

HARVI™ III • Application Data • Metric



With Neck



Without Neck

Material Group			KCSM15A	Recommended feed per tooth (fz = mm/th) for side milling.									
				Cutting Speed — vc m/min		mm	D1 — Diameter						
				ap	ae		Min	Max	10,0	12,0	14,0	16,0	18,0
P	4	ap max	0,4 x D	90	150	Fz	0,054	0,062	0,070	0,077	0,083	0,088	0,098
	5	ap max	0,4 x D	60	100	Fz	0,048	0,056	0,063	0,070	0,076	0,081	0,091
M	1	ap max	0,4 x D	90	115	Fz	0,061	0,070	0,079	0,087	0,095	0,101	0,114
	2	ap max	0,4 x D	60	80	Fz	0,048	0,056	0,063	0,070	0,076	0,081	0,091
	3	ap max	0,4 x D	60	70	Fz	0,040	0,047	0,052	0,057	0,061	0,065	0,071
	1	ap max	0,4 x D	50	90	Fz	0,061	0,070	0,079	0,087	0,095	0,101	0,114
S	2	ap max	0,4 x D	25	50	Fz	0,032	0,037	0,042	0,046	0,050	0,054	0,061
	3	ap max	0,4 x D	25	40	Fz	0,032	0,037	0,042	0,046	0,050	0,054	0,061
	4	ap max	0,4 x D	50	60	Fz	0,045	0,052	0,058	0,064	0,069	0,074	0,084
	1	ap max	0,4 x D	80	140	Fz	0,054	0,062	0,070	0,077	0,083	0,088	0,098
H	2	ap max	0,4 x D	70	120	Fz	0,040	0,047	0,052	0,057	0,061	0,065	0,071

NOTE: These guidelines may require variations to achieve optimum results.

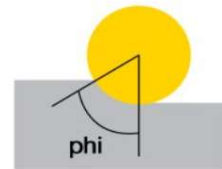
Lower value of cutting speed is used for high stock removal applications or for higher hardness (machinability) within group.

Higher value of cutting speed is used for finishing applications or for lower hardness (machinability) within group.

Above parameters are based on ideal conditions. For smaller taper machining centers, please adjust parameters accordingly on >12mm diameter.

HARVI III • Adjustment Factor for Feed and Speed Calculation • Metric

	Ae/D	2%	4%	5%	8%	10%	12%	20%	30%
Speed factor	Kv	1,75–3,0	1,33–2,52	1,33–2,1	1,33	1,17	1,15	1,08	1,00
Feed factor	KFz	3,28	2,35	2,11	1,69	1,53	1,41	1,15	1,00
phi [°]		16,26	23,07	25,84	32,86	36,87	40,54	53,13	66,42



NOTE: For an Ae/D ratio of 5% or less there is a range given for speed factor Kv, which allows the user to either be more conservative at the lower value or more aggressive with the higher value.

This can also be considered based on the machinability of the material, from difficult to free cutting.

These calculations are for roughing/semi-finishing cuts when used with the recommended base Fz.

For light finishing cuts requiring improved surface quality it is recommended to reduce the base Fz approximately 50% and then apply these factors.

To calculate application specific cutting data, please use above Kv coefficient for adaptation of cutting speed and KFz for feed respectively.

$$Vc_{new} = Vc \cdot Kv$$

$$Fz_{new} = Fz \cdot KFz$$

Calculation example:

Application: D1 = 16,0mm;
S4 material group;
Ae 1,6mm (Ae = 10% of D)
Cutting data recommendation: Vc = 60m/min;
Fz = 0,064mm/th
Adjustment coefficients: Kv = 1,17mm;
KFz = 1,53

Final cutting data recommendation:

Vc new = 60 * 1,17 = 70m/min
Fz new = 0,064128 * 1,53 = 0,098mm/th

HARVI™ III Ballnose • HARVI III Taper Ball Nose • Application Data • **Roughing** • Metric



Ball Nose With Neck



Taper Ball Nose

Material Group		KCSM15A		Recommended feed per tooth (fz = mm/th) for side milling.														
		Cutting Speed — vc m/min			mm	D1 — Diameter												
		ap	ae	Min		Max	4,0	5,0	6,0	8,0	10,0	12,0	14,0	16,0	18,0	20,0	25,0	
P	0	Ap max	0,4 x D	150	—	200	Fz	0,028	0,036	0,044	0,060	0,072	0,083	0,092	0,101	0,108	0,114	0,124
	1	Ap max	0,4 x D	150	—	200	Fz	0,028	0,036	0,044	0,060	0,072	0,083	0,092	0,101	0,108	0,114	0,124
	2	Ap max	0,4 x D	140	—	190	Fz	0,028	0,036	0,044	0,060	0,072	0,083	0,092	0,101	0,108	0,114	0,124
	3	Ap max	0,4 x D	120	—	160	Fz	0,023	0,030	0,036	0,050	0,061	0,070	0,079	0,087	0,095	0,101	0,114
	4	Ap max	0,4 x D	90	—	150	Fz	0,021	0,027	0,033	0,045	0,054	0,062	0,070	0,077	0,083	0,088	0,098
	5	Ap max	0,4 x D	60	—	100	Fz	0,019	0,024	0,029	0,040	0,048	0,056	0,063	0,070	0,076	0,081	0,091
M	6	Ap max	0,4 x D	50	—	75	Fz	0,016	0,020	0,025	0,034	0,040	0,047	0,052	0,057	0,061	0,065	0,071
	1	Ap max	0,4 x D	90	—	115	Fz	0,023	0,030	0,036	0,050	0,061	0,070	0,079	0,087	0,095	0,101	0,114
	2	Ap max	0,4 x D	60	—	80	Fz	0,019	0,024	0,029	0,040	0,048	0,056	0,063	0,070	0,076	0,081	0,091
S	3	Ap max	0,4 x D	60	—	70	Fz	0,016	0,020	0,025	0,034	0,040	0,047	0,052	0,057	0,061	0,065	0,071
	1	Ap max	0,4 x D	50	—	90	Fz	0,023	0,030	0,036	0,050	0,061	0,070	0,079	0,087	0,095	0,101	0,114
	2	Ap max	0,4 x D	25	—	50	Fz	0,013	0,016	0,019	0,026	0,032	0,037	0,042	0,046	0,050	0,054	0,061
H	3	Ap max	0,4 x D	25	—	40	Fz	0,013	0,016	0,019	0,026	0,032	0,037	0,042	0,046	0,050	0,054	0,061
	4	Ap max	0,4 x D	50	—	60	Fz	0,016	0,021	0,026	0,037	0,045	0,052	0,058	0,064	0,069	0,074	0,084
	1	Ap max	0,4 x D	80	—	140	Fz	0,021	0,027	0,033	0,045	0,054	0,062	0,070	0,077	0,083	0,088	0,098

