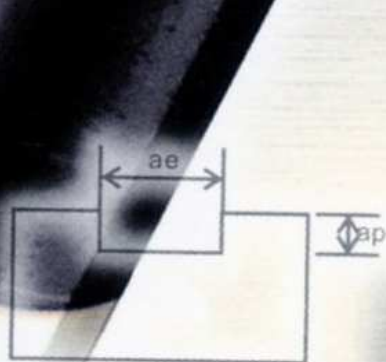
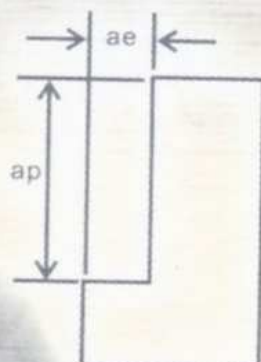


PARÂMETROS DE CORTE



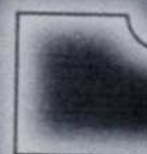
$$\begin{aligned} ae=D \} fz \times 1 \\ ap=D \} \\ ae=D \} fz \times 1.2 \\ ap=0.5 \times D \} \end{aligned}$$



$$\begin{aligned} ae=D \times 1.5 \} fz \times 1 \\ ap=D \times 1.5 \} \\ ae=D \times 0.5 \} fz \times 1.2 \\ ap=D \} \end{aligned}$$



$$\begin{aligned} P=D \times 0.5 \} fz \times 1.5 \\ H=D \} \\ P=D \times 0.5 \} fz \times 3 \\ H=0.05 \div 0.1 \text{ mm} \} \end{aligned}$$



$$\begin{aligned} H=D \} \\ H=D \} \end{aligned}$$

FRESAS DE TOPO RETO - MICRO DIÂMETRO – 2 CORTES

Work Material	SS,SC,FC150~250HB Structural Steels, Carbon Steels, Cast Irons 150~250HB		SCM,NAK,HPM25~35HRC Alloy Steels, Pre-Hardened Steels 25~35HRC		40~50HRC Hardened Steels 40~50HRC		SUS304,316 Stainless Steels		20~45HRC Nickel Alloys Titanium Alloys 20~45HRC	
	Milling Conditions									
Outside Diameter	Rotation min ⁻¹	Feed mm/min	Rotation min ⁻¹	Feed mm/min	Rotation min ⁻¹	Feed mm/min	Rotation min ⁻¹	Feed mm/min	Rotation min ⁻¹	Feed mm/min
0 2	32000	130	32000	120	32000	100	32000	90	19000	30
0 3	32000	190	32000	170	24000	120	29000	120	14000	30
0 4	32000	260	29000	210	18000	120	21000	120	11000	30
0 5	29000	290	23000	210	14000	110	17000	120	8600	30
0 6	27000	320	21000	230	13000	120	16000	130	8000	40
0 8	20000	320	16000	230	10000	130	12000	130	6000	40
	a _p	1D								
	a _e	0 05D(D<1)0 1D(D≥1)				0 05D		0 05D(D<1)0 1D(D≥1)		
	a _p	0 3D(D<1)0 5D(D≥1)				0 2D		0 3D		0 1D
Grooving  Side Milling  1. When using low speed machines, use the maximum speed and adjust the feed rate. 2. When grooving Stainless Steels, reduce the rotation to 60%, and the feed to 40% of table values. 3. Use in wet condition in case of Stainless Steels, Nickel Alloys, Titanium Alloys. 4. Adjust milling condition when unusual vibration, different sound occur by cutting.										

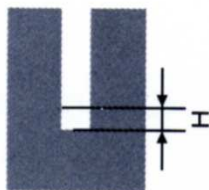
FRESAS DE TOPO RETO - LONG NECK - 2 CORTES

Work Material		150~250HB Carbon Steels, Alloy Steels		25~35HRC Stainless Steels, Mold Steels		35~45HRC Pre-hardened Steels		45~55HRC Hardened Steels	
		150~250HB		25~35HRC		35~45HRC		45~55HRC	
		Rotation min ⁻¹	Feed mm/min	Rotation min ⁻¹	Feed mm/min	Rotation min ⁻¹	Feed mm/min	Rotation min ⁻¹	Feed mm/min
Milling Conditions									
Outside Diameter	Effective Length								
0 2	0 5	50000	300	50000	270	50000	240	50000	210
0 2	1	50000	300	50000	270	50000	240	50000	210
0 3	1	50000	500	50000	450	50000	400	42000	300
0 3	2	50000	500	50000	450	50000	400	42000	300
0 3	3	50000	500	50000	450	45000	400	42000	300
0 4	2	50000	750	50000	680	50000	560	34000	340
0 4	3	50000	750	50000	680	50000	560	34000	340
0 4	4	50000	750	50000	680	35000	560	34000	340
0 5	2	50000	900	43000	770	30000	450	25000	320
0 5	4	50000	900	43000	770	30000	450	25000	320
0 5	6	48000	860	41000	730	29000	430	24000	300
0 6	2	50000	1000	43000	850	30000	500	25000	350
0 6	4	50000	1000	43000	850	30000	500	25000	350
0 6	6	42000	840	36000	710	25000	420	21000	290
0 6	8	32000	640	27000	540	19000	320	16000	220
0 7	2	45000	990	38000	840	27000	500	23000	350
0 7	4	45000	990	38000	840	27000	500	23000	350
0 7	6	36000	790	31000	670	22000	400	18000	280
0 7	8	36000	790	31000	670	22000	400	18000	280
0 7	10	28000	620	24000	530	17000	310	14000	220
0 8	4	40000	1000	34000	850	24000	500	20000	350
0 8	6	40000	1000	34000	850	24000	500	20000	350
0 8	8	32000	800	27000	680	19000	400	16000	280
0 8	10	24000	600	20000	510	14000	300	12000	210
0 8	12	24000	600	20000	510	14000	300	12000	210
0 9	6	36000	1190	31000	1010	22000	600	18000	420
0 9	8	30000	990	26000	840	18000	500	15000	350
0 9	10	30000	990	26000	840	18000	500	15000	350
1	4	32000	1280	27000	900	22000	640	11000	300
1	6	32000	1280	27000	900	22000	640	11000	300
1	8	32000	1280	27000	900	22000	640	11000	300
1	10	26000	1040	22000	730	18000	520	9000	250
1	12	26000	1040	22000	730	18000	520	9000	250
1 5	6	21000	1130	18000	790	15000	570	7000	300

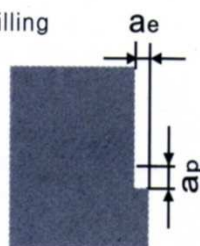
FRESAS DE TOPO RETO - LONG NECK - 2 CORTES

Work Material		150~250HB Carbon Steels, Alloy Steels 150~250HB		25~35HRC Stainless Steels, Mold Steels 25~35HRC		35~45HRC Pre-hardened Steels 35~45HRC		45~55HRC Hardened Steels 45~55HRC	
		Rotation min ⁻¹	Feed mm/min	Rotation min ⁻¹	Feed mm/min	Rotation min ⁻¹	Feed mm/min	Rotation min ⁻¹	Feed mm/min
Milling Conditions	Effective Length								
		Outside Diameter							
1 5	8	21000	1130	18000	790	15000	570	7000	300
1 5	10	21000	1130	18000	790	15000	570	7000	300
1 5	12	21000	1130	18000	790	15000	570	7000	300
1 5	14	17000	920	14000	640	12000	460	6000	260
1 5	16	17000	920	14000	640	12000	460	6000	260
1 5	18	17000	920	14000	640	12000	460	6000	260
1 5	20	12800	690	11000	480	9000	350	6000	260
2	6	16000	1120	14000	780	11000	560	6000	360
2	8	16000	1120	14000	780	11000	560	6000	360
2	10	16000	1120	14000	780	11000	560	6000	360
2	12	16000	1120	14000	780	11000	560	6000	360
2	14	16000	1120	14000	780	11000	560	6000	360
2	16	16000	1120	14000	780	11000	560	6000	360
2	18	12000	840	10000	590	8000	420	5000	300
2	20	12000	840	10000	590	8000	420	5000	300
3	8	11000	1760	9000	1230	8000	880	4000	450
3	10	11000	1760	9000	1230	8000	880	4000	450
3	12	11000	1760	9000	1230	8000	880	4000	450
3	14	11000	1760	9000	1230	8000	880	4000	450
3	16	11000	1760	9000	1230	8000	880	4000	450
3	18	11000	1760	9000	1230	8000	880	4000	450
3	20	11000	1760	9000	1230	8000	880	4000	450
3	25	8000	1280	7000	900	6000	640	3000	330
4	12	8000	1440	7000	1010	6000	720	3000	420
4	20	8000	1440	7000	1010	6000	720	3000	420
4	25	8000	1440	7000	1010	6000	720	3000	420

Grooving

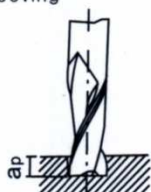
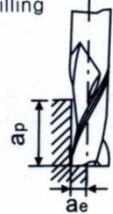


Side Milling



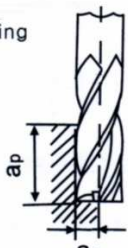
1. When corner processing, reduce the feed rate by approximately half.
2. Recommend non water soluble cutting fluid.
3. To achieve flute depth, sequential use of each neck length is most effective.
4. The run out of the end mill should be in 10µm after chucking.

FRESAS DE TOPO RETO – 2 CORTES

Work Material	SS,SC,FC150~250HB Structural Steels, Carbon Steels, Cast Irons 150~250HB		SCM,NAK,HPM25~35HRC Alloy Steels, Pre-Hardened Steels 25~35HRC		35~45HRC Hardened Steels 25~35HRC		45~55HRC Hardened Steels 45~55HRC		SUS304,316 Stainless Steels		20~45HRC Nickel Alloys Titanium Alloys 20~45HRC		
	Milling Conditions												
	Rotation min ⁻¹	Feed mm/min	Rotation min ⁻¹	Feed mm/min	Rotation min ⁻¹	Feed mm/min	Rotation min ⁻¹	Feed mm/min	Rotation min ⁻¹	Feed mm/min	Rotation min ⁻¹	Feed mm/min	
Outside Diameter													
2	11200	340	10500	240	7300	130	5300	80	5300	90	3300	50	
4	6400	460	6000	320	4200	180	3000	110	3000	130	1900	70	
6	4600	550	4300	390	3000	210	2200	130	2200	150	1400	80	
8	3400	550	3200	390	2200	210	1600	130	1600	150	1000	80	
10	2800	560	2600	390	1800	210	1300	130	1300	150	800	80	
12	2300	560	2200	400	1500	210	1100	130	1100	150	700	80	
16	1700	450	1600	320	1100	180	800	100	800	110	500	60	
20	1350	380	1300	280	900	160	650	90	650	100	400	50	
	ap	1 5D						1D		1 5D		1D	
	ae	0 1D				0 05D		0 02D		0 1D		0 05D	
	ap	0 5D				0 3D		0 05D		0 5D		0 05D	
Grooving  Side Milling  1. When grooving Stainless Steels, reduce the rotation to 60%, and the feed to 40% of table values. 2. Use in wet condition in case of Stainless Steels, Nickel Alloys, Titanium Alloys. 3. Adjust milling condition when unusual vibration, different sound occur by cutting.													

