

SANDHOG®
CUTTING TOOLS 刀三具韩

Milling Tooling



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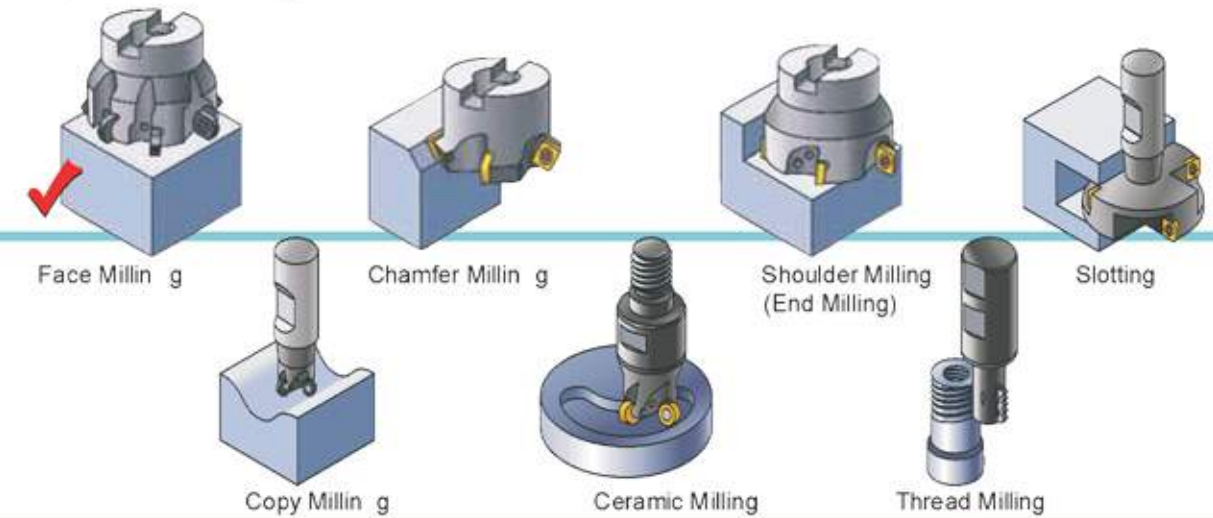
Milling Tooling

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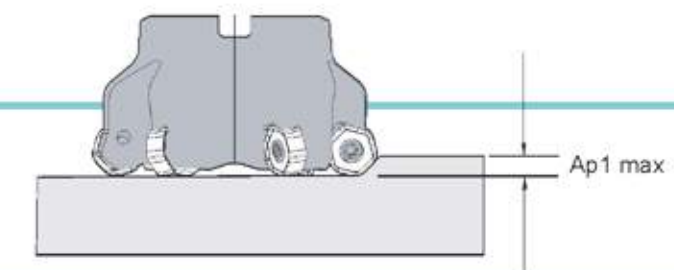
Step 1 ♦ Select Application

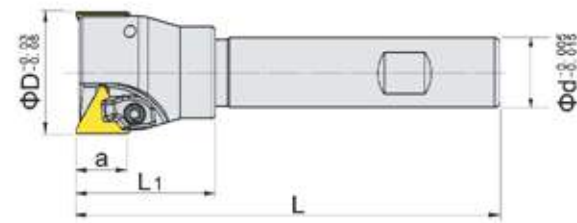


Step 2 ♦ Select Workpiece Material

ISO Description	Material Group	first choice	alternate choice
Steel	P1 - P2	•	
	P3 - P4		
	P5 - P6		
Stainless Steel	M1, M2	•	
	M3		
Cast Iron	K1, K2		
	K3		
Non-Ferrous Materials	N1, N2		
	N3		
High-Temp Alloys	S1, S2		
	S3		
	S4		
Hardened Material	H1		

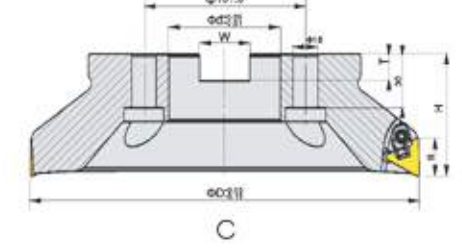
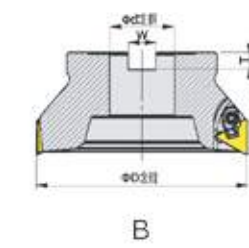
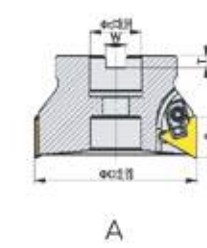
Step 3 ♦ Select a Maximum Axial Depth of Cut (A_p)





TP type end mill

Designation	Dimension					Z	Applicable Insert	Spare Parts		
	D	d	L	L1	a			Clamp	Screw	Wrench
TP90-2016-100-C16	16	16	100	45	9	1	TP□□1103	AMS-3	AOB-3S	T-10S
TP90-2020-100-C20	20	20	100	45	9	2				
TP90-3030-100-C20	30	20	100	45	14	2	TP□□1603	AMS-4	AOB-4S	T-15S
TP90-3035-100-C20	35	20	100	45	14	2				
TP90-3035-150-C20	35	20	150	45	14	2				
TP90-3035-200-C20	35	20	200	45	14	2				
TP90-3035-150-C25	35	25	150	45	14	2				
TP90-3035-200-C25	35	25	200	45	14	2				
TP90-3035-110-C32	35	32	110	45	14	2				
TP90-3035-150-C32	35	32	150	45	14	2				
TP90-3035-200-C32	35	32	200	45	14	2				
TP90-3040-110-C20	40	20	110	45	14	3				
TP90-3040-150-C20	40	20	150	45	14	3				
TP90-3040-110-C25	40	25	110	45	14	3				
TP90-3040-150-C25	40	25	150	45	14	3				
TP90-3040-200-C25	40	25	200	45	14	3				
TP90-3040-115-C32	40	32	115	45	14	3				
TP90-3040-150-C32	40	32	150	45	14	3				
TP90-3040-200-C32	40	32	200	45	14	3				
TP90-3050-110-C20	50	20	110	45	14	3				
TP90-3050-150-C20	50	20	150	45	14	3				
TP90-3050-110-C25	50	25	110	45	14	3				
TP90-3050-150-C25	50	25	150	45	14	3				
TP90-3050-200-C25	50	25	200	45	14	3				
TP90-4050-115-C32	50	32	115	42	20	3	TP□□2204	AMS-5	AOB-5S	T-20S
TP90-4050-150-C32	50	32	150	42	20	3				
TP90-4050-200-C32	50	32	200	42	20	3				
TP90-4063-150-C20	63	20	150	42	20	4				
TP90-4063-150-C25	63	25	150	42	20	4				
TP90-4063-150-C32	63	32	150	42	20	4				
TP90-4063-200-C32	63	32	200	42	20	4				

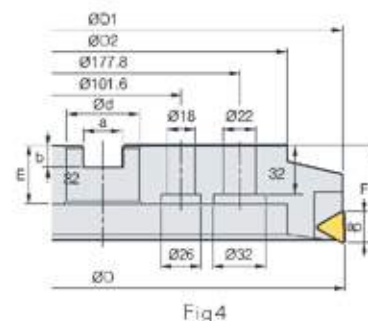
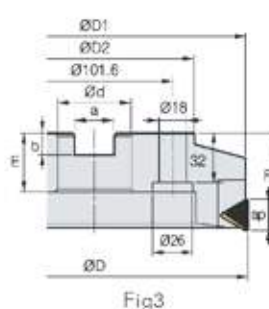
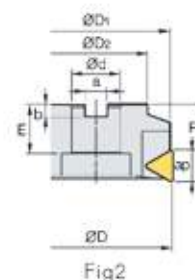
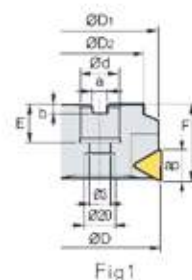
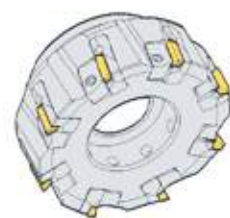


TP type shell mill

Designation	D	d	H	Z	W	T	a	Fig.	Applicable Insert
TP90-2040-04T	40	16.0	40	4	8.4	5.6	9	A	TP□□1103
TP90-2050-04T	50	22.0	40	4	10.4	6.3	9	A	
TP90-3050-04T	50	22.0	50	4	10.4	6.3	14	A	TP□□1603
TP90-3063-04T	63	22.0	50	4	10.4	6.3	14	A	
TP90-3080-05T	80	27.0	50	5	12.4	7	14	A	
TP90-3100-06T	100	32.0	50	6	14.4	8	14	B	TP□□2204
TP90-4063-03T	63	22.0	50	3	10.4	6.3	18	A	
TP90-4080-04T	80	27.0	50	4	12.4	7	18	A	
TP90-4100-05T	100	32.0	63	5	14.4	8	18	B	
TP90-4125-06T	125	40.0	63	6	16.4	9	18	B	
TP90-4160-07T	160	40.0	63	7	16.4	9	18	B	
TP90-4200-08T	200	60.0	63	8	25.7	14	18	C	

Applicable spare parts

Designation	CLAMP	SCREW	WRENCH
TP90-2040-04T	AMS-3	AOB-3S	T-10S
TP90-2050-04T			
TP90-3050-04T	AMS-4	AOB-4S	T-15S
TP90-3063-04T			
TP90-3080-05T			
TP90-3100-06T	AMS-5	AOB-5S	T-20S
TP90-4063-03T			
TP90-4080-04T			
TP90-4100-05T			
TP90-4125-06T			
TP90-4160-07T			
TP90-4200-08T			



TP type indexable shell Mill

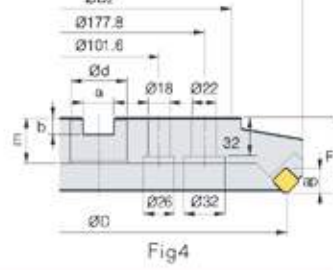
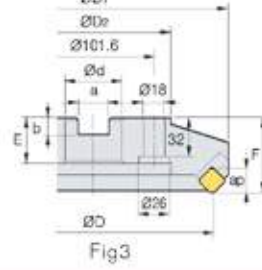
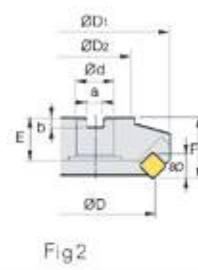
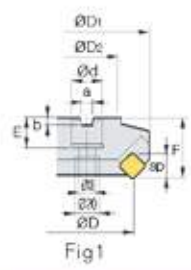
Designation	D	D1	D2	d	a	b	E	F	ap	Z	Kg	Fig.
LM90TP-4080-05T	80	79	57	57	12.4	7	22	50	18.0	5	1.3	1
LM90TP-4100-06T	100	99	67	67	14.4	8	28	50	18.0	6	1.9	2
LM90TP-4125-08T	125	124	87	87	16.4	9	30	63	18.0	8	3.5	2
LM90TP-4160-10T	160	158	107	107	16.4	9	30	63	18.0	10	5.6	2
LM90TP-4200-12T	200	198	130	130	25.7	14	38	63	18.0	12	8.1	3
LM90TP-4250-16T	250	248	180	180	25.7	14	38	63	18.0	16	13.3	3
LM90TP-4315-20T	315	313	240	240	25.4	14	38	63	18.0	20	21.4	4

Applicable spare parts

Designation	Applicable Insert	Locator	Wedge	Locator Screw	Wedge Screw	Wrench
LM90TP-4080-05T	TP□□2204	LTP22R1/L1	W04R/L	DHA0817F	LTX0514	L-4.0T
LM90TP-4100-06T		LTP22R/L		DHA0821F		
LM90TP-4125-08T						
LM90TP-4160-10T						
LM90TP-4200-12T						
LM90TP-4250-16T						
LM90TP-4315-20T						

Applicable Inserts information

Designation	P35	SMU 206	YBG 302	YBC 251	K20	Insert Sharp	l	d	a	b	t	r
TPGN110304							10	6.35	-	-	3.18	0.4
TPGN110308							9	6.35	-	-	3.18	0.8
TPGR110304							10	6.35	-	-	3.18	0.4
TPGR110308							9	6.35	-	-	3.18	0.8
TPMN110304							10	6.35	-	-	3.18	0.4
TPMN110308							9	6.35	-	-	3.18	0.8
TPMR110304				●			10	6.35	-	-	3.18	0.4
TPMR110308				●			9	6.35	-	-	3.18	0.8
TPUN110304	●						10	6.35	-	-	3.18	0.4
TPUN110308	●						9	6.35	-	-	3.18	0.8
TPGN160304							15.5	9.525	-	-	3.18	0.4
TPGN160308							14.5	9.525	-	-	3.18	0.8
TPGR160304							15.5	9.525	-	-	3.18	0.4
TPGR160308							14.5	9.525	-	-	3.18	0.8
TPMN160304	●				●		15.5	9.525	-	-	3.18	0.4
TPMN160308	●				●		14.5	9.525	-	-	3.18	0.8
TPMR160304				●	●		15.5	9.525	-	-	3.18	0.4
TPMR160308				●	●		14.5	9.525	-	-	3.18	0.8
TPUN160304	●				●		15.5	9.525	-	-	3.18	0.4
TPUN160308	●				●		14.5	9.525	-	-	3.18	0.8
TPKN1603PDR	●			●	●		16.5	9.525	1.2	0.7	3.18	-
TPKN1603PDTR							16.5	9.525	1.2	0.7	3.18	-
TPXN1603PDSR							16.5	9.525	1.0	1.3	3.18	-
TPGN220404							21.0	12.7	-	-	4.76	0.4
TPGN220408							20.0	12.7	-	-	4.76	0.8
TPGR220404							21.0	12.7	-	-	4.76	0.4
TPGR220408							20.0	12.7	-	-	4.76	0.8
TPMN220404	●						21.0	12.7	-	-	4.76	0.4
TPMN220408	●						20.0	12.7	-	-	4.76	0.8
TPMR220404				●			21.0	12.7	-	-	4.76	0.4
TPMR220408				●			20.0	12.7	-	-	4.76	0.8
TPUN220404	●						21.0	12.7	-	-	4.76	0.4
TPUN220408	●						20.0	12.7	-	-	4.76	0.8
TPKN2204PDR	●			●	●		22.0	12.7	1.4	0.7	4.76	-
TPKN2204PDTR		●	●				22.0	12.7	1.4	0.7	4.76	-
TPXN2204PDSR							22.0	12.7	1.0	1.51	4.76	-



45° FP type Indexable Shell Mill

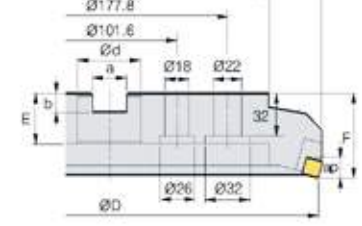
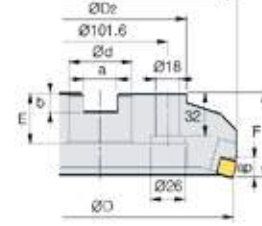
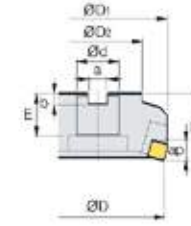
Designation	D	D1	D2	d	a	b	E	F	ap	Z	Kg	Fig.
LM45FP-4080-04T	80	103	60	27	12.4	7	22	50	5.5	4	1.7	1
LM45FP-4100-05T	100	122	80	32	14.4	8	28	50	5.5	5	2.9	2
LM45FP-4125-06T	125	146	100	40	16.4	9	30	63	5.5	6	4.4	2
LM45FP-4160-08T	160	181	120	40	16.4	9	30	63	5.5	8	6.1	2
LM45FP-4200-10T	200	220	130	60	25.7	14	38	63	5.5	10	8.9	3
LM45FP-4250-12T	250	270	180	60	25.7	14	38	63	5.5	12	15.7	3
LM45FP-4315-15T	315	335	240	60	25.4	14	38	63	5.5	15	25.1	4
LM45FP-5080-04T	80	103	60	27	12.4	7	22	50	7.5	4	1.7	1
LM45FP-5100-05T	100	122	80	32	14.4	8	28	50	7.5	5	2.9	2
LM45FP-5125-06T	125	146	100	40	16.4	9	30	63	7.5	6	4.4	2
LM45FP-5160-08T	160	181	120	40	16.4	9	30	63	7.5	8	6.1	2
LM45FP-5200-10T	200	220	130	60	25.7	14	38	63	7.5	10	8.9	3
LM45FP-5250-12T	250	270	180	60	25.7	14	38	63	7.5	12	15.7	3
LM45FP-5315-15T	315	335	240	60	25.7	14	38	63	7.5	15	25.1	4

Applicable inserts and spare parts

Designation	Applicable Insert	Locator	Wedge	Locator Screw	Wedge Screw	Wrench
LM45FP-4	SEK□1203	LSE12R/L	W01R/L	DHA0821F	LTX0514	L-2.0T
LM45FP-5	SEK□1504	LSE15R/L				L-4.0T

Applicable Inserts information

Designation	P35	SMU 206	YBG 302	YBC 251	K20	Insert Sharp	L	IC	s	bs
SEKN1203AFTN							12.7	12.7	3.18	1.8
SEKN1203AFFN							12.7	12.7	3.18	1.8
SEKN1203AFN	●	●		●	●		12.7	12.7	3.18	1.8
SEKN1203AFTN			●	●			12.7	12.7	3.18	1.8
SEKR1203AFN		●		●			12.7	12.7	3.18	1.8
SEKN1504AFN	●			●	●		15.875	15.875	4.76	1.6
SEKN1504AFTN				●			15.875	15.875	4.76	1.6
SEKR1504AFN							15.875	15.875	4.76	1.6



75° FP type Indexable Shell Mill

Designation	D	D1	D2	d	a	b	E	F	ap	Z	Kg	Fig.
LM75FP-4080-05T	80	86	57	27	12.4	7	22	50	9.0	5	1.4	1
LM75FP-4100-06T	100	107	67	32	14.4	8	28	50	9.0	6	2.1	2
LM75FP-4125-08T	125	132	87	40	16.4	9	30	63	9.0	8	3.8	2
LM75FP-4160-10T	160	166	107	40	16.4	9	30	63	9.0	10	5.7	2
LM75FP-4200-12T	200	206	130	60	25.7	14	38	63	9.0	12	8.2	3
LM75FP-4250-16T	250	256	180	60	25.7	14	38	63	9.0	16	13.5	3
LM75FP-4315-20T	315	321	240	60	25.4	14	38	63	9.0	20	21.1	4
LM75FP-5080-05T	80	91	57	27	12.4	7	22	50	12.0	5	1.5	1
LM75FP-5100-06T	100	110	67	32	14.4	8	28	50	12.0	6	2.1	2
LM75FP-5125-08T	125	134	87	40	16.4	9	30	63	12.0	8	3.9	2
LM75FP-5160-10T	160	169	107	40	16.4	9	30	63	12.0	10	5.7	2
LM75FP-5200-12T	200	209	130	60	25.7	14	38	63	12.0	12	8.4	3
LM75FP-5250-16T	250	259	180	60	25.7	14	38	63	12.0	16	13.6	3
LM75FP-5315-20T	315	324	240	60	25.7	14	38	63	12.0	20	21.6	4

Applicable inserts and spare parts

Designation	Applicable Insert	Locator	Wedge	Locator Screw	Wedge Screw	Wrench
LM75FP-4080~4100	SPK□1203	LSP12R1/L1	W04R/L	DHA0817F	LTX0514	L-4.0T
LMP75FP-4125~4315		LSP12R/L		DHA0821F		
LM75FP-5	SPK□1504	LSP15R/L				

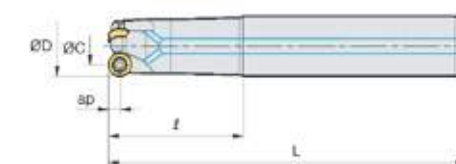


Fig1

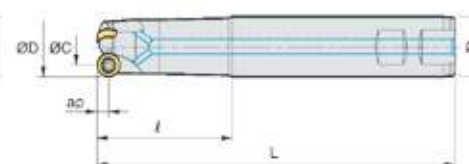


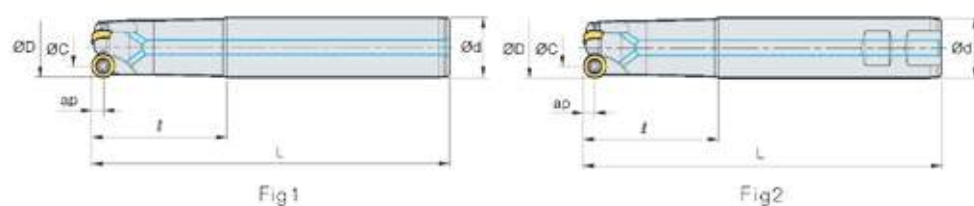
Fig2

Applicable Inserts information

Designation	P35	SMU 206	YBG 302	YBC 251	K20	Insert Sharp	L	IC	s	bs	be
SPKN1203EDR	●	●	●	●	●		12.7	12.7	3.18	1	1.4
SPKN1203EDL							12.7	12.7	3.18	1	1.4
SPKN1203EDER							12.7	12.7	3.18	0.8	1.63
SPKN1203EDEL							12.7	12.7	3.18	0.8	1.63
SPKN1203EDTR							12.7	12.7	3.18	0.8	1.63
SPKN1203EDTL							12.7	12.7	3.18	0.8	1.63
SPKR1203EDR							12.7	12.7	3.18	1	1.4
SPKR1203EDL							12.7	12.7	3.18	1	1.4
SPKN1504EDR	●	●	●	●	●		15.875	15.875	4.76	1	1.4
SPKN1504EDL							15.875	15.875	4.76	1	1.4
SPKN1504EDER							15.875	15.875	4.76	0.8	1.63
SPKN1504EDEL							15.875	15.875	4.76	0.8	1.63
SPKN1504EDTR							15.875	15.875	4.76	0.8	1.63
SPKN1504EDTL							15.875	15.875	4.76	0.8	1.63
SPKR1504EDR							15.875	15.875	4.76	1	1.4
SPKR1504EDL							15.875	15.875	4.76	1	1.4

