 3 Flutes

AQDEXOH3F

3D 5D

High Precision and High Efficient Oil Hole 3 Flute Drill

AQUA Drill EX

Oil Hole 3 Flutes

AQDEXOH3F 3D 5D

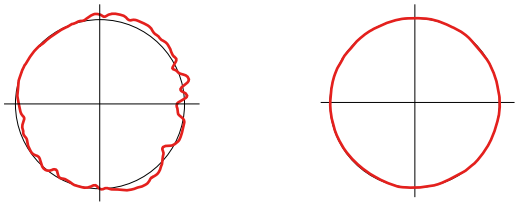
- High precision drilling until 5D depth possible
- Well balanced 3flute and optimized point geometry together with the oil hole will realize the high efficient drilling

High precision drilling

Roundness comparison

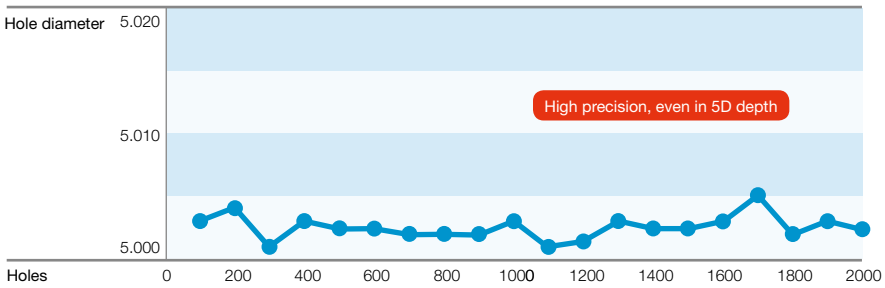
Conventional drill	
Cutting speed:	45 m/min
Feed:	300 mm/rev. (0.25 mm/rev)
Roundness:	14.5 µm

AQDEXOH3D	
Cutting speed:	50 m/min
Feed:	570 mm/rev. (0.43 mm/rev)
Roundness:	1.7 µm



Cutting Condition	
Tool:	L9826 AQDEXOH3F3D 12.0 mm
Cutting depth:	36 mm blind hole
Material:	Stainless steel 1.4301 (SUS304)
Cutting fluid:	Water soluble

Transition of hole enlargement with AQDEXOH3F5D

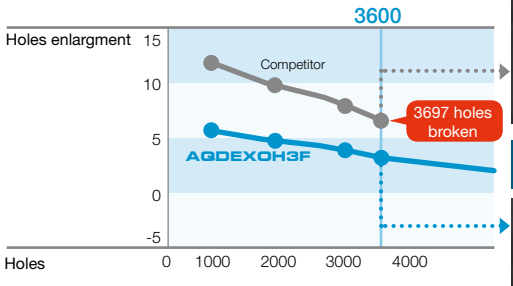


Cutting Condition	
Tool:	L9820 AQDEXOH3F3D 5.0 mm
Cutting speed:	100 m/min
Feed:	1280 mm/min (conventional drill was 950 mm/min)
Cutting depth:	25 mm blind hole
Material:	C50 (180 HB)
Cutting fluid:	Water soluble

High Efficient and Long Tool Life

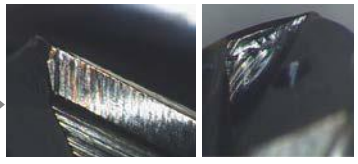
High feed non-step drilling

Feed 1500 mm/min, 5D depth

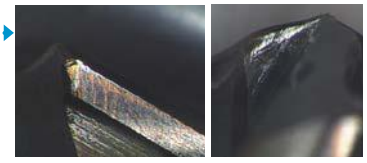


Cycle time 1.2 sec/hole
Total cutting length over 150 m

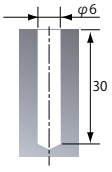
Competitor



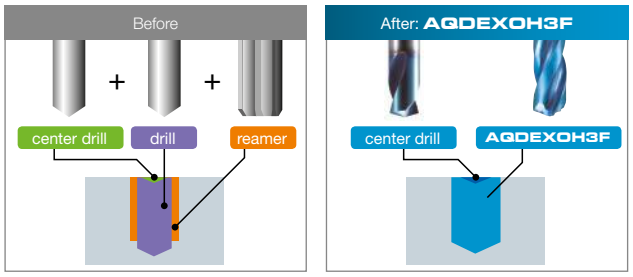
AQDEXOH3F5D 6.0

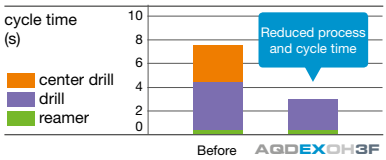


Cutting Condition	
Tool:	L9820 AQDEXOH3F5D 6.0 mm
Cutting speed:	120 m/min
Feed:	1500 mm/min
Cutting depth:	30 mm
Material:	C50 (180 HB)
Cutting fluid:	Water soluble