FRESAS DE TOPO RETO - 2 CORTES

MÉDIA - LONGA - EXTRA LONGA

Work Material	SS,SC,FC150~250HB Structural Steels, Carbon Steels, Cast Irons 150~250HB		SCM,NAK,HPM25~35HRC Alloy Steels, Pre-Hardened Steels 25~35HRC		40~50HRC Hardened Steels 40~50HRC		SUS304,316 Stainless Steels		20~45HRC Nickel Alloys Titanium Alloys 20~45HRC	
	Milling Conditions									
	Rotation min ⁻¹	Feed mm/min	Rotation min ⁻¹	Feed mm/min	Rotation min ⁻¹	Feed mm/min	Rotation min ⁻¹	Feed mm/min	Rotation min ⁻¹	Feed mm/min
Outside Diameter										
3	8500	370	5500	210	4000	180	5500	160	2600	60
4	6600	400	4500	220	3000	190	4000	160	2000	60
6	4800	480	3000	240	2500	190	3000	240	1200	60
8	3600	500	2200	300	2000	200	2000	260	1000	70
10	2800	500	1800	300	1500	200	1700	270	800	80
12	2400	470	1500	270	1200	190	1500	250	700	70
16	1800	320	1100	210	800	150	1000	180	500	60
20	1400	250	900	160	700	120	820	150	400	50
Depth of cut	a _p	3D								
	a _e	0.05D			0.02D		0.05D		0.02D	
Side Milling  1. Use highly rigid machining center(BT50). 2. When grooving Stainless Steels, reduce the rotation to 60%, and the feed to 40% of table values. 3. Use in wet condition in case of Stainless Steels, Nickel Alloys, Titanium Alloys. 4. Adjust milling condition when unusual vibration, different sound occur by cutting.										

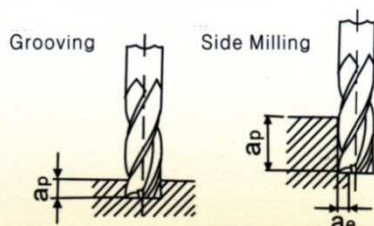
FRESAS DE TOPO RETO - 4 CORTES

Conventional Condition

Work Material	SS,SC,FC150~250HB Structural Steels, Carbon Steels, Cast Irons 150~250HB		SCM,NAK,HPM25~35HRC Alloy Steels, Pre-Hardened Steels 25~35HRC		35~45HRC Hardened Steels 25~35HRC		45~55HRC Hardened Steels 45~55HRC		SUS304,316 Stainless Steels		20~45HRC Nickel Alloys Titanium Alloys 20~45HRC	
	Rotation min ⁻¹	Feed mm/min	Rotation min ⁻¹	Feed mm/min	Rotation min ⁻¹	Feed mm/min	Rotation min ⁻¹	Feed mm/min	Rotation min ⁻¹	Feed mm/min	Rotation min ⁻¹	Feed mm/min
Outside Diameter												
2	12800	570	12000	380	8300	230	6000	150	6000	130	3700	70
4	6800	730	6400	490	4400	300	3200	200	3200	170	2000	90
6	4600	770	4300	520	3000	320	2200	210	2200	180	1400	100
8	3400	770	3200	520	2200	320	1600	210	1600	180	1000	100
10	2800	780	2600	520	1800	320	1300	210	1300	180	800	100
12	2300	780	2200	530	1500	320	1100	210	1100	180	700	100
16	1700	650	1600	420	1100	280	800	170	800	150	500	80
20	1350	600	1300	380	900	260	650	150	650	140	400	75
Depth of cut	a _p	1 5D				1D		1 5D		1D		
	a _e	0 1D				0 05D		0 02D		0 1D		
Depth of cut	a _p	0 5D				0 2D		0 05D		0 3D		
	a _e	0 5D				0 2D		0 05D		0 1D		

High Speed Milling

Work Material	SS,SC,FC150~250HB Structural Steels, Carbon Steels, Cast Irons 150~250HB		SCM,NAK,HPM25~35HRC Alloy Steels, Pre-Hardened Steels 25~35HRC		35~45HRC Hardened Steels 25~35HRC		45~55HRC Hardened Steels 45~55HRC		SUS304,316 Stainless Steels	
	Rotation min ⁻¹	Feed mm/min	Rotation min ⁻¹	Feed mm/min	Rotation min ⁻¹	Feed mm/min	Rotation min ⁻¹	Feed mm/min	Rotation min ⁻¹	Feed mm/min
Outside Diameter										
2	47800	2200	47800	1600	39800	1200	31800	900	15900	400
4	23900	2600	23900	1900	19900	1400	15900	1100	8000	490
6	16000	2700	16000	2000	13300	1500	10600	1200	5300	510
8	12000	2700	12000	2000	10000	1500	8000	1200	4000	520
10	9600	2700	9600	2000	8000	1500	6400	1200	3200	520
12	8000	2700	8000	2000	6700	1500	5300	1200	2700	520
16	6000	2200	6000	1600	5000	1200	4000	900	2000	450
20	4800	2000	4800	1400	4000	1100	3200	750	1600	380
Depth of cut	a _p	1 5D				1D		1 5D		
	a _e	0 05D				0 02D		0 05D		



1. When grooving Stainless Steels, reduce the rotation to 60%, and the feed to 40% of table values.
2. Use in wet condition in case of Stainless Steels, Nickel Alloys, Titanium Alloys.
3. Adjust milling condition when unusual vibration, different sound occur by cutting.

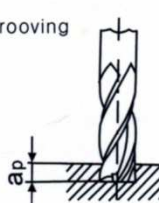
FRESAS DE TOPO RETO – 4 CORTES

(PARA AÇO INOX)

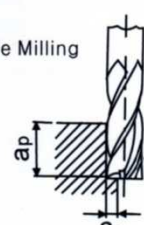
Conventional Condition

Work Material	SS,SC,FC150~250HB Structural Steels, Carbon Steels, Cast Irons 150~250HB		SCM,NAK,HPM25~35HRC Alloy Steels, Pre-Hardened Steels 25~35HRC		35~45HRC Hardened Steels 25~35HRC		45~55HRC Hardened Steels 45~55HRC		SUS304,316 Stainless Steels		20~45HRC Nickel Alloys Titanium Alloys 20~45HRC		
	Rotation min ⁻¹	Feed mm/min	Rotation min ⁻¹	Feed mm/min	Rotation min ⁻¹	Feed mm/min	Rotation min ⁻¹	Feed mm/min	Rotation min ⁻¹	Feed mm/min	Rotation min ⁻¹	Feed mm/min	
Outside Diameter	2	12800	570	12000	380	8300	230	6000	150	6000	130	3700	70
	4	6800	730	6400	490	4400	300	3200	200	3200	170	2000	90
	6	4600	770	4300	520	3000	320	2200	210	2200	180	1400	100
	8	3400	770	3200	520	2200	320	1600	210	1600	180	1000	100
	10	2800	780	2600	520	1800	320	1300	210	1300	180	800	100
	12	2300	780	2200	530	1500	320	1100	210	1100	180	700	100
	16	1700	650	1600	420	1100	280	800	170	800	150	500	80
	20	1350	600	1300	380	900	260	650	150	650	140	400	75
	a _p	1 5D						1D		1 5D		1D	
	a _e	0 1D				0 05D		0 02D		0 1D		0 05D	
	a _p	0 5D				0 2D		0 05D		0 3D		0 1D	

Grooving



Side Milling



1. When grooving Stainless Steels, reduce the rotation to 60%, and the feed to 40% of table values.

2. Use in wet condition in case of Stainless Steels, Nickel Alloys, Titanium Alloys.

3. Adjust milling condition when unusual vibration, different sound occur by cutting.

FRESAS DE TOPO RETO – 4 CORTES

MÉDIA – LONGA – EXTRA LONGA

Work Material	SS,SC,FC150~250HB Structural Steels, Carbon Steels, Cast Irons 150~250HB		SCM,NAK,HPM25~35HRC Alloy Steels, Pre-Hardened Steels 25~35HRC		40~50HRC Hardened Steels 40~50HRC		SUS304,316 Stainless Steels		20~45HRC Nickel Alloys Titanium Alloys 20~45HRC	
	Milling Conditions									
Outside Diameter	Rotation min ⁻¹	Feed mm/min	Rotation min ⁻¹	Feed mm/min	Rotation min ⁻¹	Feed mm/min	Rotation min ⁻¹	Feed mm/min	Rotation min ⁻¹	Feed mm/min
3	8500	370	5500	210	4000	180	5500	160	2600	60
4	6600	400	4500	220	3000	190	4000	160	2000	60
6	4800	480	3000	240	2500	190	3000	240	1200	60
8	3600	500	2200	300	2000	200	2000	260	1000	70
10	2800	500	1800	300	1500	200	1700	270	800	80
12	2400	470	1500	270	1200	190	1500	250	700	70
16	1800	320	1100	210	800	150	1000	180	500	60
20	1400	250	900	160	700	120	820	150	400	50
Depth of cut	a _p	3D								
	a _e	0.05D			0.02D		0.05D		0.02D	

Side Milling



1. Use highly rigid machining center(BT50).

2. When grooving Stainless Steels, reduce the rotation to 60%, and the feed to 40% of table values.

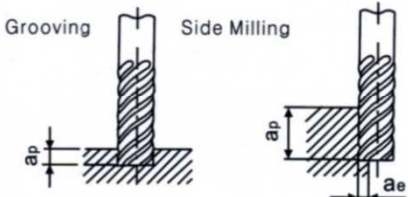
3. Use in wet condition in case of Stainless Steels, Nickel Alloys, Titanium Alloys.

4. Adjust milling condition when unusual vibration, different sound occur by cutting.

FRESAS DE TOPO RETO – 6 CORTES

Conventional Condition

Work Material	45~55HRC Hardened Steels 45~55HRC		35~45HRC Pre-Hardened Steels Mold Steels 35~45HRC		~35HRC Carbon Steels Alloy Steels ~35HRC		SUS304,SUS316 Stainless Steels		FC, FCD Cast Irons	
	Rotation min ⁻¹	Feed mm/min	Rotation min ⁻¹	Feed mm/min	Rotation min ⁻¹	Feed mm/min	Rotation min ⁻¹	Feed mm/min	Rotation min ⁻¹	Feed mm/min
Outside Diameter										
4	2400	180	4000	490	8000	1600	2800	180	8000	1600
5	1900	220	3200	490	6200	2000	2200	230	6200	2000
6	1600	250	2700	490	5300	2000	1900	230	5300	2400
8	1200	280	2000	490	4000	2000	1400	230	4000	2400
10	1000	300	1600	630	3200	2000	1100	230	3200	2400
12	800	350	1300	570	2700	2100	930	300	2700	2400
16	640	220	1100	360	2000	1900	700	270	2000	2000
20	480	180	800		1600	1600	560	240	1600	1600
Milling Conditions	a _p	1 5D	1 5D		1 5D		1 5D		1 5D	
	a _e	0 05D	0 1D		0 1D		0 1D		0 1D	
	a _p	0 005 MAX.	0 1D		0 1D		0 1D		0 1D	



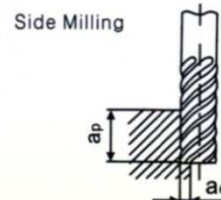
Grooving Side Milling

1. Use in wet condition in case of Stainless Steels.
2. Recommend dry process in case of high speed milling.
3. Adjust milling condition when unusual vibration, different sound occur by cutting.

High Speed Condition

Work Material	45~55HRC Hardened Steels 45~55HRC		35~45HRC Pre-Hardened Steels Mold Steels 35~45HRC		~35HRC Carbon Steels Alloy Steels ~35HRC	
	Rotation min ⁻¹	Feed mm/min	Rotation min ⁻¹	Feed mm/min	Rotation min ⁻¹	Feed mm/min
Outside Diameter						
4	24000	3200	24000	4600	24000	4800
5	19200	4000	19200	5800	19200	6000
6	16000	4000	16000	5800	16000	6000
8	12000	4000	12000	5800	12000	6000
10	9500	4200	10000	5700	10000	6000
12	8000	4600	8000	5300	8000	7600
16	6000	4000	6000	5300	6000	7600
20	4800	3000	5000	5000	5000	7000
Depth of cut	a _p	1~1 5D	1~1 5D		1~1 5D	
	a _e	0 02~0 05D	0 05D		0 1D	

1. Recommend dry process in case of high speed milling.
2. Adjust milling condition when unusual vibration, different sound occur by cutting.



