

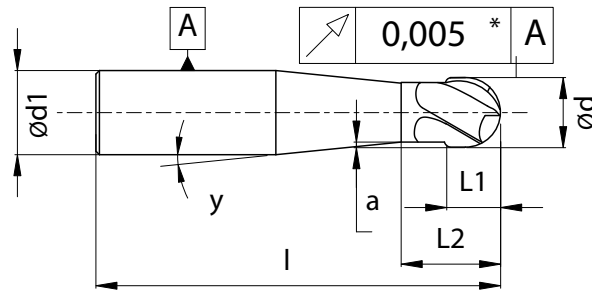


2 Flute

Centre cutting high performance ball nose 2 flute for 45-70 HRC



END MILLS



P3-P4

H1-H4

Unit : mm

Ød	r	Ød1	L	L1	L2	a	z	γ	EDP No
(mm)	(mm)	(mm)	(mm)	(mm)	(mm)	(mm)		(°)	
1	0.5	6	64	2	4	0.05	2	7	FBK0504478
1	0.5	6	78	2	4	0.05	2	4	FBK0504479
1.5	0.8	6	64	2	4	0.05	2	6	FBK0504480
1.5	0.8	6	78	2	4	0.05	2	4	FBK0504481
2	1.0	6	64	3	5	0.05	2	6	FBK0504482
2	1.0	6	64	3	8	0.05	2	9	FBK0505816
2	1.0	6	78	3	8	0.05	2	4	FBK0505817
2	1.0	6	78	3	15	0.05	2	5	FBK0504483
3	1.5	6	64	4	7	0.05	2	5	FBK0504484
3	1.5	6	78	4	15	0.05	2	4	FBK0504485
3	1.5	6	100	4	7	0.05	2	2	FBK0504486
4	2.0	6	64	5	8	0.1	2	4	FBK0504487
4	2.0	6	78	5	15	0.1	2	3	FBK0504488
4	2.0	6	100	5	8	0.1	2	1	FBK0504489
5	2.5	6	64	5	10	0.15	2	2	FBK0504490
5	2.5	6	78	5	20	0.15	2	2	FBK0504491
6	3.0	6	64	6	25	0.2	2	-	FBK0504492
6	3.0	6	78	6	35	0.2	2	-	FBK0504493
6	3.0	8	100	6	25	0.2	2	2	FBK0504494
8	4.0	8	64	8	25	0.3	2	-	FBK0504495
8	4.0	8	78	8	35	0.3	2	-	FBK0504496
8	4.0	8	100	8	50	0.3	2	-	FBK0504497
8	4.0	10	120	8	30	0.3	2	2	FBK0504498
10	5.0	10	78	10	35	0.3	2	-	FBK0504499
10	5.0	10	100	10	55	0.3	2	-	FBK0504500
10	5.0	12	120	10	30	0.3	2	2	FBK0504501
12	6.0	12	78	12	35	0.3	2	-	FBK0504502
12	6.0	12	100	12	55	0.3	2	-	FBK0504503
12	6.0	16	120	12	40	0.3	2	5	FBK0504504
16	8.0	16	100	20	50	0.3	2	-	FBK0504505
16	8.0	16	150	20	100	0.3	2	-	FBK0504506

