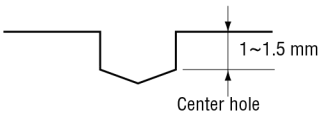
Sigma Drill Hard DZ-DHS TYPE

■ RECOMMENDED CUTTING CONDITIONS

Work Materials	SKT, SKD61 (48~56HRC)		SKD11, SKH (57~62HRC)		SKD11, SKH (63~70HRC)	
Drill dia. (mm)	Spindle speed n (min^{-1})	Feed speed Vf (mm/min)	Spindle speed n (min^{-1})	Feed speed Vf (mm/min)	Spindle speed n (min^{-1})	Feed speed Vf (mm/min)
	Cutting speed Vc (m/min)	Feed rate f (mm/rev)	Cutting speed Vc (m/min)	Feed rate f (mm/rev)	Cutting speed Vc (m/min)	Feed rate f (mm/rev)
9	710	53	460	30	355	18
	15~25	0.06~0.09	10~15	0.05~0.08	7~12	0.04~0.06
10	640	51	415	29	320	17
	15~25	0.06~0.1	10~15	0.05~0.09	7~12	0.04~0.07
11	580	46	375	26	290	15
	15~25	0.06~0.1	10~15	0.05~0.09	7~12	0.04~0.07
12	530	47	345	25	265	15
	15~25	0.06~0.12	10~15	0.05~0.1	7~12	0.04~0.08

■ NOTE

1) Use water soluble coolant.
2) Not recommended todrilling for general steel.
3) Recommend to use under the conditions of high accurate and rigid machine and rigid work.
4) The cutting parameters is for drilling depth 3 x Dc. Incase of drilling dept hover 3 x Dc, step feed is recommended.
5) To prevent breakage of drill, not recommend to making through hole. Please se tplanking.
6) Recommend to making center hole.

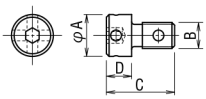
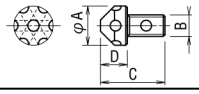


Tooling by DIJET®

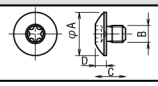
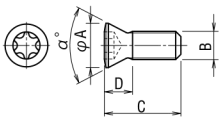
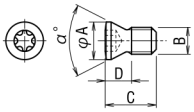
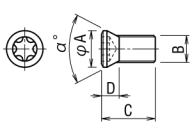
Technical Information

Parts

Adjustable screw

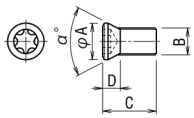
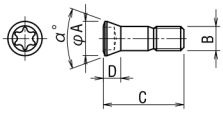
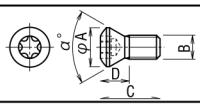
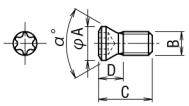
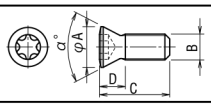
Drawings	Cat. No.	Dimensions (mm)						Wrench
		A	B	C	D	E	α°	
	**ASW-113**	4.8	No.10-32UNF	12.7	4.8	—	—	AD-1845
	ADS-513	7.8	M5×0.5	13.0	5.0	—	—	AD-2080
	ADS-514	5.6	M5×0.5	14.5	6.5	—	—	AD-2080
	**ASW-513**	9.0	M5×0.5	13.0	5.0	—	—	AD-1845