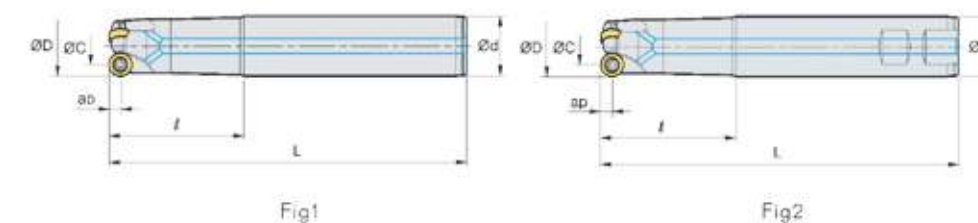
FMR type End Mill

Designation	D	C	d	l	L	Z	ap	Kg	Fig.	Applicable Insert
311.FMR04R.12D01R040B12L120	12	8	12	40	120	1	4.0	0.3	1	RPMW08T2MO RPMT08T2MO
311.FMR04R.14D01R040B12L120	14	10	12	40	120	1	4.0	0.3	1	
311.FMR04R.16D02R040B16L120	16	8	16	40	120	2	4.0	0.4	1	
311.FMR04R.16D02R040B16L160	16	8	16	40	160	2	4.0	0.4	1	
311.FMR04R.16D02R040B16L200	16	8	16	40	200	2	4.0	0.5	1	
311.FMR04R.16D02R065W16L125	16	8	16	65	125	2	4.0	0.3	2	
311.FMR04R.16D02R080W16L150	16	8	16	80	150	2	4.0	0.4	2	
311.FMR04R.16D02R090W16L200	16	8	16	90	200	2	4.0	0.5	2	
311.FMR04R.20D02R050B20L160	20	12	20	50	160	2	4.0	0.5	1	
311.FMR04R.20D02R050B20L200	20	12	20	50	200	2	4.0	0.6	1	
311.FMR04R.20D02R065W20L125	20	12	20	65	125	2	4.0	0.4	2	
311.FMR04R.20D02R080W20L150	20	12	20	80	150	2	4.0	0.5	2	
311.FMR04R.20D02R090W20L200	20	12	20	90	200	2	4.0	0.6	2	
311.FMR05R.20D02R050B20L160	20	10	20	50	160	2	5.0	0.5	1	RPMW10T3MO RPMT10T3MO
311.FMR05R.20D02R050B20L200	20	10	20	50	200	2	5.0	0.6	1	
311.FMR05R.20D02R035W20L115	20	10	20	35	115	2	5.0	0.4	2	
311.FMR05R.20D02R060W20L150	20	10	20	60	150	2	5.0	0.5	2	
311.FMR05R.21D02R050B20L160	21	11	20	50	160	2	5.0	0.4	1	
311.FMR05R.21D02R050B20L200	21	11	20	50	200	2	5.0	0.6	1	
311.FMR05R.21D02R035W20L115	25	11	20	35	115	2	5.0	0.4	2	
311.FMR05R.25D02R050B25L160	25	15	25	50	160	2	5.0	0.6	1	
311.FMR05R.25D02R050B25L200	25	15	25	50	200	2	5.0	0.7	1	
311.FMR05R.25D02R075B25L250	25	15	25	75	250	2	5.0	1.0	1	
311.FMR05R.25D02R055W25L125	25	15	25	55	125	2	5.0	0.5	2	
311.FMR05R.25D02R090W25L200	25	15	25	90	200	2	5.0	0.7	2	
311.FMR05R.25D02R110W25L250	25	15	25	110	250	2	5.0	1.0	2	
311.FMR05R.26D02R070B25L200	26	16	25	70	200	2	5.0	0.7	1	
311.FMR05R.26D02R100B25L250	26	16	25	100	250	2	5.0	0.7	1	
311.FMR05R.30D02R040B25L120	30	20	25	40	120	2	5.0	1.0	1	
311.FMR05R.30D02R050B25L160	30	20	25	50	160	2	5.0	1.0	1	
311.FMR05R.30D02R050B25L200	30	20	25	50	200	2	5.0	1.3	1	
311.FMR05R.30D02R060B25L250	30	20	25	60	250	2	5.0	1.4	1	
311.FMR05R.30D02R060B25L300	30	20	25	60	300	2	5.0	1.6	1	



FMR type End Mill

Designation	D	C	d	l	L	Z	ap	Kg	Fig.	Applicable Insert
311.FMR05R.32D03R050B32L160	32	22	32	50	160	3	5.0	1.2	1	RPMW10T3MO RPMT10T3MO
311.FMR05R.32D03R050B32L200	32	22	32	50	200	3	5.0	1.3	1	
311.FMR05R.32D03R060B32L250	32	22	32	60	250	3	5.0	1.4	1	
311.FMR05R.32D03R060B32L300	32	22	32	60	300	3	5.0	1.6	1	
311.FMR05R.32D03R040W32L125	32	22	32	40	125	3	5.0	1.0	2	
311.FMR05R.35D03R050B32L160	35	25	32	50	160	3	5.0	1.4	1	
311.FMR05R.35D03R050B32L200	35	25	32	50	200	3	5.0	1.5	1	
311.FMR05R.35D03R060B32L250	35	25	32	60	250	3	5.0	1.6	1	
311.FMR05R.35D03R060B32L300	35	25	32	60	300	3	5.0	1.8	1	
311.FMR05R.35D03R060B32L350	35	25	32	60	350	3	5.0	1.9	1	
311.FMR05R.35D03R060B32L400	35	25	32	60	400	3	5.0	2.0	1	
311.FMR05R.40D04R050B32L160	40	30	32	50	160	4	5.0	1.4	1	
311.FMR05R.40D04R050B32L200	40	30	32	50	200	4	5.0	1.5	1	
311.FMR05R.40D04R060B32L250	40	30	32	60	250	4	5.0	1.6	1	
311.FMR05R.40D04R060B32L300	40	30	32	60	300	4	5.0	1.8	1	
311.FMR05R.40D04R060B32L350	40	30	32	60	350	4	5.0	1.9	1	
311.FMR05R.40D04R060B32L400	40	30	32	60	400	4	5.0	2.0	1	
311.FMR05R.40D04R040W32L125	40	30	32	40	125	4	5.0	1.3	2	
311.FMR06R.32D02R050B32L160	32	20	32	50	160	2	6.0	1.0	1	RPMW1204MO RPMT1204MO
311.FMR06R.32D02R080B32L200	32	20	32	80	200	2	6.0	1.1	1	
311.FMR06R.32D02R100B32L250	32	20	32	100	250	2	6.0	1.3	1	
311.FMR06R.32D02R100B32L300	32	20	32	100	300	2	6.0	1.6	1	
311.FMR06R.32D02R040W32L125	32	20	32	40	125	2	6.0	0.8	2	
311.FMR06R.33D02R070B32L200	33	21	32	70	200	2	6.0	1.1	1	
311.FMR06R.33D02R150B32L300	33	21	32	150	300	2	6.0	1.7	1	
311.FMR06R.33D02R040W32L125	33	21	32	40	125	2	6.0	0.9	2	
311.FMR06R.35D03R050B32L160	35	23	32	50	160	3	6.0	1.1	1	
311.FMR06R.35D03R050B32L200	35	23	32	50	200	3	6.0	1.3	1	
311.FMR06R.35D03R060B32L250	35	23	32	60	250	3	6.0	1.5	1	
311.FMR06R.35D03R060B32L300	35	23	32	60	300	3	6.0	1.8	1	
311.FMR06R.35D03R060B32L350	35	23	32	60	350	3	6.0	2.0	1	
311.FMR06R.40D03R050B32L160	40	28	32	50	160	3	6.0	1.8	1	



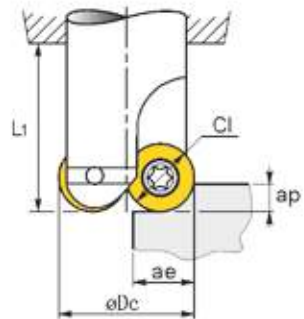
FMR type End Mill

Designation	D	C	d	l	L	Z	ap	Kg	Fig.	Applicable Insert
311.FMR06R.40D03R050B32L200	40	28	32	50	200	3	6.0	2.0	1	RPMW1204MO RPMT1204MO
311.FMR06R.40D03R060B32L250	40	28	32	60	250	3	6.0	2.2	1	
311.FMR06R.40D03R060B32L300	40	28	32	60	300	3	6.0	2.4	1	
311.FMR06R.40D03R040W32L125	40	28	32	40	125	3	6.0	1.3	2	
311.FMR06R.50D04R050B32L250	50	38	32	50	250	4	6.0	2.6	1	
311.FMR06R.50D04R050B32L300	50	38	32	50	300	4	6.0	3.2	1	
311.FMR06R.50D04R050W42L125	50	38	42	50	125	4	6.0	2.0	2	RPMW1606MO RPMT1606MO
311.FMR08R.40D02R070B32L200	40	24	32	70	200	2	8.0	1.8	1	
311.FMR08R.40D02R150B32L300	40	24	32	150	300	2	8.0	2.0	1	
311.FMR08R.40D02R040W32L125	40	24	32	40	125	2	8.0	1.4	2	
311.FMR08R.50D03R050B32L250	50	34	32	50	250	3	8.0	1.8	1	
311.FMR08R.50D03R050B32L300	50	34	32	50	300	3	8.0	2.0	1	
311.FMR08R.50D03R050W42L150	50	34	42	50	150	3	8.0	1.5	2	
311.FMR08R.63D04R050B42L250	63	47	42	50	250	4	8.0	1.8	1	
311.FMR08R.63D04R050B42L300	63	47	42	50	300	4	8.0	2.0	1	
311.FMR08R.63D04R050W42L150	63	47	42	50	150	4	8.0	1.6	2	

Applicable spare parts

Designation	Screw	Wrench	Picture
311.FMR04R	M2.5*6	T-8S	
311.FMR05R	M3.5*8	T-15S	
311.FMR06R	M4.0*10	T-15S	
311.FMR08R	M5.0*13	T-20S	

Tooth feed fz(mm)



Finishing: ae up to 25% of cutting diameter Dc

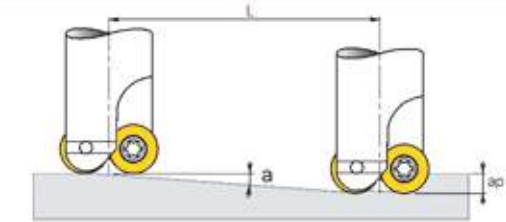
Roughing: ae up to 20-100% of cutting diameter Dc

ap(mm)

C1	0.3	0.5	0.7	0.8	1	1.2	2	3	4	5	6	8
08	0.21	0.16	0.14	0.13								
10	0.29	0.22	0.19	0.18	0.16							
12	0.38	0.29	0.25	0.23	0.21	0.19						
16	0.44	0.34	0.29	0.27	0.24	0.22	0.18					
					0.51	0.47	0.37	0.3	0.28	0.26	0.25	0.25

Ramping angle α

Formula:
 $a_{p\max} = C1/2$
 $L_{\min} = a_{p\max} / \tan(\alpha)$



Dc(mm)

C1	10	12	15	16	20	25	32	40	50	52	63	66	80	100
08				34°										
10					39°	17°	10°							
12						44°	19°	11°	8°		5°			
16							47°			12°		8°	6°	4°

Cutting condition formulas for milling

Cutting speed

$$vc = \frac{\pi \times D \times n}{1000} \text{ (m/min)}$$

RPM

$$n = \frac{vc \times 1000}{\pi \times D} \text{ (Min}^{-1}\text{)}$$

Feed(per tooth)

$$fz = \frac{vf}{nxz} \text{ (mm/t)}$$

Feed(per minute)

$$vf = fz \times nxz \text{ (mm/min)}$$

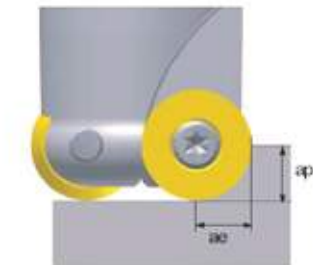
Chip removal rate

$$Q = \frac{ap \times ae \times vf}{1000} \text{ (cm}^3\text{/min)}$$

Required machine power

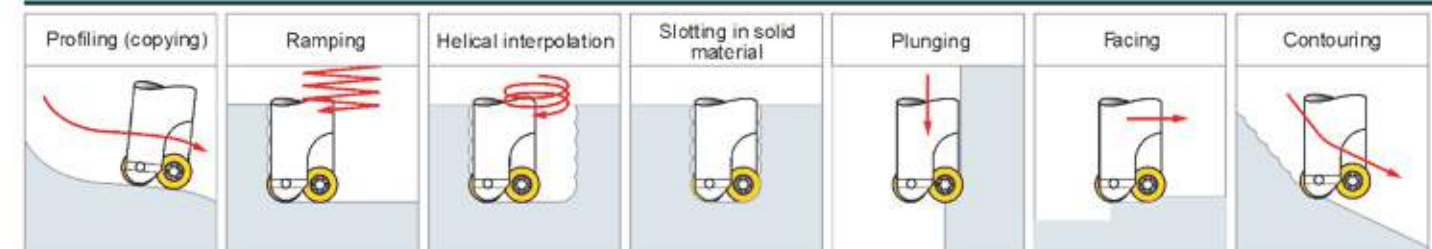
$$pkw = \frac{Q \times kc}{60 \times 102 \times \eta} \text{ (kw)}$$

$$Php = \frac{Pkw}{0.75} \text{ (hp)}$$



vc = Cutting speed(m/min)	H = Horsepower requirement(Hp)
n = Revolution per a minute(min ⁻¹)	Q = Chip removal amount(cm ³ /min)
D = Cutting diameter(mm)	ap = Depth of cut(mm)
vf = Feed per a minute(mm/min)	ae = Width of cut(mm)
fz = Feed per tooth(mm/t)	Kc = Specific cutting resistance(MPa)
z = Number of tooth	η = Mechanical efficiency(%)
Pc = Power requirement (kW)	

Use



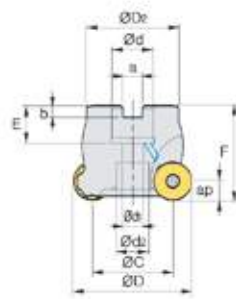


Fig1

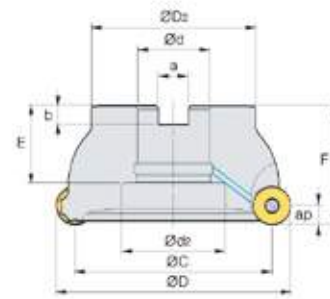


Fig2

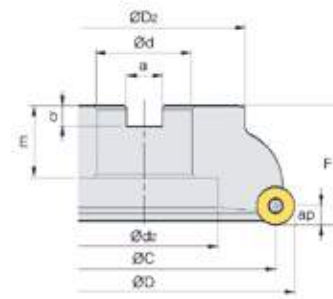


Fig3

FMR type Shell Mill

Designation	D	d	C	D2	a	b	E	F	d1	d2	Z	ap	Kg	Fig.
312.FMR05R.040A03RSMOB	40	16	30	36	8.4	5.6	18	40	9	14	3	5.0	0.2	1
312.FMR05R.040A04RSMOM	40	16	30	36	8.4	5.6	18	40	9	14	4	5.0	0.2	1
312.FMR05R.050A04RSMOB	50	22	40	42	10.4	6.3	20	40	11	16.5	4	5.0	0.3	1
312.FMR05R.050A05RSMOM	50	22	40	42	10.4	6.3	20	40	11	16.5	5	5.0	0.3	1
312.FMR05R.063A05RSMOB	63	22	53	49	10.4	6.3	20	50	11	16.5	5	5.0	0.6	1
312.FMR05R.063A06RSMOM	63	22	53	49	10.4	6.3	20	50	11	16.5	6	5.0	0.6	1
312.FMR05R.080A06RSMOB	80	27	70	57	12.4	7.0	22	50	14	19	6	5.0	1.1	1
312.FMR05R.080A07RSMOM	80	27	70	57	12.4	7.0	22	50	14	19	7	5.0	1.1	1
312.FMR05R.100B07RSMOB	100	32	90	67	14.4	8.0	28	50	18	26	7	5.0	2.1	2
312.FMR05R.100B08RSMOM	100	32	90	67	14.4	8.0	28	50	18	26	8	5.0	2.1	2
312.FMR05R.125B08RSMOB	125	40	115	87	16.4	9.0	29	63	22	32	8	5.0	2.2	2
312.FMR05R.160C10RSMOB	160	40	150	107	16.4	9.0	35	63	-	78	10	5.0	4.2	3

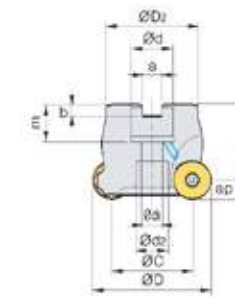


Fig1

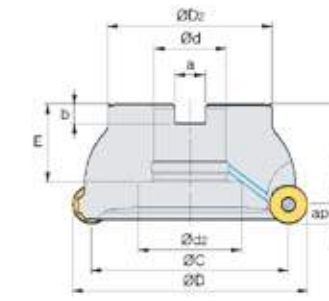


Fig2

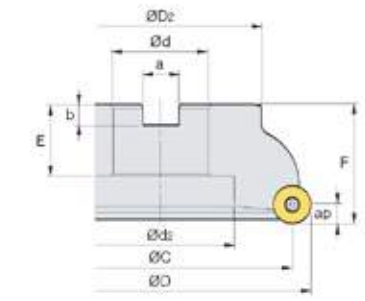


Fig3

FMR type Shell Mill

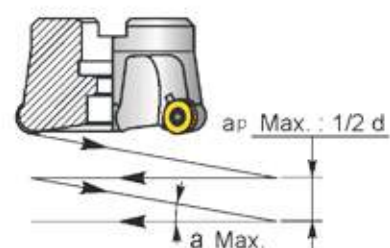
Designation	D	d	C	D2	a	b	E	F	d1	d2	Z	ap	Kg	Fig.
312.FMR06R.050A04RSMOB	50	22	38	42	10.4	6.3	20	50	11	18	4	6.0	0.4	1
312.FMR06R.063A05RSMOB	63	22	51	49	10.4	6.3	20	50	11	18	5	6.0	0.6	1
312.FMR06R.080A06RSMOB	80	27	68	57	12.4	7.0	22	50	14	20	6	6.0	1.0	1
312.FMR06R.100B06RSMOB	100	32	88	67	14.4	8.0	28	50	18	26	6	6.0	1.5	2
312.FMR06R.100B07RSMOB	100	32	88	67	14.4	8.0	28	50	18	26	7	6.0	1.5	2
312.FMR06R.125B07RSMOB	125	40	113	87	16.4	9.0	29	63	22	32	7	6.0	3.0	2
312.FMR06R.125B08RSMOM	125	40	113	87	16.4	9.0	29	63	22	32	8	6.0	3.0	2
312.FMR06R.160C08RSMOB	160	40	148	107	16.4	9.0	35	63	-	78	8	6.0	3.9	3
312.FMR08R.050A03RSMOB	50	22	34	42	10.4	6.3	20	50	11	16.5	4	8.0	0.4	1
312.FMR08R.063A04RSMOB	63	22	47	49	10.4	6.3	20	50	11	18	4	8.0	0.6	1
312.FMR08R.063A05RSMOM	63	22	47	49	10.4	6.3	20	50	11	18	5	8.0	0.6	1
312.FMR08R.080A05RSMOB	80	27	64	57	12.4	7.0	23	50	14	20	5	8.0	0.9	1
312.FMR08R.080A06RSMOM	80	27	64	57	12.4	7.0	23	50	14	20	6	8.0	0.9	1
312.FMR08R.100B06RSMOB	100	32	84	67	14.4	8.0	25	50	18	26	6	8.0	1.4	2
312.FMR08R.100B07RSMOM	100	32	84	67	14.4	8.0	25	50	18	26	7	8.0	1.4	2
312.FMR08R.125B07RSMOB	125	40	109	87	16.4	9.0	29	63	22	32	7	8.0	3.0	2
312.FMR08R.125B08RSMOM	125	40	109	87	16.4	9.0	29	63	22	32	8	8.0	3.0	2
312.FMR08R.160C08RSMOB	160	40	144	107	16.4	9.0	35	63	-	78	8	8.0	4.4	3

Applicable insert and spare parts

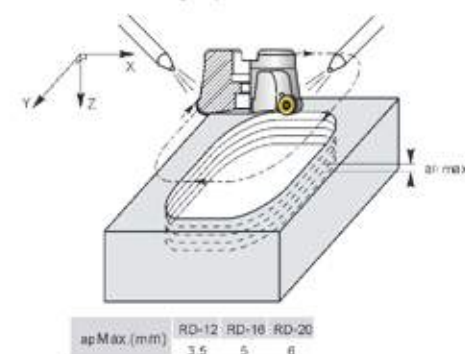
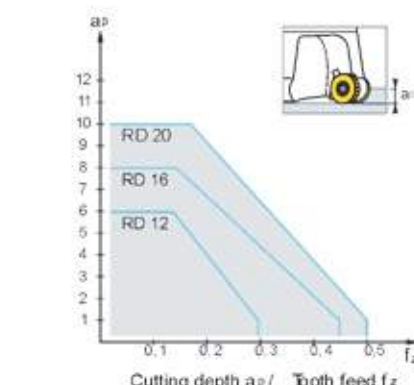
Designation	Available Inserts	Screw	Wrench	Picture
312.FMR05R	RPMW10T3MO RPMT10T3MO	M3.5*8	T-15S	
312.FMR06R	RPMW1204MO RPMT1204MO	M4.0*10	T-15S	
312.FMR08R	RPMW1606MO RPMT1606MO	M5.0*13	T-20S	

Cutting conditions

The round cutter range with round inserts are designed for rough machining of hard steel and cast irons for use with moulds and press tools as a whole, therefore, the cutters are particularly suitable for modern CNC machines making complex shapes by continuous interpolation in 3 axis. The robustness of these cutters, together with tough cutting edge ensure safe operation in rough machining of moulds and dies. The cutting depth may be as much as 6,8 or 10 mm, i.e. the value of the insert radius ($1/2 d$). Single-piece cutters with diameters from 16 to 125mm can be used for facing, slotting or pocketing. Cutters with diameters from 160 to 315mm in the cartridge version are only recommended for surfacing.