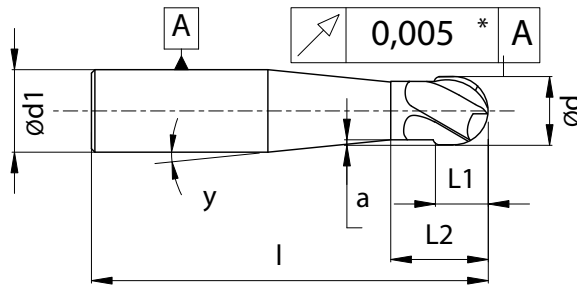
Application data on page no 2.025

4 Flute

Centre cutting high performance ball nose 4 flute for 45-70 HRc



END MILLS



P3-P4

H1-H4

Unit : mm

Ød (mm)	r (mm)	Ød1 (mm)	L (mm)	L1 (mm)	L2 (mm)	a (mm)	z	γ (°)	EDP No
6	3	6	64	6	25	0.2	4	-	FBK0504511
6	3	6	78	6	35	0.2	4	-	FBK0504512
6	3	8	100	6	25	0.2	4	2	FBK0504513
8	4	8	64	8	25	0.3	4	-	FBK0504514
8	4	8	78	8	35	0.3	4	-	FBK0504515
8	4	8	100	8	50	0.3	4	-	FBK0504516
8	4	10	120	8	30	0.3	4	2	FBK0504517
10	5	10	78	10	35	0.3	4	-	FBK0504518
10	5	10	100	10	55	0.3	4	-	FBK0504519
10	5	12	120	10	30	0.3	4	2	FBK0504520
12	6	12	78	12	35	0.3	4	-	FBK0504521
12	6	12	100	12	55	0.3	4	-	FBK0504522
12	6	16	120	12	40	0.3	4	5	FBK0504523
16	8	16	100	20	50	0.3	4	-	FBK0504524
16	8	16	150	20	100	0.3	4	-	FBK0504525

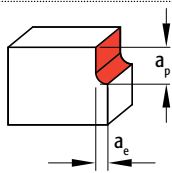


Cutting conditions

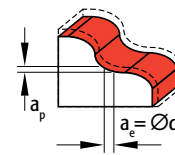
- Centre cutting high performance ball nose 2 flute for 45-70 HRc
- Centre cutting high performance ball nose 4 flute for 45-70 HRc

Material group	TSR	Hardness	Cutting speed	Coolant
	(N/mm ²)	HRc	Vc m/min	
P3	< 750	< 35 HRc	150 - 250	emulsion
P4	< 1000	< 35-48 HRc	120 - 200	emulsion
P4	< 1400	< 35 HRc	100 - 160	emulsion
H1		42-50 HRc	120 - 180	min.lub.
H2		50-55 HRc	150 - 200	min.lub.
H3		55-60 HRc	200 - 250	min.lub.
H4		60-70 HRc	200 - 250	min.lub.

Tips: Radial runout determines tool life- manufactured with precision tolerance



Roughing
P3 / P4



Finishing
P3 / P4

Ød (mm)	ap max. (mm)	ae max. (mm)	fz (mm/tooth)
1	< 1.0	< 0.30	0.015 - 0.025
1.5	< 1.5	< 0.45	0.020 - 0.030
2	< 2.0	< 0.60	0.025 - 0.035
3	< 3.0	< 0.90	0.028 - 0.040
4	< 4.0	< 1.20	0.030 - 0.045
5	< 5.0	< 1.50	0.035 - 0.050
6	< 6.0	< 1.80	0.040 - 0.055
8	< 8.0	< 2.40	0.050 - 0.065
10	< 10.0	< 3.00	0.055 - 0.080
12	< 12.0	< 3.60	0.065 - 0.090
16	< 16.0	< 4.80	0.075 - 0.110

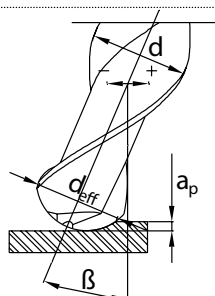
Roughing
H1 / H2 / H3 / H4

Ød (mm)	ap max. (mm)	ae max. (mm)	fz (mm/tooth)
1	< 1.0	< 0.10	0.020 - 0.030
1.5	< 1.5	< 0.15	0.025 - 0.040
2	< 2.0	< 0.20	0.030 - 0.050
3	< 3.0	< 0.30	0.040 - 0.060
4	< 4.0	< 0.40	0.050 - 0.080
5	< 5.0	< 0.50	0.060 - 0.110
6	< 6.0	< 0.60	0.065 - 0.125
8	< 8.0	< 0.80	0.080 - 0.130
10	< 10.0	< 1.00	0.085 - 0.135
12	< 12.0	< 1.20	0.100 - 0.140
16	< 16.0	< 1.60	0.120 - 0.160