Clamp screw

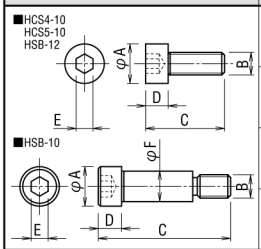
Drawings	Cat. No.	Dimensions (mm)						Wrench	Recommended torque (N•m)
		A	B	C	D	E	α°		
	**CB3540**	9.0	M3.5×0.6	6.3	2.3	—	—	T-15	2.1
	**CSW-1838**	2.7	M1.8×0.35	3.7	1.8	—	55	T-6	0.25
	CSW-206	3.5	M2.5×0.45	5.0	2.4	—	55	T-8	0.9
	CSW-2542	3.0	M2.5×0.45	4.2	2.5	—	43	T-7	0.9
	CSW-2547	3.4	M2.5×0.45	4.7	2.5	—	43	T-7	0.9
	CSW-3570	5.5	M3.5×0.6	7.0	3.5	—	55	T-15	2.1
	CSW-3575	5.5	M3.5×0.6	7.5	3.5	—	55	T-15	2.1
	CSW-3595	5.5	M3.5×0.6	9.5	3.5	—	55	T-15	2.1
	CSW-406H	5.0	M4×0.7	6.0	3.6	—	43	T-15	3.6
	CSW-407	5.0	M4×0.7	7.0	3.6	—	43	T-15	3.6
	CSW-408H	5.0	M4×0.7	8.0	3.6	—	43	T-15	3.6
	CSW-4510	6.6	M4.5×0.75	10.0	4.0	—	57	T-20	5.0
	CSW-510	6.4	M5×0.8	11.0	4.5	—	43	T-20	5.5
	CSW-513H	7.0	M5×0.8	13.0	4.4	—	63	T-20	5.5
	CSW-515	7.0	M5×0.8	15.0	5.0	—	63	T-20	5.5
	**DSW-1838H**	2.5	M1.8×0.35	3.8	2.0	—	55	T-6	0.4
	DSW-2045H	3.0	M2×0.4	4.5	2.3	—	60	T-7	0.5
	DSW-2563H	3.45	M2.5×0.45	6.3	2.6	—	55	T-8	0.9
	DSW-306H	4.3	M3×0.5	6.5	3.2	—	55	T-10	1.8
	DSW-307	4.3	M3×0.5	7.5	2.8	—	55	T-10	1.4
	DSW-307H	4.3	M3×0.5	7.6	3.2	—	55	T-10	1.8
	DSW-309H	4.3	M3×0.5	9.0	3.2	—	55	T-10	1.8
	DSW-4075	5.2	M4×0.7	7.5	3.5	—	55	T-15	3.6
	DSW-408	6.0	M4×0.7	8.5	3.6	—	55	T-15	3.6
	DSW-4085	5.3	M4×0.7	8.5	3.5	—	55	T-15	3.6
	DSW-410H	5.3	M4×0.7	10.0	3.7	—	55	T-15	3.6
	DSW-4510H	6.8	M4.5×0.75	10.0	4.7	—	55	T-20	6.0
	DSW-4512H	6.8	M4.5×0.75	12.5	5.2	—	55	T-20	6.0
	DSW-4515H	6.8	M4.5×0.75	15.5	5.2	—	55	T-20	6.0
	DSW-509	7.0	M5×0.8	9.5	4.9	—	55	T-20	6.1
	DSW-511H	7.0	M5×0.8	11.5	4.9	—	55	T-20	6.1
	**ESW-205**	3.6	M2.5×0.45	5.5	2.0	—	60	T-8	0.9
	ESW-206	3.6	M2.5×0.45	6.0	2.0	—	60	T-8	0.9
	ESW-304	4.0	M3×0.5	4.5	2.0	—	55	T-8	1.4
	ESW-306	4.0	M3×0.5	6.0	2.0	—	55	T-8	1.4
	ESW-307	4.0	M3×0.5	7.5	2.0	—	55	T-8	1.4
	ESW-405	5.3	M4×0.7	5.9	2.7	—	55	T-15	3.1
	ESW-406	5.3	M4×0.7	6.6	2.7	—	55	T-15	3.1
	ESW-408	5.3	M4×0.7	8.0	2.7	—	55	T-15	3.1

Parts

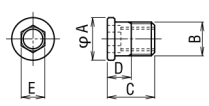
Clamp screw

Drawings	Cat. No.	Dimensions (mm)						Wrench	Recommended torque (N•m)
		A	B	C	D	E	α°		
	**ESW-410**	5.3	M4×0.7	10.0	2.7	—	55	T-15	3.1
	ESW-412	5.3	M4×0.7	12.0	2.7	—	55	T-15	3.1
	ESW-507	6.8	M5×0.8	7.5	3.4	—	55	T-25	5.5
	ESW-508	6.8	M5×0.8	8.2	3.4	—	55	T-25	5.5
	ESW-510	6.8	M5×0.8	10.0	3.4	—	55	T-25	5.5
	**FSW-2005H**	2.5	M2×0.25	5.0	1.3	—	40	T-6	0.5
	FSW-2506H	3.0	M2.5×0.35	6.6	1.5	—	40	T-7	0.9
	FSW-3007H	3.8	M3×0.35	8.1	2.0	—	40	T-8	1.2
	FSW-3509H	4.7	M3.5×0.6	9.6	2.3	—	40	T-10	2.0
	FSW-4013H	5.8	M4×0.7	13.5	3.3	—	40	T-15	3.0
	FSW-5016H	6.8	M5×0.8	16.4	3.2	—	40	T-20	4.0
	FSW-6020	8.5	M6×1.0	20.0	4.3	—	40	T-30	5.0
	FSW-8025	11.0	M8×1.25	25.0	5.5	—	40	T-40	6.0
	**HSW-614H**	10.0	M6×1.0	15.0	7.3	—	60	T-30	7.5
	**TSW-2250**	3.1	M2.2×0.45	5.0	2.3	—	60	T-7	0.6
	TSW-2556H	3.6	M2.5×0.45	5.6	2.7	—	60	T-8	0.9
	TSW-2567H	3.6	M2.5×0.45	6.7	2.7	—	60	T-8	0.9
	TSW-3510H	5.3	M3.5×0.6	10.0	4.5	—	60	T-15	2.1
	TSW-3512H	5.3	M3.5×0.6	11.5	4.5	—	60	T-15	2.1
	TSW-408	5.5	M4×0.7	8.0	3.3	—	60	T-15	3.1
	TSW-511	7.0	M5×0.8	11.0	5.0	—	60	T-20	5.5
	TSW-612	8.5	M6×1.0	12.0	4.8	—	60	T-25	7.5
	TSW-614H	8.5	M6×1.0	14.0	6.2	—	60	T-25	7.5
	**S4513P**	6.7	M4.5×0.75	13.0	3.5	—	55	20IP	5.0

Set bolt

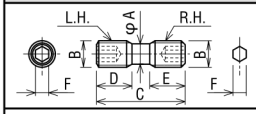
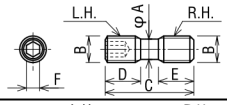
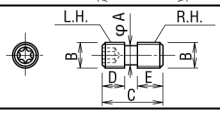
Drawings	Cat. No.	Dimensions (mm)						Wrench	Recommended torque (N•m)
		A	B	C	D	E	F		
 ■HCS4-10 HCS5-10 HSB-12 ■HSB-10	**HCS4-10**	7.0	M4×0.7	14.0	4.0	3.0	—	—	—
	HCS5-10	8.5	M5×0.8	15.0	5.0	4.0	—	—	—
	HSB-10	17.0	M10×1.5	56.0	10.0	8.0	13	—	—
	HSB-12	18.0	M12×1.75	62.0	12.0	10.0	—	—	—