Ø D	α Max.		
	R6	R8	R10
25	10°	—	12°
32	12°	—	—
40	9°	—	—
50	7°	10°	12°
63	5°	7°	—
80	3°	5°	7°
100	2°	4°	5°



These values must be reduced by 50% for single-tooth cutters.

Chip evacuation

Coolant pressure, preferably along two different directions as close as possible to the inserts.

Slotting

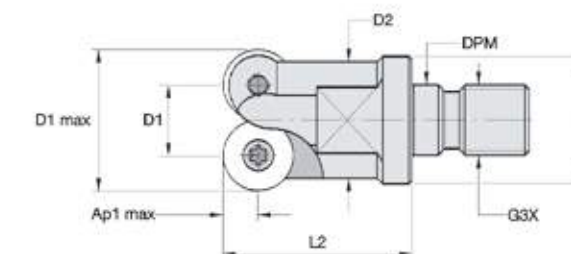
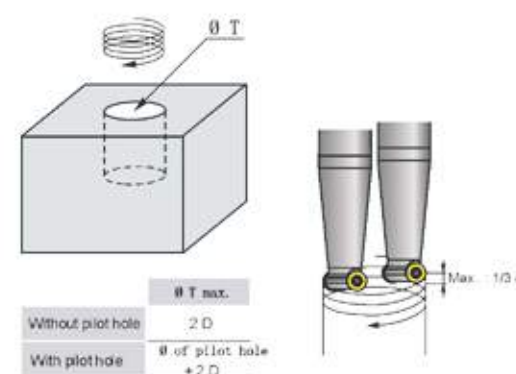
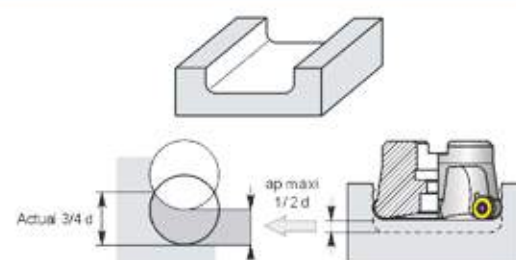
In slotting, when the cutting depth reached the insert radius ($1/2 d$), the cutting height on the sides of the slot is equal to $1/2 d$.

Drilling with helical cycle

Round cutters are designed to allow drilling in solid material or the enlargement of holes by helical interpolation within the limits shown on the sketches below

Assembly instructions for inserts with facets

Before tightening the screw, make sure that:
1- the insert facets are contact with the 11° slopes of the cutter housing.
2- the insert lower face is in contact with the cutter housing seat.



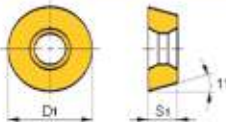
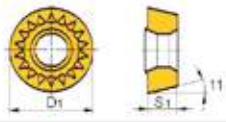
FMR type Milling Modular

Designation	D1 max	D1	D	D2	L2	DPM	G3X	Ap1 max	Z	Kg	Available inserts
313.FMR04R.12D01R028M08	12	4	13.0	11.0	28	8.5	M08	4.0	1	0.03	RPM08T2MO RPMT08T2
313.FMR04R.16D02R030M08	16	8	14.5	13.0	30	8.5	M08	4.0	2	0.04	
313.FMR04R.20D02R035M10	20	12	18.0	18.0	35	10.5	M10	4.0	2	0.07	
313.FMR04R.25D03R045M12	25	17	22.5	21.0	45	12.5	M12	4.0	3	0.13	
313.FMR05R.20D02R035M10	20	10	18.0	18.0	35	10.5	M10	5.0	2	0.07	RPMW10T3MO RPMT10T3MO
313.FMR05R.21D02R035M10	21	11	18.0	18.0	35	10.5	M10	5.0	2	0.10	
313.FMR05R.25D02R045M12	25	15	22.5	21.0	45	12.5	M12	5.0	2	0.15	
313.FMR05R.30D03R050M16	30	20	29.0	25.0	50	17.0	M16	5.0	3	0.20	
313.FMR05R.32D03R050M16	32	22	29.0	25.0	50	17.0	M16	5.0	3	0.20	RPMW1204MO RPMT1204MO
313.FMR05R.35D04R050M16	35	25	29.0	32.9	50	17.0	M16	5.0	4	0.25	
313.FMR05R.42D04R050M16	42	32	29.0	37.7	50	17.0	M16	5.0	4	0.25	
313.FMR06R.25D02R045M12	25	13	22.5	21.0	45	12.5	M12	6.0	2	0.12	
313.FMR06R.32D02R050M16	32	20	29.0	25.0	50	17.0	M16	6.0	2	0.22	RPMW1606MO RPMT1606MO
313.FMR06R.35D03R050M16	35	23	29.0	32.6	50	17.0	M16	6.0	3	0.23	
313.FMR06R.40D03R050M16	40	28	29.0	38.0	50	17.0	M16	6.0	3	0.24	
313.FMR06R.42D04R050M16	42	30	29.0	38.0	50	17.0	M16	6.0	4	0.25	
313.FMR08R.32D02R050M16	32	16	29.0	26.5	50	17.0	M16	8.0	2	0.20	RPMW1606MO RPMT1606MO
313.FMR08R.40D02R050M16	40	24	29.0	38.0	50	17.0	M16	8.0	2	0.25	

Applicable spare parts

Designation	Screw	Wrench	Picture
313.FMR04R	M2.5*6	T-8S	
313.FMR05R	M3.5*8	T-15S	
313.FMR06R	M4.0*10	T-15S	
313.FMR08R	M5.0*13	T-20S	

Applicable Inserts information

Designation	SMU 10	SMU 206	YBG 302	YBC 251	SMU 200	Insert Sharp	R	D1	S1
RPMW08T2MO							4	8	2.78
RPMW10T3MO					●		5	10	3.97
RPMW1204MO					●		6	12	4.76
RPMW1606MO							8	16	6.35
RPMT08T2MOE					●		4	8	2.78
RPMT10T3MOE					●		5	10	3.97
RPMT1204MOE					●		6	12	4.76
RPMT1606MOE							8	16	6.35

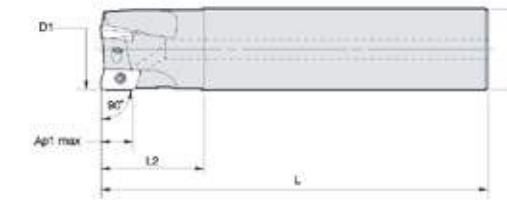


Fig.1

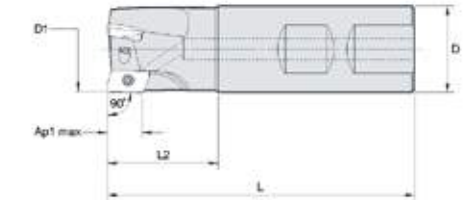


Fig.2

ZAP type End Mill

Designation	D1	D	L2	L	Z	Ap1 max	Kg	Fig.	Available Inserts
311.ZAP9010.10D01R030B10L100	10	10	30	100	1	9.0	0.04	1	APLX1003PDTR
311.ZAP9010.12D01R030B12L100	12	12	30	100	1	9.0	0.10	1	
311.ZAP9010.12D01R025W16L085	12	16	25	85	1	9.0	0.10	2	
311.ZAP9010.14D01R030B12L100	14	12	30	100	1	9.0	0.10	1	
311.ZAP9010.14D01R025W16L085	14	16	25	85	1	9.0	0.12	2	
311.ZAP9010.16D02R040B16L120	16	16	40	120	2	9.0	0.10	1	
311.ZAP9010.16D02R040B16L160	16	16	40	160	2	9.0	0.12	1	
311.ZAP9010.16D02R040B16L200	16	16	40	200	2	9.0	0.21	1	
311.ZAP9010.16D02R025W16L090	16	16	25	90	2	9.0	0.10	2	
311.ZAP9010.18D02R040B16L160	18	16	40	160	2	9.0	0.12	1	
311.ZAP9010.18D02R040B16L200	18	16	40	200	2	9.0	0.21	1	
311.ZAP9010.18D02R030W20L100	18	20	30	100	2	9.0	0.14	2	

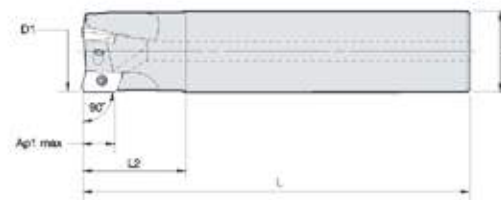


Fig.1

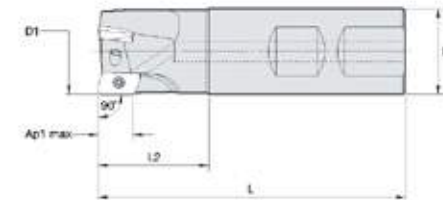


Fig.2

ZAP type End Mill

Designation	D1	D	L2	L	Z	Ap1 max	Kg	Fig.	Available Inserts
311.ZAP9010.20D02R050B20L120	20	20	50	120	2	9.0	0.20	1	APLX1003PDTR
311.ZAP9010.20D03R050B20L120	20	20	50	120	3	9.0	0.20	1	
311.ZAP9010.20D02R050B20L160	20	20	50	160	2	9.0	0.21	1	
311.ZAP9010.20D03R050B20L160	20	20	50	160	3	9.0	0.21	1	
311.ZAP9010.20D02R050B20L200	20	20	50	200	2	9.0	0.49	1	
311.ZAP9010.20D03R050B20L200	20	20	50	200	3	9.0	0.49	1	
311.ZAP9010.20D02R030W20L100	20	20	30	100	2	9.0	0.20	2	
311.ZAP9010.20D03R030W20L100	20	20	50	100	3	9.0	0.20	2	
311.ZAP9010.22D03R050B20L120	22	20	50	120	3	9.0	0.25	1	
311.ZAP9010.22D03R050B20L160	22	20	50	160	3	9.0	0.28	1	
311.ZAP9010.22D03R050B20L200	22	20	50	200	3	9.0	0.38	1	
311.ZAP9010.22D03R035W25L115	22	25	35	115	3	9.0	0.25	2	
311.ZAP9010.25D03R050B25L120	25	25	50	120	3	9.0	0.40	1	
311.ZAP9010.25D04R050B25L120	25	25	50	120	4	9.0	0.40	1	
311.ZAP9010.25D03R050B25L160	25	25	50	160	3	9.0	0.59	1	
311.ZAP9010.25D04R050B25L160	25	25	50	160	4	9.0	0.59	1	
311.ZAP9010.25D03R050B25L200	25	25	50	200	3	9.0	0.59	1	
311.ZAP9010.25D04R050B25L200	25	25	50	200	4	9.0	0.59	1	
311.ZAP9010.25D03R035W25L115	25	25	35	115	3	9.0	0.40	2	
311.ZAP9010.25D04R035W25L115	25	25	35	115	4	9.0	0.40	2	
311.ZAP9010.32D04R050B32L160	32	32	50	160	4	9.0	0.70	1	
311.ZAP9010.32D05R050B32L160	32	32	50	160	5	9.0	0.70	1	
311.ZAP9010.32D04R050B32L200	32	32	50	200	4	9.0	1.00	1	
311.ZAP9010.32D05R050B32L200	32	32	50	200	5	9.0	1.00	1	
311.ZAP9010.32D04R050B32L250	32	32	50	250	4	9.0	1.00	1	
311.ZAP9010.32D05R050B32L250	32	32	50	250	5	9.0	1.00	1	
311.ZAP9010.32D04R040W32L125	32	32	40	125	4	9.0	0.70	2	
311.ZAP9010.32D05R040W32L125	32	32	40	125	5	9.0	0.70	2	
311.ZAP9010.40D05R060B32L160	40	32	60	160	5	9.0	1.20	1	
311.ZAP9010.40D05R050W32L130	40	32	50	130	5	9.0	1.20	2	
311.ZAP9010.50D06R050W42L135	50	42	50	135	6	9.0	1.50	2	
311.ZAP9010.63D08R050W42L135	63	42	50	135	8	9.0	1.70	2	

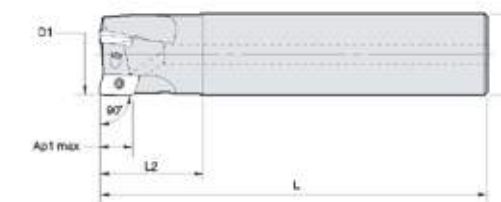


Fig.1

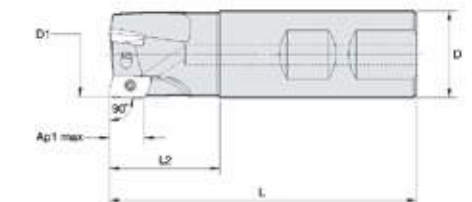


Fig.2

ZAP type End Mill

Designation	D1	D	L2	L	Z	Ap1 max	Kg	Fig.	Available Inserts
311.ZAP9011.10D01R030B10L100	10	10	30	100	1	9.0	0.04	1	APKT11T3□□
311.ZAP9011.12D01R030B12L100	12	12	30	100	1	9.0	0.10	1	
311.ZAP9011.12D01R025W16L085	12	16	25	85	1	9.0	0.10	2	
311.ZAP9011.14D01R030B12L100	14	12	30	100	1	9.0	0.10	1	
311.ZAP9011.14D01R025W16L085	14	16	25	85	1	9.0	0.12	2	
311.ZAP9011.16D02R040B16L120	16	16	40	120	2	9.0	0.10	1	
311.ZAP9011.16D02R040B16L160	16	16	40	160	2	9.0	0.12	1	
311.ZAP9011.16D02R040B16L200	16	16	40	200	2	9.0	0.21	1	
311.ZAP9011.16D02R025W16L090	16	16	25	90	2	9.0	0.10	2	
311.ZAP9011.18D02R040B16L160	18	16	40	160	2	9.0	0.12	1	
311.ZAP9011.18D02R040B16L200	18	16	40	200	2	9.0	0.21	1	
311.ZAP9011.18D02R030W20L100	18	20	30	100	2	9.0	0.14	2	
311.ZAP9011.20D02R050B20L120	20	20	50	120	2	9.0	0.20	1	
311.ZAP9011.20D03R050B20L120	20	20	50	120	3	9.0	0.20	1	
311.ZAP9011.20D02R050B20L160	20	20	50	160	2	9.0	0.21	1	
311.ZAP9011.20D03R050B20L160	20	20	50	160	3	9.0	0.21	1	
311.ZAP9011.20D02R050B20L200	20	20	50	200	2	9.0	0.49	1	
311.ZAP9011.20D03R050B20L200	20	20	50	200	3	9.0	0.49	1	
311.ZAP9011.20D02R030W20L100	20	20	30	100	2	9.0	0.20	2	
311.ZAP9011.20D03R030W20L100	20	20	50	100	3	9.0	0.20	2	
311.ZAP9011.22D03R050B20L120	22	20	50	120	3	9.0	0.25	1	
311.ZAP9011.22D03R050B20L160	22	20	50	160	3	9.0	0.28	1	
311.ZAP9011.22D03R050B20L200	22	20	50	200	3	9.0	0.38	1	
311.ZAP9011.22D03R035W25L115	22	25	35	115	3	9.0	0.25	2	

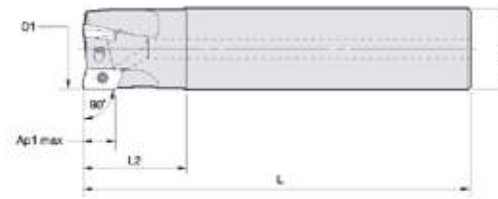


Fig.1

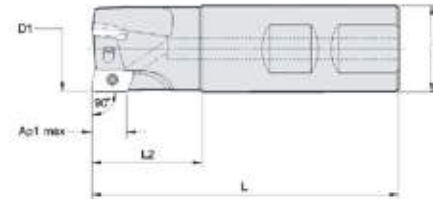


Fig.2

ZAP type End Mill

Designation	D1	D	L2	L	Z	Ap1 max	Kg	Fig.	Available Inserts
311.ZAP9011.25D03R050B25L120	25	25	50	120	3	9.0	0.40	1	APKT11T3□□
311.ZAP9011.25D04R050B25L120	25	25	50	120	4	9.0	0.40	1	
311.ZAP9011.25D03R050B25L160	25	25	50	160	3	9.0	0.59	1	
311.ZAP9011.25D04R050B25L160	25	25	50	160	4	9.0	0.59	1	
311.ZAP9011.25D03R050B25L200	25	25	50	200	3	9.0	0.59	1	
311.ZAP9011.25D04R050B25L200	25	25	50	200	4	9.0	0.59	1	
311.ZAP9011.25D03R035W25L115	25	25	35	115	3	9.0	0.40	2	
311.ZAP9011.25D04R035W25L115	25	25	35	115	4	9.0	0.40	2	
311.ZAP9011.32D04R050B32L160	32	32	50	160	4	9.0	0.70	1	
311.ZAP9011.32D05R050B32L160	32	32	50	160	5	9.0	0.70	1	
311.ZAP9011.32D04R050B32L200	32	32	50	200	4	9.0	1.00	1	
311.ZAP9011.32D05R050B32L200	32	32	50	200	5	9.0	1.00	1	
311.ZAP9011.32D04R050B32L250	32	32	50	250	4	9.0	1.00	1	
311.ZAP9011.32D05R050B32L250	32	32	50	250	5	9.0	1.00	1	
311.ZAP9011.32D04R040W32L125	32	32	40	125	4	9.0	0.70	2	
311.ZAP9011.32D05R040W32L125	32	32	40	125	5	9.0	0.70	2	
311.ZAP9011.40D05R060B32L160	40	32	60	160	5	9.0	1.20	1	
311.ZAP9011.40D05R050W32L130	40	32	50	130	5	9.0	1.20	2	
311.ZAP9011.50D06R050W42L135	50	42	50	135	6	9.0	1.50	2	
311.ZAP9011.63D08R050W42L135	63	42	50	135	8	9.0	1.70	2	

