



Product Table: Miniature End Mills - Ball - Tapered Reach (Clearance Cutters)
Characteristics: 2 Flutes
Series: 177xx, 178xx, 188xx, 189xx, 248xx, 249xx, 298xx, 9249xx

Product Notes:
 Posted values represent a 5x Reach. Use the table below to adjust Chip Load (IPT) and Depths of Cut for tools with longer reach.

Reach Multiple	SLOTTING						ROUGHING						FINISHING					
	Chip Load	DOC (Dia < .062)		DOC (Dia ≥ .062)		Chip Load	DOC (Dia < .062)		DOC (Dia ≥ .062)		Chip Load	DOC (Dia < .062)		DOC (Dia ≥ .062)				
	Radial	Axial	Radial	Axial	Radial	Radial	Axial	Radial	Axial	Radial	Radial	Axial	Radial	Radial	Axial			
5x	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%			
8x	75%	100%	88%	100%	90%	75%	93%	86%	92%	86%	83%	100%	100%	100%	100%			
10x	67%	100%	88%	100%	90%	67%	83%	86%	83%	86%	79%	75%	100%	80%	100%			
12x	60%	100%	75%	100%	75%	60%	77%	71%	75%	71%	75%	63%	100%	67%	100%			
15x	50%	100%	75%	100%	75%	50%	50%	71%	50%	71%	67%	50%	100%	53%	100%			
18x	45%	100%	63%	100%	60%	45%	47%	63%	50%	57%	63%	38%	100%	40%	100%			
20x	40%	100%	50%	100%	50%	40%	43%	57%	42%	57%	58%	25%	100%	33%	100%			
25x	30%	100%	50%	100%	50%	30%	43%	57%	42%	57%	50%	25%	100%	33%	100%			
30x	25%	100%	38%	100%	40%	25%	37%	43%	33%	43%	42%	25%	100%	27%	100%			
40x	25%	100%	38%	100%	40%	25%	33%	43%	30%	43%	42%	13%	100%	20%	100%			
50x	20%	100%	25%	100%	25%	20%	27%	29%	25%	29%	33%	13%	100%	13%	100%			
60x	20%	100%	25%	100%	25%	20%	20%	29%	20%	29%	33%	13%	100%	13%	100%			

General Notes:
 All posted speed and feed parameters are suggested starting values that may be increased given optimal setup conditions. Chip loads reflect uncoated cutters and may be increased 10%-20% if coated. For ferrous materials with hardness ≤ 28 Rc, chip loads can be increased 10%-20%.

If you require additional information, Harvey Tool has a team of technical experts available to assist you through even the most challenging applications. Please contact us at **800-645-5609** or **Harveytech@harveyperformance.com**.

WARNING: Cutting tools may shatter under improper use. Government regulations require use of safety glasses and other appropriate safety equipment in the vicinity of use.