FRESAS DE TOPO ESFÉRICO - MICRO DIÂMETRO - 2 CORTES

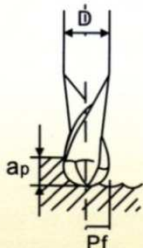
Conventional Condition

Work Material	SC, FC Carbon Steels, Cast Irons		SCM, SKD Alloy Steels, Mold Steels		30~38HRC Hardened Steels, Pre-Hardened Steels 30~38HRC		38~45HRC Stainless Steels, Hardened Steels 38~45HRC		45~55HRC Hardened Steels 45~55HRC		55~60HRC Hardened Steels 55~60HRC	
	Rotation min ⁻¹	Feed mm/min	Rotation min ⁻¹	Feed mm/min	Rotation min ⁻¹	Feed mm/min	Rotation min ⁻¹	Feed mm/min	Rotation min ⁻¹	Feed mm/min	Rotation min ⁻¹	Feed mm/min
Milling Conditions												
R Ball Radius(mm)												
0 1	32000	320	32000	320	32000	300	32000	250	32000	160	32000	125
0 15	32000	480	32000	480	32000	450	32000	375	32000	240	32000	190
0 2	32000	600	32000	600	32000	520	32000	500	32000	320	32000	255
0 25	32000	750	32000	650	32000	620	32000	600	32000	400	32000	320
0 3	32000	900	32000	700	32000	700	32000	640	32000	480	32000	380
0 4	32000	1200	32000	1000	32000	920	32000	850	32000	640	25000	400
0 5	32000	1500	32000	1250	32000	1150	32000	1000	32000	800	20000	400
0 75	32000	2200	32000	1600	32000	1700	29500	1400	25500	950	13500	400
1	32000	2900	28500	2100	25000	1800	22000	1400	19000	950	10000	400
1 5	21000	2900	19000	2100	17000	1800	14500	1400	12500	950	6800	400
2	16000	2900	14000	2100	12500	1800	11000	1400	9500	950	5000	400
Depth of cut	a _p	0.05D (R < 0.5) 0.1D (R ≥ 0.5)								0.05D		
	P _f	0.2D								0.1D		

High Speed Condition

Work Material	SC, FC Carbon Steels, Cast Irons		SCM, SKD Alloy Steels, Mold Steels		30~38HRC Hardened Steels, Pre-Hardened Steels 30~38HRC		38~45HRC Stainless Steels, Hardened Steels 38~45HRC		45~55HRC Hardened Steels 45~55HRC		55~60HRC Hardened Steels 55~60HRC	
	Rotation min ⁻¹	Feed mm/min	Rotation min ⁻¹	Feed mm/min	Rotation min ⁻¹	Feed mm/min	Rotation min ⁻¹	Feed mm/min	Rotation min ⁻¹	Feed mm/min	Rotation min ⁻¹	Feed mm/min
Milling Conditions												
R Ball Radius(mm)												
0 1	60000	600	60000	600	60000	560	60000	480	48000	240	48000	180
0 15	60000	900	60000	900	60000	840	60000	700	48000	360	48000	280
0 2	60000	1100	60000	1100	60000	1000	60000	940	48000	480	48000	380
0.25	60000	1200	60000	1200	60000	1150	60000	1100	48000	600	48000	480
0 3	60000	1400	60000	1400	60000	1300	60000	1200	48000	720	48000	570
0 4	60000	1900	60000	1900	60000	1700	60000	1600	48000	960	48000	750
0 5	60000	2350	60000	2350	60000	2150	60000	1900	48000	1200	48000	950
0 75	60000	3000	60000	3000	55000	2900	51000	2400	42500	1600	32000	950
1	48000	4350	45000	3300	41500	2900	38000	2400	32000	1600	24000	950
1 5	32000	4350	30000	3300	27500	2900	25000	2400	21000	1600	16000	950
2	24000	4350	22000	3300	20500	2900	19000	2400	16000	1600	12000	950
Depth of cut	a _p	0.05D										
	P _f	0.1D										

D: Dia. of Mill
R: Ball Radius



1. When using Long Neck Type End Mills, reduce the feed to 40% of table values.
2. Use in wet condition in case of Stainless Steels.
3. When using low speed machines, use the maximum speed and adjust the feed rate.
4. Adjust milling condition when unusual vibration, different sound occur by cutting.

FRESAS DE TOPO ESFÉRICO - LONG NECK - 2 CORTES

Conventional Condition

Work Material			150~250HB Carbon Steels, Alloy Steels 150~250HB		25~35HRC Stainless Steels, Mold Steels 25~35HRC		35~45HRC Pre-hardened Steels 35~45HRC		45~55HRC Hardened Steels 45~55HRC	
			Rotation min ⁻¹	Feed mm/min	Rotation min ⁻¹	Feed mm/min	Rotation min ⁻¹	Feed mm/min	Rotation min ⁻¹	Feed mm/min
Milling Conditions										
Ball Radius mm	Dia. of Mill mm	Effective Length								
0 2	0 4	1	50000	900	50000	810	50000	720	50000	500
0 2	0 4	1 5	50000	900	50000	810	50000	720	50000	500
0 2	0 4	2	50000	800	50000	810	50000	640	50000	500
0 2	0 4	2 5	50000	800	50000	740	50000	640	50000	500
0 2	0 4	3	50000	800	50000	740	50000	640	50000	500
0 2	0 4	4	50000	800	50000	740	50000	640	50000	500
0 2	0 4	5	48000	480	46000	420	50000	350	50000	500
0 25	0 5	2	50000	1100	50000	990	45000	770	32000	500
0 25	0 5	4	50000	1100	50000	990	40000	700	29000	450
0 25	0 5	5	50000	1100	40000	790	40000	700	29000	450
0 25	0 5	6	50000	1100	40000	790	31000	540	29000	450
0 3	0 6	2	50000	1300	48000	1110	37000	780	27000	520
0 3	0 6	3	50000	1300	46000	1060	35000	740	25000	480
0 3	0 6	4	50000	1300	43000	990	33000	700	24000	460
0 3	0 6	5	42000	1090	38000	880	30000	630	24000	440
0 3	0 6	6	42000	1090	33000	760	26000	550	24000	440
0 4	0 8	2	48000	1750	36000	1180	28800	840	20000	500
0 4	0 8	4	48000	1750	36000	1180	28800	840	20000	500
0 4	0 8	5	40000	1460	30000	980	24000	700	18000	420
0 4	0 8	6	40000	1460	30000	980	24000	700	18000	420
0 4	0 8	7	32000	1120	24000	780	20000	560	18000	420
0 4	0 8	8	32000	1120	24000	780	20000	560	18000	420
0 4	0 8	10	24000	840	21000	680	18000	500	16000	380
0 5	1	3	38000	1710	29000	1160	22800	770	16000	480
0 5	1	4	38000	1710	29000	1160	22800	770	16000	480
0 5	1	5	38000	1710	29000	1160	22800	770	16000	480
0 5	1	6	32000	1440	24000	960	19200	650	14500	435
0 5	1	7	32000	1440	24000	960	19200	650	14500	435
0 5	1	8	32000	1440	24000	960	19200	650	14500	435
0 5	1	9	26000	1170	20000	800	15600	530	14500	435
0 5	1	10	26000	1170	20000	800	15600	530	13000	390
0 5	1	12	26000	1170	20000	800	15600	530	13000	390

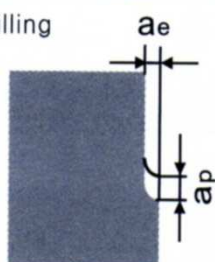
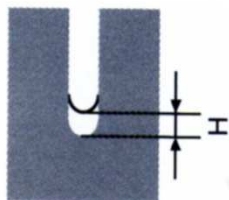
FRESAS DE TOPO ESFÉRICO - LONG NECK - 2 CORTES

Conventional Condition

Work Material			150~250HB Carbon Steels, Alloy Steels 150~250HB		25~35HRC Stainless Steels, Mold Steels 25~35HRC		35~45HRC Pre-hardened Steels 35~45HRC		45~55HRC Hardened Steels 45~55HRC	
			Rotation min ⁻¹	Feed mm/min	Rotation min ⁻¹	Feed mm/min	Rotation min ⁻¹	Feed mm/min	Rotation min ⁻¹	Feed mm/min
Milling Conditions										
Ball Radius mm	Dia. of Mill mm	Effective Length								
0.75	1.5	8	13200	680	8800	450	22000	1500	16500	1050
0.75	1.5	10	13200	680	8800	450	22000	1500	16500	1050
0.75	1.5	12	13200	680	8800	450	22000	1500	16500	1050
0.75	1.5	14	17000	1160	12750	810	10200	520	6800	350
0.75	1.5	16	17000	1160	12750	810	10200	520	6800	350
1	2	4	19000	1710	14250	1200	11400	770	7600	510
1	2	6	19000	1710	14250	1200	11400	770	7600	510
1	2	8	19000	1710	14250	1200	11400	770	7600	510
1	2	12	16000	1440	12000	1010	9600	650	6400	430
1	2	14	16000	1440	12000	1010	9600	650	6400	430
1	2	16	16000	1440	12000	1010	9600	650	6400	430
1	2	18	12800	1150	9600	810	7680	520	5120	350
1.5	3	8	12800	2180	9600	1530	7680	980	5120	650
1.5	3	10	12800	2180	9600	1530	7680	980	5120	650
1.5	3	16	10600	1800	7950	1260	6360	810	4240	540
1.5	3	20	10600	1800	7950	1260	6360	810	4240	540
2	4	10	10000	2200	7500	1540	6000	990	4000	660
2	4	16	10000	2200	7500	1540	6000	990	4000	660
2	4	20	10000	2200	7500	1540	6000	990	4000	660
2	4	25	8000	1760	6000	1230	4800	790	3200	530

Grooving

Side Milling



1. When corner processing, reduce the feed rate by approximately half.
2. Recommend non water soluble cutting fluid.
3. To achieve flute depth, sequential use of each neck length is most effective.
4. The run out of the end mill should be in 10 μ m after chucking.