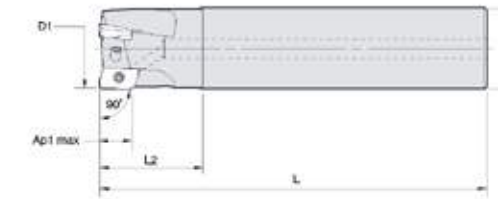


Fig.1

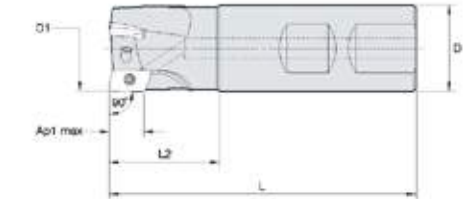


Fig.2

ZAP type End Mill

Designation	D1	D	L2	L	Z	Ap1 max	Kg	Fig.	Available Inserts
311.ZAP9016.20D01R030W20L100	20	20	30	100	1	15.0	0.20	2	APKT1604PDTR
311.ZAP9016.25D02R050B50L120	25	25	50	120	2	15.0	0.40	1	
311.ZAP9016.25D02R050B25L160	25	25	50	160	2	15.0	0.40	1	
311.ZAP9016.25D02R050B25L200	25	25	50	200	2	15.0	0.65	1	
311.ZAP9016.25D02R050B25L250	25	25	50	250	2	15.0	0.75	1	
311.ZAP9016.25D02R050B25L300	25	25	50	300	2	15.0	0.75	1	
311.ZAP9016.25D02R040W25L100	25	25	40	100	2	15.0	0.40	2	
311.ZAP9016.25D02R040W25L180	25	25	40	180	2	15.0	0.65	2	
311.ZAP9016.25D02R060W25L220	25	25	60	220	2	15.0	0.75	2	
311.ZAP9016.32D02R050B25L200	32	25	50	200	2	15.0	1.13	1	
311.ZAP9016.32D02R050B25L250	32	25	50	250	2	15.0	1.52	1	
311.ZAP9016.32D02R050B25L300	32	25	50	300	2	15.0	1.52	1	
311.ZAP9016.32D02R050B32L160	32	32	50	160	2	15.0	0.70	1	
311.ZAP9016.32D02R080B32L200	32	32	80	200	2	15.0	1.13	1	
311.ZAP9016.32D03R060B32L200	32	32	60	200	3	15.0	1.12	1	
311.ZAP9016.32D03R060B32L250	32	32	60	250	3	15.0	1.48	1	
311.ZAP9016.32D03R060B32L300	32	32	60	300	3	15.0	1.48	1	
311.ZAP9016.32D03R040W32L125	32	32	40	125	3	15.0	0.70	2	
311.ZAP9016.32D03R040W32L200	32	32	40	200	3	15.0	1.12	2	
311.ZAP9016.32D03R065W32L260	32	32	65	260	3	15.0	1.48	2	
311.ZAP9016.35D03R060B32L160	35	32	60	160	3	15.0	0.70	1	
311.ZAP9016.35D03R060B32L200	35	32	60	200	3	15.0	1.12	1	
311.ZAP9016.35D03R060B32L250	35	32	60	250	3	15.0	1.48	1	
311.ZAP9016.35D03R060B32L300	35	32	60	300	3	15.0	1.48	1	

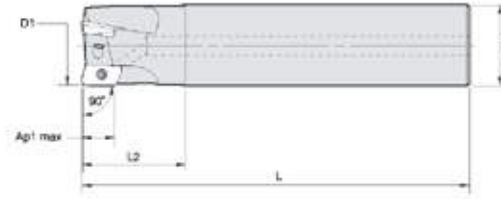


Fig.1

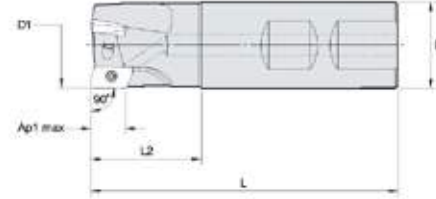


Fig.2

ZAP type End Mill

Designation	D1	D	L2	L	Z	Ap1 max	Kg	Fig.	Available Inserts
311.ZAP9016.35D03R060B32L350	35	32	60	350	3	15.0	1.61	1	APKT1604PDTR
311.ZAP9016.35D03R060B32L400	35	32	60	400	3	15.0	1.78	1	
311.ZAP9016.40D03R060B32L200	40	32	60	200	3	15.0	1.24	1	
311.ZAP9016.40D03R060B32L250	40	32	60	250	3	15.0	1.61	1	
311.ZAP9016.40D03R060B32L300	40	32	60	300	3	15.0	1.65	1	
311.ZAP9016.40D03R060B32L350	40	32	60	350	3	15.0	1.80	1	
311.ZAP9016.40D03R060B32L400	40	32	60	400	3	15.0	1.98	1	
311.ZAP9016.40D03R042W32L130	40	32	42	130	3	15.0	0.80	2	
311.ZAP9016.40D03R042W32L200	40	32	42	200	3	15.0	1.24	2	
311.ZAP9016.40D03R042W32L260	40	32	42	260	3	15.0	1.61	2	
311.ZAP9016.40D04R060B32L200	40	32	60	200	4	15.0	1.21	1	
311.ZAP9016.40D04R060B32L250	40	32	60	250	4	15.0	1.58	1	
311.ZAP9016.40D04R042W42L130	40	42	42	130	4	15.0	0.80	2	
311.ZAP9016.40D04R042W32L200	40	32	42	200	4	15.0	1.21	2	
311.ZAP9016.40D04R042W32L260	40	32	42	260	4	15.0	1.58	2	
311.ZAP9016.50D05R060B32L160	50	32	60	160	5	15.0	1.00	1	
311.ZAP9016.50D05R060B32L200	50	32	60	200	5	15.0	1.40	1	
311.ZAP9016.50D05R045W42L135	50	42	45	135	5	15.0	1.40	2	
311.ZAP9016.63D06R060B32L160	63	32	60	160	6	15.0	1.25	1	
311.ZAP9016.63D06R060B32L200	63	32	60	200	6	15.0	1.50	1	
311.ZAP9016.63D06R045W42L135	63	42	45	135	6	15.0	1.54	2	

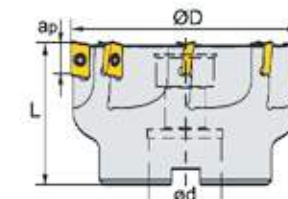


Fig.1

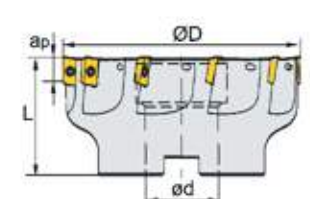


Fig.2

ZAP Type Shell Mill

Designation	D	d	L	Z	Ap1 max	Kg	Fig.	Available Inserts
312.ZAP9010.040A05RS90B	40	16	40	5	9.0	0.22	1	APLX1003PDTR
312.ZAP9010.040A06RS90M	40	16	40	6	9.0	0.22	1	
312.ZAP9010.050A05RS90B	50	22	40	5	9.0	0.34	1	
312.ZAP9010.050A06RS90M	50	22	40	6	9.0	0.34	1	
312.ZAP9010.050A07RS90H	50	22	40	7	9.0	0.34	1	
312.ZAP9010.063A07RS90B	63	22	40	7	9.0	0.57	1	
312.ZAP9010.063A08RS90M	63	22	40	8	9.0	0.57	1	
312.ZAP9010.080A08RS90B	80	27	50	8	9.0	1.10	1	
312.ZAP9010.080A10RS90M	80	27	50	10	9.0	1.10	1	
312.ZAP9010.100B10RS90B	100	32	50	10	9.0	2.10	2	
312.ZAP9011.040A05RS90B	40	16	40	5	9.0	0.22	1	APKT11T3□□
312.ZAP9011.040A06RS90M	40	16	40	6	9.0	0.22	1	
312.ZAP9011.050A05RS90B	50	22	40	5	9.0	0.34	1	
312.ZAP9011.050A06RS90M	50	22	40	6	9.0	0.34	1	
312.ZAP9011.050A07RS90H	50	22	40	7	9.0	0.34	1	
312.ZAP9011.063A07RS90B	63	22	40	7	9.0	0.57	1	
312.ZAP9011.063A08RS90M	63	22	40	8	9.0	0.57	1	
312.ZAP9011.080A08RS90B	80	27	50	8	9.0	1.10	1	
312.ZAP9011.080A10RS90M	80	27	50	10	9.0	1.10	1	
312.ZAP9011.100B10RS90B	100	32	50	10	9.0	2.10	2	

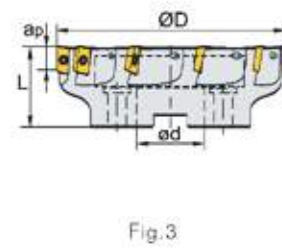
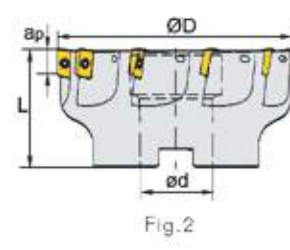
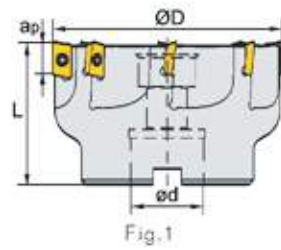


Fig.3

ZAP Type Shell Mill

Designation	D	d	L	Z	Ap1 max	Kg	Fig.	Available Inserts
312.ZAP9016.040A04RS90B	40	16	40	4	15.0	0.15	1	APKT1604PDTR
312.ZAP9016.050A04RS90B	50	22	40	4	15.0	0.24	1	
312.ZAP9016.050A05RS90M	50	22	40	5	15.0	0.24	1	
312.ZAP9016.063A05RS90B	63	22	40	5	15.0	0.24	1	
312.ZAP9016.063A06RS90M	63	22	40	6	15.0	0.24	1	
312.ZAP9016.080A06RS90B	80	27	50	6	15.0	0.36	1	
312.ZAP9016.080A07RS90M	80	27	50	7	15.0	0.36	1	
312.ZAP9016.100B07RS90B	100	32	50	7	15.0	0.61	2	
312.ZAP9016.100B08RS90M	100	32	50	8	15.0	0.61	2	
312.ZAP9016.125B07RS90B	125	40	63	7	15.0	3.20	2	
312.ZAP9016.125B09RS90M	125	40	63	9	15.0	3.20	2	
312.ZAP9016.160B08RS90B	160	40	63	8	15.0	6.30	2	
312.ZAP9016.160B10RS90M	160	40	63	10	15.0	6.30	2	
312.ZAP9016.200C12RS90B	200	60	63	12	15.0	8.10	3	
312.ZAP9016.250C12RS90B	200	60	63	12	15.0	11.20	3	

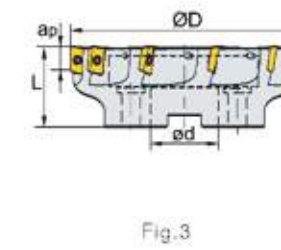
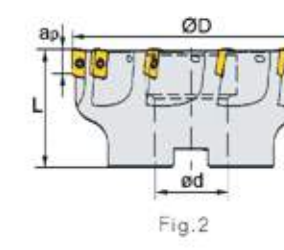
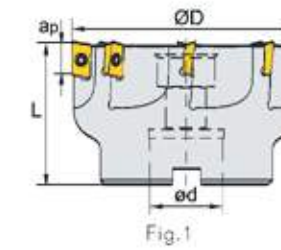
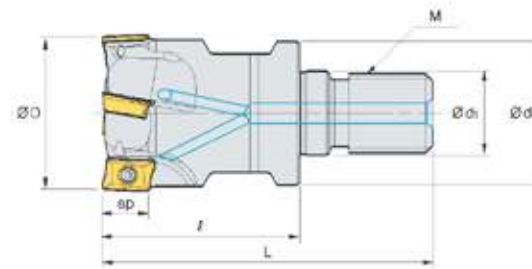


Fig.3

ZAP Type Shell Mill

Designation	D	d	L	Z	Ap1 max	Kg	Fig.	Available Inserts
312.ZAP9016.040A04RS90B	40	16	40	4	15.0	0.15	1	APKT1604PDTR
312.ZAP9016.050A04RS90B	50	22	40	4	15.0	0.24	1	
312.ZAP9016.050A05RS90M	50	22	40	5	15.0	0.24	1	
312.ZAP9016.063A05RS90B	63	22	40	5	15.0	0.24	1	
312.ZAP9016.063A06RS90M	63	22	40	6	15.0	0.24	1	
312.ZAP9016.080A06RS90B	80	27	50	6	15.0	0.36	1	
312.ZAP9016.080A07RS90M	80	27	50	7	15.0	0.36	1	
312.ZAP9016.100B07RS90B	100	32	50	7	15.0	0.61	2	
312.ZAP9016.100B08RS90M	100	32	50	8	15.0	0.61	2	
312.ZAP9016.125B07RS90B	125	40	63	7	15.0	3.20	2	
312.ZAP9016.125B09RS90M	125	40	63	9	15.0	3.20	2	
312.ZAP9016.160B08RS90B	160	40	63	8	15.0	6.30	2	
312.ZAP9016.160B10RS90M	160	40	63	10	15.0	6.30	2	
312.ZAP9016.200C12RS90B	200	60	63	12	15.0	8.10	3	
312.ZAP9016.250C12RS90B	200	60	63	12	15.0	11.20	3	



ZAP Type Milling Modular

Designation	D	d	d1	I	L	M	Z	Kg	Ap1 max	Available Inserts
313.ZAP9010.10D01R025M06	10	9.5	6.5	25	40	M06	1	9.0	0.01	APLX1003PDTR
313.ZAP9010.12D01R025M08	12	11.0	8.5	25	40	M08	1	9.0	0.03	
313.ZAP9010.16D02R025M08	16	14.5	8.5	25	42	M08	2	9.0	0.04	
313.ZAP9010.20D03R030M10	20	18.0	10.5	30	51	M10	3	9.0	0.06	
313.ZAP9010.25D03R035M12	25	23.0	12.5	35	59	M12	3	9.0	0.12	
313.ZAP9010.25D04R035M12	25	23.0	12.5	35	59	M12	4	9.0	0.12	
313.ZAP9010.32D04R040M16	32	29.0	17	40	67	M16	4	9.0	0.22	
313.ZAP9010.32D05R040M16	32	29.0	17	40	67	M16	5	9.0	0.23	
313.ZAP9010.40D05R040M16	40	29.0	17	40	67	M16	5	9.0	0.25	
313.ZAP9011.10D01R025M06	10	9.5	6.5	25	40	M06	1	9.0	0.01	APKT11T3□□
313.ZAP9011.12D01R025M08	12	11.0	8.5	25	40	M08	1	9.0	0.03	
313.ZAP9011.16D02R025M08	16	14.5	8.5	25	42	M08	2	9.0	0.04	
313.ZAP9011.20D03R030M10	20	18.0	10.5	30	51	M10	3	9.0	0.06	
313.ZAP9011.25D03R035M12	25	23.0	12.5	35	59	M12	3	9.0	0.12	
313.ZAP9011.25D04R035M12	25	23.0	12.5	35	59	M12	4	9.0	0.12	
313.ZAP9011.32D04R040M16	32	29.0	17	40	67	M16	4	9.0	0.22	
313.ZAP9011.32D05R040M16	32	29.0	17	40	67	M16	5	9.0	0.23	
313.ZAP9011.40D05R040M16	40	29.0	17	40	67	M16	5	9.0	0.25	
313.ZAP9016.20D01R043M10	20	18	10.5	43	70	M10	1	15.0	0.07	APKT1604PDTR
313.ZAP9016.25D02R043M12	25	21	12.5	43	70	M12	2	15.0	0.11	
313.ZAP9016.32D02R043M16	32	29	17.0	43	70	M16	2	15.0	0.15	
313.ZAP9016.32D03R043M16	32	29	17.0	43	70	M16	3	15.0	0.15	
313.ZAP9016.40D03R043M16	40	29	17.0	43	70	M16	4	15.0	0.20	
313.ZAP9016.40D04R043M16	40	29	17.0	43	70	M16	4	15.0	0.20	

Applicable spare parts

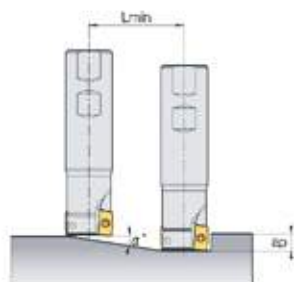
Designation	Screw	Wrench	Picture
311 312 313	ZAP9010 ZAP9011 ZAP9016	M2.5*6 M2.5*6 M4.0*10	T-8S T-8S T-15S

Applicable Inserts information

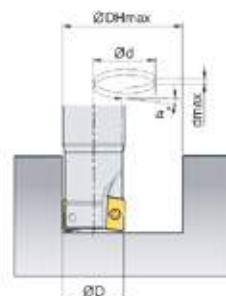
Designation	SMU 10	SMU 206	YBG 302	YBC 251	SMU 200	Insert Sharp	L	lw	s	d	r
APLX1003PDTR		●					10.95	6.70	3.5	2.8	0.5
APKT1003PDTR-ALU							10.95	6.70	3.5	2.8	0.4
APKT11T304-PM			●	●			12.24	6.50	3.6	2.8	0.4
APKT11T308-PM			●	●			12.24	6.50	3.6	2.8	0.8
APKT160404-ALU	●						16.5	9.525	4.76	4.4	0.4
APKT1604PDTR		●					16.5	9.525	5.76	4.4	0.8

Cutting condition for ramping and helical operation

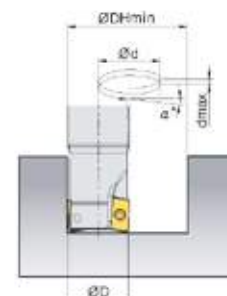
1. Ramping



2. Helical cutting for blind hole

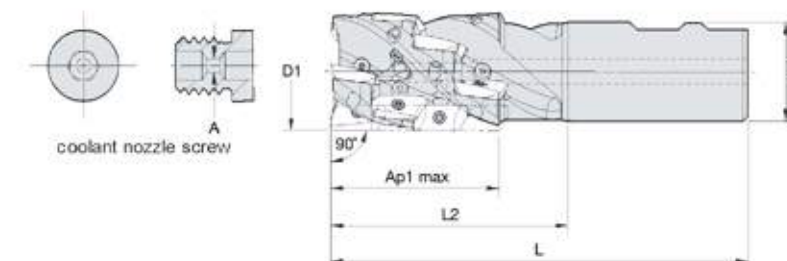


3. Helical cutting for through hole



Tool Dia. φD(mm)	ap	Ramping		Helical cutting for blind hole				Helical cutting for through hole	
		Maximum angle α	Lmin(mm)	Max. desirable hole Dia. φ DHmax(mm)	Max. pitch dmax(mm)	Min. desirable hole Dia. φ DHmin(mm)	Max. pitch dmax(mm)	Min. desirable hole Dia. φ DHmin(mm)	Max. pitch dmax(mm)
10	9	7.50	68	18.8	2.5	17.4	2.3	11	1.5
12		6.50	79	22.8	2.6	21.4	2.4	15	1.7
14		6.30	82	26.8	2.9	25.4	2.8	19	2.1
16		5.00	102	30.8	2.7	29.4	2.6	23	2.0
18		4.20	122	34.8	2.6	33.4	2.5	27	2.0
20		3.60	142	38.8	2.5	37.4	2.4	31	2.0
22		3.20	162	42.8	2.4	41.4	2.3	35	1.9
25		2.70	192	48.8	2.3	47.4	2.2	41	1.9
32		2.00	262	62.8	2.2	61.4	2.1	55	1.9
40		1.50	342	78.8	2.1	77.4	2.0	71	1.9
40	10	1.50	342	78.8	2.1	77.4	2.0	71	1.9
50		1.20	442	98.8	2.0	97.4	2.0	91	1.9
63		0.90	572	124.8	2.0	123.4	1.9	117	1.8
80		0.70	742	158.8	1.9	157.4	1.9	151	1.8
100		0.50	942	198.8	1.9	197.4	1.9	191	1.8
10		16.82	33	18	5.4	16.4	5.0	11	3.3
12		11.69	48	22	4.6	20.4	4.2	15	3.1
14		7.55	75	26	3.4	24.4	3.2	19	2.5
16		10.30	55	30	5.5	28.0	5.1	23	4.2
18		8.23	69	34	4.9	32.0	4.6	27	3.9
20		5.60	102	38	3.7	36.0	3.5	31	3.0
22		5.15	111	42	3.8	40.0	3.6	35	3.2
25		3.92	146	48	3.3	46.0	3.2	41	2.8
32		2.70	212	62	2.9	60.0	2.8	55	2.6
40		1.98	289	78	2.7	76.0	2.6	71	2.5
50		1.48	389	98	2.5	96.0	2.5	91	2.4
63		1.11	514	124	2.4	122.0	2.4	117	2.3
50	16	0.36	1576	98	0.6	96.0	0.6	91	0.6
63		0.27	2104	124	0.6	122.0	0.6	117	0.6
80		0.21	2784	158	0.6	156.0	0.6	151	0.5
100		0.16	3584	198	0.6	196.0	0.5	191	0.5
20		9.5	98	38.8	6.5	37.4	6.2	31	5.2
25		7.6	122	48.8	6.5	47.4	6.3	41	5.5
32		3.4	276	62.8	3.7	61.4	3.6	55	3.3
40		2.5	376	78.8	3.4	77.4	3.4	71	3.1
50		1.9	502	98.8	3.2	97.4	3.2	91	3.0
63		1.4	665	124.8	3.1	123.4	3.0	117	2.9
50	16	1.9	502	98.8	3.2	97.4	3.2	91	3.0
63		1.4	665	124.8	3.1	123.4	3.0	117	2.9
80		1.1	878	158.8	2.9	157.4	2.9	151	2.8
100		0.8	1128	198.8	2.9	197.4	2.9	191	2.8
125		0.6	1442	248.8	2.8	247.4	2.8	241	2.7

$$L_{min} = \frac{ap}{\tan \alpha} \text{ (mm)}$$

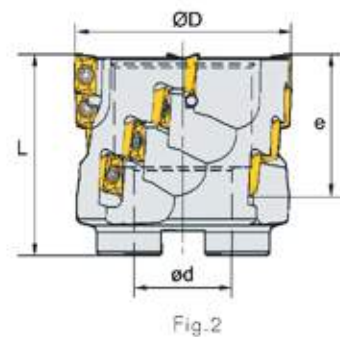
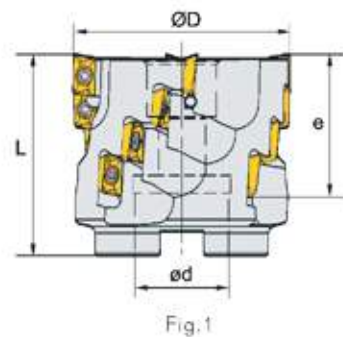