Shim screw

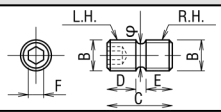
Drawings	Cat. No.	Dimensions (mm)						Wrench	Recommended torque (N•m)
		A	B	C	D	E	F		
	**SSW-535**	6.3	M5×0.5	7.0	3.1	3.5	—	—	6.5
	SSW-745	8.4	M7×0.5	8.0	2.9	4.5	—	—	8.0

Parts

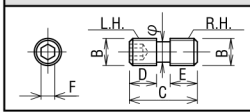
Wedge screw

Drawings	Cat. No.	Dimensions (mm)						Wrench	Recommended torque (N•m)
		A	B	C	D	E	F		
	**LS-1**	4.6	M6×1.0	22.0	8.5	8.5	3.0	—	6.0
	**LS-101**	4.6	M6×1.0	16.0	6.5	6.5	3.0	—	6.0
	LS-106	4.6	M6×1.0	14.5	6.5	5.0	3.0	—	6.0
	LS-107	4.6	M6×1.0	13.0	5.0	5.0	3.0	—	6.0
	**LS-109**	5.5	M7×0.75	19.0	7.5	8.0	—	T-25	7.0
	LS-110	4.8	M6×0.75	22.0	8.0	8.0	—	T-15	6.0
	LS-180	6.0	M8×1.0	19.0	7.0	8.0	—	T-27	8.0

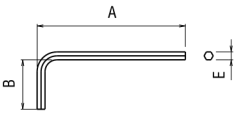
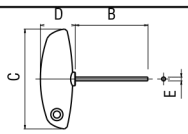
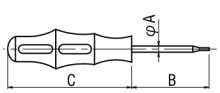
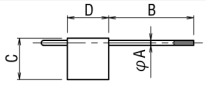
Rest button screw

Drawings	Cat. No.	Dimensions (mm)						Wrench	Recommended torque (N•m)
		A	B	C	D	E	F		
	**LS-113**	3.7	No.10-32UNF	10.2	4.5	4.1	2.4	—	—

Clamp screw

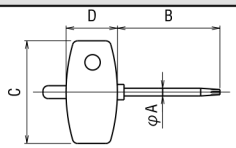
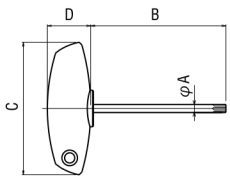
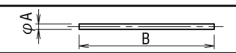
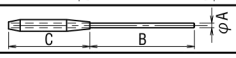
Drawings	Cat. No.	Dimensions (mm)						Wrench	Recommended torque (N•m)
		A	B	C	D	E	F		
	**SLS-3**	6.0	M8×1.0	20.0	8.0	8.0	4.0	—	8.0

Wrench

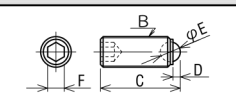
Drawings	Cat. No.	Dimensions (mm)					Wrench size
		A	B	C	D	E	
	**LW-015**	46.5	14.0	—	—	1.5	—
	LW-020	52.0	15.0	—	—	2.0	—
	LW-025	59.5	18.0	—	—	2.5	—
	LW-030	67.0	20.0	—	—	3.0	—
	LW-035	71.5	22.5	—	—	3.5	—
	LW-040	75.0	25.0	—	—	4.0	—
	LW-045	80.5	27.0	—	—	4.5	—
	LW-050	80.0	28.0	—	—	5.0	—
	LW-120	137.0	45.0	—	—	12.0	—
	LW-140	154.0	56.0	—	—	14.0	—
	**A-030**	—	60.0	80.0	28.0	3.0	—
	**A-07SD**	4.0	60.0	80.0	—	—	T-7
	A-08SD	4.0	70.0	80.0	—	—	T-8
	A-10SD	4.0	70.0	95.0	—	—	T-10
	A-20SD	5.0	90.0	105.0	—	—	T-20
	A-25SD	5.0	100.0	105.0	—	—	T-25
	**A-06**	1.7	34.5	15.0	15.0	—	T-6
	A-07	2.0	34.5	15.0	15.9	—	T-7
	A-08	2.3	39.0	19.0	19.0	—	T-8

Parts

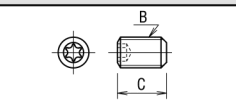
Wrench

Drawings	Cat. No.	Dimensions (mm)					Wrench size
		A	B	C	D	E	
	**A-10**	3.0	40.0	40.0	20.0	—	T-10
	A-15	3.5	45.0	40.0	20.0	—	T-15
	A-20W	4.0	45.0	40.0	20.0	—	T-20
	**A-15T**	4.0	100.0	80.0	26.0	—	T-15
	A-20	4.0	100.0	100.0	32.0	—	T-20
	A-20L	5.5	200.0	100.0	32.0	—	T-20
	A-25	4.5	100.0	100.0	32.0	—	T-25
	A-27	5.5	100.0	100.0	32.0	—	T-27
	A-30	6.0	100.0	100.0	32.0	—	T-30
	A-40	7.0	100.0	100.0	32.0	—	T-40
	AP-20	4.0	100.0	100.0	32.0	—	20IP
	**AD-1845**	1.8	45.0	—	—	—	—
	**AD-2080**	2.0	45.0	35.0	—	—	—