NOTE: These guidelines may require variations to achieve optimum results.

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HARVI III Ballnose • HARVI III Taper Ball Nose • Application Data • **Finishing** • Metric



Ball Nose With Neck



Taper Ball Nose

Material Group		KCSM15A			Recommended feed per tooth (fz = mm/th) for side milling.												
		Cutting Speed — vc m/min			mm	D1 — Diameter											
		ap	ae	Min		Max	4,0	5,0	6,0	8,0	10,0	12,0	16,0	18,0	20,0	25,0	
P	0	Ap max	0,06 x D	285	—	380	Fz	0,034	0,043	0,053	0,072	0,086	0,099	0,121	0,130	0,137	0,149
	1	Ap max	0,06 x D	285	—	380	Fz	0,034	0,043	0,053	0,072	0,086	0,099	0,121	0,130	0,137	0,149
	2	Ap max	0,06 x D	266	—	361	Fz	0,034	0,043	0,053	0,072	0,086	0,099	0,121	0,130	0,137	0,149
	3	Ap max	0,06 x D	228	—	304	Fz	0,028	0,036	0,044	0,060	0,073	0,084	0,105	0,113	0,121	0,137
	4	Ap max	0,06 x D	171	—	285	Fz	0,026	0,033	0,039	0,054	0,065	0,075	0,092	0,099	0,106	0,117
	5	Ap max	0,06 x D	114	—	190	Fz	0,023	0,029	0,035	0,048	0,058	0,067	0,084	0,091	0,097	0,109
M	6	Ap max	0,06 x D	95	—	142,5	Fz	0,019	0,024	0,030	0,040	0,048	0,056	0,068	0,073	0,078	0,085
	1	Ap max	0,06 x D	171	—	218,5	Fz	0,028	0,036	0,044	0,060	0,073	0,084	0,105	0,113	0,121	0,137
	2	Ap max	0,06 x D	114	—	152	Fz	0,023	0,029	0,035	0,048	0,058	0,067	0,084	0,091	0,097	0,109
S	3	Ap max	0,06 x D	114	—	133	Fz	0,019	0,024	0,030	0,040	0,048	0,056	0,068	0,073	0,078	0,085
	1	Ap max	0,06 x D	95	—	171	Fz	0,028	0,036	0,044	0,060	0,073	0,084	0,105	0,113	0,121	0,137
	2	Ap max	0,06 x D	47,5	—	95	Fz	0,015	0,019	0,023	0,032	0,038	0,045	0,056	0,060	0,065	0,074
H	3	Ap max	0,06 x D	47,5	—	76	Fz	0,015	0,019	0,023	0,032	0,038	0,045	0,056	0,060	0,065	0,074
	4	Ap max	0,06 x D	95	—	114	Fz	0,019	0,025	0,031	0,044	0,053	0,062	0,077	0,083	0,089	0,100
H	1	Ap max	0,06 x D	152	—	266	Fz	0,026	0,033	0,039	0,054	0,065	0,075	0,092	0,099	0,106	0,117

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Application Recommendation for Surface Profiling with HARVI™ III Ball Nose Series

Not all six cutting edges reach the center of the HARVI III series ball nose end mill. Due to this, certain tilt angles will engage different numbers of cutting edges and can alter the required cutting parameters. This will also be altered by the depths of cut, which will change the contact area and resulting number of edges engaged.

When surface profiling with any ball nose end mill, optimum performance will be achieved by tilting away from the center of the tool if possible. This is due to the fact that at the tip of the tool only the center cutting edges exist (two in the case of HARVI III series), and also the fact that the rotational velocity is zero in the center. Therefore, Kennametal recommends tilting the end mill to engage more cutting edges and avoid the zero-speed condition.

As the HARVI III series ball nose end mills do have two center cutting edges, it is possible to machine without tilting if the application requires this. Just factor in the reduced number of cutting edges into the cutting parameter calculations.



At the tip of the tool, only the center cutting edges exist.
The rotational velocity is zero in the center.



When surface profiling with any ball nose end mill, optimum performance will be achieved by tilting away from the center of the tool if possible.

HARVI III Ball Nose & HARVI III Taper Ball Nose



15°

For tilt angles less than 15° and shallow profiling depths, only two cutting edges will be typically engaged. As the end mill is tilted above this, the next two edges will engage.



22°

After reaching a tilt angle of at least 22°, then all six edges will at least be partially engaged.



40°–45°

For maximum profiling performance, a tilt angle of 40°–45° will result in full engagement of all edges with a wide range of cutting depths.