ZAP Type Helical End Mill

Designation	D	d	L	Z	ap	No. of Insert	Available Inserts
314.ZAP9010.20D01R036W20S	20	20	36	87	1	29.0	4
314.ZAP9010.25D02R047W25S	25	25	47	105	2	37.6	8
314.ZAP9010.32D02R055W32S	32	32	55	115	2	47.0	12
314.ZAP9010.40D03R069W32S	40	32	69	130	3	56.0	18
314.ZAP9011.20D01R045W20S	20	20	45	120	1	29.4	3
314.ZAP9011.25D02R055W25S	25	25	55	130	2	38.9	8
314.ZAP9011.32D02R065W32S	32	32	65	140	2	48.5	10
314.ZAP9011.40D02R075W32S	40	32	75	150	2	58.0	14

Applicable spare parts

Designation	Screw	Wrench	Picture
314.ZAP9010	M2.5*6	T-8S	
314.ZAP9011	M2.5*6	T-8S	

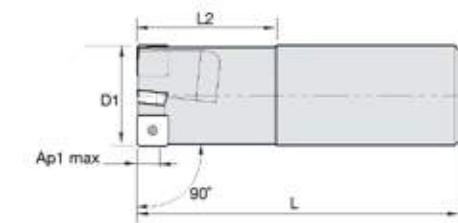


ZAP Type Helical shell Mill

Designation	D	d	L	Z	e	No. of Insert	Kg	Fig	Available Inserts
315.ZAP9011.050A04RS90SL39	50	22	58	4	39	16	0.700	1	APKT11T3□□
315.ZAP9011.063A04RS90SL39	63	27	58	4	39	16	0.800	1	
315.ZAP9011.080B05RS90SL39	80	32	63	5	39	20	0.960	2	
315.ZAP9011.100B06RS90SL39	100	40	63	6	39	24	1.200	2	
315.ZAP9016.063A04RS90SL57	63	27	85	4	57	16	1.100	1	APKT1604PDTR
315.ZAP9016.080B04RS90SL71	80	32	100	4	71	20	2.230	2	
315.ZAP9016.100B06RS90SL71	100	40	100	6	71	30	3.590	2	

Applicable insert and spare parts

Designation	Screw	Wrench	Picture
315.ZAP9011	M2.5*6	T-8S	
315.ZAP9016	M4.0*10	T-15S	



90° SE Type End Mill

Designation	D1	D	L2	L	Z	Ap1 max	Kg
311.350.25D02RS90W25SE09	25	25	35	115	2	6.7	0.4
311.350.32D03RS90W32SE09	32	32	40	125	3	6.7	0.5
311.350.40D04RS90W32SE09	40	32	40	130	4	6.7	0.8
311.350.50D05RS90W32SE09	50	32	40	135	5	6.7	1.0
311.350.50D05RS90W42SE09	50	42	45	140	5	6.7	1.4
311.350.63D06RS90W32SE09	63	32	40	135	6	6.7	1.2
311.350.63D06RS90W42SE09	63	42	45	145	6	6.7	1.7

Applicable insert and spare parts

Applicable Insert	Screw	Wrench
SEET09T308PER	M3.0*7	T-8S

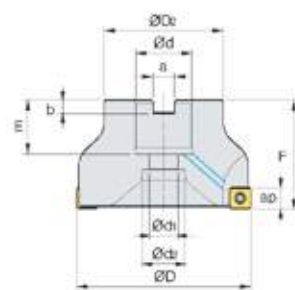


Fig.1

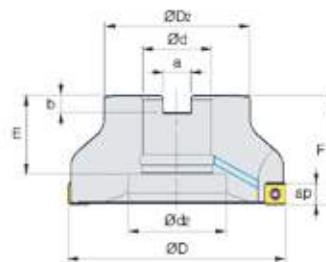


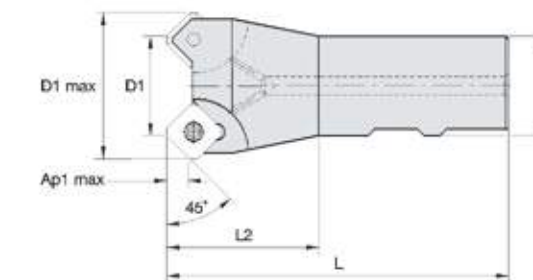
Fig.2

90° SE Type Shell Mill

Designation	D	D2	d	a	b	E	F	d1	d2	ap	Z	Kg	Fig.
312.350.050A05RS90SE09B	50	40	22	10.4	6.3	20	40	11	18	6.7	5	0.3	1
312.350.063A06RS90SE09B	63	40	22	10.4	6.3	20	40	11	18	6.7	6	0.5	1
312.350.080A07RS90SE09B	80	55	27	12.4	7.0	22	50	14	20	6.7	7	1.0	1
312.350.080A08RS90SE09M	80	55	27	12.4	7.0	22	50	14	20	6.7	8	1.0	1
312.350.100B08RS90SE09B	100	67	32	14.4	8.0	26	50	18	26	6.7	8	1.5	2
312.350.100B10RS90SE09M	100	67	32	14.4	8.0	26	50	18	26	6.7	10	1.7	2
312.350.125B12RS90SE09B	125	87	40	16.4	9.0	29	63	22	32	6.7	12	2.6	2

Applicable insert and spare parts

Applicable Insert	Screw	Wrench
SEET09T308PER	M3.0*7	T-8S



45° SE Type End Mill

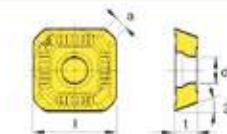
Designation	D1	D1max	D	L2	L	Z	Ap1max	Kg
311.351.32D03RS45W32SE12	32	46	32	49	110	3	6.0	0.8
311.351.40D03RS45W32SE12	40	54	32	49	110	3	6.0	0.9
311.351.50D03RS45W32SE12	50	64	32	49	120	3	6.0	1.1
311.351.50D03RS45W42SE12	50	64	42	49	120	3	6.0	1.5
311.351.63D04RS45W32SE12	63	77	32	49	120	4	6.0	1.2
311.351.63D04RS45W42SE12	63	77	42	49	120	4	6.0	1.7
311.351.50D03RS45W32SE12S	50	64	32	45	135	3	6.5	1.5
311.351.50D03RS45W42SE12S	50	64	42	45	135	3	6.5	2.7
311.351.63D04RS45W32SE12S	63	77	32	45	135	4	6.5	2.0
311.351.63D04RS45W42SE12S	63	77	42	45	135	4	6.5	3.2

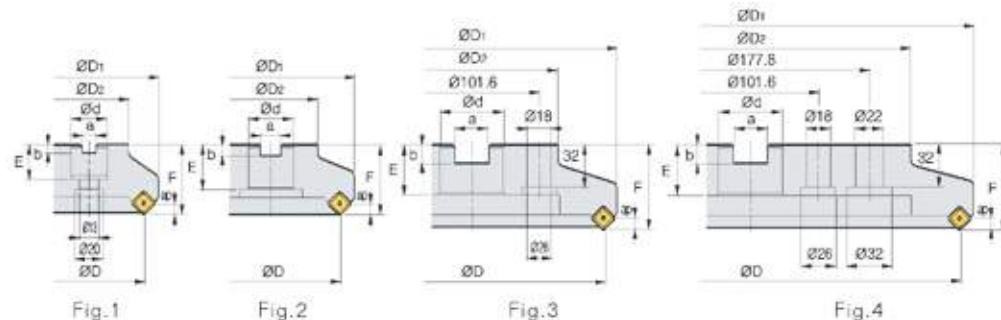
Applicable insert and spare parts

Designation	Applicable Insert	Shim	Shim Screw	Screw	Wrench
SE12	SEKT1204AFTN	-	-	M5.0*10	T-20S
SE12S	SEKT1204AFTN	S13BS	SHXN0509F	M3.5*12	T-16S L3.5

Insert Information

Designation	SMU 10	SMU 206	YBG 302	YBC 251	SMU 200	Insert Sharp	d	t	r	d1	a
SEET09T308PER-PF							9.525	4.01	0.8	3.3	-
SEET09T308PER-PM							9.525	4.01	0.8	3.3	-
SEKT1204AFTN		●					12.7	4.76	-	4.1	2.55
SEKT1204AFFN-ALU	●						12.7	4.76	-	4.1	2.55



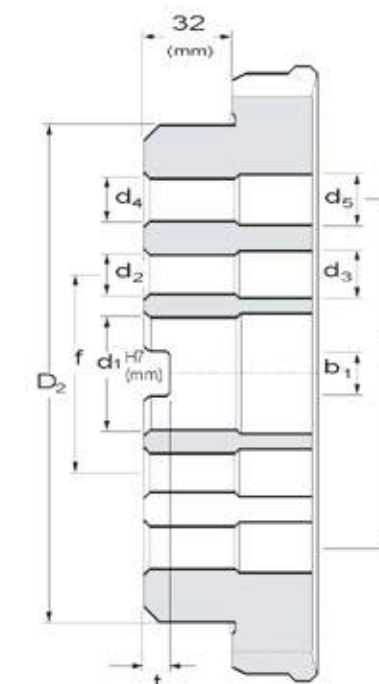
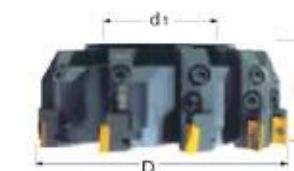


45° SE Type Shell Mill

Designation	D	D2	d	a	b	E	F	d1	d2	ap	Z	Kg	Fig.
312.351.040A03RS45SE12B	40	44	16	10,4	6,3	20	40	11	18	6,0	3	0,3	1
312.351.050A04RS45SE12B	50	49	22	10,4	6,3	20	40	11	18	6,0	4	0,4	1
312.351.063A05RS45SE12B	63	49	22	10,4	6,3	20	40	11	18	6,0	5	0,5	1
312.351.080A06RS45SE12B	80	57	27	12,4	7,0	23	50	14	20	6,0	6	1,1	1
312.351.100B06RS45SE12B	100	67	32	14,4	8,0	25	50	18	26	6,0	6	1,7	2
312.351.125B06RS45SE12B	125	87	40	16,4	9,0	29	63	22	32	6,0	6	2,9	2
312.351.160B06RS45SE12B	160	107	40	16,4	9,0	35	63	-	-	6,0	6	4,1	2
312.351.200C08RS45SE12B	200	130	60	25,7	14,0	32	63	-	-	6,0	8	6,1	3
312.351.050A04RS45SE12SB	50	49	22	10,4	6,3	20	40	11	18	6,0	4	0,4	1
312.351.063A05RS45SE12SB	63	49	22	10,4	6,3	20	40	11	18	6,0	5	0,6	1
312.351.063A06RS45SE12SM	63	49	22	10,4	6,3	20	40	11	18	6,0	6	0,6	1
312.351.080A06RS45SE12SB	80	57	27	12,4	7,0	23	50	14	20	6,0	6	1,1	1
312.351.080A08RS45SE12SM	80	57	27	12,4	7,0	23	50	14	20	6,0	8	1,1	1
312.351.100B07RS45SE12SB	100	67	32	14,4	8,0	25	50	18	26	6,0	7	1,6	2
312.351.100B10RS45SE12SM	100	67	32	14,4	8,0	25	50	18	26	6,0	10	1,6	2
312.351.125B08RS45SE12SB	125	87	40	16,4	9,0	29	63	22	32	6,0	8	3,1	2
312.351.125B12RS45SE12SM	125	87	40	16,4	9,0	29	63	22	32	6,0	12	3,1	2
312.351.160B10RS45SE12SB	160	107	40	16,4	9,0	35	63	-	-	6,0	10	4,8	2
312.351.160B16RS45SE12SM	160	107	40	16,4	9,0	35	63	-	-	6,0	16	4,8	2
312.351.200C12RS45SE12SB	200	130	60	25,7	14,0	32	63	-	-	6,0	12	6,1	3
312.351.200C18RS45SE12SM	200	130	60	25,7	14,0	32	63	-	-	6,0	18	6,1	3
312.351.250C14RS45SE12SB	250	180	60	25,7	14,0	38	63	-	-	6,0	14	13,5	3
312.351.315D18RS45SE12SB	315	240	60	25,7	14,0	38	63	-	-	6,0	18	20,8	4

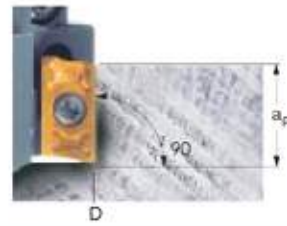
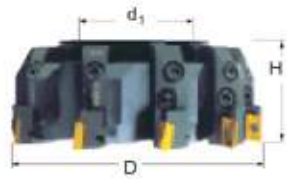
Applicable insert and spare parts

Designation	Applicable Insert	Shim	Shim Screw	Screw	Wrench
SE12	SEKT1204AFTN	.	.	M5.0*10	T-20S
SE12S	SEKT1204AFTN	S13BS	SHXN0509F	M3.5*12	T-15S L3.5



Cartridge Type Aluminum Body Cutter

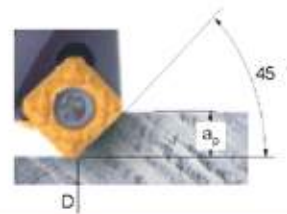
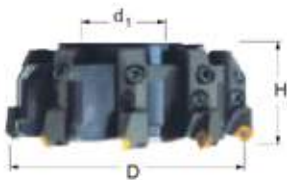
Designation	D	D (X 90°)	No. of teeth	H	d1	D2	F	f1	d2	d3	d4	D5	b1	t
312.A.590.100B06CA1	100	106	6	68	32	53	-	-	-	-	-	-	14.4	8
312.A.590.125B08CA1	125	131	8	63	40	77	-	-	-	-	-	-	16.4	9
312.A.590.160B10CA1	160	166	10	63	40	100	66.7	-	14	20	-	-	16.4	9
312.A.590.200C12CA1	200	206	12	63	60	136	101.6	-	18	26	-	-	25.7	14
312.A.590.250C16CA1	250	256	16	63	60	180	101.6	-	18	26	-	-	25.7	14
312.A.590.315D20CA1	315	321	20	80	60	240	101.6	177.8	18	26	22	34	25.7	14
312.A.590.400D24CA1	400	406	24	80	60	260	101.6	177.8	18	26	22	34	25.7	14



90° ZAP Type

Designation	Cartridge	Dimensions(mm)					Spares		Applicable Insert
		D	H	d1	ap	Z	Screw	Wrench	
312.A.590.ZAP9016.100B06CA	ZAP90CA-16	100	68	32	16	6	M4.0*10	T-15S	APKT1604PDTR
312.A.590.ZAP9016.125B08CA	ZAP90CA-16	125	63	40	16	8			
312.A.590.ZAP9016.160B10CA	ZAP90CA-16	160	63	40	16	10			
312.A.590.ZAP9016.200C12CA	ZAP90CA-16	200	63	40	16	12			
312.A.590.ZAP9016.250C16CA	ZAP90CA-16	250	63	40	16	16			
312.A.590.ZAP9016.315D20CA	ZAP90CA-16	315	80	60	16	20			
312.A.590.ZAP9016.400D24CA	ZAP90CA-16	400	80	60	16	24			

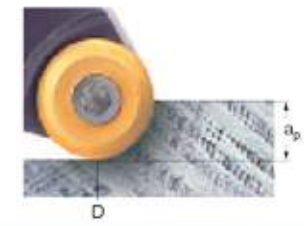
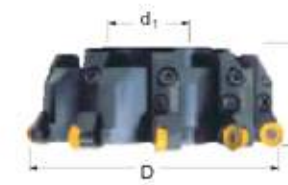
Cartridge	Adjust	Wrench	Screw
ZAP90CA-16	SCC060250	LW-5	SAC060145



45° KM Type

Designation	Cartridge	Dimensions(mm)					Spares		Applicable Insert
		D	H	d1	ap	Z	Screw	Wrench	
312.A.590.KM45.12.100B06CA	KM45CA-12	100	68	32	6	6	M4.0*10	T-15S	SEKT1204AFTN
312.A.590.KM45.12.125B08CA	KM45CA-12	125	63	40	6	8			
312.A.590.KM45.12.160B10CA	KM45CA-12	160	63	40	6	10			
312.A.590.KM45.12.200C12CA	KM45CA-12	200	63	40	6	12			
312.A.590.KM45.12.250C16CA	KM45CA-12	250	63	40	6	16			
312.A.590.KM45.12.315D20CA	KM45CA-12	315	80	60	6	20			
312.A.590.KM45.12.400D24CA	KM45CA-12	400	80	60	6	24			

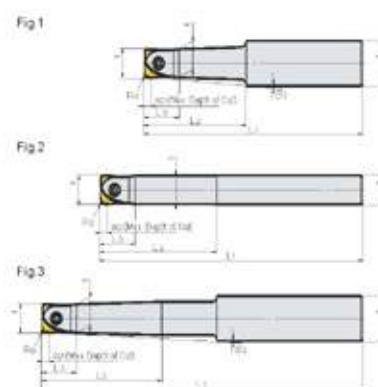
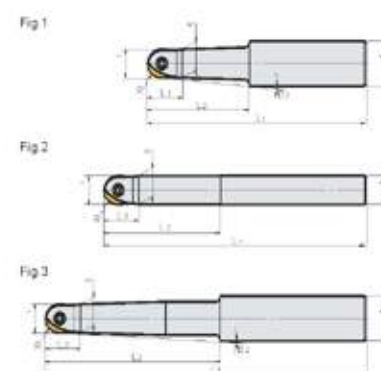
Cartridge	Adjust	Wrench	Screw
KM45CA-12	SCC060250	LW-5	SAC060145



FMR Type

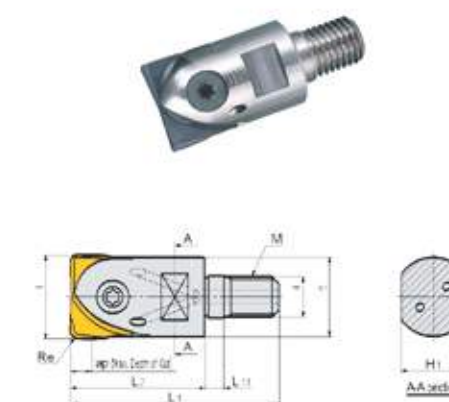
Designation	Cartridge	Dimensions(mm)					Spares		Applicable Insert
		D	H	d1	ap	Z	Screw	Wrench	
312.A.590.FMRC.16.100B06CA	FMRC-16	100	68	32	8	6	M5.0*12	T-20S	RCKT1606MO
312.A.590.FMRC.16.125B08CA	FMRC-16	125	63	40	8	8			
312.A.590.FMRC.16.160B10CA	FMRC-16	160	63	40	8	10			
312.A.590.FMRC.16.200C12CA	FMRC-16	200	63	40	8	12			
312.A.590.FMRC.16.250C16CA	FMRC-16	250	63	40	8	16			
312.A.590.FMRC.16.315D20CA	FMRC-16	315	80	60	8	20			
312.A.590.FMRC.16.400D24CA	FMRC-16	400	80	60	8	24			