FRESAS DE TOPO ESFÉRICO – 2 CORTES

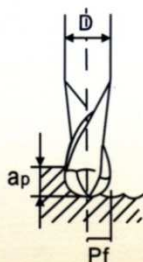
Conventional Condition

Work Material	SC, FC Carbon Steels, Cast Irons		SCM, SKD Alloy Steels, Mold Steels		30~38HRC Hardened Steels, Pre-Hardened Steels 30~38HRC		38~45HRC Stainless Steels, Hardened Steels 38~45HRC		45~55HRC Hardened Steels 45~55HRC		55~60HRC Hardened Steels 55~60HRC	
	Rotation min ⁻¹	Feed mm/min	Rotation min ⁻¹	Feed mm/min	Rotation min ⁻¹	Feed mm/min	Rotation min ⁻¹	Feed mm/min	Rotation min ⁻¹	Feed mm/min	Rotation min ⁻¹	Feed mm/min
Milling Conditions												
R Ball Radius(mm)												
0.5	32000	820	31000	620	25000	440	22000	330	19000	240	14000	130
1	16000	920	15000	680	13000	510	11000	380	9600	280	7200	160
2	8000	1000	7600	760	6400	560	5600	430	4800	310	3600	170
3	5300	1000	5100	770	4200	550	3700	420	3200	310	2400	170
5	3200	1000	3100	780	2500	550	2200	420	1900	300	1400	170
8	2000	920	1900	680	1600	510	1400	380	1200	280	900	160
10	1600	820	1500	600	1300	460	1100	330	960	250	720	140
Depth of cut												
a _p	0.05D (R < 0.5) 0.1D (R ≥ 0.5)								0.05D			
Pf	0.2D								0.1D			

High Speed Condition

Work Material	SC, FC Carbon Steels, Cast Irons		SCM, SKD Alloy Steels, Mold Steels		30~38HRC Hardened Steels, Pre-Hardened Steels 30~38HRC		38~45HRC Stainless Steels, Hardened Steels 38~45HRC		45~55HRC Hardened Steels 45~55HRC		55~60HRC Hardened Steels 55~60HRC	
	Rotation min ⁻¹	Feed mm/min	Rotation min ⁻¹	Feed mm/min	Rotation min ⁻¹	Feed mm/min	Rotation min ⁻¹	Feed mm/min	Rotation min ⁻¹	Feed mm/min	Rotation min ⁻¹	Feed mm/min
Milling Conditions												
R Ball Radius(mm)												
0.5	60000	3600	60000	3600	60000	3000	60000	3000	60000	2400	48000	1900
1	51000	5100	48000	4800	40000	3200	37000	3000	35000	2100	24000	1400
2	25000	5000	24000	4800	20000	3200	18000	2500	18000	2200	12000	1400
3	17000	4100	16000	3800	13000	2900	12000	2200	12000	1900	8000	1300
5	10200	3100	9600	2500	8000	1900	7300	1500	7000	1400	4800	960
8	6400	1900	6000	1800	5000	1200	4600	1000	4400	900	3000	600
10	5100	1600	4800	1400	4000	1000	3700	890	3500	700	2400	480
Depth of cut												
a _p	0.05D (R < 0.5) 0.5mm (R ≥ 0.5)											
Pf	0.1D								0.05D			

D: Dia. of Mill Mill
R: Ball Radius



1. When using Pencil Neck Type End Mills, reduce the feed to 70% of table values.
2. When using Long Shank Type End Mills, reduce milling condition according to its over hang length.
3. Use in wet condition in case of Stainless Steels.
4. When using low speed machines, use the maximum speed and adjust the feed rate.
5. Adjust milling condition when unusual vibration, different sound occur by cutting.

FRESAS DE TOPO ESFÉRICO - 4 CORTES

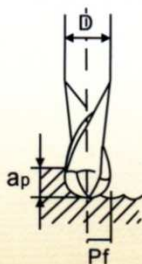
Conventional Condition

Work Material	SC, FC Carbon Steels, Cast Irons		SCM, SKD Alloy Steels, Mold Steels		30~38HRC Hardened Steels, Pre-Hardened Steels 30~38HRC		38~45HRC Stainless Steels, Hardened Steels 38~45HRC		45~55HRC Hardened Steels 45~55HRC		55~60HRC Hardened Steels 55~60HRC	
Milling Conditions	Rotation min ⁻¹	Feed mm/min	Rotation min ⁻¹	Feed mm/min	Rotation min ⁻¹	Feed mm/min	Rotation min ⁻¹	Feed mm/min	Rotation min ⁻¹	Feed mm/min	Rotation min ⁻¹	Feed mm/min
R Ball Radius(mm)												
0.5	32000	820	31000	620	25000	440	22000	330	19000	240	14000	130
1	16000	920	15000	680	13000	510	11000	380	9600	280	7200	160
2	8000	1000	7600	760	6400	560	5600	430	4800	310	3600	170
3	5300	1000	5100	770	4200	550	3700	420	3200	310	2400	170
5	3200	1000	3100	780	2500	550	2200	420	1900	300	1400	170
8	2000	920	1900	680	1600	510	1400	380	1200	280	900	160
10	1600	820	1500	600	1300	460	1100	330	960	250	720	140
15	1100	740	1000	530	850	390	700	280	640	220	480	120
Depth of cut	ap 0.05D (R < 0.5) 0.1D (R ≥ 0.5)								0.05D			
	Pf 0.2D								0.1D			

High Speed Condition

Work Material	SC, FC Carbon Steels, Cast Irons		SCM, SKD Alloy Steels, Mold Steels		30~38HRC Hardened Steels, Pre-Hardened Steels 30~38HRC		38~45HRC Stainless Steels, Hardened Steels 38~45HRC		45~55HRC Hardened Steels 45~55HRC		55~60HRC Hardened Steels 55~60HRC	
Milling Conditions	Rotation min ⁻¹	Feed mm/min	Rotation min ⁻¹	Feed mm/min	Rotation min ⁻¹	Feed mm/min	Rotation min ⁻¹	Feed mm/min	Rotation min ⁻¹	Feed mm/min	Rotation min ⁻¹	Feed mm/min
R Ball Radius(mm)												
0.5	60000	3600	60000	3600	60000	3000	60000	3000	60000	2400	48000	1900
1	51000	5100	48000	4800	40000	3200	37000	3000	35000	2100	24000	1400
2	25000	5000	24000	4800	20000	3200	18000	2500	18000	2200	12000	1400
3	17000	4100	16000	3800	13000	2900	12000	2200	12000	1900	8000	1300
5	10200	3100	9600	2500	8000	1900	7300	1500	7000	1400	4800	960
8	6400	1900	6000	1800	5000	1200	4600	1000	4400	900	3000	600
10	5100	1600	4800	1400	4000	1000	3700	890	3500	700	2400	480
15	3400	1100	3200	960	2700	650	2400	600	2300	460	1600	320
Depth of cut	ap 0.05D (R < 0.5) 0.5mm (R ≥ 0.5)								0.05D			
	Pf 0.1D								0.05D			

D: Dia. of Mill
R: Ball Radius

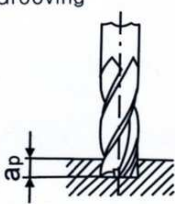


1. When using Pencil Neck Type End Mills, reduce the feed to 70% of table values.
2. When using Long Shank Type End Mills, reduce milling condition according to its over hang length.
3. Use in wet condition in case of Stainless Steels.
4. When using low speed machines, use the maximum speed and adjust the feed rate.
5. Adjust milling condition when unusual vibration, different sound occur by cutting.

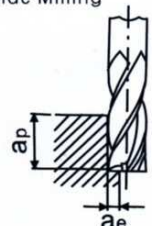
FRESAS DE TOPO COM RAIO – 2 CORTES

Work Material	SS,SC,FC150~250HB Structural Steels, Carbon Steels, Cast Irons 150~250HB		SCM,NAK,HPM25~35HRC Alloy Steels, Pre-Hardened Steels 25~35HRC		40~50HRC Hardened Steels 40~50HRC		SUS304,316 Stainless Steels		20~45HRC Nickel Alloys Titanium Alloys 20~45HRC	
	Milling Conditions									
Outside Diameter	Rotation min ⁻¹	Feed mm/min	Rotation min ⁻¹	Feed mm/min	Rotation min ⁻¹	Feed mm/min	Rotation min ⁻¹	Feed mm/min	Rotation min ⁻¹	Feed mm/min
2	9000	720	6000	430	4000	320	5500	320	2600	120
4	6600	800	4500	450	3000	380	4000	320	2000	120
6	4800	960	3000	480	2500	380	3000	480	1200	120
8	3600	1000	2200	610	2000	400	2000	520	1000	140
10	2800	1000	1800	610	1500	400	1700	550	800	160
12	2400	950	1500	550	1200	380	1500	500	700	140
	a _p	1 5D								
	a _e	0 1D			0 05D		0 1D		0 05D	
	a _p	1D			0 2D		0 3D		0 2D	

Grooving



Side Milling



1. Use highly rigid machining center(BT50).

2. When grooving Stainless Steels, reduce the rotation to 60%, and the feed to 40% of table values.

3. Use in wet condition in case of Stainless Steels, Nickel Alloys, Titanium Alloys.

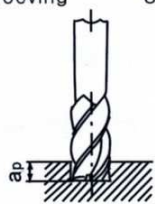
4. Adjust milling condition when unusual vibration, different sound occur by cutting.

FRESAS DE TOPO COM RAIO – 2 CORTES

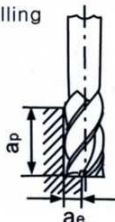
MÉDIA – LONGA

Work Material	SS,SC,FC150~250HB Structural Steels, Carbon Steels, Cast Irons 150~250HB		SCM,NAK,HPM25~35HRC Alloy Steels, Pre-Hardened Steels 25~35HRC		40~50HRC Hardened Steels 40~50HRC		SUS304,316 Stainless Steels		20~45HRC Nickel Alloys Titanium Alloys 20~45HRC		
	Rotation min ⁻¹	Feed mm/min	Rotation min ⁻¹	Feed mm/min	Rotation min ⁻¹	Feed mm/min	Rotation min ⁻¹	Feed mm/min	Rotation min ⁻¹	Feed mm/min	
Outside Diameter	3	8500	520	5500	300	3800	260	5000	220	2500	80
	4	6600	560	4500	320	3000	270	4000	220	2000	80
	6	4800	670	3000	340	2500	270	3000	340	1200	80
	8	3600	700	2200	430	2000	280	2000	360	1000	100
	10	2800	700	1800	430	1500	280	1700	390	800	110
	12	2400	670	1500	390	1200	270	1500	350	700	100
	ap	1 2D									
	ae	0 01D				0 05D		0 1D		0 05D	
	ap	0 05D				0 1D		0 2D		0 1D	

Grooving



Side Milling



1. Use highly rigid machining center(BT50).

2. When grooving Stainless Steels, reduce the rotation to 60%, and the feed to 40% of table values.

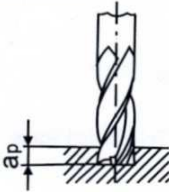
3. Use in wet condition in case of Stainless Steels, Nickel Alloys, Titanium Alloys.

4. Adjust milling condition when unusual vibration, different sound occur by cutting.

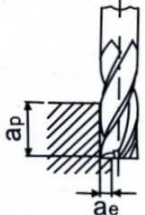
FRESAS DE TOPO COM RAIO – 4 CORTES

Work Material	SS,SC,FC150~250HB Structural Steels, Carbon Steels, Cast Irons 150~250HB		SCM,NAK,HPM25~35HRC Alloy Steels, Pre-Hardened Steels 25~35HRC		40~50HRC Hardened Steels 40~50HRC		SUS304,316 Stainless Steels		20~45HRC Nickel Alloys Titanium Alloys 20~45HRC	
	Milling Conditions									
Outside Diameter	Rotation min ⁻¹	Feed mm/min	Rotation min ⁻¹	Feed mm/min	Rotation min ⁻¹	Feed mm/min	Rotation min ⁻¹	Feed mm/min	Rotation min ⁻¹	Feed mm/min
2	9000	720	6000	430	4000	320	5500	320	2600	120
4	6600	800	4500	450	3000	380	4000	320	2000	120
6	4800	960	3000	480	2500	380	3000	480	1200	120
8	3600	1000	2200	610	2000	400	2000	520	1000	140
10	2800	1000	1800	610	1500	400	1700	550	800	160
12	2400	950	1500	550	1200	380	1500	500	700	140
	ap	1.5D								
	ae	0.1D			0.05D		0.1D		0.05D	
	ap	1D			0.2D		0.3D		0.2D	

Grooving



Side Milling



1. Use highly rigid machining center(BT50).

2. When grooving Stainless Steels, reduce the rotation to 60%, and the feed to 40% of table values.

3. Use in wet condition in case of Stainless Steels, Nickel Alloys, Titanium Alloys.

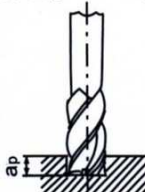
4. Adjust milling condition when unusual vibration, different sound occur by cutting.