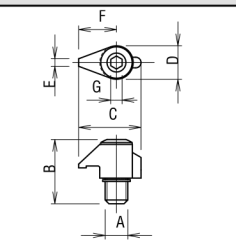
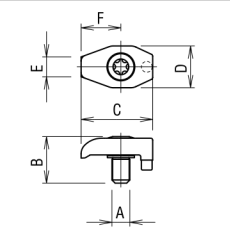
Wedge lock screw

Drawings	Cat. No.	Dimensions (mm)						Wrench	Recommended torque (N•m)
		A	B	C	D	E	F		
	**LSM-512**	—	M5×1.0	12.6	1.0	3.0	2.5	—	—

Adjustable screw

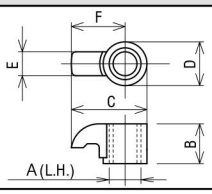
Drawings	Cat. No.	Dimensions (mm)						Wrench	Recommended torque (N•m)
		A	B	C	D	E	F		
	**RSW-05008**	—	M5×0.8	8.0	—	—	—	T-10	—

Clamp set

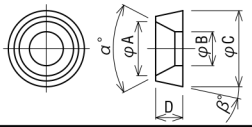
Drawings	Cat. No.	Dimensions (mm)							Wrench
		A	B	C	D	E	F	G	
	**DCM-1**	M5×0.8	13.8	13.8	6.8	2.0	8.5	2.5	—
	DCM-5	M6×1.0	17.0	16.5	8.9	2.0	10.0	3.0	—
	**DCM-17**	M4.5×0.75	11.7	18.0	10.5	5.0	10.0	—	T-20
	DCM-18	M3.5×0.6	10.0	13.0	7.6	3.0	7.2	—	T-15

Parts

Clamp

Drawings	Cat. No.	Dimensions (mm)					
		A	B	C	D	E	F
	**DCM-2**	M8×1.0	10.0	19.0	11.0	6.0	13.5

Clamp washer

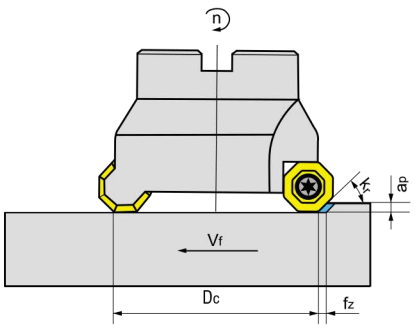
Drawings	Cat. No.	Dimensions (mm)					
		A	B	C	D	$\alpha°$	$\beta°$
	**CW-11**	8.0	5.0	11.0	4.0	55	12

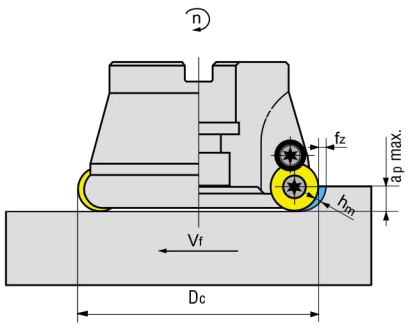
Terminology and Formulas (for milling)

D_c	= Cutting diameter	mm.	Z_c	= Effective number of teeth	
a_e	= Width of cut	mm.	h_{ex}	= Max chip thickness	mm.
a_p	= Depth of cut	mm.	h_m	= Average chip thickness	mm.
f	= Feed rate per revolution	mm/rev.	k_{c1}	= Specific cutting force (hex = mm)	N/mm².
f_z	= Feed rate per tooth	mm/t.	P_c	= Net cutting power	KW.
D_e	= Effective cutting diameter	mm.	k_r	= Major cutting edge	deg.
V_c	= Cutting speed	m/mm.	V_{co}	= Constant for cutting speed	
Q	= Metal removal rate	cm³/min.	C_{vc}	= Correction factor for cutting speed	
l	= Machined length	mm.	n	= Spindle speed	min⁻¹ .
V_f	= Feed speed	mm/min.	n_{mt}	= Efficiency	KW
Da_p	= Max cutting diameter at specific depth	mm.	m_c	= Rise in specific cutting force (kc) as a function of chip thickness	
Z_n	= Total number of edges in the tool				

General formulas

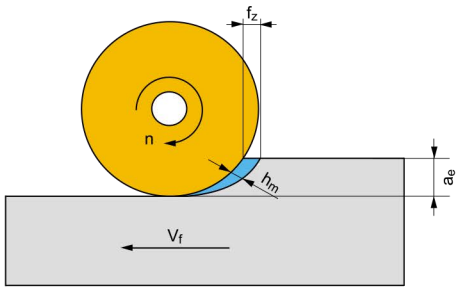
Cutting speed	$V_c = \frac{\pi \times D_c \times n}{1000}$ = m/min.	Spindle speed	$n = \frac{V_c \times 1000}{\pi \times D_c}$ = min.⁻¹
Feed speed	$V_f = f_z \times n \times z_n$ = mm/min.	Feed per tooth	$f_z = \frac{V_f}{n \times z_n}$ = mm.
Feed per revolution	$f = \frac{V_f}{n}$ = mm/rev.	Metal Removal rate	$Q = \frac{a_p \times a_e \times V_f}{1000}$ = cm³.
Specific cutting force	$k_c = k_{c1} \times h_{nm^{-mc}}$ = mm/min.	Effective cutting diameter	$D_e = 2 \times \sqrt{a_p \times (D_c - a_p)}$ = mm.
Average chip thickness (side & facemilling) when ae / Dc ≤0.1	$h_m = f_z \sqrt{\frac{a_e}{D_c}}$ = mm.	Net power	$P_c = \frac{a_p \times a_e \times V_f \times k_c}{60 \times 10^6 \times n_{mt}}$ = kW
Average chip thickness when ae / Dc ≥ 0.1	$h_m = \frac{\sin k_r \times 180 \times a_e \times f_z}{\pi \times D_c \times \arcsin\left(\frac{a_e}{D_c}\right)}$ = mm.	Cutting time	$T_c = \frac{l}{V_f}$ = min.