Cartridge	Adjust	Wrench	Screw
FMRC-16	SCC060250	LW-5	SAC060145



Arc Type End Mill

Designation	D1	D4	L1	D5	L2	L3	B2°	Fig	Screw	Wrenh	Applicable Insert
311.191.10R040A12ST.L110	10	12	110	9.5	40	13	1° 30'	1	M3.0*8	T-8S	SR□T10 SUFT10R□□
311.191.10R060A12ST.L150	10	12	150	9.5	60	13	1° 30'	1			
311.191.12R050A16ST.L120	12	16	120	11.5	50	15	1° 30'	1	M3.5*10	T-15S	SR□T12 SUFT12R□□
311.191.12R050A12SN.L120	12	12	120	11.5	50	15	-	2			
311.191.12R070A16ST.L160	12	16	160	11.5	70	15	1° 30'	1			
311.191.16R030A16SN.L100	16	16	100	15.5	30	20	-	2			
311.191.16R050A20ST.L130	16	20	130	15.5	50	20	1° 30'	1			
311.191.16R050A16SN.L130	16	16	130	15.5	50	20	-	2	M4.0*15	T-15S	SR□T16 SUFT16R□□
311.191.16R070A20ST.L160	16	20	160	15.5	70	20	1° 30'	1			
311.191.16R070A16SN.L160	16	16	160	15.5	70	20	-	2			
311.191.20R050B20SN.L100	20	20	100	19.5	50	24	-	2			
311.191.20R070B25ST.L150	20	25	150	19.5	70	24	1° 30'	1			
311.191.20R070B20SN.L150	20	20	150	19.5	70	24	-	2	M5.0*20	T-20S	SR□T20 SUFT20R□□
311.191.20R080B25ST.L200	20	25	200	19.5	80	24	1° 30'	1			
311.191.20R080B20SN.L200	20	20	200	19.5	80	24	-	2			
311.191.20R120B25ST.L250	20	25	250	19.5	120	24	1° 30'	3			
311.191.25R080B25SN.L150	25	25	150	24.5	80	30	-	2			
311.191.25R100B32ST.L200	25	32	200	24.5	100	30	1° 30'	1			
311.191.25R100B25SN.L200	25	25	200	24.5	100	30	-	2	M6.0*25	T-25T	SR□T25 SUFT25R□□
311.191.25R100B25SN.L200	25	25	200	24.5	100	30	-	2			
311.191.25R150B32ST.L250	25	32	250	24.5	150	30	1° 30'	3			
311.191.25R150B25SN.L250	25	25	250	24.5	150	30	-	2			
311.191.25R200B32ST.L300	25	32	300	24.5	200	30	1° 30'	3			
311.191.30R100B32SN.L200	30	32	200	29.5	100	35	-	2			
311.191.30R130B32SN.L250	30	32	250	29.5	130	35	-	2	M8.0*30	T-30T	SR□T30 SUFT30R□□
311.191.30R200B32SN.L300	30	32	300	29.5	200	35	-	2			
311.191.30R250B32SN.L350	30	32	350	29.5	250	35	-	2			
311.191.32R100B32SN.L200	32	32	200	31.5	100	35	-	2			
311.191.32R200B32SN.L300	32	32	300	31.5	200	35	-	2	M8.0*30	T-30T	SR□T32 SUFT32R□□
311.191.32R250B32SN.L350	32	32	350	31.5	250	35	-	2			



Arc Type Milling Modular

Designation	D1	D4	L1	D5	L2	L3	B2°	Fig	Screw	Wrenh	Applicable Insert
313.191.16R030M08	16	8.5	48	14.9	30	6	10	M8	M4.0*15	T-15S	SR□T16 SUFT16R□□
313.191.20R035M10	20	10.5	54	18.4	35	6	14	M10	M5.0*20	T-20S	SR□T20 SUFT20R□□
313.191.25R040M12	25	12.5	62	23.5	40	6	19	M12	M6.0*25	T-25T	SR□T25 SUFT25R□□
313.191.30R045M16	30	17.0	68	28.1	45	6	24	M16	M8.0*30	T-30T	SR□T30 SUFT30R□□
313.191.32R045M16	32	17.0	68	28.1	45	6	24	M16	M8.0*30	T-30T	SR□T32 SUFT32R□□

191 Style milling cutter characteristics

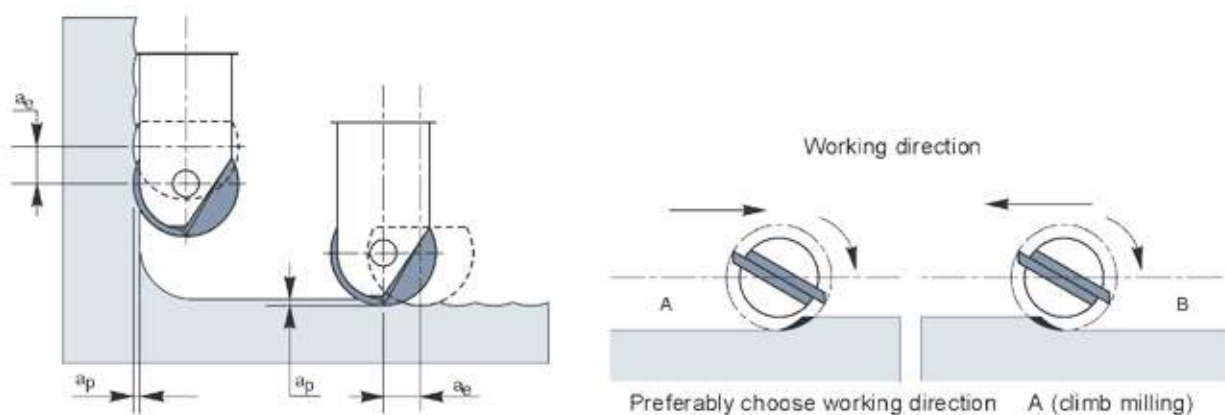
Be intended for finish cutting operations in 3D copying on CNC

Consists of a tool holder and a replaceable single-piece carbide insert $\phi \pm 0.01\text{mm}$.

Be suitable for finishing mock-ups, models, stamping tools, casting, plastic, glass, rubber moulds, etc.



Recommendations for use



Chip thickness "ap" and step over "ae"

	P	M	K	N	S	H
Cutting depth ap or ae	0.05 to 0.07 x D	0.05 x D	0.07 to 0.1 x D	0.05 to 0.07 x D	0.03 x D	0.03 x D

Cutting Speed Formulae

- Employing $\theta^\circ \Rightarrow$ Calculate cutting speed at point P.
(Cutting speed at the cutting depth border for oblique machining)

$$\text{Formula : Cutting Speed} = \frac{\pi \cdot D_1 \cdot \sin \theta \cdot n}{1000} \text{ (m/min)}$$

$$\theta^\circ = \cos^{-1} \left(\frac{D_1 - 2ap}{D_1} \right) + 90 - \alpha$$

n : Spindle Speed (min⁻¹)

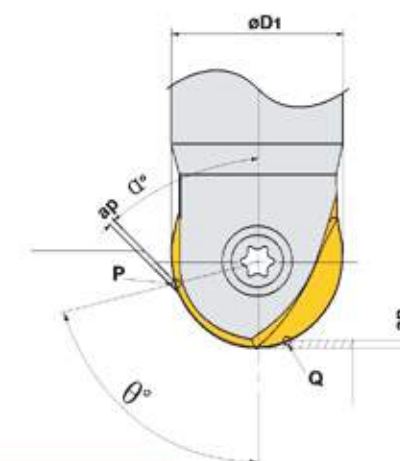
- Employing ap $\Rightarrow$ Calculate cutting speed at point Q.
(Cutting speed at the cutting depth border)

$$\text{Formula : Cutting Speed} = \frac{2\pi n \sqrt{ap(D_1 - ap)}}{1000} \text{ (m/min)}$$

n : Spindle Speed (min⁻¹)

D₁ : Cutting Edge Diameter (mm)

ap : Depth of Cut (mm)



Fitting Inserts on Holders

1. Clean the insert seat

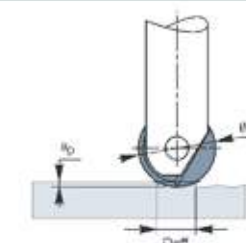
Clean the insert seat in the holder body by blowing air or using a brush.

2. Fit the insert

Place the concave mark of the insert into the clamp-screw-fastening part of the holder (only SRF type inserts). Fasten the clamp screw while firmly pressing the insert against the insert seat wall. You are recommended to use the special lubricant for preventing screw seizing, MK1KS, and to fasten with recommended torque.



Effective diameter depending on cutter infeed



Calculation of effective cutting diameter (φ D eff) depending on ap

φ D	ap																		
	0.1	0.2	0.3	0.4	0.5	0.6	0.7	0.8	0.9	1.0	1.5	2.0	2.5	3.0	3.5	4.0	5.0	6.0	7.0
10	2.0	2.8	3.4	3.9	4.4	4.7	5.1	5.4	5.7	6.0	7.1	8.0	8.7	9.2	9.5	-	-	-	-
12	2.2	3.1	3.7	4.3	4.8	5.2	5.6	6.0	6.3	6.6	7.9	8.9	9.7	10.4	10.9	11.3	11.8	-	-
16	2.5	3.6	4.3	5.0	5.6	6.1	6.5	7.0	7.4	7.7	9.3	10.6	11.6	12.5	13.2	13.9	14.8	15.5	15.9
20	2.8	4.0	4.9	5.6	6.2	6.8	7.4	7.8	8.3	8.7	10.5	12.0	13.2	14.3	15.2	16.0	17.3	18.3	19.1
25	-	4.5	5.4	6.3	7.0	7.7	8.2	8.8	9.3	9.8	11.9	13.6	15.0	16.2	17.3	18.3	20.0	21.4	22.4
30	-	-	6.0	6.9	7.7	8.4	9.1	9.7	10.2	10.8	13.1	15.0	16.6	18.0	19.3	20.4	22.4	24.0	25.4
32	-	-	-	7.1	7.9	8.7	9.4	10.0	10.6	11.1	13.5	15.5	17.2	18.7	20.0	21.2	23.2	25.0	26.5

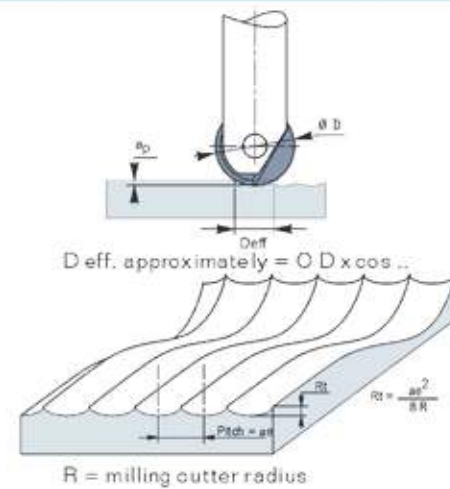
Milling on inclined face

Effective diameter will depend on:
Inclined face angle γ
Cutting depth

Typically, it will be between:
Minimum effective diameter = $\phi D \times \cos \gamma$
Maximum effective diameter = ϕD

Roughness

Value of R_t is dependant upon step over



Cutter Diameter ϕD	10	12	16	20	25	32
Pitch = ae	0.7	1.0	1.5	2.0	3.0	5.0
R_t	0.01	0.02	0.05	0.08	0.16	0.20

Feed correction factor

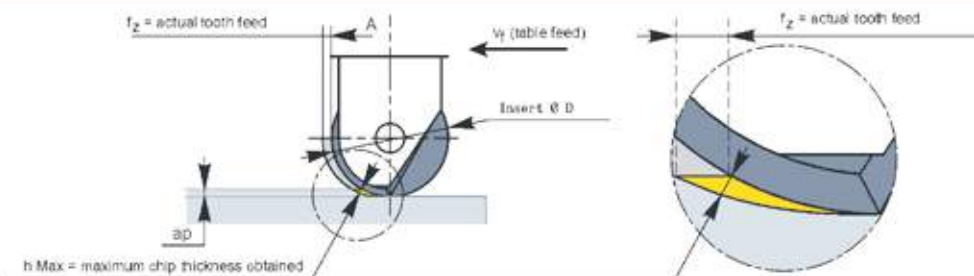


Table of feed correction factors f_z
 $ap = \text{Cutting depth}$

$\phi D = \text{insert } \phi$

ϕD	0.1	0.2	0.3	0.4	0.5	0.6	0.7	0.8	0.9	1.0	1.5	2.0	2.5	3.0	3.5	4.0	5.0	6.0	7.0
10	5.0	3.6	2.9	2.6	2.3	2.1	2.0	1.8	1.7	1.7	1.4	1.3	1.2	1.1	1.0	1.0	1.0	-	-
12	5.5	3.9	3.2	2.8	2.5	2.3	2.1	2.0	1.9	1.8	1.5	1.3	1.2	1.2	1.1	1.1	1.0	1.0	-
16	6.3	4.5	3.7	3.2	2.9	2.6	2.4	2.3	2.2	2.1	1.7	1.5	1.4	1.3	1.2	1.2	1.1	1.0	1.0
20	7.1	5.0	4.1	3.6	3.2	2.9	2.7	2.6	2.4	2.3	1.9	1.7	1.5	1.4	1.3	1.3	1.2	1.1	1.0
25	-	5.6	4.6	4.0	3.6	3.3	3.0	2.8	2.7	2.6	2.1	1.8	1.7	1.5	1.4	1.4	1.3	1.2	1.1
30	-	-	5.0	4.4	3.9	3.6	3.3	3.1	2.9	2.8	2.3	2.0	1.8	1.7	1.6	1.5	1.3	1.3	1.2
32	-	-	-	4.5	4.0	3.7	3.4	3.2	3.0	2.9	2.4	2.1	1.9	1.7	1.6	1.5	1.4	1.3	1.2

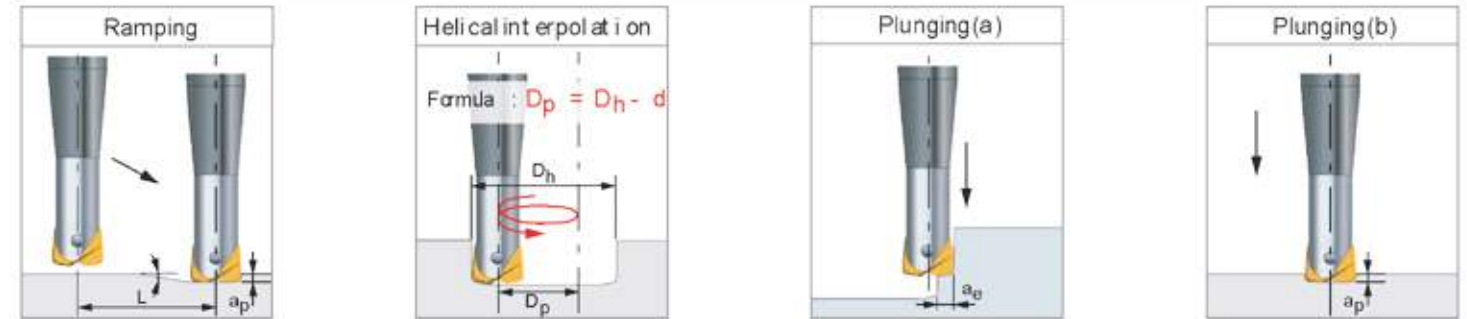
Example: Cutter: 311.191.20R050B20SN.L100

Chip thickness required = 0.2mm (h_{Max})

$ap = 1\text{mm}$

Actual tooth feed to be used = 0.46mm = 0.2×2.3 correction factor (f_z)

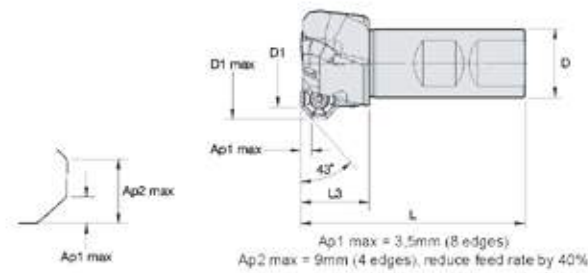
Use



Diameter d (mm)	Effective diameter dw (mm)	Cutting depth ap max (mm)	Ramping (1)		Helical interpolation (1)		Plunging (a) (2) ae max (mm)	Plunging (b) (2) ae max (mm)
			Angle α	L (mm)	Dh min / max (mm)	Dp min / max (mm)		
10	3.5	0.5	8°	3.5	13/18.4	3/8.4	2.5	0.5
12	4.2	0.6	8°	4.3	15.7/22	3.7/10	3.0	0.6
16	5.6	0.8	8°	5.7	20.9/29.4	4.9/13.4	4.0	0.8
20	7.0	1.0	8°	7.1	26.2/36.7	6.2/16.7	5.0	1.0
25	9.2	1.2	8°	8.5	33/46.1	8/21.1	6.0	1.2

1.Reduce cutting date by 30% when working in ramping and helical interpolation.

2.Reduce cutting date by 50 to 80% when plunging depending on ae or ap

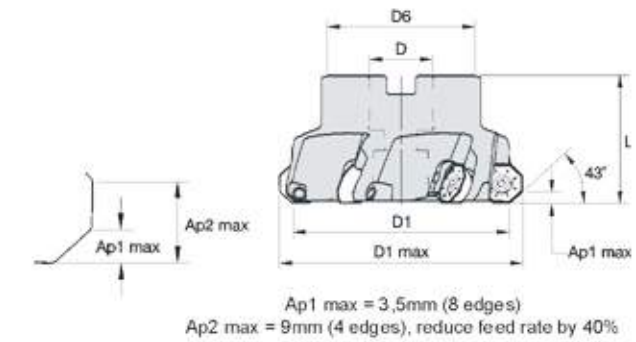


Eight cutting angle Type End Mill

Designation	D1	D	D1max	L3	L	Z	Ap1max	Max Ramp Angle
311.408.32D02R25W20OF05	32	20	41	25	76	2	3.5	11.0°
311.408.32D03R25W20OF05	32	20	41	25	76	3	3.5	11.0°
311.408.32D03R25W25OF05	32	25	41	25	82	3	3.5	11.0°
311.408.40D03R25W25OF05	40	25	49	25	82	3	3.5	7.5°
311.408.40D04R25W25OF05	40	25	49	25	82	4	3.5	7.5°
311.408.40D04R49W32OF05	40	32	49	49	110	4	3.5	7.5°

Applicable insert and spare parts

Applicable Insert	Screw	Wrench
OFKT05T3	M4.0*8	T-15S

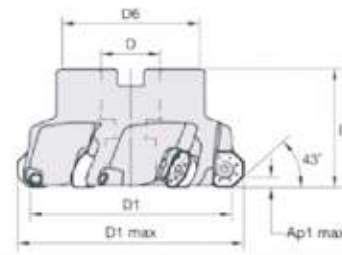


Eight cutting angle Type Shell Mill

Designation	D1	D	D1max	D4	D6	L	Ap1max	Z	Max Ramp Angle	Kg
312.408.050R04OF05B	50	22	58.9	-	38	43	3.5	4	5.0°	0.35
312.408.050R06OF05M	50	22	58.9	-	38	43	3.5	6	5.0°	0.35
312.408.063R05OF05B	63	22	71.8	-	50	43	3.5	5	3.9°	0.62
312.408.063R07OF05M	63	22	71.8	-	50	43	3.5	7	3.9°	0.63
312.408.080R06OF05B	80	27	88.7	-	60	50	3.5	6	2.9°	1.10
312.408.080R09OF05M	80	27	88.7	-	60	50	3.5	9	2.9°	1.12
312.408.100R07OF05B	100	32	108.6	-	80	50	3.5	7	2.2°	1.71
312.408.100R10OF05M	100	32	108.6	-	80	50	3.5	10	2.2°	1.75
312.408.125R08OF05B	125	40	133.6	-	94	63	3.5	8	1.7°	2.74
312.408.125R12OF05M	125	40	133.6	-	94	63	3.5	12	1.7°	2.83
312.408.160R10OF05B	160	40	168.5	66.7	114	63	3.5	10	1.3°	4.30
312.408.160R16OF05M	160	40	168.5	66.7	114	63	3.5	16	1.3°	4.46
312.408.063R04OF07B	63	22	74.3	-	50	43	5.0	4	5.5°	0.62
312.408.063R05OF07M	63	22	74.3	-	50	43	5.0	5	5.5°	0.55
312.408.080R04OF07B	80	27	91.2	-	60	50	5.0	4	4.0°	1.14
312.408.080R06OF07M	80	27	91.2	-	60	50	5.0	5	4.0°	1.06
312.408.100R05OF07B	100	32	110.9	-	80	50	5.0	5	3.0°	1.66
312.408.100R08OF07M	100	32	110.9	-	80	50	5.0	8	3.0°	1.57
312.408.125R06OF07B	125	40	136.0	-	90	63	5.0	6	2.3°	2.56
312.408.125R10OF07M	125	40	136.0	-	90	63	5.0	10	2.3°	2.68
312.408.160R07OF07B	160	40	170.9	66.7	110	63	5.0	7	1.7°	4.20
312.408.160R12OF07M	160	40	170.9	66.7	110	63	5.0	12	1.7°	4.34

Applicable insert and spare parts

Applicable Insert	Screw	Wrench
OFKT05T3□□	M4.0*8	T-15S
OFKT0704□□	M5.0*12	T-20S

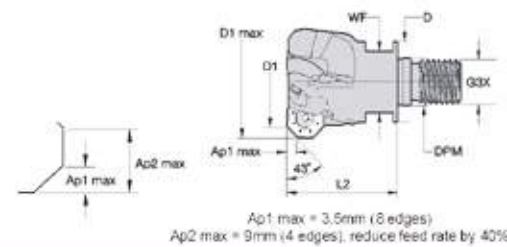


Eight cutting angle Type Shell Mill

Designation	D1	D	D1max	D4	D6	L	Ap1max	Z	Kg
312.409.063A05RS45OF07CA	63	22	74.2	-	50	43	5.0	5	0.62
312.409.080A06RS45OF07CA	80	27	91.1	-	60	50	5.0	6	1.40
312.409.100B08RS45OF07CA	100	32	111.0	-	80	50	5.0	8	2.00
312.409.125B10RS45OF07CA	125	40	135.9	-	90	63	5.0	10	3.10
312.409.160C12RS45OF07CA	160	40	170.8	66.7	110	63	5.0	12	5.20
312.409.200C12RS45OF07CA	200	60	211.0	101.6	130	63	5.0	12	7.50
312.409.250C16RS45OF07CA	250	60	261.0	101.6	180	63	5.0	16	16.10
312.409.315D20RS45OF07CA	315	60	326.0	101.6	240	63	5.0	20	22.80