Finishing
H1 / H2 / H3 / H4

Ød (mm)	ap max. (mm)	ae max. (mm)	fz (mm/tooth)
1	< 0.5	< 0.05	0.015 - 0.025
1.5	< 0.75	< 0.08	0.020 - 0.030
2	< 1.0	< 0.10	0.025 - 0.035
3	< 1.5	< 0.15	0.028 - 0.040
4	< 2.0	< 0.20	0.030 - 0.045
5	< 2.5	< 0.25	0.035 - 0.050
6	< 3.0	< 0.30	0.040 - 0.055
8	< 4.0	< 0.40	0.050 - 0.065
10	< 5.0	< 0.50	0.055 - 0.080
12	< 6.0	< 0.60	0.065 - 0.090
16	< 8.0	< 0.80	0.075 - 0.110

Ød (mm)	ap max. (mm)	ae max. (mm)	fz (mm/tooth)
1	< 0.5	< 0.02	0.020 - 0.030
1.5	< 0.75	< 0.03	0.025 - 0.040
2	< 1.0	< 0.04	0.030 - 0.050
3	< 1.5	< 0.06	0.040 - 0.060
4	< 2.0	< 0.08	0.050 - 0.080
5	< 2.5	< 0.10	0.060 - 0.110
6	< 3.0	< 0.12	0.065 - 0.125
8	< 4.0	< 0.16	0.080 - 0.130
10	< 5.0	< 0.20	0.085 - 0.135
12	< 6.0	< 0.24	0.100 - 0.140
16	< 8.0	< 0.32	0.120 - 0.160



For the cutting speed Vc calculation the effective cutting diameter d_{eff} has to be taken into account. See formula.

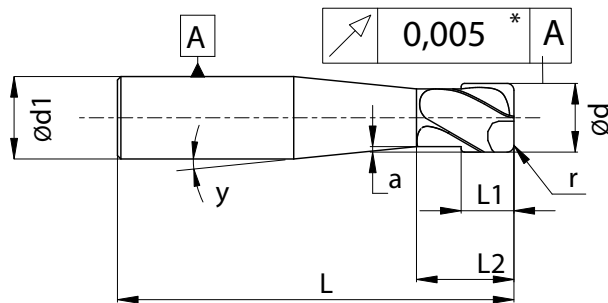
$$\beta \neq 0; \quad d_{eff} = d \times \sin \left[\beta \pm \arccos \left(\frac{d - 2a_p}{d} \right) \right]$$

2 Flute

Centre cutting high performance torus 2 flute for 45-70 HRc



END MILLS


P3-P4
H1-H4

Unit : mm

Ød	r	Ød1	L	L1	L2	a	z	γ	EDP No
(mm)	(mm)	(mm)	(mm)	(mm)	(mm)	(mm)		(°)	
1.5	0.3	6	64	2	5	0.05	2	7	FBK0504534
1.5	0.3	6	64	2	10	0.05	2	9	FBK0504535
2	0.5	6	64	3	5	0.05	2	6	FBK0504536
2	0.5	6	64	3	8	0.05	2	7	FBK0505818
2	0.5	6	64	3	10	0.05	2	8	FBK0504537
2	0.5	6	78	3	15	0.05	2	5	FBK0504538
2	0.5	6	78	3	8	0.05	2	4	FBK0505819
3	0.5	6	64	4	7	0.05	2	5	FBK0504539
3	0.5	6	78	4	15	0.05	2	4	FBK0504540
4	0.5	6	64	5	8	0.1	2	4	FBK0504541
4	1.0	6	64	5	8	0.1	2	4	FBK0504542
4	0.5	6	78	5	15	0.1	2	3	FBK0504543
4	1.0	6	78	5	15	0.1	2	3	FBK0504544
5	0.5	6	64	5	10	0.15	2	3	FBK0504545
5	1.0	6	64	5	10	0.15	2	3	FBK0504546
5	0.5	6	78	5	20	0.15	2	3	FBK0504547
5	1.0	6	78	5	20	0.15	2	2	FBK0504548
6	0.5	6	64	6	25	0.2	2	-	FBK0504549
6	1.0	6	64	6	25	0.2	2	-	FBK0504550
6	1.5	6	64	6	25	0.2	2	-	FBK0504551
6	0.5	6	78	6	35	0.2	2	-	FBK0504552
6	1.0	6	78	6	35	0.2	2	-	FBK0504553
6	1.5	6	78	6	35	0.2	2	-	FBK0504554
6	0.5	8	100	6	25	0.2	2	2	FBK0504555
6	1.0	8	100	6	25	0.2	2	2	FBK0504556