Up Cut and Down Cut

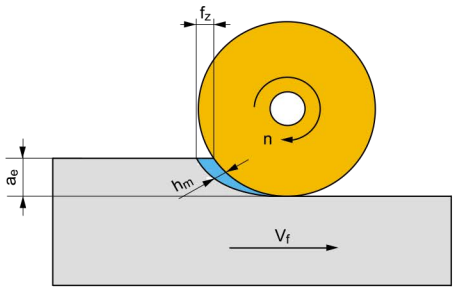
Down cut milling



- same workpiece direction, feed rate and rotation of milling cutter.
- chip cross-section start on the strongest point.

Generally down milling should be prefered if rigid machine is available.

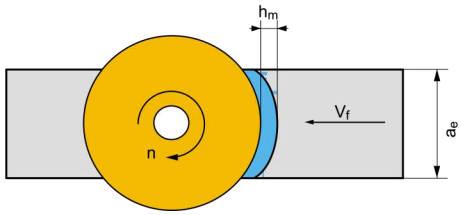
Up cut milling



- the feed rate of workpiece is counter-clock-wise to the sense of milling cutter rotation.
- chip cross-section start on the weakest point.

Up milling should be applied on instable milling machine and workpiece materials with higher hardness.

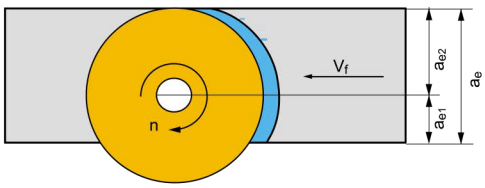
Tool with central work piece



Formulas :

$$h_m = \frac{\sin(k_r) \times 180 \times a_e \times f_z}{\pi \times d_c \times \arcsin\left(\frac{a_e}{d_c}\right)} \qquad f_z = \frac{h_m \times \pi \times \arcsin\left(\frac{a_e}{d_c}\right)}{\sin(k_r) \times 180 \times a_e}$$

Tool with outside center work piece



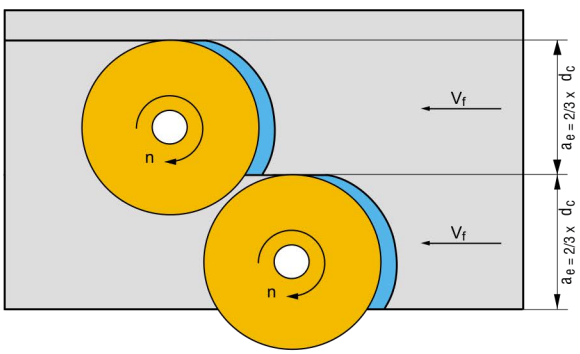
Formulas :

$$h_m = \frac{\sin(k_r) \times 360 \times a_e \times f_z}{\pi \times d_c \times \left[\arcsin\left(\frac{2 \times a_{e1}}{d_c}\right) + \arcsin\left(\frac{2 \times a_{e2}}{d_c}\right)\right]}$$

$$f_z = \frac{h_m \times \pi \times d_c \times \left[\arcsin\left(\frac{2 \times a_{e1}}{d_c}\right) + \arcsin\left(\frac{2 \times a_{e2}}{d_c}\right)\right]}{\sin(k_r) \times 360 \times a_e}$$

Suggested milling operation

We suggest to work like this when possible or in any case work with tangential tool exit. Up cut and down cut is possible with Ae Max. 2/3 of tool diameter.



Troubleshooting

APPLICATIONS
Milling

PROBLEM	CAUSE	RECOMMENDED ACTION
Chipping 	• insert grade • speeds & feeds	• Change to tougher grade • Increase the cutting speed • Reduce the feed/tooth
Flank Wear 	• insert grade • speeds & feeds	• Use a more wear-resistant grade • Reduce the cutting speed • Increase the feed/tooth
Crater Wear 	• insert grade • speeds & feeds	• Use a more crater wear-resistant grade • Reduce the cutting speed • Reduce the feed/tooth
Broken Nose 	• insert grade • speeds & feeds • insert shape	• Use a tougher grade • Adjust the cutting speed • Adjust the feed/tooth • Use a thicker insert
Poor Surface Finish	• insert grade • speeds & feeds • insert shape • tool shape	• Use a more wear-resistant grade • Increase the cutting speed • Use a polished insert • Use a higher rake cutter
Burrs, Chipping, etc.	• insert grade • tool shape	• Increase the cutting speed • Reduce the feed/tooth • Use a higher rake cutter
Vibration	• speeds & feeds	• Reduce the cutting speed • Reduce the feed/tooth