Applicable insert and spare parts

Applicable Insert	Screw	Clamp	Fasten of screw	Wrench
OFKT0704□□	M5.0*12	AMS-5	AOB-5S	T-20S

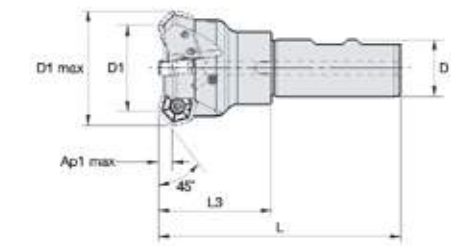


Eight cutting angle Type Milling Modular

Designation	D1	D	D1max	DPM	G3X	L2	WF	Z	Ap1max	Kg
313.408.32D02R40M16OF05	32	29	41.1	17.0	M16	40	22	2	3.5	0.23
313.408.32D03R40M16OF05	32	29	41.1	17.0	M16	40	22	3	3.5	0.21
313.408.40D03R40M16OF05	40	29	49.0	17.0	M16	40	22	3	3.5	0.27
313.408.40D04R40M16OF05	40	29	49.0	17.0	M16	40	22	4	3.5	0.27

Applicable insert and spare parts

Applicable Insert	Screw	Wrench
OFKT05T3□□	M4.0*8	T-15S



45° Double-side Twelve Cutting Edge Type End Mill

Designation	D1	D	D1max	L3	L	Ap1max	Z	Kg
311.513.32D02R50W25ON08	32	25	47	50	107	5.5	2	0.4
311.513.40D03R50W25ON08	40	25	55	50	107	5.5	3	0.5
311.513.40D04R50W25ON08	40	25	55	50	107	5.5	4	0.5
311.513.50D04R50W25ON08	50	25	65	50	107	5.5	4	0.6

Applicable insert and spare parts

Applicable Insert	Screw	Wrench
ONHX080608	M5.0*13	T-20S

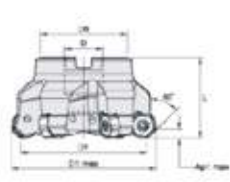
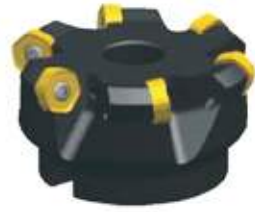


Fig.1

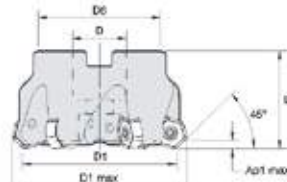


Fig.2

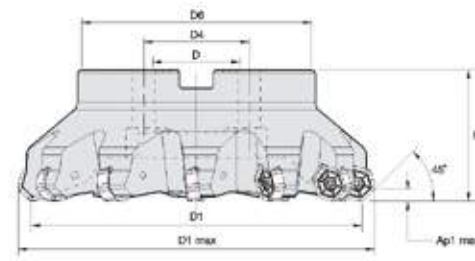


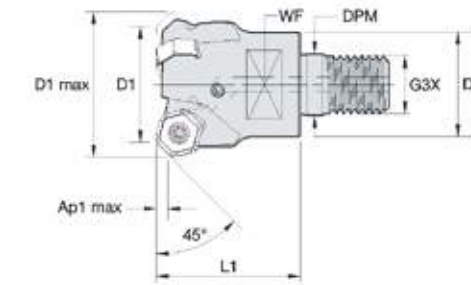
Fig.3

45° Double-side Twelve Cutting Edge Type Shell Mill

Designation	D1	D	D1max	D6	D4	L	Ap1 max	Z	Fig	Kg
312.513.050A04RS45ON08B	50	22	65	38	-	40	5.5	4	1	0.3
312.513.050A05RS45ON08M	50	22	65	38	-	40	5.5	5	1	0.3
312.513.063A06RS45ON08B	63	22	78	50	-	40	5.5	6	1	0.7
312.513.063A07RS45ON08M	63	22	78	50	-	40	5.5	7	1	0.7
312.513.080A06RS45ON08B	80	27	95	60	-	50	5.5	6	1	1.2
312.513.080A09RS45ON08M	80	27	95	60	-	50	5.5	9	1	1.2
312.513.080A10RS45ON08H	80	27	95	60	-	50	5.5	10	1	1.2
312.513.100B08RS45ON08B	100	32	115	80	-	50	5.5	8	2	1.8
312.513.100B11RS45ON08M	100	32	115	80	-	50	5.5	11	2	1.8
312.513.125B10RS45ON08B	125	40	140	90	-	63	5.5	10	2	3.5
312.513.125B14RS45ON08M	125	40	140	90	-	63	5.5	14	2	3.5
312.513.160C12RS45ON08B	160	40	171	110	66.7	63	5.5	12	2	4.5
312.513.160C16RS45ON08M	160	40	171	110	66.7	63	5.5	16	2	4.5
312.513.200C12RS45ON08B	200	60	215	135	101.6	63	5.5	12	3	5.8
312.513.200C16RS45ON08M	200	60	215	135	101.6	63	5.5	16	3	5.8
312.513.250C16RS45ON08B	250	60	265	180	101.6	63	5.5	16	3	12.0
312.513.250C20RS45ON08M	250	60	265	180	101.6	63	5.5	20	3	12.0

Applicable insert and spare parts

Applicable Insert	Screw	Wrench
ONHX080608	M5.0*13	T-20S

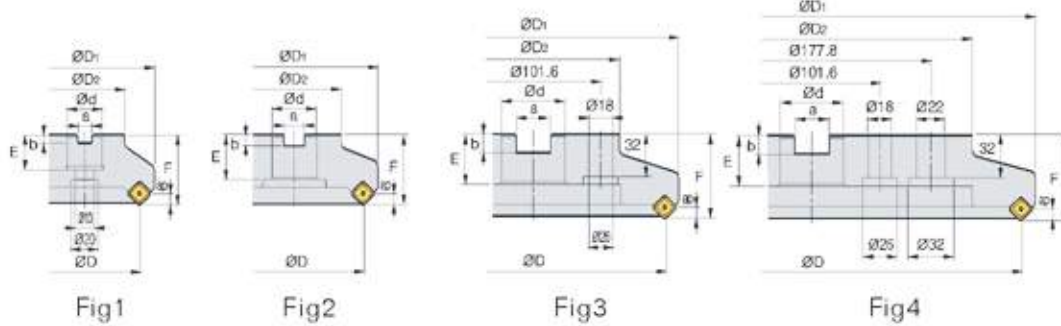


45° Double-side Twelve Cutting Edge Type Milling Modular

Designation	D1	D	D1max	DPM	G3X	L1	WF	Z	Ap1 max	Kg
313.513.25D02R032M16ON06	25	29	33.2	17.0	M16	32	22	2	4.0	0.14
313.513.25D03R032M16ON06	25	29	33.2	17.0	M16	32	22	3	4.0	0.14
313.513.32D03R040M16ON06	32	29	40.2	17.0	M16	40	22	3	4.0	0.21
313.513.32D04R040M16ON06	32	29	40.2	17.0	M16	40	22	4	4.0	0.21
313.513.40D04R040M16ON06	40	29	48.2	17.0	M16	40	22	4	4.0	0.26
313.513.40D05R040M16ON06	40	29	48.2	17.0	M16	40	22	5	4.0	0.26

Applicable insert and spare parts

Applicable Insert	Screw	Wrench
ONHX060608	M5.0*13	T-20S

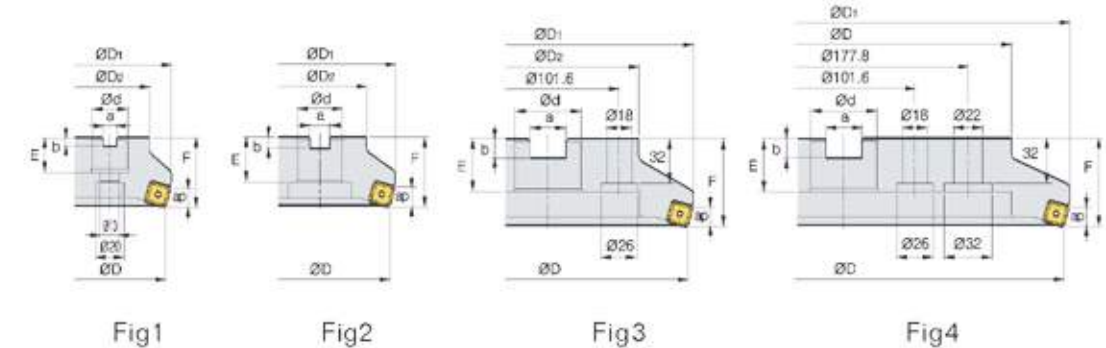


45° Double-side Eight Cutting Edge Type Shell Mill

Designation	D	D2	d	d1	d2	a	b	E	F	Z	ap	Fig	Kg
312.459.050A04RS45SN12B	50	49	22	11	18	10.4	6.3	20.0	40	4	6.0	1	0.5
312.459.050A06RS45SN12M	50	49	22	11	18	10.4	6.3	20.0	40	6	6.0	1	0.5
312.459.063A06RS45SN12B	63	49	22	11	18	10.4	6.3	20.0	40	6	6.0	1	0.7
312.459.063A08RS45SN12M	63	49	22	11	18	10.4	6.3	20.0	40	8	6.0	1	0.7
312.459.080A07RS45SN12B	80	57	27	14	20	12.4	7.0	23.0	50	7	6.0	1	1.2
312.459.080A10RS45SN12M	80	57	27	14	20	12.4	7.0	23.0	50	10	6.0	1	1.3
312.459.100B08RS45SN12B	100	67	32	18	26	14.4	8.0	25.5	50	8	6.0	2	1.7
312.459.100B12RS45SN12M	100	67	32	18	26	14.4	8.0	25.5	50	12	6.0	2	1.7
312.459.125B10RS45SN12B	125	87	40	22	32	16.4	9.0	30.0	63	10	6.0	2	3.6
312.459.125B16RS45SN12M	125	87	40	22	32	16.4	9.0	30.0	63	16	6.0	2	3.7
312.459.160B12RS45SN12B	160	107	40	-	107	16.4	9.0	32.0	63	12	6.0	2	5.3
312.459.160B20RS45SN12M	160	107	40	-	107	16.4	9.0	32.0	63	20	6.0	2	5.4
312.459.200C14RS45SN12B	200	130	60	-	135	25.7	14	32	63	14	6.0	3	7.1
312.459.200C24RS45SN12M	200	130	60	-	135	25.7	14	32	63	24	6.0	3	7.1
312.459.250C16RS45SN12B	250	180	60	-	180	25.7	14	32	63	16	6.0	3	11.9
312.459.250C30RS45SN12M	250	180	60	-	180	25.7	14	32	63	30	6.0	3	12.0
312.459.315D18RS45SN12B	315	240	60	-	238	25.7	14	38	63	18	6.0	4	18.6
312.459.315D20RS45SN12M	315	240	60	-	238	25.7	14	38	63	20	6.0	4	18.6

Applicable insert and spare parts

Applicable Insert	Screw	Wrench
SNEX1206ANN	M4.0*10	T-15S
SNMX1206ANN	M4.0*10	T-15S

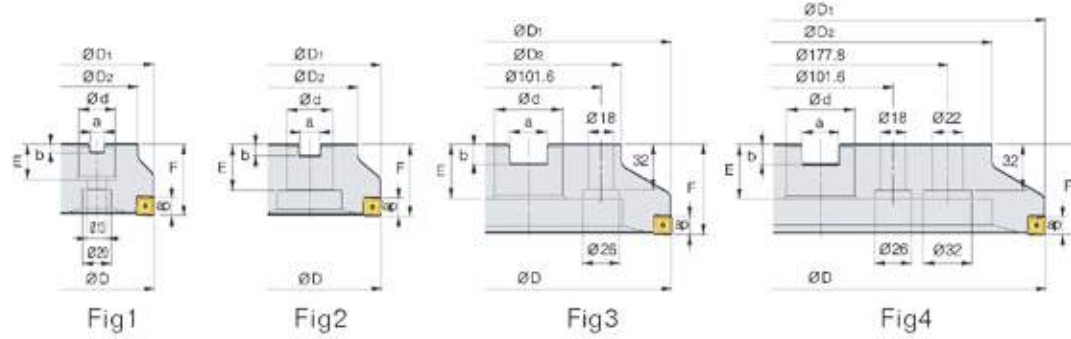


75° Double-side Eight Cutting Edge Type Shell Mill

Designation	D	D2	d	d1	d2	a	b	E	F	Z	ap	Fig	Kg
312.459.050A04RS75SN12B	50	49	22	11	18	10.4	6.3	20	40	4	9.0	1	0.4
312.459.063A06RS75SN12B	63	49	22	11	18	10.4	6.3	20	40	6	9.0	1	0.6
312.459.080A05RS75SN12B	80	57	27	14	20	12.4	7.0	23	50	5	9.0	1	1.2
312.459.080A07RS75SN12M	80	57	27	14	20	12.4	7.0	23	50	7	9.0	1	1.1
312.459.100B06RS75SN12B	100	67	32	18	26	14.4	8.0	25	50	6	9.0	2	1.6
312.459.100B08RS75SN12M	100	67	32	18	26	14.4	8.0	25	50	8	9.0	2	2.5
312.459.125B08RS75SN12B	125	87	40	22	32	16.4	9.0	29	63	8	9.0	2	3.3
312.459.125B10RS75SN12M	125	87	40	22	32	16.4	9.0	29	63	10	9.0	2	3.0
312.459.160B10RS75SN12B	160	107	40	-	107	16.4	9.0	32	63	10	9.0	2	4.4
312.459.160B12RS75SN12M	160	107	40	-	107	16.4	9.0	32	63	12	9.0	2	4.0
312.459.200C16RS75SN12B	200	130	60	-	135	25.7	14	32	63	16	9.0	3	5.9
312.459.250C16RS75SN12B	250	180	60	-	180	25.7	14	38	63	16	9.0	3	10.6
312.459.315D20RS75SN12B	315	240	60	-	238	25.7	14	38	63	20	9.0	4	17.9

Applicable insert and spare parts

Applicable Insert	Screw	Wrench
SNEX1206ENN	M4.0*10	T-15S
SNMX1206ENN	M4.0*10	T-15S

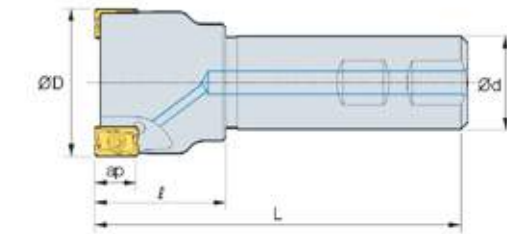


88° Double-side Eight Cutting Edge Type Shell Mill

Designation	D	D2	d	d1	d2	a	b	E	F	Z	ap	Fig	Kg
312.459.063A06RS88SN12B	63	49	22	11	18	10.4	6.3	20	40	6	11.5	1	0.4
312.459.063A08RS88SN12M	63	49	22	11	18	10.4	6.3	20	40	8	11.5	1	0.6
312.459.080A07RS88SN12B	80	57	27	14	20	12.4	7.0	23	50	7	11.5	1	1.2
312.459.080A10RS88SN12M	80	57	27	14	20	12.4	7.0	23	50	10	11.5	1	1.1
312.459.100B08RS88SN12B	100	67	32	18	26	14.4	8.0	25.5	50	8	11.5	2	1.6
312.459.100B12RS88SN12M	100	67	32	18	26	14.4	8.0	25.5	50	12	11.5	2	2.5
312.459.125B10RS88SN12B	125	87	40	22	32	16.4	9.0	30	63	10	11.5	2	3.3
312.459.125B14RS88SN12M	125	87	40	22	32	16.4	9.0	30	63	14	11.5	2	3.0
312.459.160B12RS88SN12B	160	107	40	-	107	16.4	9.0	32	63	12	11.5	2	4.4
312.459.160B20RS88SN12M	160	107	40	-	107	16.4	9.0	32	63	20	11.5	2	4.0
313.459.200C14RS88SN12B	200	130	60	-	135	25.7	14	32	63	14	11.5	3	6.4
313.459.200C24RS88SN12M	200	130	60	-	180	25.7	14	32	63	24	11.5	3	6.4
313.459.250C36RS88SN12B	250	180	60	-	238	25.7	14	38	63	36	11.5	3	10.6

Applicable insert and spare parts

Applicable Insert	Screw	Wrench
SNEX1206QNN	M4.0*11-R3	T-15S
SNMX1206QNN	M4.0*11-R3	T-15S



90° Double-side Four Cutting Edge Type End Mill

Designation	D	d	l	L	Z	ap	Kg
311.458.14D01RS90W16LN10	14	16	25	90	1	9.0	0.11
311.458.16D01RS90W16LN10	16	16	25	90	1	9.0	0.11
311.458.18D02RS90W16LN10	18	16	25	90	2	9.0	0.12
311.458.20D02RS90W20LN10	20	20	30	100	2	9.0	0.21
311.458.20D03RS90W20LN10	20	20	30	100	3	9.0	0.21
311.458.25D02RS90W25LN10	25	25	35	115	2	9.0	0.38
311.458.25D03RS90W25LN10	25	25	35	115	3	9.0	0.38
311.458.32D03RS90W32LN10	32	32	40	125	3	9.0	0.70
311.458.32D04RS90W32LN10	32	32	40	125	4	9.0	0.70
311.458.40D04RS90W42LN10	40	42	42	130	4	9.0	1.25
311.458.40D05RS90W42LN10	40	42	42	130	5	9.0	1.25
311.458.50D05RS90W42LN10	50	42	45	135	5	9.0	1.48
311.458.50D07RS90W42LN10	50	42	45	135	7	9.0	1.48
311.458.32D02RS90W32LN15	32	32	40	125	2	14.0	0.68
311.458.40D03RS90W32LN15	40	32	42	125	3	14.0	0.83
311.458.50D03RS90W42LN15	50	42	45	125	3	14.0	1.45
311.458.50D04RS90W42LN15	50	42	45	125	4	14.0	1.45
311.458.63D04RS90W42LN15	63	42	45	125	4	14.0	1.71
311.458.63D06RS90W42LN15	63	42	45	125	6	14.0	1.71

Applicable insert and spare parts

Applicable Insert	Screw	Wrench
LNEX/LNMX1006□	M3.0*7	T-10S
LNEX/LNMX1510□	M4.0*12	T-15S

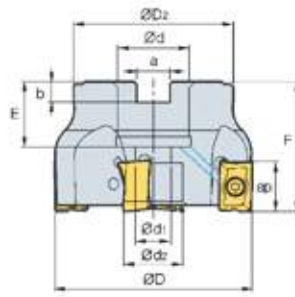


Fig.1

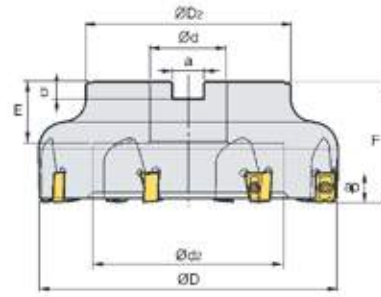


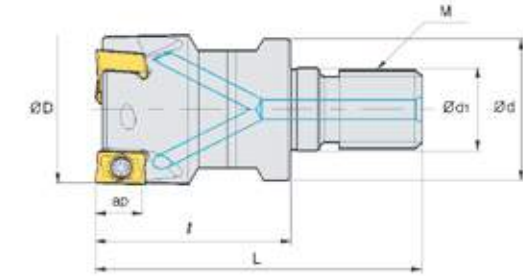
Fig.2

90° Double-side Four Cutting Edge Type Shell Mill

Designation	D	D2	d	d1	d2	a	b	E	F	Z	ap	Kg	Fig
312.458.040A04RS90LN10B	40	35	16	9	14	8.4	5.6	19	40	4	9.0	0.24	1
312.458.040A05RS90LN10M	40	35	16	9	14	8.4	5.6	19	40	5	9.0	0.23	1
312.458.050A05RS90LN10B	50	42	22	11	18	10.4	6.3	20	40	5	9.0	0.36	1
312.458.050A07RS90LN10M	50	42	22	11	18	10.4	6.3	20	40	7	9.0	0.35	1
312.458.063A07RS90LN10B	63	49	22	11	18	10.4	6.3	20	40	7	9.0	0.61	1
312.458.063A09RS90LN10M	63	49	22	11	18	10.4	6.3	20	40	9	9.0	0.6	1
312.458.080A08RS90LN10B	80	57	27	14	20	12.4	7.0	23	50	8	9.0	1.24	1
312.458.080A10RS90LN10M	80	57	27	14	20	12.4	7.0	23	50	10	9.0	1.23	1
312.458.100A09RS90LN10B	100	67	32	18	26	14.4	8.0	25	50	9	9.0	1.94	1
312.458.100A12RS90LN10M	100	67	32	18	26	14.4	8.0	25	50	12	9.0	1.93	1
312.458.050A03RS90LN15B	50	46	22	11	18	10.4	6.3	20	40	3	14.0	0.36	1
312.458.050A04RS90LN15M	50	46	22	11	18	10.4	6.3	20	40	4	14.0	0.35	1
312.458.063A04RS90LN15B	63	49	22	11	18	10.4	6.3	20	40	4	14.0	0.56	1
312.458.063A06RS90LN15M	63	49	22	11	18	10.4	6.3	20	40	6	14.0	0.57	1
312.458.080A05RS90LN15B	80	57	27	14	20	12.4	7.0	23	50	5	14.0	1.16	1
312.458.080A07RS90LN15M	80	57	27	14	20	12.4	7.0	23	50	7	14.0	1.14	1
312.458.100A05RS90LN15B	100	67	32	18	26	14.4	8.0	25	50	5	14.0	1.84	1
312.458.100A08RS90LN15M	100	67	32	18	26	14.4	8.0	25	50	8	14.0	1.82	1
312.458.125A07RS90LN15B	125	87	40	22	32	16.4	9.0	30	63	7	14.0	3.79	1
312.458.125A10RS90LN15M	125	87	40	22	32	16.4	9.0	30	63	10	14.0	3.70	1
312.458.160B08RS90LN15B	160	107	40	-	100	16.4	9.0	32	63	8	14.0	4.75	2
312.458.160B12RS90LN15M	160	107	40	-	100	16.4	9.0	32	63	12	14.0	4.71	2