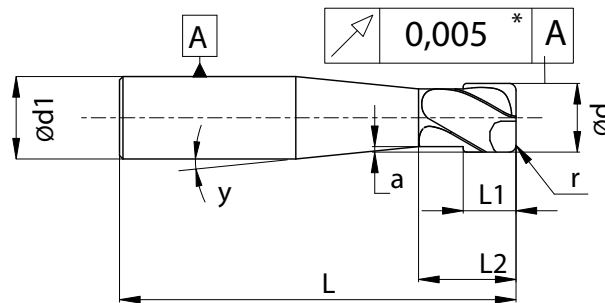


2 Flute

Centre cutting high performance
torus 2 flute for 45-70 HRc



END MILLS



P3-P4

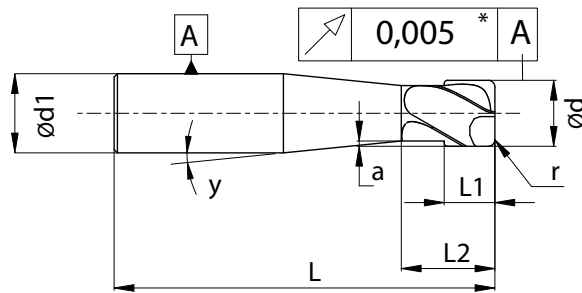
H1-H4

Unit : mm

Ød (mm)	r (mm)	Ød1 (mm)	L (mm)	L1 (mm)	L2 (mm)	a (mm)	z	y (°)	EDP No
6	1.5	8	100	6	25	0.2	2	2	FBK0504557
8	0.5	8	64	8	25	0.3	2	-	FBK0504558
8	1.0	8	64	8	25	0.3	2	-	FBK0504559
8	2.0	8	64	8	25	0.3	2	-	FBK0504560
8	0.5	8	78	8	25	0.3	2	-	FBK0504561
8	1.0	8	78	8	35	0.3	2	-	FBK0504562
8	2.0	8	78	8	35	0.3	2	-	FBK0504563
8	1.0	8	100	8	50	0.3	2	-	FBK0504564
8	2.0	8	100	8	50	0.3	2	-	FBK0504565
8	1.0	10	120	8	30	0.3	2	2	FBK0504566
8	2.0	10	120	8	30	0.3	2	2	FBK0504567
10	0.5	10	78	10	35	0.3	2	-	FBK0504568
10	1.0	10	78	10	35	0.3	2	-	FBK0504569
10	2.0	10	78	10	35	0.3	2	-	FBK0504570
10	1.0	10	100	10	55	0.3	2	-	FBK0504571
10	2.0	10	100	10	55	0.3	2	-	FBK0504572
10	2.0	12	120	10	30	0.3	2	2	FBK0504573
12	0.5	12	78	12	35	0.3	2	-	FBK0504574
12	2.0	12	78	12	35	0.3	2	-	FBK0504575
12	1.0	12	100	12	55	0.3	2	-	FBK0504576
12	2.0	12	100	12	55	0.3	2	-	FBK0504577
12	2.0	16	120	12	40	0.3	2	5	FBK0504578
16	3.5	16	100	20	50	0.3	2	-	FBK0504579
16	3.5	16	150	20	100	0.3	2	-	FBK0504580