FRESAS DE TOPO COM RAIO – 4 CORTES

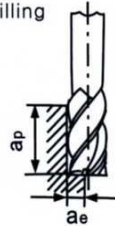
MÉDIA – LONGA

Work Material	SS,SC,FC150~250HB Structural Steels, Carbon Steels, Cast Irons 150~250HB		SCM,NAK,HPM25~35HRC Alloy Steels, Pre-Hardened Steels 25~35HRC		40~50HRC Hardened Steels 40~50HRC		SUS304,316 Stainless Steels		20~45HRC Nickel Alloys Titanium Alloys 20~45HRC			
	Rotation min ⁻¹	Feed mm/min	Rotation min ⁻¹	Feed mm/min	Rotation min ⁻¹	Feed mm/min	Rotation min ⁻¹	Feed mm/min	Rotation min ⁻¹	Feed mm/min		
Outside Diameter	3	4	6	8	10	12	3	4	6	8	10	12
	8500	6600	4800	3600	2800	2400	520	560	670	700	700	670
	5500	4500	3000	2200	1800	1500	300	320	340	430	430	390
	3800	3000	2500	2000	1500	1200	260	270	270	280	280	270
	5000	4000	3000	2000	1700	1500	220	220	340	360	390	350
	2500	2000	1200	1000	800	700	80	80	80	100	110	100
ap	1 2D											
	0 01D				0 05D		0 1D		0 05D			
	0.05D				0.1D		0.2D		0 1D			

Grooving



Side Milling



1. Use highly rigid machining center(BT50).

2. When grooving Stainless Steels, reduce the rotation to 60%, and the feed to 40% of table values.

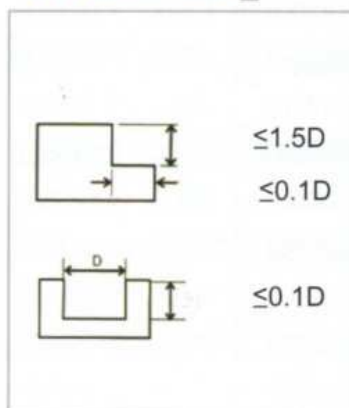
3. Use in wet condition in case of Stainless Steels, Nickel Alloys, Titanium Alloys.

4. Adjust milling condition when unusual vibration, different sound occur by cutting.

FRESAS DE TOPO RETO PARA ALUMÍNIO

2 CORTES

DEPTH OF CUT

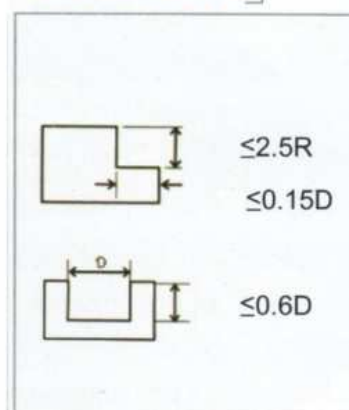


Material	Aluminum 1070		Aluminum alloy 2014/4032/5052/6061/7075		Aluminum alloy AC85	
DIAMETER	SPEED (mm-1)	FEED mm/min	SPEED (mm-1)	FEED mm/min	SPEED (mm-1)	FEED mm/min
2	37000	2000(800)	16000	850(350)	20000	1100(450)
3	35000	2000(900)	14000	850(450)	18000	1100(550)
4	26000	2000(1100)	11000	850(550)	13000	1100(660)
5	21000	2000(1100)	9000	850(550)	10000	1100(660)
6	17000	2000(1100)	7000	850(550)	9000	1100(660)
8	13000	2000(1100)	5500	850(650)	7000	1100(800)
10	11000	2000(1300)	7000	850(650)	5500	1100(800)
12	8800	2000(1300)	3600	850(800)	4500	1100(800)
16	6500	2000(1100)	3000	850(550)	3500	1100(900)
20	5300	2000(1100)	2200	850(550)	2500	1100(650)

FRESAS DE TOPO RETO PARA ALUMÍNIO

2 CORTES - LONGA

DEPTH OF CUT

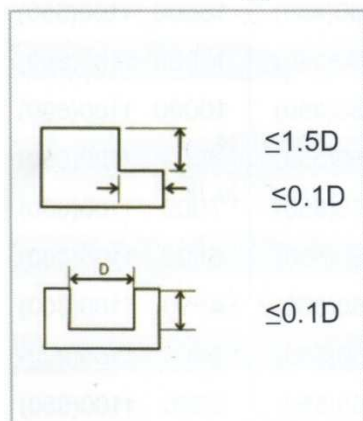


Material	Aluminum 1070		Aluminum alloy 2014/4032/5052/6061/7075		Aluminum alloy AC85	
DIAMETER	SPEED (mm-1)	FEED mm/min	SPEED (mm-1)	FEED mm/min	SPEED (mm-1)	FEED mm/min
2	37000	2000(800)	16000	850(350)	20000	1100(450)
3	35000	2000(900)	14000	850(450)	18000	1100(550)
4	26000	2000(1100)	11000	850(550)	13000	1100(660)
5	21000	2000(1100)	9000	850(550)	10000	1100(660)
6	17000	2000(1100)	7000	850(550)	9000	1100(660)
8	13000	2000(1100)	5500	850(650)	7000	1100(800)
10	11000	2000(1300)	7000	850(650)	5500	1100(800)
12	8800	2000(1300)	3600	850(800)	4500	1100(800)
16	6500	2000(1100)	3000	850(550)	3500	1100(900)
20	5300	2000(1100)	2200	850(550)	2500	1100(650)

FRESAS DE TOPO RETO PARA ALUMÍNIO

3 CORTES

DEPTH OF CUT

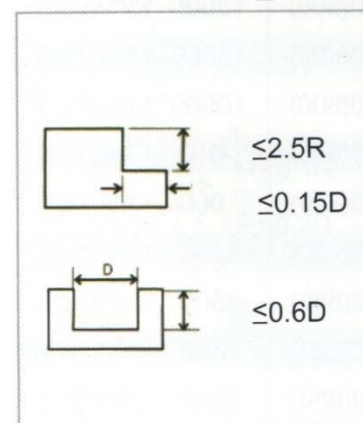


Material	Aluminum 1070		Aluminum alloy 2014/4032/5052/6061/7075		Aluminum alloy AC85	
DIAMETER	SPEED (mm-1)	FEED mm/min	SPEED (mm-1)	FEED mm/min	SPEED (mm-1)	FEED mm/min
2	37000	2400(950)	16000	1000(380)	20000	1300(500)
3	35000	2400(1050)	14000	1000(500)	18000	1300(600)
4	26000	2400(1200)	11000	1000(600)	13000	1300(720)
5	21000	2400(1200)	9000	1000(600)	10000	1300(720)
6	17000	2400(1200)	7000	1000(600)	9000	1300(720)
8	13000	2400(1200)	5500	1000(700)	7000	1300(880)
10	11000	2400(1400)	7000	1000(700)	5500	1300(880)
12	8800	2400(1400)	3600	1000(880)	4500	1300(880)
16	6500	2400(1200)	3000	1000(600)	3500	1300(1000)
20	5300	2400(1200)	2200	1000(600)	2500	1300(700)

FRESAS DE TOPO RETO PARA ALUMÍNIO

3 CORTES - LONGA

DEPTH OF CUT

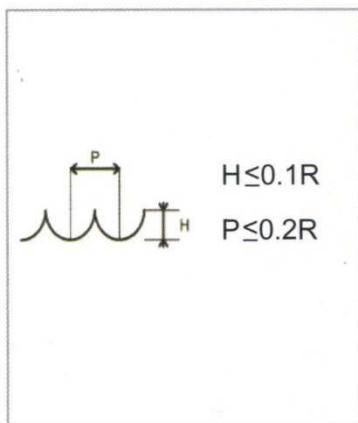


Material	Aluminum 1070		Aluminum alloy 2014/4032/5052/6061/7075		Aluminum alloy AC85	
DIAMETER	SPEED (mm-1)	FEED mm/min	SPEED (mm-1)	FEED mm/min	SPEED (mm-1)	FEED mm/min
2	37000	2400(950)	16000	1000(380)	20000	1300(500)
3	35000	2400(1050)	14000	1000(500)	18000	1300(600)
4	26000	2400(1200)	11000	1000(600)	13000	1300(720)
5	21000	2400(1200)	9000	1000(600)	10000	1300(720)
6	17000	2400(1200)	7000	1000(600)	9000	1300(720)
8	13000	2400(1200)	5500	1000(700)	7000	1300(880)
10	11000	2400(1400)	7000	1000(700)	5500	1300(880)
12	8800	2400(1400)	3600	1000(880)	4500	1300(880)
16	6500	2400(1200)	3000	1000(600)	3500	1300(1000)
20	5300	2400(1200)	2200	1000(600)	2500	1300(700)

FRESAS DE TOPO ESFÉRICO PARA ALUMÍNIO

2 CORTES

DEPTH OF CUT



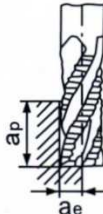
Material	Aluminum 1070		Aluminum alloy 2014/4032/5052/6061/7075		Aluminum alloy AC85	
RADIUS	SPEED (mm-1)	FEED mm/min	SPEED (mm-1)	FEED mm/min	SPEED (mm-1)	FEED mm/min
0.5	50000	2300	37000	2000	50000	1400
0.75	50000	3000	28000	2000	50000	1800
1	44000	4000	18500	2000	44000	2500
1.5	28000	4000	11500	2000	28000	2500
2	22000	4000	8800	2000	22000	2500
3	16000	4000	6400	2000	16000	2500
4	12000	4000	4800	2000	12000	2500
5	10000	4000	4000	2000	10000	2500
6	8000	4000	3200	2000	8000	2500

FRESAS DE TOPO PARA DESBASTE

Side Milling

Work Material		SS,SC,FC150~250HB Structural Steels, Carbon Steels 150~250HB		FC, FCD Cast Irons		SCM,NAK,HPM25~35HRC Alloy Steels, Pre-Hardened Steels 25~35HRC		45~55HRC Hardened Steels 45~55HRC		SUS304,316 Stainless Steels		NickelAlloys TitaniumAlloys	
		Rotation min ⁻¹	Feed mm/min	Rotation min ⁻¹	Feed mm/min	Rotation min ⁻¹	Feed mm/min	Rotation min ⁻¹	Feed mm/min	Rotation min ⁻¹	Feed mm/min	Rotation min ⁻¹	Feed mm/min
Milling Conditions													
Outside Diameter													
6	4800	800	5300	890	4200	510	270	290	3200	230	1600	110	
8	3600	800	4000	890	3200	510	2000	290	2400	230	1200	110	
10	2800	800	3200	890	2500	510	1600	290	1900	230	950	110	
12	2400	800	2700	890	2100	510	1300	290	1600	230	800	110	
16	1800	740	2000	830	1600	460	1000	250	1200	190	600	110	
20	1400	700	1600	780	1300	410	800	220	950	150	480	80	
	a _p	1 5D						1 0D		1 5D		1 0D	
	a _e	0 3D						0 02D		0 2D		0 1D	
	a _p	1 0D						0 6D		1 5D		0 6D	
	a _e	0 05D				0 03D		0 01D		0 02D		0 01D	

Side Milling



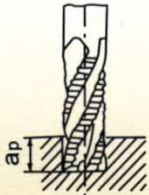
*1.It is depth of the cut when it used the #30 taper spindle machining center.

1.Use highly rigid machining center and holder.

2.Grooving is not recommended use in #30 taper spindle machining center.

3.Use in wet condition in case of Stainless Steels, Nickel Alloys, Titanium Alloys.