Process reduction



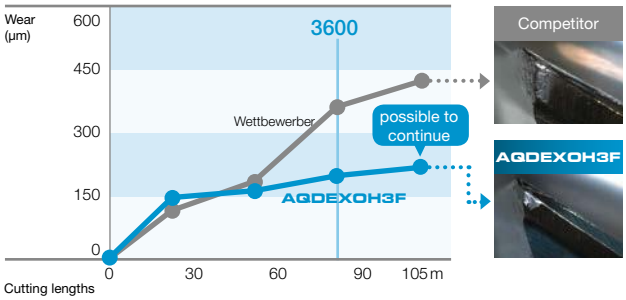


Cutting Condition

Hole requirement:	12.0 mm
Material:	C50 (200 HB)
Cutting depth:	20 mm

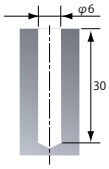
Stable drilling on Structural Steels (ST37-2)

Wear comparison after 150 m driling!



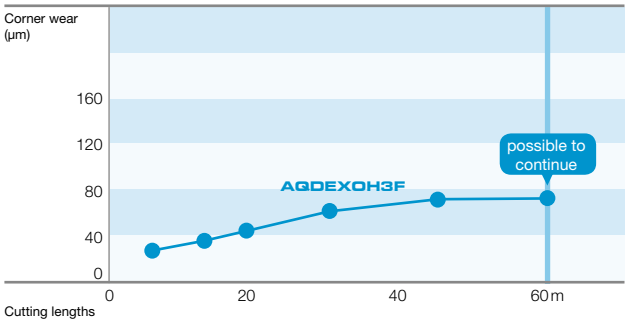
Cutting Condition

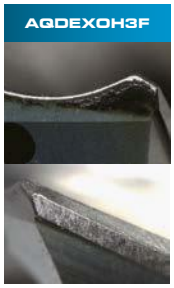
Tool:	L9820 AQDEXOH3F5D 6.0 mm
Cutting speed:	100 m/min
Feed:	1280 mm/min (0.24 mm/rev)
Cutting depth:	30 mm blind hole
Material:	Structural steel ST37-2 (SS400)
Cutting fluid:	Water soluble



Long tool life even on Stainless Steel 1.4301 (SUS304)

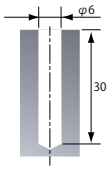
Wear comparison after 60 m driling





Cutting Condition

Tool:	L9820 AQDEXOH3F5D 6.0 mm
Cutting speed:	50 m/min
Feed:	480 mm/min (0.18 mm/rev)
Cutting depth:	30 mm blind hole
Material:	Structural steel 1.4301 (SUS304)
Cutting fluid:	Water soluble

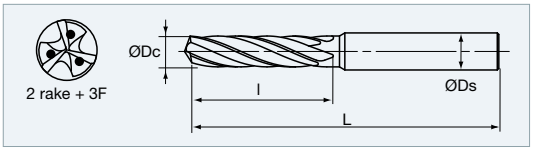


Applicable work materials

Structural Steels	Carbon Steels	Pre-Hard-ened Steels Alloy Steels	Hardened Steels Mold Steels	Hardened Steels		Stainless Steels		Ti Alloys Ni Alloys	Cast Iron	Alumnium Alloys	Copper Alloys
ST37-2	C45/C50	42CrMo4 SCR/NAK	30~40 HRC	40~50 HRC	50~65 HRC	Austentic 1.4301/1.4401 SUS304/SUS316	Martenstic 1.4021/1.4028 SUS420		GG/GGG	Al/ADC	Cu
■	■	■	■	■		❍	❍		❍		

AQDEXOH3F3D

AQUA Drill EX Oil-Hole 3Flutes 3D



LIST9826			Unit: mm
Dc	l	L	Ds
3.0	17	68	3
3.1	20	72	4
3.2	20	72	4
3.3	20	72	4
3.4	20	72	4
3.5	20	72	4
3.6	22	72	4
3.7	22	72	4
3.8	22	72	4
3.9	22	72	4
4.0	22	72	4
4.1	25	80	5
4.2	25	80	5
4.3	25	80	5
4.4	25	80	5
4.5	25	80	5
4.6	27	80	5
4.7	27	80	5
4.8	27	80	5
4.9	27	80	5
5.0	27	80	5
5.1	27	82	6
5.2	27	82	6
5.3	27	82	6
5.4	27	82	6
5.5	27	82	6