MATERIAL	SFM	Hardness: ≤ 28 Rc (≤ 271 HBn)													
		Chip Load (IPT) By Cutter Dia			Depth of Cut		Chip Load (IPT) By Cutter Dia					Depth of Cut			
		.015	.031	.047	Radial	Axial	.062	.078	.093	.125	.187	.250	Radial	Axial	
ALUMINUM ALLOYS															
Casting (2xx, 5xx, 7xx, 8xx)	750	Slotting	.00020	.00042	.00064	1 x Dia	.08 x Dia	.00073	.00092	.00110	.00147	.00221	.00295	1 x Dia	.20 x Dia
		Roughing	.00025	.00053	.00080	.30 x Dia	.35 x Dia	.00091	.00115	.00137	.00184	.00276	.00369	.60 x Dia	.35 x Dia
		Finishing	.00039	.00080	.00121	.08 x Dia	1.5 x Dia	.00139	.00174	.00208	.00280	.00418	.00559	.15 x Dia	1.5 x Dia
Wrought (1xxx, 2xxx, 3xxx, 5xxx, 6xxx, 7xxx, 8xxx)	1000	Slotting	.00018	.00038	.00057	1 x Dia	.08 x Dia	.00066	.00083	.00099	.00133	.00199	.00265	1 x Dia	.20 x Dia
Casting - 3%-5% Si (3xx, A3xx, C3xx, 4xx, A4xx, B4xx)	750	Slotting	.00018	.00038	.00057	1 x Dia	.08 x Dia	.00066	.00083	.00099	.00133	.00199	.00265	1 x Dia	.20 x Dia
Casting - 5%-8% Si (3xx, A3xx, C3xx, 4xx, A4xx, B4xx)	700	Slotting	.00018	.00038	.00057	1 x Dia	.08 x Dia	.00066	.00083	.00099	.00133	.00199	.00265	1 x Dia	.20 x Dia
Casting - 8%-12% Si (3xx, A3xx, C3xx, 4xx, A4xx, B4xx)	650	Roughing	.00023	.00047	.00072	.30 x Dia	.35 x Dia	.00082	.00104	.00123	.00166	.00248	.00332	.60 x Dia	.35 x Dia
Casting - 12%-16% Si (3xx, A3xx, C3xx, 4xx, A4xx, B4xx)	475	Roughing	.00023	.00047	.00072	.30 x Dia	.35 x Dia	.00082	.00104	.00123	.00166	.00248	.00332	.60 x Dia	.35 x Dia
Wrought - 5%-8% Si (4xxx)	1000	Finishing	.00035	.00072	.00109	.08 x Dia	1.5 x Dia	.00125	.00157	.00187	.00252	.00376	.00503	.15 x Dia	1.5 x Dia
Wrought - 8%-12% Si (4xxx)	800	Finishing	.00035	.00072	.00109	.08 x Dia	1.5 x Dia	.00125	.00157	.00187	.00252	.00376	.00503	.15 x Dia	1.5 x Dia
MAGNESIUM ALLOYS															
	1500	Slotting	.00020	.00042	.00064	1 x Dia	.08 x Dia	.00073	.00092	.00110	.00147	.00221	.00295	1 x Dia	.20 x Dia
		Roughing	.00025	.00053	.00080	.30 x Dia	.35 x Dia	.00091	.00115	.00137	.00184	.00276	.00369	.60 x Dia	.35 x Dia
		Finishing	.00039	.00080	.00121	.08 x Dia	1.5 x Dia	.00139	.00174	.00208	.00280	.00418	.00559	.15 x Dia	1.5 x Dia
ZINC ALLOYS															
	800	Slotting	.00020	.00042	.00064	1 x Dia	.08 x Dia	.00073	.00092	.00110	.00147	.00221	.00295	1 x Dia	.20 x Dia
		Roughing	.00025	.00053	.00080	.30 x Dia	.35 x Dia	.00091	.00115	.00137	.00184	.00276	.00369	.60 x Dia	.35 x Dia
		Finishing	.00039	.00080	.00121	.08 x Dia	1.5 x Dia	.00139	.00174	.00208	.00280	.00418	.00559	.15 x Dia	1.5 x Dia
COPPER ALLOYS															
High Coppers - 90%+ (C1xxx)	225	Slotting	.00016	.00034	.00051	1 x Dia	.08 x Dia	.00059	.00074	.00088	.00118	.00177	.00236	1 x Dia	.20 x Dia
Brass (Copper Zinc alloys, C2xxx, C3xxx, C4xxx, C6400-C6980)	500	Slotting	.00016	.00034	.00051	1 x Dia	.08 x Dia	.00059	.00074	.00088	.00118	.00177	.00236	1 x Dia	.20 x Dia
Phosphor Bronzes (Copper Tin alloys, C5xxx)	225	Slotting	.00016	.00034	.00051	1 x Dia	.08 x Dia	.00059	.00074	.00088	.00118	.00177	.00236	1 x Dia	.20 x Dia
Aluminum Bronzes (Copper Aluminum alloys, C6500-C6420)	500	Roughing	.00020	.00042	.00064	.30 x Dia	.35 x Dia	.00073	.00092	.00110	.00147	.00221	.00295	.60 x Dia	.35 x Dia
Silicon Bronzes (Copper Silicon alloys, C64700-C66100)	500	Roughing	.00020	.00042	.00064	.30 x Dia	.35 x Dia	.00073	.00092	.00110	.00147	.00221	.00295	.60 x Dia	.35 x Dia
Copper Nickels, Nickel Silvers (Copper Nickel alloys, C7xxx)	225	Slotting	.00016	.00034	.00051	1 x Dia	.08 x Dia	.00059	.00074	.00088	.00118	.00177	.00236	1 x Dia	.20 x Dia
Cast Copper Alloys (C8300-C86200, C86400-C87900, C92200-C95800, C97300-C97800, C99400-C99700)	550	Finishing	.00031	.00064	.00097	.08 x Dia	1.5 x Dia	.00111	.00140	.00166	.00224	.00335	.00447	.15 x Dia	1.5 x Dia