Grooving

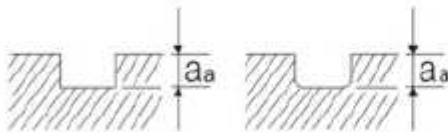
Work Material		SS,SC,FC150~250HB Structural Steels, Carbon Steels 150~250HB		FC, FCD Cast Irons		SCM,NAK,HPM25~35HRC Alloy Steels, Pre-Hardened Steels 25~35HRC		45~55HRC Hardened Steels 45~55HRC		SUS304,316 Stainless Steels		Nickel Alloys Titanium Alloys	
		Milling Conditions											
Outside Diameter		Rotation min ⁻¹	Feed mm/min	Rotation min ⁻¹	Feed mm/min	Rotation min ⁻¹	Feed mm/min	Rotation min ⁻¹	Feed mm/min	Rotation min ⁻¹	Feed mm/min	Rotation min ⁻¹	Feed mm/min
6		3700	620	4200	710	3200	380	1900	200	2700	190	1100	80
8		2800	620	3200	710	2400	380	1400	200	2000	190	800	80
10		2200	620	2600	710	1900	380	1100	200	1600	190	650	80
12		1900	620	2100	710	1600	380	900	200	1300	190	550	80
16		1400	580	1600	660	1200	340	700	180	1000	160	400	60
20		1100	540	1300	620	950	300	550	160	800	130	320	50
ap		0 7D						0 2D		0 3D		0 2D	
Grooving		 1. Use highly rigid machining center and holder. 2. Grooving is not recommended use in #30 taper spindle machining center. 3. Use in wet condition in case of Stainless Steels, Nickel Alloys, Titanium Alloys.											

FRESAS DE TOPO RETO – 2 CORTES - NACO

Side Milling & Grooving

WORK MATERIAL	MILD STEELS CARBON STEELS CAST IRON SS400,S55C,FC250 (~750N/mm ²)		ALLOY STEELS TOOL STEELS SCM,SKT,SKS,SKD (~30HRC)		HARDENED STEELS PREHARDENED STEELS (FREE-CUTTING) SKT,SKD,NAK55,HPM1 (30~38HRC)		HARDENED STEELS (55~60HRC)		STAINLESS STEELS HARDENED STEELS SUS304,SKD (38~45HRC)		HARDENED STEELS HEAT RESISTANT ALLOY STEELS (45~55HRC)	
MILL DIA. (mm)	SPEED (min ⁻¹)	FEED (mm/min)	SPEED (min ⁻¹)	FEED (mm/min)	SPEED (min ⁻¹)	FEED (mm/min)	SPEED (min ⁻¹)	FEED (mm/min)	SPEED (min ⁻¹)	FEED (mm/min)	SPEED (min ⁻¹)	FEED (mm/min)
0.2	32,000	125	32,000	115	32,000	100	24,500	30	32,000	90	32,000	60
0.3	32,000	190	32,000	170	32,000	150	18,000	40	32,000	135	32,000	90
0.4	32,000	250	32,000	230	32,000	200	14,000	40	32,000	180	32,000	120
0.5	32,000	320	32,000	290	32,000	250	12,000	40	32,000	225	26,000	130
0.6	32,000	380	32,000	345	32,000	310	10,500	40	27,500	250	22,000	130
0.7	32,000	440	32,000	400	32,000	340	9,620	42	27,500	260	22,000	130
0.8	32,000	512	32,000	460	29,000	370	8,750	45	22,000	280	17,500	130
0.9	32,000	550	32,000	470	29,000	380	8,175	47	20,500	290	15,700	130
1	30,000	600	27,000	480	25,000	400	7,600	50	19,000	300	14,000	130
1.5	21,000	630	19,000	510	16,500	400	5,700	60	12,500	300	9,500	130
2	15,500	630	14,000	510	12,500	400	4,750	65	9,500	300	7,150	130
2.5	12,500	630	11,000	510	10,000	400	3,800	65	7,600	300	5,700	130
3	10,000	660	8,600	540	8,000	420	3,000	70	6,000	310	4,500	140
3.5	8,000	660	6,700	540	6,400	420	2,350	70	4,700	310	3,550	140
4	6,400	660	5,200	540	5,100	420	1,800	70	3,650	310	2,800	140
DEPTH OF CUT												
			a_a				a_a				a_a	
	$D < \phi 1$		0.1D		$D < \phi 1$		0.01D		$D < \phi 1$		0.02D	
	$\phi 1 \leq D$		0.3D		$\phi 1 \leq D$		0.02D		$\phi 1 \leq D$		0.05D	

Grooving



1. Use a rigid and precise machine and holder.
2. When chattering occurs, reduce the speed and feed simultaneously.
3. Use a suitable cutting fluid with high smoke retardant properties.

FRESAS DE TOPO RETO - 2 CORTES - NACO

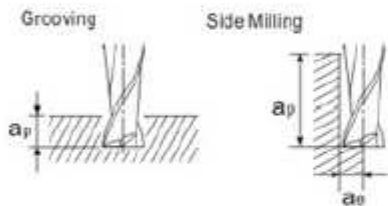
Conventional Milling

Work Material	Carbon Steels, Cast Irons (150~250HB)		Alloy Steels (25~35HRC)		Hardened Steels (35~45HRC)		Hardened Steels (45~55HRC)		Stainless Steels (SUS304,316)		Nickel Alloys, Titanium Alloys	
	Rotation min ⁻¹	Feed mm/min	Rotation min ⁻¹	Feed mm/min	Rotation min ⁻¹	Feed mm/min	Rotation min ⁻¹	Feed mm/min	Rotation min ⁻¹	Feed mm/min	Rotation min ⁻¹	Feed mm/min
Milling Conditions												
D mm												
1	13,900	250	13,100	180	9,140	90	6,670	55	6,670	60	4,120	35
1.5	12,500	295	11,760	210	8,170	110	5,950	65	5,950	75	3,690	40
2	11,200	340	10,500	240	7,300	130	5,300	80	5,300	90	3,300	50
2.5	10,000	370	9,370	260	6,520	140	4,720	85	4,720	100	2,950	55
3	8,800	400	8,250	280	5,750	150	4,150	95	4,150	110	2,600	60
3.5	7,600	430	7,120	300	4,970	160	3,570	100	3,570	120	2,250	65
4	6,400	460	6,000	320	4,200	180	3,000	110	3,000	130	1900	70
4.5	5,950	480	5,570	330	3,900	180	2,800	110	2,800	135	1770	72
5	5,500	500	5,150	350	3,600	190	2,600	120	2,600	140	1650	75
5.5	5,050	520	4,720	370	3,300	200	2,400	125	2,400	145	1520	77
6	4,600	550	4,300	390	3,000	210	2,200	130	2,200	150	1,400	80
6.5	4,600	550	4,300	390	3,000	210	2,200	130	2,200	150	1,400	80
7	4,600	550	4,300	390	3,000	210	2,200	130	2,200	150	1,400	80
7.5	4,600	550	4,300	390	3,000	210	2,200	130	2,200	150	1,400	80
8	3,400	550	3,200	390	2,200	210	1,600	130	1,600	150	1,000	80
8.5	3,400	550	3,200	390	2,200	210	1,600	130	1,600	150	1,000	80
9	3,400	550	3,200	390	2,200	210	1,600	130	1,600	150	1,000	80
9.5	3,400	550	3,200	390	2,200	210	1,600	130	1,600	150	1,000	80
Side Milling	ap	1.5D					1D		1.5D		1D	
	ae	0.1D			0.05D		0.02D		0.1D		0.05D	
Grooving	ap	0.5D			0.3D		0.05D		0.5D		0.05D	

FRESAS TOPO RETO - 2 CORTES - NACO

Conventional Milling

Work Material	Carbon Steels, Cast Irons (150-250HB)		Alloy Steels (25-35HRC)		Hardened Steels (35-45HRC)		Hardened Steels (45-55HRC)		Stainless Steels (SUS304,316)		Nickel Alloys, Titanium Alloys	
	Rotation min ⁻¹	Feed mm/min	Rotation min ⁻¹	Feed mm/min	Rotation min ⁻¹	Feed mm/min	Rotation min ⁻¹	Feed mm/min	Rotation min ⁻¹	Feed mm/min	Rotation min ⁻¹	Feed mm/min
Milling Conditions												
D mm												
10	2,800	560	2,600	390	1,800	210	1,300	130	1,300	150	800	80
11	2,800	560	2,600	390	1,800	210	1,300	130	1,300	150	800	80
12	2,300	560	2,200	400	1,500	210	1,100	130	1,100	150	700	80
13	2,300	560	2,200	400	1,500	210	1,100	130	1,100	150	700	80
14	2,300	560	2,200	400	1,500	210	1,100	130	1,100	150	700	80
15	1,700	450	1,600	320	1,100	180	800	100	800	110	500	60
16	1,700	450	1,600	320	1,100	180	800	100	800	110	500	60
17	1,700	450	1,600	320	1,100	180	800	100	800	110	500	60
18	1,700	450	1,600	320	1,100	180	800	100	800	110	500	60
19	1,350	380	1,300	280	900	160	650	90	650	100	400	50
20	1,350	380	1,300	280	900	160	650	90	650	100	400	50
22	1,150	320	1,160	240	810	140	580	80	580	90	350	40
25	920	260	970	200	690	120	490	70	490	80	290	30
Side Milling	a _p	1.5D				1D		1.5D		1D		
	a _e	0.1D				0.05D		0.02D		0.1D		
Grooving	a _p	0.5D				0.3D		0.05D		0.5D		



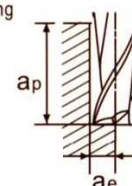
1. When using low speed machines, use the maximum speed and adjust the feed rate.
2. In grooving stainless steels, reduce the rotation to 60% of table values and feed to 40% of table values.
3. Use in wet-condition in case of Stainless Steels, Nickel Alloys and Titanium Alloys.
4. Adjust milling condition when an unusual vibration, different sound occur by cutting.

FRESAS DE TOPO RETO – 4 CORTES - NACO

High-Speed Milling

Work Material	Carbon Steels, Cast Irons (150~250HB)		Alloy Steels (25~35HRC)		Hardened Steels (35~45HRC)		Hardened Steels (45~55HRC)		Stainless Steels (SUS304,316)	
	Rotation min ⁻¹	Feed mm/min	Rotation min ⁻¹	Feed mm/min	Rotation min ⁻¹	Feed mm/min	Rotation min ⁻¹	Feed mm/min	Rotation min ⁻¹	Feed mm/min
Milling Conditions										
D mm										
1	47,800	2,200	47,800	1,600	39,800	1,200	31,800	900	15,900	400
1.5	47,800	2,200	47,800	1,600	39,800	1,200	31,800	900	15,900	400
2	47,800	2,200	47,800	1,600	39,800	1,200	31,800	900	15,900	400
2.5	41,800	2,200	41,800	1,600	34,800	1,200	27,800	900	19,900	400
3	35,850	2,600	35,850	1,800	29,800	1,400	23,800	1,100	23,900	490
3.5	29,800	2,600	29,800	1,800	24,800	1,400	19,800	1,100	15,900	490
4	23,900	2,600	23,900	1,800	19,900	1,400	15,900	1,100	8,000	490
5	19,900	2,600	19,900	1,800	16,600	1,400	13,200	1,100	6,600	490
6	16,000	2,700	16,000	2,000	13,300	1,500	10,600	1,200	5,300	510
7	14,000	2,700	14,000	2,000	11,600	1,500	9,300	1,200	4,600	510
8	12,000	2,700	12,000	2,000	10,000	1,500	8,000	1,200	4,000	520
9	10,800	2,700	10,800	2,000	9,000	1,500	7,200	1,200	3,600	520
10	9,600	2,700	9,600	2,000	8,000	1,500	6,400	1,200	3,200	520
11	8,800	2,700	8,800	2,000	7,000	1,500	5,800	1,200	2,900	520
12	8,000	2,700	8,000	2,000	6,700	1,500	5,300	1,200	2,700	520
13	7,500	2,200	7,500	1,600	6,200	1,200	4,900	900	2,500	450
14	7,000	2,200	7,000	1,600	5,800	1,200	4,600	900	2,300	450
15	6,500	2,200	6,500	1,600	5,400	1,200	4,300	900	2,100	450
16	6,000	2,200	6,000	1,600	5,000	1,200	4,000	900	2,000	450
17	5,700	2,000	5,700	1,400	4,750	1,100	3,800	750	1,900	380
18	5,400	2,000	5,400	1,400	4,500	1,100	3,600	750	1,800	380
19	5,100	2,000	5,100	1,400	4,200	1,100	3,400	750	1,700	380
20	4,800	2,000	4,800	1,400	4,000	1,100	3,200	750	1,600	380
22	4,200	1,800	4,200	1,200	3,500	900	2,800	600	1,400	320
25	3,450	1,800	3,450	1,200	2,900	900	2,300	600	1,100	320
Depth of Cut	ap	1.5D					1D		1.5D	
	ae	0.05D					0.02D		0.05D	

Side Milling



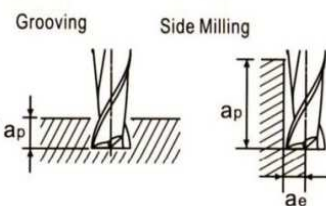
1. When using low speed machines, use the maximum speed and adjust the feed rate.
2. In grooving stainless steels, reduce the rotation to 60% of table values and feed to 40% of table values.
3. Use in wet-condition in case of Stainless Steels, Nickel Alloys and Titanium Alloys.
4. Adjust milling condition when an unusual vibration, different sound occur by cutting.