Troubleshooting

APPLICATIONS
Drilling

PROBLEM	CAUSE	RECOMMENDED ACTION
Drill Breakage	• speeds & feeds • cutting fluid • others	• Maintain constant feed rate • Reduce the cutting speed • Reduce the feed rate • Increase coolant flow • Use a machine with sufficient horsepower • Tighten work piece clamping
Center Point Breakage	• tool • speeds & feeds • others	• Reduce drill overhang • Maintain constant feed rate • Reduce the feed rate when starting drill • Use a machine with sufficient horsepower • Tighten work piece clamping
Peripheral Cutting Edge Breakage	• tool • speeds & feeds • others	• Reduce drill overhang • Maintain constant feed rate • Reduce the cutting speed • Use a machine with sufficient horsepower • Tighten work piece clamping
Chipping	• tool • speeds & feeds • cutting fluid • others	• Reduce drill overhang • Maintain constant feed rate • Change the feed rate • Increase coolant flow • Use a machine with sufficient horsepower • Tighten work piece clamping
Long Stringy Chips	• tool • speeds & feeds	• Less lead angle • Increase hone • Maintain constant feed rate • Increase the feed rate
Chip Form Varies	• speeds & feeds • cutting fluid • others	• Maintain constant feed rate • Maintain constant coolant flow • Use a machine with sufficient horsepower

Troubleshooting

APPLICATIONS
Drilling

PROBLEM	CAUSE	RECOMMENDED ACTION
Over Size or Out-of-Round	• tool • speeds & feeds • others	• Reduce drill overhang • Increase lead angle • Increase the cutting speed • Reduce the feed rate • Use a machine with sufficient horsepower • Tighten work piece clamping
Poor Surface Finish	• speeds & feeds • others	• Maintain constant feed rate • Increase the cutting speed • Reduce the feed rate • Use low feed rate when starting drill • Use a machine with sufficient horsepower • Tighten work piece clamping
Galling on Drill Body	• tool • speeds & feeds • others	• Reduce drill overhang • Reduce the cutting speed • Increase the feed rate • Use a machine with sufficient horsepower • Tighten work piece clamping
Vibration	• tool • speeds & feeds • others	• Use light hone • Reduce drill overhang • Maintain constant feed rate • Use a machine with sufficient horsepower • Tighten work piece clamping

Material Cross Reference

Carbon steel

Japan	USA	Germany	
JIS	AISI/SAE	W.-nr	DIN
S10C	1010	1.0301	C10
S15C	1015	1.0401	C15
S20C	1020	1.0402	C22
S25C	1025	1.0406	C25
S30C	1030	1.0528	C30
S35C	1035	1.0501	C35
S40C	1040	1.0511	C40
S45C	1045	1.0503	C45
S50C	1049	1.0540	C50
S55C	1055	1.0535	C55
S58C	1060	1.0601	C58

Nickel chromium steel

JIS	AISI/SAE	W.-nr	DIN
SNC236	3135	1.5710	36NiCr6
SNC415	3415	1.5732	14NiCr10
SNC631	—	—	—
SNC815	3310	1.5752	14NiCr14
SNC836	—	—	—

Nickel chromium molybdenum steel

JIS	AISI/SAE	W.-nr	DIN
SNCM220	8620	1.6523	21NiCrMo2
SNCM240	8640	1.6546	40NiCrMo22
SNCM415	—	—	—
SNCM420	4320	—	—
SNCM439	4340	1.6582	35CrNiMo6
SNCM447	—	—	—
SNCM630	—	—	—
SNCM815	—	—	—

Chromium steel

JIS	AISI/SAE	W.-nr	DIN
SCr415	5015	1.7015	15Cr3
SCr420	5120	1.7020	20Cr4
SCr430	5130	1.7033	34Cr4
SCr435	5132	1.7034	37Cr4
SCr440	5140	1.7045	42Cr4
SCr445	5147	—	—

Chromium molybdenum steel

JIS	AISI/SAE	W.-nr	DIN
SCM415	—	1.7262	15CrMo5
SCM420	—	—	—
SCM430	4130	1.7218	25CrMo4
SCM435	4137	1.7220	34CrMo4
SCM440	4140	1.7223	41CrMo4
SCM445	4145	—	—

Manganese steel and Manganese chromium steel

Japan	USA	Germany	
JIS	AISI/SAE	W.-nr	DIN
SMn420	1522	—	—
SMn433	1536	—	—
SMn438	1541	—	—
SMn443	1541	—	—
SMnC420	—	—	—
SMnC443	—	—	—

Carbon tool steel

JIS	AISI/SAE	W.-nr	DIN
SK1	W1-13	—	—
SK2	W1-11 1/2	—	—
SK3	W1-10	1.1545	C105W1
SK4	W1-9	—	—
SK5	W1-8	1.1525	C80W1
SK6	W1-7	1.1525	C80W1
SK7	—	1.1620	C70W2

High speed steel

JIS	AISI/SAE	W.-nr	DIN
SKH2	T1	—	—
SKH3	T4	—	—
SKH10	T15	—	—
SKH51	M2	1.3343	S6-5-2
SKH52	M3-1	—	—
SKH53	M3-2	1.3344	S6-5-3
SKH54	M4	—	—
SKH56	M36	—	—