4 Flute

Centre cutting high performance torus 4 flute for 45-70 HRc



P3-P4

H1-H4

Unit : mm

Ød (mm)	r (mm)	Ød1 (mm)	L (mm)	L1 (mm)	L2 (mm)	a (mm)	z	γ (°)	EDP No
3	0.5	6	64	4	7	0.05	4	5	FBK0505820
3	0.5	6	78	4	15	0.05	4	4	FBK0505821
4	0.5	6	64	5	8	0.1	4	4	FBK0505822
4	1.0	6	64	5	8	0.1	4	4	FBK0505823
4	0.5	6	78	5	15	0.1	4	3	FBK0505824
4	1.0	6	78	5	15	0.1	4	3	FBK0505825
5	0.5	6	64	5	10	0.15	4	2	FBK0505826
5	1.0	6	64	5	10	0.15	4	2	FBK0505827
5	0.5	6	78	5	20	0.15	4	2	FBK0505828
5	1.0	6	78	5	20	0.15	4	2	FBK0505829
6	0.5	6	64	6	25	0.2	4	-	FBK0504581
6	1.0	6	64	6	25	0.2	4	-	FBK0504582
6	1.5	6	64	6	25	0.2	4	-	FBK0504583
6	0.5	6	78	6	35	0.2	4	-	FBK0504584
6	1.5	6	78	6	35	0.2	4	-	FBK0504585
6	0.5	8	100	6	25	0.2	4	2	FBK0504586
6	1.5	8	100	6	25	0.2	4	2	FBK0504587
8	0.5	8	64	8	25	0.3	4	-	FBK0504588
8	1.0	8	64	8	25	0.3	4	-	FBK0504589
8	2.0	8	64	8	25	0.3	4	-	FBK0504590



Solid Carbide End Mills

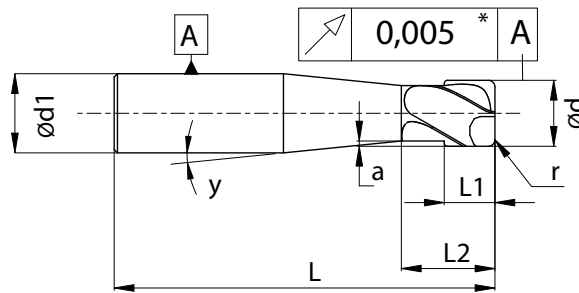
Proton HD Series

4 Flute

Centre cutting high performance
torus 4 flute for 45-70 HRc



END MILLS



P3-P4

H1-H4

Unit : mm

Ød	r	Ød1	L	L1	L2	a	z	γ	EDP No
(mm)	(mm)	(mm)	(mm)	(mm)	(mm)	(mm)		(°)	
8	0.5	8	78	8	25	0.3	4	-	FBK0504591
8	1.0	8	78	8	35	0.3	4	-	FBK0504592
8	2.0	8	78	8	35	0.3	4	-	FBK0504593
8	0.5	8	100	8	50	0.3	4	-	FBK0505830
8	1.0	8	100	8	50	0.3	4	-	FBK0504594
8	2.0	8	100	8	50	0.3	4	-	FBK0504595
8	1.0	10	120	8	30	0.3	4	-	FBK0504596
8	2.0	10	120	8	30	0.3	4	2	FBK0504597
10	0.5	10	78	10	35	0.3	4	2	FBK0504598
10	2.0	10	78	10	35	0.3	4	-	FBK0504599
10	1.0	10	100	10	55	0.3	4	-	FBK0504600
10	2.0	10	100	10	55	0.3	4	-	FBK0504601
10	2.0	12	120	10	30	0.3	4	-	FBK0504602
12	0.5	12	78	12	35	0.3	4	2	FBK0504603
12	2.0	12	78	12	35	0.3	4	-	FBK0504604
12	1.0	12	100	12	55	0.3	4	-	FBK0504605
12	2.0	12	100	12	55	0.3	4	-	FBK0504606
12	2.0	16	120	12	40	0.3	4	-	FBK0504607
16	3.5	16	100	20	50	0.3	4	5	FBK0504608
16	3.5	16	150	20	100	0.3	4	-	FBK0504609