LIST9826			Unit: mm
Dc	l	L	Ds
5.6	30	82	6
5.7	30	82	6
5.8	30	82	6
5.9	30	82	6
6.0	30	82	6
6.1	32	88	7
6.2	32	88	7
6.3	32	88	7
6.4	32	88	7
6.5	32	88	7
6.6	35	88	7
6.7	35	88	7
6.8	35	88	7
6.9	35	88	7
7.0	35	88	7
7.1	37	94	8
7.2	37	94	8
7.3	37	94	8
7.4	37	94	8
7.5	37	94	8
7.6	40	94	8
7.7	40	94	8
7.8	40	94	8
7.9	40	94	8
8.0	40	94	8
8.1	42	100	9

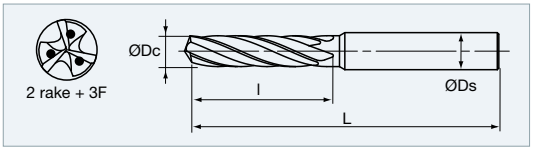
LIST9826			Unit: mm
Dc	l	L	Ds
8.2	42	100	9
8.3	42	100	9
8.4	42	100	9
8.5	42	100	9
8.6	45	100	9
8.7	45	100	9
8.8	45	100	9
8.9	45	100	9
9.0	45	100	9
9.1	47	106	10
9.2	47	106	10
9.3	47	106	10
9.4	47	106	10
9.5	47	106	10
9.6	50	106	10
9.7	50	106	10
9.8	50	106	10
9.9	50	106	10
10.0	50	106	10
10.1	52	116	11
10.2	52	116	11
10.3	52	116	11
10.4	52	116	11
10.5	52	116	11
10.6	55	116	11
10.7	55	116	11

LIST9826			Unit: mm
Dc	l	L	Ds
10.8	55	116	11
10.9	55	116	11
11.0	55	116	11
11.1	57	122	12
11.2	57	122	12
11.3	57	122	12
11.4	57	122	12
11.5	57	122	12
11.6	60	122	12
11.7	60	122	12
11.8	60	122	12
11.9	60	122	12
12.0	60	122	12
12.1	62	128	13
12.5	62	128	13
13.0	65	128	13
13.5	67	134	14
14.0	70	134	14
14.1	72	140	15
14.5	72	140	15
15.0	75	140	15
15.5	77	146	16
15.6	80	146	16
16.0	80	146	16

AQDEXOH3F5D

VHM AQ EX 25° ~30° js6 140° h6

AQUA Drill EX Oil-Hole 3Flutes 5D



LIST9820			Unit: mm
Dc	l	L	Ds
3.0	28	78	3
3.1	32	86	4
3.2	32	86	4
3.3	32	86	4
3.4	32	86	4
3.5	32	86	4
3.6	36	86	4
3.7	36	86	4
3.8	36	86	4
3.9	36	86	4
4.0	36	86	4
4.1	40	98	5
4.2	40	98	5
4.3	40	98	5
4.4	40	98	5
4.5	40	98	5
4.6	44	98	5
4.7	44	98	5
4.8	44	98	5
4.9	44	98	5
5.0	44	98	5
5.1	44	100	6
5.2	44	100	6
5.3	44	100	6
5.4	44	100	6
5.5	44	100	6

LIST9820			Unit: mm
Dc	l	L	Ds
5.6	48	100	6
5.7	48	100	6
5.8	48	100	6
5.9	48	100	6
6.0	48	100	6
6.1	52	109	7
6.2	52	109	7
6.3	52	109	7
6.4	52	109	7
6.5	52	109	7
6.6	56	109	7
6.7	56	109	7
6.8	56	109	7
6.9	56	109	7
7.0	56	109	7
7.1	60	118	8
7.2	60	118	8
7.3	60	118	8
7.4	60	118	8
7.5	60	118	8
7.6	64	118	8
7.7	64	118	8
7.8	64	118	8
7.9	64	118	8
8.0	64	118	8
8.1	68	127	9

LIST9820			Unit: mm
Dc	l	L	Ds
8.2	68	127	9
8.3	68	127	9
8.4	68	127	9
8.5	68	127	9
8.6	72	127	9
8.7	72	127	9
8.8	72	127	9
8.9	72	127	9
9.0	72	127	9
9.1	76	136	10
9.2	76	136	10
9.3	76	136	10
9.4	76	136	10
9.5	76	136	10
9.6	80	136	10
9.7	80	136	10
9.8	80	136	10
9.9	80	136	10
10.0	80	136	10
10.1	84	149	11
10.2	84	149	11
10.3	84	149	11
10.4	84	149	11
10.5	84	149	11
10.6	88	149	11
10.7	88	149	11