Alloy tool steel

JIS	AISI/SAE	W.-nr	DI
SKS11	F2	—	—
SKS51	L6	—	—
SKS43	W2-9 1/2	—	—
SKS44	W2-8 1/2	—	—
SKD1	D3	1.2080	X210Cr12
SKD11	D2	1.2379	X100CrMoV5
SKD12	A2	1.2363	X100CrMoV51
SKD2	—	1.2436	X210CrW12
SKD5	H21	1.2581	X30WCrV9
SKD61	H13	1.2344	X40CrMoV5

Stainless steel (Ferritic)

JIS	AISI/ASTM	W.-nr	DIN
SUS405	AISI 405	1.4724	X6CrAl13
SUS429	AISI 429	—	—
SUS430	AISI 430	1.4742	X6Cr17
SUS430F	AISI 430F	1.4104	X12CrMoS17
SUS434	AISI 434	—	—

Material Cross Reference

Stainless steel (Martensitic)

Japan	USA	Germany	
JIS	AISI/ASTM	W.-nr	DIN
SUS403	AISI 403	—	—
SUS410	AISI 410	1.4006	X10Cr13
SUS416	AISI 416	—	—
SUS420J1	AISI 420	1.4034	X20Cr13
SUS420F	AISI 420F	—	—
SUS431	AISI 431	1.4057	X20CrNi172
SUS440A	AISI 440A	—	—
SUS440B	AISI 440B	—	—
SUS440C	AISI 440C	—	—

Stainless steel (Austenitic)

JIS	AISI/ASTM	W.-nr	DIN
SUS201	AISI 201	—	—
SUS202	AISI 202	—	—
SUS301	AISI 301	—	—
SUS302	AISI 302	—	—
SUS302B	AISI 302B	—	—
SUS303	AISI 303	1.4305	X10CrNiS189
SUS303Se	AISI 303Se	—	—
SUS304	AISI 304	1.4301	X5CrNi1810
SUS304L	AISI 304L	1.4306	X2CrNi1911
SUS304NI	AISI 304N	—	—
SUS305	AISI 305	1.4303	X5CrNi1812
SUS308	AISI 308	—	—
SUS309S	AISI 309S	—	—
SUS310S	AISI 310S	—	—
SUS316	AISI 316	1.4401	X5CrNiMo17122
SUS316L	AISI 316L	—	X2CrNiMo17132
SUS316N	AISI 316N	1.4404	—
SUS317	AISI 317	1.4438	X2CrNiMo18164
SUS317L	AISI 317L	1.4438	X2CrNiMo18164
SUS321	AISI 321	—	—
SUS347	AISI 347	1.4550	X6CrNiNb1810
SUS384	AISI 384	—	—

Heat resistant steel (Austenitic)

JIS	AISI/ASTM	W.-nr	DIN
SUH31	—	—	—
SUH35	—	—	—
SUH36	—	—	—
SUH37	—	—	—
SUH38	—	—	—
SUH309	AISI 309	—	—
SUH310	AISI 310	1.4845	CrNi2520
SUH330	AISI 330	—	—

Heat resistant steel (Martensitic)

Japan	USA	Germany	
JIS	AISI/ASTM	W.-nr	DIN
SUH21	—	—	CrAl1205
SUH409	AISI 409	1.4512	X6CrTi12
SUH446	AISI 446	—	—

Heat resistant steel (Ferritic)

JIS	AISI/ASTM	W.-nr	DIN
SUH1	—	—	—
SUH3	—	—	—
SUH4	—	—	—
SUH11	—	—	—
SUH600	ASTM 616	—	—

Grey cast iron

JIS	AISI/SAE	W.-nr	DIN
FC100	20	0.6010	GG 10
FC150	25	0.6015	GG 15
FC200	30	0.6020	GG 20
FC250	35	0.6025	GG 25
FC300	40	0.6030	GG 30
FC350	50	0.6035	GG 35

Nodular cast iron

JIS	AISI/SAE	W.-nr	DIN
FCD400	60-40-18	0.7040	GGG 40
FCD450	60-40-8	0.7045	GGG 45
FCD500	65-45-12	0.7050	GGG 50
FCD600	80-55-06	0.7060	GGG 60
FCD700	100-70-03	0.7070	GGG 70