Applicable insert and spare parts

Applicable Insert	Screw	Wrench
LNEX/LNMX1006□	M3.0*7	T-10S
LNEX/LNMX1510□	M4.0*12	T-15S



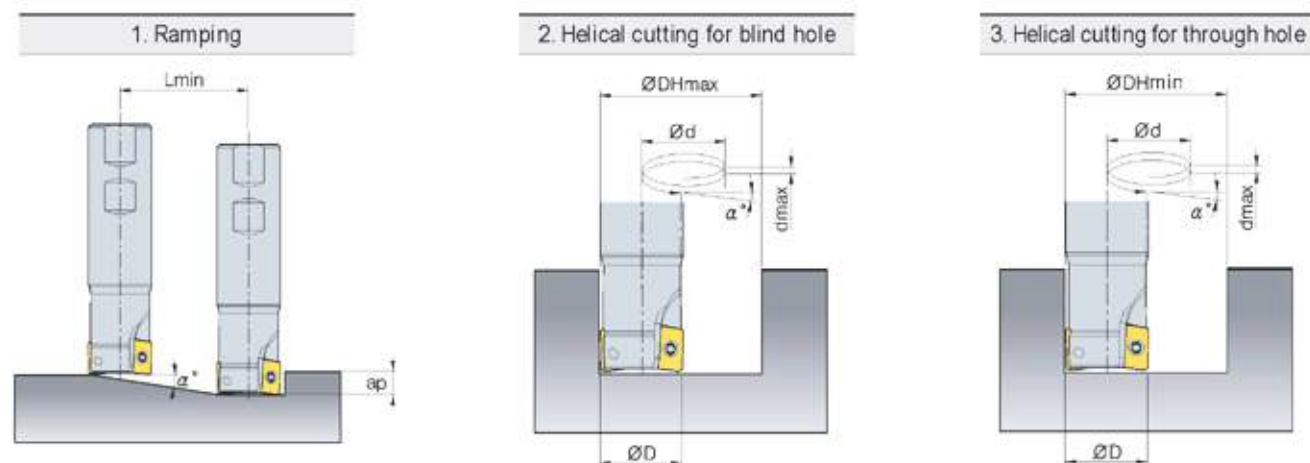
90° Double-side Four Cutting Edge Type Milling Modular

Designation	D	d	d1	l	L	M	Z	ap	Kg
313.458.14D01RS90M06LN10	14	12.0	6.5	25	40	M06	1	9.0	0.02
313.458.16D01RS90M08LN10	16	14.5	8.5	25	42	M08	1	9.0	0.02
313.458.18D02RS90M08LN10	18	14.5	8.5	25	42	M08	2	9.0	0.03
313.458.20D02RS90M10LN10	20	18.0	10.5	30	51	M10	2	9.0	0.06
313.458.25D02RS90M12LN10	25	23.0	12.5	35	59	M12	2	9.0	0.11
313.458.32D03RS90M16LN10	32	28.0	17.0	40	67	M16	3	9.0	0.21
313.458.40D04RS90M16LN10	40	28.0	17.0	40	67	M16	4	9.0	0.26
313.458.32D02RS90M16LN15	32	28.0	17.0	45	72	M16	2	14.0	0.21
313.458.40D03RS90M16LN15	40	28.0	17.0	45	72	M16	3	14.0	0.26
313.458.50D04RS90M16LN15	50	30.0	17.0	45	72	M16	4	14.0	0.41

Applicable insert and spare parts

Applicable Insert	Screw	Wrench
LNEX/LNMX1006□	M3.0*7	T-10S
LNEX/LNMX1510□	M4.0*12	T-15S

Cutting condition for ramping and helical operation



ZAP Type Milling Modular

Tool Dia. ϕD (mm)	a_p	Ramping		Helical cutting for blind hole				Helical cutting for through hole	
		Maximum angle α	L_{min} (mm)	Max. desirable hole Dia. ϕDH_{max} (mm)	Max. pitch d_{max} (mm)	Min. desirable hole Dia. ϕDH_{min} (mm)	Max. pitch d_{max} (mm)	Min. desirable hole Dia. ϕDH_{min} (mm)	Max. pitch d_{max} (mm)
14	10	5.0	114	27	3	25.0	2.5	19	1.0
16		4.0	143	31	3	29.0	2.0	23	1.0
18		4.0	143	35	3	33.0	3.0	27	2.0
20		4.0	143	39	4	37.0	3.0	31	2.0
25		3.5	163	49	4	47.0	4.0	41	3.0
32		3.0	191	63	4.5	61.0	4.0	55	3.5
40		2.0	289	79	4.0	77.0	3.5	71	3.0
50		1.5	382	99	3.5	97.0	3.5	91	3.0
40		2.0	286	79	4.0	77.0	4.0	71	3.0
50		1.5	382	99	3.5	97.0	3.5	91	3.0
63	15	1.0	573	125	3.0	123.0	3.0	117	2.5
80		1.0	573	159	4.0	157.0	4.0	151	3.5
100		0.5	1146	199	2.0	197.0	2.0	191	2.0
32		2.5	229	62	4.0	59.5	3.0	49	2.0
40		2.0	286	78	4.0	75.5	3.0	65	2.0
50		2.0	286	98	5.0	95.5	4.0	85	3.5
63		2.0	286	124	5.0	121.5	5.0	111	5.0
50		2.0	286	98	5.0	95.5	4.0	85	3.5
63		2.0	286	124	5.0	121.5	5.0	111	5.0
80		1.5	382	158	5.0	155.5	5.0	145	5.0
100	15	1.0	573	198	5.0	195.5	4.5	185	4.0
125		1.0	573	248	5.0	245.5	5.0	235	5.0
160	15	0.5	1146	318	4.0	315.5	3.5	3.5	3.5

The L_{min} is when depth of cut is 10.0mm($L_{min} = 10 / \tan \alpha$)

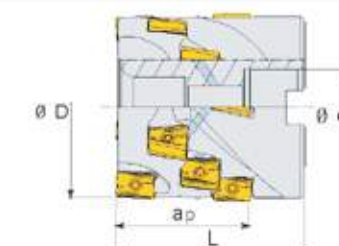


Double-side Four Cutting Edge Type Helical End Mill

Designation	D	d	l	L	Z	ap	No. of Insert
314.558.32D02RS90W32SAN11.L40	32	32	48	110	2	40	8
314.558.40D03RS90W32SAN11.L40	40	32	50	125	3	40	12
314.558.40D02RS90W32SAN16.L42	40	32	55	120	2	42	6
314.558.40D02RS90W32SAN16.L56	40	32	75	140	2	56	8
314.558.50D03RS90W42SAN16.L56	50	42	70	140	3	56	12

Applicable insert and spare parts

Applicable Insert	Screw	Wrench
ANMX/ANHX1106□	M3.0*7.0	T-10S
ANMX/ANHX1607□	M4.0*12	T-15S

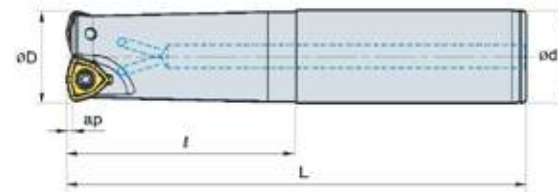


Double-side Four Cutting Edge Type Helical Sell Mill

Designation	D	d	L	Z	a_p	Kg	No. of Insert	Mounting Bolt
315.558.050A03RS90SAN11L40	50	22	60	3	40	0.59	12	M10*1.5*40
315.558.063A04RS90SAN11L60	63	27	80	4	60	1.34	24	M12*1.75*60
315.558.080A05RS90SAN11L60	80	40	80	5	60	2.27	30	M16*2.0*60
315.558.050A02RS90SAN16L42	50	22	65	2	42	0.65	6	M10*1.5*40
315.558.063A02RS90SAN16L42	63	27	70	2	42	1.12	6	M12*1.75*50
315.558.063A03RS90SAN16L56	63	27	80	3	56	1.33	12	M12*1.75*50
315.558.080A04RS90SAN16L56	80	32	80	4	56	2.23	16	M16*2.0*50
315.558.100A05RS90SAN16L69	100	40	100	5	69	4.51	25	M20*2.5*60

Applicable insert and spare parts

Applicable Insert	Screw	Wrench
ANMX/ANHX1106□	M3.0*7.0	T-10S
ANMX/ANHX1607□	M4.0*12	T-15S

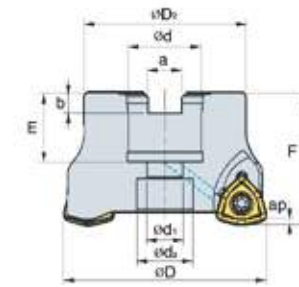


Double-side Six Cutting Edge End Mill

Designation	D	d	l	L	Z	ap	Kg
311.512.16D02R030B16WN06L100	16	16	30	100	2	1.0	0.15
311.512.16D02R070B16WN06L150	16	16	70	150	2	1.0	0.20
311.512.16D02R100B16WN06L200	16	16	100	200	2	1.0	0.26
311.512.18D02R020B16WN06L100	18	16	20	100	2	1.0	0.15
311.512.18D02R020B16WN06L150	18	16	20	150	2	1.0	0.21
311.512.18D02R020B16WN06L200	18	16	20	200	2	1.0	0.28
311.512.20D02R050B20WN06L150	20	20	50	150	2	1.0	0.28
311.512.20D02R100B20WN06L200	20	20	100	200	2	1.0	0.28
311.512.20D02R130B20WN06L250	20	20	130	250	2	1.0	0.38
311.512.25D03R060B25WN06L150	25	25	60	150	3	1.0	0.44
311.512.25D03R080B25WN06L200	25	25	80	200	3	1.0	0.57
311.512.25D03R120B25WN06L250	25	25	120	250	3	1.0	0.80
311.512.32D04R070B32WN06L150	32	32	70	150	4	1.0	0.82
311.512.32D04R100B32WN06L200	32	32	100	200	4	1.0	1.10
311.512.32D04R180B32WN06L300	32	32	180	300	4	1.0	1.66
311.512.25D02R060B25WN09L150	25	25	60	150	2	1.5	0.5
311.512.25D02R120B25WN09L200	25	25	120	200	2	1.5	0.6
311.512.25D02R180B25WN09L300	25	25	180	300	2	1.5	1.0
311.512.30D03R070B32WN09L150	30	32	70	150	3	1.5	0.8
311.512.30D03R120B32WN09L200	30	32	120	200	3	1.5	1.0
311.512.30D03R180B32WN09L300	30	32	180	300	3	1.5	1.5
311.512.32D03R070B32WN09L150	32	32	70	150	3	1.5	0.8
311.512.32D03R120B32WN09L200	32	32	120	200	3	1.5	1.1
311.512.32D03R180B32WN09L300	32	32	180	300	3	1.5	1.7
311.512.40D04R050B32WN09L150	40	32	50	150	4	1.5	0.9
311.512.40D04R050B32WN09L250	40	32	50	250	4	1.5	1.5
311.512.40D04R050B32WN09L300	40	32	50	300	4	1.5	1.8
311.512.32D02R070B32WN13L150	32	32	70	150	2	2.0	0.8
311.512.32D02R120B32WN13L200	32	32	120	200	2	2.0	1.0
311.512.32D02R180B32WN13L300	32	32	180	300	2	2.0	1.6
311.512.35D02R050B32WN13L150	35	32	50	150	2	2.0	0.8
311.512.35D02R050B32WN13L200	35	32	50	200	2	2.0	1.1
311.512.35D02R050B32WN13L300	35	32	50	300	2	2.0	1.7
311.512.40D03R050B32WN13L150	40	32	50	150	3	2.0	0.8
311.512.40D03R050B32WN13L250	40	32	50	250	3	2.0	1.4
311.512.40D03R050B32WN13L300	40	32	50	300	3	2.0	1.7
311.512.50D04R050B32WN13L150	50	32	50	150	4	2.0	1.1
311.512.50D04R050B32WN13L250	50	32	50	250	4	2.0	1.7
311.512.50D04R050B32WN13L300	50	32	50	300	4	2.0	2.0

Applicable insert and spare parts

Applicable Insert	Screw	Wrench
WNMX060312ZNN	WNMX060312ZNN	T-8S
WNMX09T316ZNN	WNMX09T316ZNN	T-10S
WNMX130520ZNN	WNMX130520ZNN	T-15S

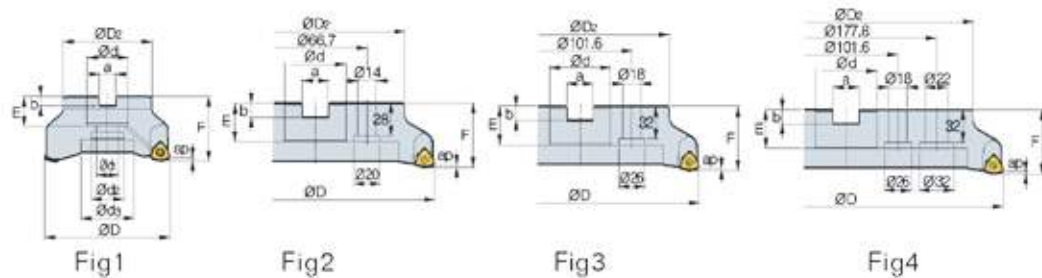


Double-side Six Cutting Edge Type Shell Mill

Designation	D	D2	d	d1	d2	a	b	E	F	Z	ap	Kg
312.512.050A03RS14WN13B	50	42	22	11	17	10.4	6.3	21	40	3	2.0	0.3
312.512.050A04RS14WN13M	50	42	22	11	17	10.4	6.3	21	40	4	2.0	0.3
312.512.063A04RS14WN13B	63	49	22	11	18	10.4	6.3	21	40	4	2.0	0.5
312.512.063A05RS14WN13M	63	49	22	11	18	10.4	6.3	21	40	5	2.0	0.5
312.512.080A05RS14WN13B	80	57	27	14	20	12.4	7.0	23	50	5	2.0	1.0
312.512.080A06RS14WN13M	80	57	27	14	20	12.4	7.0	23	50	6	2.0	1.0
312.512.100A06RS14WN13B	100	67	32	18	26	14.4	8.0	25	50	6	2.0	1.6
312.512.100A07RS14WN13M	100	67	32	18	26	14.4	8.0	25	50	7	2.0	1.6
312.512.125A07RS14WN13B	125	87	40	22	32	16.4	9.0	29	63	7	2.0	3.2
312.512.125A08RS14WN13M	125	87	40	22	32	16.4	9.0	29	63	8	2.0	3.2

Applicable insert and spare parts

Applicable Insert	Screw	Wrench
WNMX130520ZNN	M4.0*12	T-15S

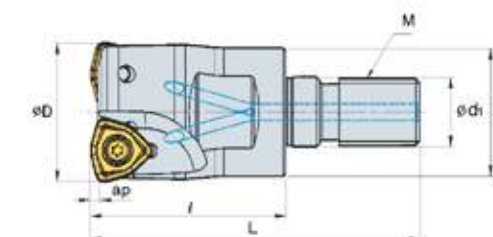


Double-side Six Cutting Edge Type Shell Mill

Designation	D	D2	d	d1	d2	d3	a	b	E	F	Z	ap	Kg	Fig
312.512.080A04RS14WN16B	80	65	27	14	20	-	12.4	7	23	50	4	2.5	0.99	1
312.512.080A05RS14WN16M	80	65	27	14	20	-	12.4	7	23	50	5	2.5	0.91	1
312.512.100A05RS14WN16B	100	85	32	18	26	-	14.4	8	25	50	5	2.5	1.68	1
312.512.100A06RS14WN16M	100	85	32	18	26	-	14.4	8	25	50	6	2.5	1.64	1
312.512.125A06RS14WN16B	125	100	40	22	32	52	16.4	9	29	63	6	2.5	3.23	1
312.512.125A07RS14WN16M	125	100	40	22	32	52	16.4	9	29	63	7	2.5	3.24	1
312.512.160B07RS14WN16B	160	107	40	-	90	-	16.4	9	32	63	7	2.5	3.73	2
312.512.160B08RS14WN16M	160	107	40	-	90	-	16.4	9	32	63	8	2.5	3.77	2
312.512.200C08RS14WN16B	200	145	60	-	132	-	25.7	14	38	63	8	2.5	6.48	3
312.512.200C10RS14WN16M	200	145	60	-	132	-	25.7	14	38	63	10	2.5	6.61	3
312.512.250C10RS14WN16B	250	190	60	-	190	-	25.7	14	38	63	10	2.5	11.01	3
312.512.250C12RS14WN16M	250	190	60	-	190	-	25.7	14	38	63	12	2.5	11.04	3
312.512.315D12RS14WN16B	315	250	60	-	238	-	25.7	14	38	63	12	2.5	18.34	4
312.512.315D14RS14WN16M	315	250	60	-	238	-	25.7	14	38	63	14	2.5	18.35	4

Applicable insert and spare parts

Applicable Insert	Screw	Wrench
WNMX160720ZNN	M5.0*13	T-20S

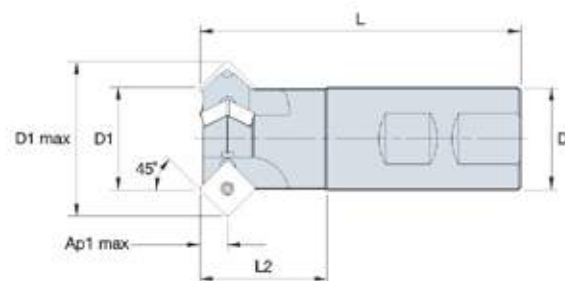


Double-side Six Cutting Edge Type Milling Modular

Designation	D	d	D1	I	L	M	Z	ap	Kg
313.512.16D02R25M08WN06	16	14.5	8.5	25	42	M08	2	1.0	0.03
313.512.18D02R25M08WN06	18	14.5	8.5	25	42	M08	2	1.0	0.03
313.512.20D02R30M10WN06	20	18.0	10.5	30	51	M10	2	1.0	0.06
313.512.25D03R35M12WN06	25	23.0	12.5	35	59	M12	3	1.0	0.10
313.512.32D04R40M16WN06	32	29.0	17.0	40	67	M16	4	1.0	0.21
313.512.25D02R35M12WN09	25	23.0	12.5	35	59	M12	2	1.5	0.10
313.512.32D03R40M16WN09	32	29.0	17.0	40	67	M16	3	1.5	0.20
313.512.40D04R40M16WN09	40	29.0	17.0	40	67	M16	4	1.5	0.25
313.512.32D02R40M16WN13	32	29.0	17.0	40	67	M16	2	2.0	0.20
313.512.40D03R45M16WN13	40	29.0	17.0	45	72	M16	3	2.0	0.26

Applicable insert and spare parts

Applicable Insert	Screw	Wrench
WNMX060312ZNN	M2.5*6	T-8S
WNMX09T316ZNN	M3.0*7	T-10S
WNMX130520ZNN	M4.0*12	T-15S



Chamfer End Mill

Designation	D	D1max	L2	L	Z	ap	Kg
311.102.10D01RS45W16SD09	10	22	34	83	1	6,5	0.1
311.102.12D01RS45W16SD09	12	24	34	83	1	6,5	0.2
311.102.16D02RS45W16SD09	16	28	34	83	2	6,5	0.3
311.102.20D02RS45W20SD09	20	32	34	83	2	6,5	0.4
311.102.25D03RS45W25SD09	25	37	34	83	3	6,5	0.6
311.102.12D01RS45W20SP12	12	29	40	101	1	9.0	0.2
311.102.25D02RS45W25SP12	25	42	40	101	2	9.0	0.6
311.102.32D03RS45W32SP12	32	47	40	101	3	9.0	1.0

Applicable insert and spare parts

Applicable Insert	Screw	Wrench
SDMT090308	M3.5*9	T-15S
SPMT120408	M5.0*12	T-20S

SUMMARY OF MILLING GRADE

[illegible]