FRESAS DE TOPO RETO - 4 CORTES - NACO

Conventional Milling

Work Material	Carbon Steels, Cast Irons (150~250HB)		Alloy Steels (25~35HRC)		Hardened Steels (35~45HRC)		Hardened Steels (45~55HRC)		Stainless Steels (SUS304,316)		Nickel Alloys, Titanium Alloys	
	Milling Conditions	D mm	Rotation min ⁻¹	Feed mm/min	Rotation min ⁻¹	Feed mm/min	Rotation min ⁻¹	Feed mm/min	Rotation min ⁻¹	Feed mm/min	Rotation min ⁻¹	Feed mm/min
			Rotation min ⁻¹	Feed mm/min	Rotation min ⁻¹	Feed mm/min	Rotation min ⁻¹	Feed mm/min	Rotation min ⁻¹	Feed mm/min	Rotation min ⁻¹	Feed mm/min
1			16,200	450	15,100	290	10,800	180	7,500	110	7,400	100
1.5			14,400	450	13,500	290	9,500	180	6,700	110	6,700	100
2			12,800	570	12,000	380	8,300	230	6,000	150	6,000	130
2.5			11,300	570	10,600	380	7,300	230	5,300	150	5,300	130
3			9,800	570	9,200	380	6,350	230	4,600	150	4,600	130
3.5			8,300	570	7,800	380	5,300	230	3,900	150	3,900	130
4			6,800	730	6,400	490	4,400	300	3,200	200	3,200	170
5			5,700	730	5,300	490	3,700	300	2,700	200	2,700	170
6			4,600	770	4,300	520	3,000	320	2,200	210	2,200	180
7			4,000	770	3,700	520	2,600	320	1,900	210	1,900	180
8			3,400	770	3,200	520	2,200	320	1,600	210	1,600	180
9			3,100	770	2,900	520	2,000	320	1,450	210	1,450	180
10			2,800	780	2,600	520	1,800	320	1,300	210	1,300	180
11			2,500	780	2,400	530	1,650	320	1,200	210	1,200	180
12			2,300	780	2,200	530	1,500	320	1,100	210	1,100	180
13			2,150	780	2,050	530	1,400	320	1,000	210	1,020	180
14			2,000	780	1,900	530	1,300	320	950	210	950	180
15			1,850	650	1,750	420	1,200	280	1,750	170	870	150
16			1,700	650	1,600	420	1,100	280	800	170	800	150
17			1,600	650	1,500	420	1,050	280	760	170	760	150
18			1,500	650	1,450	420	1,000	280	720	170	720	150
19			1,400	650	1,350	420	950	280	680	170	680	140
20			1,350	600	1,300	380	900	260	650	150	650	140
22			1,200	600	1,100	380	800	260	580	150	580	140
25			1,000	600	850	380	650	260	490	150	490	140
Side Milling	a _p		1.5D				1D		1.5D		1D	
	a _e		0.1D				0.05D		0.02D		0.1D	
	a _p		0.5D				0.2D		0.05D		0.3D	
Grooving	a _p		0.5D				0.2D		0.05D		0.3D	

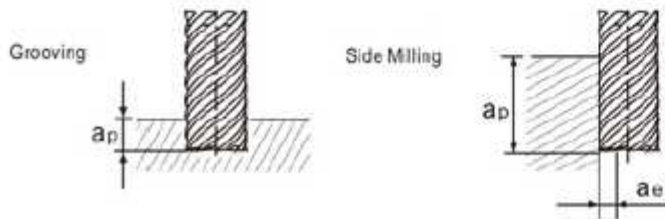
1. When using low speed machines, use the maximum speed and adjust the feed rate.
2. In grooving stainless steels, reduce the rotation to 60% of table values and feed to 40% of table values.
3. Use in wet-condition in case of Stainless Steels, Nickel Alloys and Titanium Alloys.
4. Adjust milling condition when an unusual vibration, different sound occur by cutting.



FRESAS DE TOPO RETO – 6 e 8 CORTES - NACO

Conventional Milling

Work Material	Carbon Steels, Cast irons (150~250HB)		Alloy Steels (25~35HRC)		Hardened Steels (35~45HRC)		Hardened Steels (45~55HRC)		Stainless Steels (SUS304,316)		Nickel Alloys, Titanium Alloys	
	Rotation min ⁻¹	Feed mm/min	Rotation min ⁻¹	Feed mm/min	Rotation min ⁻¹	Feed mm/min	Rotation min ⁻¹	Feed mm/min	Rotation min ⁻¹	Feed mm/min	Rotation min ⁻¹	Feed mm/min
Milling Conditions												
D mm												
3	15,000	2,150	13,400	1,540	10,400	1,050	8,200	650	7,400	540	5,200	380
4	11,200	2,400	10,000	1,740	7,800	1,180	6,100	730	5,600	600	3,900	420
5	9,000	2,700	8,000	1,930	6,200	1,300	4,900	810	4,400	670	3,100	470
6	7,500	2,700	6,700	1,930	5,200	1,300	4,100	810	3,700	670	2,600	470
8	5,600	2,700	5,000	1,930	3,900	1,300	3,050	810	2,800	670	1,950	470
10	4,500	2,700	4,000	1,930	3,100	1,300	2,450	810	2,200	670	1,550	470
12	3,750	2,700	3,350	1,930	2,600	1,300	2,050	810	1,850	670	1,300	470
16	2,800	2,500	2,500	1,800	1,950	1,220	1,530	760	1,400	630	980	440
20	2,250	2,100	2,000	1,540	1,550	1,050	1,230	650	1,100	540	780	380
25	1,350	1,700	1,100	1,200	900	880	700	540	650	450	460	320
Side Milling	a _p	1~1.5D										
	a _e	0.1D				0.05D				0.02D		
Grooving	a _p	0.1D				0.05D				~0.05D (max.) 0.5D		

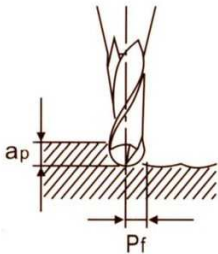


Adjust milling condition when unusual vibration, different sound occur by cutting.

FRESAS TOPO ESFÉRICO – 2 CORTES - NACO

High-Speed Milling

Work Material	Carbon Steels, Cast Irons (150~250HB)		Alloy Steels (25~35HRC)		Hardened Steels (35~45HRC)		Hardened Steels (45~55HRC)		Stainless Steels (SUS304,316)	
	Rotation min ⁻¹	Feed mm/min	Rotation min ⁻¹	Feed mm/min	Rotation min ⁻¹	Feed mm/min	Rotation min ⁻¹	Feed mm/min	Rotation min ⁻¹	Feed mm/min
Milling Conditions										
R mm										
0.5	66,000	2,100	51,500	1,300	46,000	960	30,600	640	46,000	960
0.75	58,500	2,100	45,600	1,300	40,100	960	27,000	640	40,100	960
1	51,000	2,100	39,800	1,300	35,700	960	23,700	640	35,700	960
1.25	44,500	2,700	34,900	1,700	31,000	1,300	20,600	830	31,000	1,300
1.5	38,000	2,700	30,000	1,700	26,000	1,300	17,500	830	26,000	1,300
2	25,500	2,700	19,900	1,700	17,900	1,300	11,900	830	17,900	1,300
2.5	21,000	3,000	16,400	1,900	14,700	1,400	9,700	920	14,700	1,400
3	17,000	3,000	13,300	1,900	11,900	1,400	7,900	920	11,900	1,400
4	12,800	3,100	10,000	2,000	9,000	1,500	6,000	960	9,000	1,500
5	10,200	3,100	8,000	2,000	7,200	1,500	4,800	960	7,200	1,500
6	8,500	3,100	6,700	2,000	6,000	1,500	4,000	960	6,000	1,500
8	7,000	3,100	5,500	2,000	4,900	1,500	3,200	960	4,900	1,500
10	5,900	3,100	4,600	2,000	4,100	1,500	2,600	960	4,100	1,500
Depth of Cut	a _p	0.05D					0.02D		0.05D	
	P _f	0.1D					0.05D		0.1D	

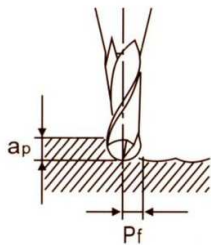


1. When using low speed machines, use the maximum speed and adjust the feed rate.
2. Use in wet-condition in case of Stainless Steels, Nickel Alloys and Titanium Alloys.
3. Adjust milling condition when an unusual vibration, different sound occur by cutting.

FRESAS DE TOPO ESFÉRICO – 2 CORTES - NACO

Conventional Milling

Work Material	Carbon Steels, Cast Irons (150~250HB)		Alloy Steels (25~35HRC)		Hardened Steels (35~45HRC)		Hardened Steels (45~55HRC)		Stainless Steels (SUS304,316)		Nickel Alloys, Titanium Alloys	
	Rotation min ⁻¹	Feed mm/min	Rotation min ⁻¹	Feed mm/min	Rotation min ⁻¹	Feed mm/min	Rotation min ⁻¹	Feed mm/min	Rotation min ⁻¹	Feed mm/min	Rotation min ⁻¹	Feed mm/min
Milling Conditions												
R mm												
0.5	24,000	770	16,000	370	12,700	270	11,100	190	11,100	210	8,000	120
0.75	21,500	770	14,400	370	11,400	270	9,900	190	9,900	210	7,200	120
1	19,100	770	12,800	370	10,200	270	8,900	190	8,900	210	6,400	120
1.25	17,000	1,100	11,400	550	9,000	400	7,900	280	7,900	310	5,700	180
1.5	14,900	1,100	10,000	550	7,900	400	6,900	280	6,900	310	5,000	180
2	10,800	1,100	7,200	550	5,700	400	5,000	280	5,000	310	3,600	180
2.5	9,200	1,300	6,200	660	4,900	480	4,300	330	4,300	380	3,100	210
3	7,700	1,300	5,200	660	4,100	480	3,600	330	3,600	380	2,600	210
4	6,000	1,400	4,000	700	3,200	510	2,800	360	2,800	400	2,000	230
5	4,800	1,400	3,200	700	2,600	520	2,300	370	2,300	410	1,600	230
6	4,000	1,400	2,700	710	2,200	530	1,900	370	1,900	410	1,400	240
8	2,600	1,500	1,700	720	1,400	540	1,200	380	1,200	420	900	250
10	1,700	1,600	1,100	730	900	550	800	390	800	430	600	260
Depth of Cut	a _p	0.1D				0.05D				0.1D		0.05D
	P _f	0.2D				0.1D				0.2D		0.1D



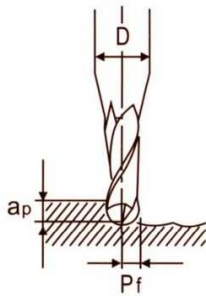
1. When using low speed machines, use the maximum speed and adjust the feed rate.
2. In grooving stainless steels, reduce the rotation to 60% of table values and feed to 40% of table values.
3. Use in wet-condition in case of Stainless Steels, Nickel Alloys and Titanium Alloys.
4. Adjust milling condition when an unusual vibration, different sound occur by cutting.