Tool Steel Brand Cross Reference

Steel for cold molding

Group	JIS	AISI	Aichi Steel	Sanyo Special Steel	Daido Steel	Nippon Koshuha Steel	Hitachi Metals	Nachi Fujikoshi	Udde Holm	Bohler
Carbon tool steel	SK105	W1-10		QK3	YK3					K990
Alloy tool steel	SKS93		SK301	QK3M	YK30	K3M	YCS3			
	SKS3		SKS3	QKS3	GOA	KS3	SGT		ARNE	K460
	SKD1	D3		QC1	DC1	KD1	CRD		SVERKER3	K100, K107
	SKD11	D2	SKD11	QC11	DC11	KD11	SLD	CDS11	SVERKER21	K105, K110
	8% Cr		AUD15 AUD11	QCM7 QCM8	DC53	KD11MAX KD11S, KD21	SLD8	MDS9	SLEIPNER	K340
	Die steel (Matrix type)		SXACE		DCMX	NOGA	ARK1		CALDIE UNIMAX	W360
	SKD12	A2			DC12	KD12			RIGOR	K305
	Pre-harden 40HRC				GO40F	KAP65	HPM-MAGIC		IMPAX HH	
	Flame tempered steel		SX105V	QF3	GO5	KRCX	HMD5		FERMO	
	Low temperature air cooled steel				GO4	KSM	ACD37			
	Impact resistant steel		AKS4	QF1	GS5	KTV5	YSM			
	Others		AUD11X				SLD10 SLD-MAGIC	ICS22	CALMAX ELMAX VANCRON40 VANADIS4E VANADIS10	K390 K890
High speed tool steel	SKH51	M2		QH51	MH51	H51	YXM1	SKH9		S600
	SKH51 type							SKH9D		
	SKH55 type					HM35	YXM4	HM35 HS53M		S705
	SKH57 type					MV10	XVC5	HS93R DURO-SP		S700
	Matrix type			QHZ	DRM1 DRM2 DRM3 MH85	KMX1 KMX2 KMX3	YXR3 YXR7 YXR33	DURO-F1 DURO-F3 DURO-F7 DURO-V2 DURO-V5		
Sintered high speed tool steel	SKH40				DEX40		HAP40	FAX38	VANADIS30	S590
	Matrix type				DEX-M1 DEX-M3		HAP5R			
	Others			SPM23 SPM30 SPM60 SPMR8	DEX20 DEX60		HAP10 HAP50 HAP72	FAX31 FAX40 FAX55 FAXG2	VANADIS23 VANADIS60	S290 S390 S690 S790

Tool Steel Brand Cross Reference

High speed tool steel

Group	JIS	AISI	Aichi Steel	Daido Steel	Nippon Koshuha Steel	Hitachi Metals	Nachi Fujikoshi	Udde Holm	Bohler
Tungsten type	SKH2	T1			H2	YHX2	SKH2		S200
	SKH3	T4			H3		SKH3		S305
	SKH4	T5			H4		SKH4		
	SKH10	T15			HV5				
Molybdenum type	SKH51	M2	QH51	MH51	H51	YXM1	SKH9		S600 S614 S401
	SKH52	M3-1			H52				
	SKH53	M3-2			HV1				S607
	SKH54	M4			HV2		HM4		
	SKH55				HM35	YXM4	HM35		S705
	SKH56	M36			HM36		HM36		
	SKH57				HV10	XVC5	HS93R		S700
	SKH58	M7			HM3		HM7		S400
	SKH59	M42			HM42	YXM42	HM42		S500
	Others				S70	YXM27 YXM60	HS53M HS97R HM1 HMT12 HM33 SKH9D DURO-SP		
Matrix type	Matrix type		QHZ	DRM1 DRM2 DRM3 MH85	KMX1 KMX2 KMX3	YXR3 YXR33 YXR7	DURO-FZ DURO-F1 DURO-F3 DURO-F7 DURO-V2 DURO-V5		
Powdered type	SKH40		SPM30	DEX40		HAP40	FAX38	VANADIS30	S590
	Others		SPM23 SPM60 SPMR8	DEX20 DEX60 DEX-M1 DEX-M3		HAP10 HAP50 HAP72 HAP5R	FAX31 FAX40 FAX55 FAXG2	VANADIS23 VANADIS60	S290 S390 S690 S790

Tool Steel Brand Cross Reference

Steel for plastic mold

Group	Hardness (HRC)	JIS	AISI	Aichi Steel	JFE Steel	Kobelco	Sanyo Special Steel	Daido Steel	Nippon Koshuha Steel	Hitachi Metals	Nachi Fujikoshi	Udde Hdm	Bohler
Pre hardened steel	13	SC type	1055		JFE-MD1	KTSM21 KTSM21M KTSM2A KTSM22	PC55		KPM1 KPMAX				
	28	SCM type	4140		JFE-MD3 JFE-MD5	KTSM31		PDS3					
	33	SCM (Improved)	P20			KTSM3M	PCM30	PX5 PXA30	KPM30	HPM7		IMPAXHH	M200 M201 M238
		SUS type	420					S-STAR D-STAR	GHX 420M	HPM38	PROVA-400 PROVA-450	STAVAX	M303 M310
		SUS type (Free cutting)						G-STAR	U630	HPM77		RoyAlloy	M315
	35	SUS type	S17400				QSH6	NAK101		PSL		CORRAX	N700
	36	SCM (Improved)	P20						JHX				
	40	SUS type										EDRO400	
		SKD61 (Improved)	H13					DH2F	KAP90F	FDAC			
		Others	P21				PCM40S	NAK80	KAP88	HPM-PRO			M461
			P21 (Free cutting)				PCM40	NAK55	KAP65	HPM1			M261
			P21 (Rust resistant)							CENA1			
										HPM-MAGIC		NIMAX	
Quench tempered steel	60	SKD11 (Improved)	D2	AUD11			QCM8	PD613	NOGA	HPM31		RIGOR SLEIPNER CALDIE CALMAX	K105 K110 K340
	57	SUS type 440C	440C				QPD5 SPC5 (Powdered)	SUS440C		SUS440C	440C PROVA-500 (Powdered)	ELMAX	M340 M390 N685 N690 N695
	52	SUS type 420						S-STAR D-STAR G-STAR	GHX	HPM38 HPM38S HPM77	PROVA-400 PROVA-450	STAVAX POLMAX MIRRAX	M310 M330
Age hardened steel	Over 50	Maraging steel						MAS1C	KMS18-20	YAG	EXEO-M21		V720 V721
		Others										CORRAX	
	40	Non-magnetic steel							NMS1	HPM75			