Solid Carbide End Mills

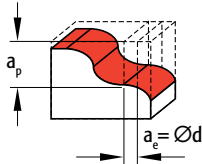
Cutting conditions

END MILLS

- Centre cutting high performance torus 2 flute for 45-70 HRc
- Centre cutting high performance torus 4 flute for 45-70 HRc

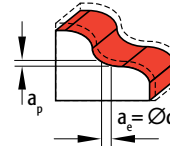
Material group	TSR	Hardness	Cutting speed	Coolant
	(N/mm ²)	HRc	Vc m/min	
P3	< 750	< 35 HRc	150 - 250	emulsion
P4	< 1000	< 35-48 HRc	120 - 200	emulsion
P4	< 1400	< 35 HRc	100 - 160	emulsion
H1		42-50 HRc	120 - 180	min.lub.
H2		50-55 HRc	150 - 200	min.lub.
H3		55-60 HRc	200 - 250	min.lub.
H4		60-70 HRc	200 - 250	min.lub.

Tips: 
Radial runout determines tool life- manufactured with precision tolerance



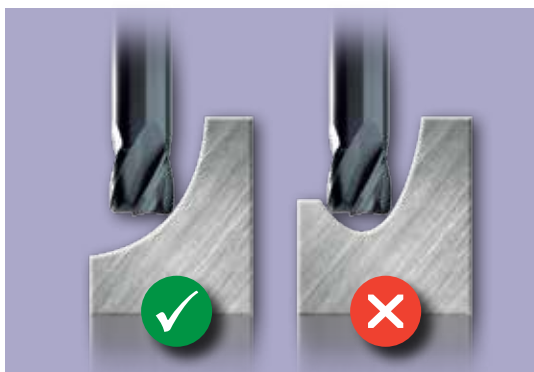
Shoulder milling
P3 / P4

Ød (mm)	ap max. (mm)	ae max. (mm)	fz (mm/tooth)
1.5	< 1.5	< 0.15	0.025 - 0.040
2	< 2.0	< 0.2	0.030 - 0.050
3	< 3.0	< 0.30	0.040 - 0.060
4	< 4.0	< 0.40	0.050 - 0.080
5	< 5.0	< 0.50	0.060 - 0.110
6	< 6.0	< 0.60	0.065 - 0.125
8	< 8.0	< 0.80	0.080 - 0.130
10	< 10.0	< 1.00	0.085 - 0.135
12	< 12.0	< 1.20	0.100 - 0.140
16	< 16.0	< 1.60	0.100 - 0.150



Shoulder milling
H1 / H2 / H3 / H4

Ød (mm)	ap max. (mm)	ae max. (mm)	fz (mm/tooth)
1.5	< 0.7	< 0.03	0.025 - 0.040
2	< 1.0	< 0.04	0.030 - 0.050
3	< 1.5	< 0.06	0.040 - 0.060
4	< 2.0	< 0.10	0.050 - 0.080
5	< 2.5	< 0.13	0.060 - 0.110
6	< 3.0	< 0.18	0.065 - 0.125
8	< 4.0	< 0.24	0.080 - 0.130
10	< 5.0	< 0.30	0.085 - 0.135
12	< 6.0	< 0.36	0.100 - 0.140
16	< 8.0	< 0.50	0.100 - 0.150



Torus endmills:

- High effective cutting speed
- Optimized surface finish
- Available in 2 Flute and 4 flute
- Finishing – Semi finishing (Roughing) with a single tool