MATERIAL	SFM	Hardness: 29-37 Rc (279-344 HBn)													
		Chip Load (IPT) By Cutter Dia			Depth of Cut		Chip Load (IPT) By Cutter Dia					Depth of Cut			
		.015	.031	.047	Radial	Axial	.062	.078	.093	.125	.187	.250	Radial	Axial	
CARBON STEELS															
Free-Machining/Low Carbon steels, 10xx - 1029 & all 10Lxx, 11xx - 1139 & all 11Lxx, 12xx - 1215 & all 12Lxx	600	Slotting	.00007	.00014	.00022	1 x Dia	.08 x Dia	.00025	.00032	.00038	.00051	.00076	.00101	1 x Dia	.20 x Dia
		Roughing	.00008	.00016	.00025	.30 x Dia	.35 x Dia	.00028	.00036	.00042	.00057	.00085	.00114	.60 x Dia	.35 x Dia
		Finishing	.00012	.00025	.00038	.08 x Dia	1.5 x Dia	.00043	.00055	.00065	.00087	.00131	.00175	.15 x Dia	1.5 x Dia
1030 - 1095, 1140 - 1151, 113x, 15xx, 20xx, 30xx, 40xx & 4xLxx, 50xx & 5xLxx, 50xxx & 50Lxxx, 51xxx & 51Lxxx, 52xxx & 52Lxxx, 60xx, 80xx, 90xx	200	Slotting	.00006	.00013	.00020	1 x Dia	.08 x Dia	.00023	.00029	.00034	.00046	.00069	.00093	1 x Dia	.20 x Dia
		Roughing	.00007	.00015	.00023	.30 x Dia	.35 x Dia	.00026	.00033	.00039	.00052	.00078	.00104	.60 x Dia	.35 x Dia
		Finishing	.00011	.00023	.00035	.08 x Dia	1.5 x Dia	.00040	.00050	.00059	.00080	.00120	.00160	.15 x Dia	1.5 x Dia
STAINLESS STEELS															
203 EZ, 303 (all types), 416, 416Se, 416 Plus X, 420F, 420FSe, 430F, 430FSe, 440F, 440FSe	450	Slotting	.00007	.00014	.00022	1 x Dia	.08 x Dia	.00025	.00032	.00038	.00051	.00076	.00101	1 x Dia	.20 x Dia
		Roughing	.00008	.00016	.00025	.30 x Dia	.35 x Dia	.00028	.00036	.00042	.00057	.00085	.00114	.60 x Dia	.35 x Dia
		Finishing	.00012	.00025	.00038	.08 x Dia	1.5 x Dia	.00043	.00055	.00065	.00087	.00131	.00175	.15 x Dia	1.5 x Dia
201, 202, 203, 205, 301, 302, 304, 304L, 308, 309, 310, 314, 316, 316L, 317, 321, 329, 330, 347, 348, 385, 403, 405, 409, 410, 413, 420, 429, 430, 434, 436, 442, 446, 501, 502	200	Slotting	.00006	.00013	.00020	1 x Dia	.08 x Dia	.00023	.00029	.00034	.00046	.00069	.00093	1 x Dia	.20 x Dia
		Roughing	.00007	.00015	.00023	.30 x Dia	.35 x Dia	.00026	.00033	.00039	.00052	.00078	.00104	.60 x Dia	.35 x Dia
		Finishing	.00011	.00023	.00035	.08 x Dia	1.5 x Dia	.00040	.00050	.00059	.00080	.00120	.00160	.15 x Dia	1.5 x Dia
414, 431, 440A, 440B, 440C, 13-8, 15-5, 15-7, 17-4, 17-7	150	Slotting	.00004	.00008	.00013	1 x Dia	.08 x Dia	.00014	.00018	.00022	.00029	.00043	.00058	1 x Dia	.20 x Dia
		Roughing	.00004	.00009	.00014	.30 x Dia	.35 x Dia	.00016	.00020	.00024	.00033	.00049	.00065	.60 x Dia	.35 x Dia
		Finishing	.00007	.00014	.00022	.08 x Dia	1.5 x Dia	.00025	.00031	.00037	.00050	.00075	.00100	.15 x Dia	1.5 x Dia
TOOL STEELS															
A, L, O, P, W series	200	Slotting	.00006	.00013	.00020	1 x Dia	.08 x Dia	.00023	.00029	.00034	.00046	.00069	.00093	1 x Dia	.20 x Dia
		Roughing	.00007	.00015	.00023	.30 x Dia	.35 x Dia	.00026	.00033	.00039	.00052	.00078	.00104	.60 x Dia	.35 x Dia
		Finishing	.00011	.00023	.00035	.08 x Dia	1.5 x Dia	.00040	.00050	.00059	.00080	.00120	.00160	.15 x Dia	1.5 x Dia
D, H, M, T, S series	150	Slotting	.00004	.00008	.00013	1 x Dia	.08 x Dia	.00014	.00018	.00022	.00029	.00043	.00058	1 x Dia	.20 x Dia
		Roughing	.00004	.00009	.00014	.30 x Dia	.35 x Dia	.00016	.00020	.00024	.00033	.00049	.00065	.60 x Dia	.35 x Dia
		Finishing	.00007	.00014	.00022	.08 x Dia	1.5 x Dia	.00025	.00031	.00037	.00050	.00075	.00100	.15 x Dia	1.5 x Dia
TITANIUM ALLOYS															
	150	Slotting	.00004	.00008	.00013	1 x Dia	.08 x Dia	.00014	.00018	.00022	.00029	.00043	.00058	1 x Dia	.20 x Dia
		Roughing	.00004	.00009	.00014	.30 x Dia	.35 x								