FRESAS DE TOPO ESFÉRICO LONGA – 2 CORTES

NACO

Conventional Milling

Work Material	Pre-Hardened Steels, Mold Steels (40~50HRC)		Hardened Steels (50~55HRC)		Hardened Steels (55~60HRC)		Hardened Steels (60~65HRC)	
	Rotation min^{-1}	Feed mm/min	Rotation min^{-1}	Feed mm/min	Rotation min^{-1}	Feed mm/min	Rotation min^{-1}	Feed mm/min
Milling Conditions								
R mm								
0.5	50,000	1,400	50,000	1,400	50,000	1,300	42,000	1,000
0.75	50,000	2,000	50,000	2,000	37,300	1,400	28,000	1,000
1	38,100	2,100	38,100	2,100	28,000	1,400	21,000	1,000
1.25	30,500	2,100	30,500	2,100	22,400	1,400	16,800	1,000
1.5	25,400	2,100	25,400	2,100	18,700	1,400	14,000	1,000
2	19,100	2,100	19,100	2,100	14,000	1,400	10,500	1,000
2.5	15,300	2,100	15,300	2,100	11,200	1,400	8,400	1,000
3	12,700	2,100	12,700	2,100	9,300	1,400	7,000	1,000
4	9,500	2,100	9,500	2,100	7,000	1,400	5,300	1,000
5	7,600	2,100	7,600	2,100	5,600	1,400	4,200	1,000
6	6,400	2,100	6,400	2,100	4,700	1,400	3,500	1,000
Depth of Cut	a_p	0.08D			0.05D			
	P_f	0.25D			0.15D			

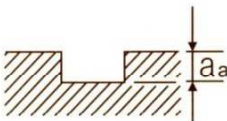


1. Recommend oil mist process.
2. When depth of the cut is small, can increase feed speed more.
3. When using low speed machines, use the maximum speed and adjust the feed rate.
4. Adjust milling condition when unusual vibration, different sound occur by cutting.

FRESAS DE TOPO COM RAIO – 4 CORTES

NACO

High-Speed Slotting

WORK MATERIAL	MILD STEELS CARBON STEELS, CAST IRON SS400,S55C,FC250 (~750N/mm ²)		ALLOY STEELS TOOL STEELS SCM,SKT,SKS,SKD (~30HRC)		HARDENED STEELS PREHARDENED STEELS SKT,SKD,NAK55,HPM1 (30~38HRC)		STAINLESS STEELS HARDENED STEELS SUS304,SKD (38~45HRC)	
MILL DIA. (mm)	SPEED (min ⁻¹)	FEED (mm/min)	SPEED (min ⁻¹)	FEED (mm/min)	SPEED (min ⁻¹)	FEED (mm/min)	SPEED (min ⁻¹)	FEED (mm/min)
1	16,600	545	15,200	490	13,200	420	10,200	275
2	13,300	655	12,100	590	10,600	515	8,100	330
3	10,600	765	9,600	690	8,500	610	6,400	385
4	8,400	875	7,600	790	6,800	705	5,000	440
5	7,000	980	6,400	895	5,700	800	4,100	490
6	6,100	950	5,600	875	5,000	780	3,600	475
8	4,800	920	4,400	845	4,000	780	2,800	450
10	3,800	920	3,500	840	3,200	780	2,200	440
12	3,200	920	2,900	840	2,700	780	1,900	450
DEPTH OF CUT	$\frac{a_a}{0.2D}$ $a_a \text{ Max}=3\text{mm}$ 							

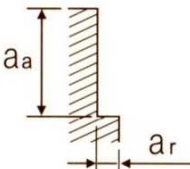
1. Use a rigid and precise machine and holder
 2. We suggest using an air blow or MQL (mist). For milling stainless steels, titanium alloys and heat resistant alloys, use a coolant with high smoke retardant properties.
 3. Please adjust the speed, feed and cutting depth according to actual cutting conditions.
 4. These milling conditions are for an end mill where the tool overhang length is less than 3XD (mill dia). When the tool overhang length is longer, please adjust the speed, feed and cutting depth.
- ※These milling conditions are for 4-flutes type. In case of 3-flutes type, please reduce the feed rate to 60-70%

FRESAS DE TOPO COM RAIO – 4 CORTES

NACO

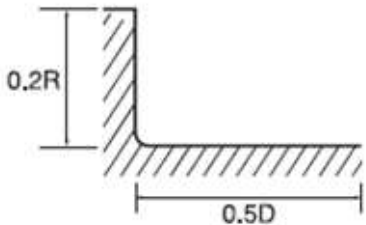
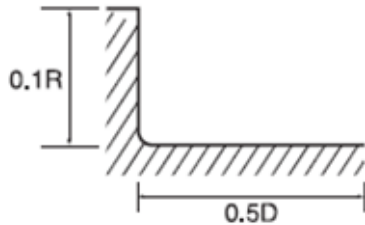
FRESAMENTO LATERAL

Side Milling

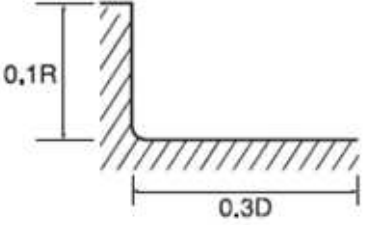
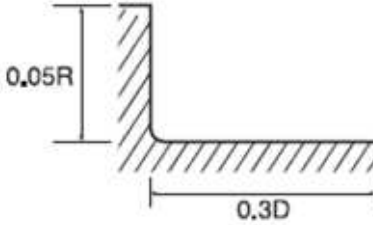
WORK MATERIAL	MILD STEELS CARBON STEELS CAST IRON SS400,S55C,FC250 (~750N/mm ²)		ALLOY STEELS TOOL STEELS SCM,SKT,SKS,SKD (~30HRC)		HARDENED STEELS PREHARDENED STEELS (FREE-CUTTING) SKT,SKD,NAK55,HPM1 (30~38HRC)		STAINLESS STEELS HARDENED STEELS SUS304,SKD (38~45HRC)		HARDENED STEELS HEAT RESISTANT ALLOY STEELS (45~55HRC)									
MILL DIA. (mm)	SPEED (min ⁻¹)	FEED (mm/min)	SPEED (min ⁻¹)	FEED (mm/min)	SPEED (min ⁻¹)	FEED (mm/min)	SPEED (min ⁻¹)	FEED (mm/min)	SPEED (min ⁻¹)	FEED (mm/min)								
1	6,600	400	4,600	180	4,200	220	2,600	55	2,100	35								
2	5,800	420	4,100	200	3,750	235	2,300	65	1,900	40								
3	5,000	440	3,500	220	3,250	235	2,000	65	1,650	40								
4	4,200	470	3,000	240	2,750	240	1,700	70	1,400	45								
5	3,600	490	2,650	250	2,400	240	1,500	70	1,250	45								
6	3,150	525	2,300	275	2,100	245	1,300	75	1,100	50								
8	2,350	470	1,750	315	1,550	250	995	80	835	55								
10	1,900	450	1,400	295	1,250	235	795	85	665	50								
12	1,550	415	1,150	275	1,050	215	660	75	555	50								
DEPTH OF CUT	<table><tr><td>a_a</td><td>a_r</td></tr><tr><td>2.5D</td><td>0.05D</td></tr></table> 								a _a	a _r	2.5D	0.05D	<table><tr><td>a_a</td><td>a_r</td></tr><tr><td>2.5D</td><td>0.02D</td></tr></table>		a _a	a _r	2.5D	0.02D
	a _a	a _r																
2.5D	0.05D																	
a _a	a _r																	
2.5D	0.02D																	

1. Use a rigid and precise machine and holder.
2. Adjust speeds and feeds according to cutting conditions, cutting depth, and rigidity of the machine.
3. Use a suitable cutting fluid with high smoke retardant properties.
4. For milling stainless steels and heat resistant alloy steels (e.g. INCONEL[®]), non water-soluble fluids are recommended.
5. When dry milling, use an air blow to avoid chip packing.

FRESAS DE TOPO ALTO AVANÇO

Conventional Milling										
Material	Hardened Steels ~40HRC		Hardened Steels 40~50HRC		Hardened Steels 50~60HRC		Hardened Steels 55~60HRC		Hardened Steels 60~65HRC	
Diameter	Rotation (RPM)	Feed (mm/min)	Rotation (RPM)	Feed (mm/min)	Rotation (RPM)	Feed (mm/min)	Rotation (RPM)	Feed (mm/min)	Rotation (RPM)	Feed (mm/min)
3xR0,5	9550	6500	6900	4150	4550	2750	2850	1150	1900	610
4xR0,5 4xR1,0	7950	7000	5750	4600	4000	3200	2250	1350	1750	700
5xR0,5 5xR1,0	6500	7300	4800	4800	3400	3200	2200	1600	1500	700
6xR0,5 6xR1,0 6xR1,5	5800	7650	4100	4900	2900	3500	1850	1850	1350	795
8xR0,5 8xR1,0 8xR1,5 8xR2,0	4350	7650	3050	4900	2200	3500	1400	1850	995	795
10xR0,5 10xR1,0 10xR1,5 10xR2,0	3500	7650	2450	4900	1750	3500	1100	1850	795	795
12xR0,5 12xR1,0 12xR1,5 12xR2,0	2900	7650	2050	4900	1450	3500	925	1850	665	795
										

FRESAS DE TOPO ALTO AVANÇO

High-Speed Milling										
Material	Hardened Steels ~40HRC		Hardened Steels 40~50HRC		Hardened Steels 50~60HRC		Hardened Steels 55~60HRC		Hardened Steels 60~65HRC	
Diameter	Rotation (RPM)	Feed (mm/min)	Rotation (RPM)	Feed (mm/min)	Rotation (RPM)	Feed (mm/min)	Rotation (RPM)	Feed (mm/min)	Rotation (RPM)	Feed (mm/min)
3xR0,5	22000	16000	17000	10000	12500	8000	9500	4600	6900	2500
4xR0,5 4xR1,0	17000	17500	13000	12000	11000	9200	8000	5500	5600	2900
5xR0,5 5xR1,0	15000	18000	11000	12500	10000	10000	7000	6000	4900	3100
6xR0,5 6xR1,0 6xR1,5	13500	18500	10500	13800	9000	11000	6400	6400	4500	3600
8xR0,5 8xR1,0 8xR1,5 8xR2,0	10000	18500	8000	14000	6800	11000	4800	6700	3400	4100
10xR0,5 10xR1,0 10xR1,5 10xR2,0	8000	18500	6400	14000	5400	11000	3800	6800	2700	3800
12xR0,5 12xR1,0 12xR1,5 12xR2,0	6600	18500	5300	14000	4500	11000	3200	7000	2250	3600
										

FÓRMULAS

Fz (mm) = Avanço por dente

$$Fz (mm) = \frac{Vf}{Z \times N} \text{ mm}$$

N (1/min) = Rotação

$$N = \frac{Vc \times 1000}{\pi \times \varnothing} \text{ 1min}$$

Vc (mm) = Velocidade de corte

$$Vc = \frac{\pi \times \varnothing \times N}{1000} \text{ 1 min}$$

Vf (mm/min) = Velocidade de avanço

$$Vf = Z \times N \times fz \text{ m/min.}$$

- Sugerimos avanço e velocidade de corte 50% menor no início da operação, aumentando gradualmente até que a estabilidade seja determinada;

- É recomendado o uso de sistemas de fixação de alta precisão e alta rigidez. A excentricidade não deve exceder 0,01mm.