LIST9820			Unit: mm
Dc	l	L	Ds
10.8	88	149	11
10.9	88	149	11
11.0	88	149	11
11.1	92	158	12
11.2	92	158	12
11.3	92	158	12
11.4	92	158	12
11.5	92	158	12
11.6	96	158	12
11.7	96	158	12
11.8	96	158	12
11.9	96	158	12
12.0	96	158	12
12.1	100	167	13
12.5	100	167	13
13.0	104	167	13
13.5	108	176	14
14.0	112	176	14
14.1	116	185	15
14.5	116	185	15
15.0	120	185	15
15.5	124	194	16
15.6	128	194	16
16.0	128	194	16

Standard Drilling Conditions AQDEXOH3F3D/5D

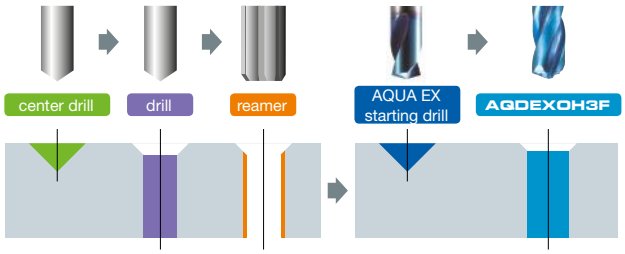
Work material	Structural Steels Carbon Steels Grey cast iron ST-37-2, C50, GG		Alloy Steels Pre-Hardened Steels		Mold Steels Hardened Steels		Hardened Steels		Stainless Steels 1.4301, 1.4401		Cast Irons GGG	
	–200HB		20–30HRC		30–40HRC		40–50HRC					
mm	min^{-1}	mm/min	min^{-1}	mm/min	min^{-1}	mm/min	min^{-1}	mm/min	min^{-1}	mm/min	min^{-1}	mm/min
3.0	10700	1280	8500	1020	7450	780	5600	540	5300	560	8500	1020
4.0	8000	1280	6400	1020	5600	780	4200	540	4000	560	6400	1020
6.0	5300	1280	4250	1020	3750	780	2800	540	2650	560	4250	1020
8.0	4000	1280	3200	1020	2800	780	2100	540	2000	560	3200	1020
10.0	3200	1280	2550	1020	2250	780	1700	540	1600	560	2550	1020
12.0	2650	1280	2100	1020	1850	780	1400	540	1350	560	2100	1020
14.0	2250	1120	1800	900	1600	670	1200	450	1150	480	1800	890
16.0	2000	1120	1600	900	1400	670	1050	450	1000	480	1600	890

Attention on using the drilling condition tables

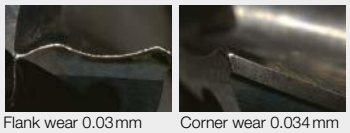
1. Adjust cutting conditions according to the situation, such as rigidity of machine, work clamp, and shape of workpiece.
2. Cutting conditions listed here use water-soluble cutting fluid.
3. Reduce RPM and feed speeds by 20% for non-water-soluble cutting fluids.
4. Use internal coolant.
5. These drilling conditions are for the AQDEXOH3F3D up to 3D and for the AQDEXOH3F5D up to 5D. However a work material and drilling condition to chip removal may be worse. In that case, add step feed even if drilling depth 3xD, 5xD it as follows.
6. In step feed, return to the entrance hole.
7. Step feed intarval is about 0.2~1xD.
8. Set up the chuck for the drill bit so there is less than 0.01mm of runout.

Other examples

Machine part Stainless steel 1.4301 (SUS304)



AQDEXOH3D after 2260 holes



Flank wear 0.03mm

Corner wear 0.034mm

Hole tolerance

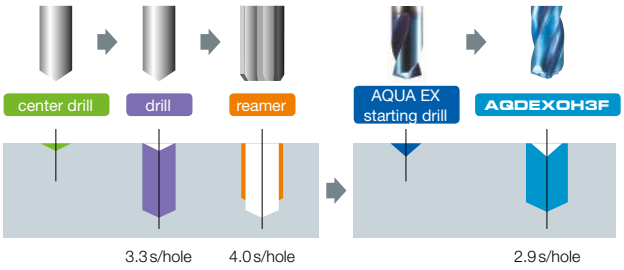
Hole enlargment under 0.01 mm
Roundness under 0.01 mm
Cylindricity under 0.02 mm

Possible to continue

Cutting Condition

Tool:	L9826 AQDEXOH3F3D 4.4mm
Cutting speed:	40m/min
Feed:	300mm/min
Hole depth:	7 mm through hole
Machine:	Vertical Machining Centre (BT40)
Cutting fluid:	Water soluble

Construction equipment parts C45 (200 HB)



Succeed Ø14.0 H7
Succeed reducing process
Reduced 60% of cycle time

Cutting Condition

Tool:	L9826 AQDEXOH3F3D 14.0mm
Cutting speed:	65m/min
Feed:	430mm/min
Hole depth:	21 mm through hole
Machine:	Vertical Machining Centre (BT40)
Cutting fluid:	Water soluble

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