Member IMC Group

IMCO

Power. Precision. Performance.

STREAKERS® M213

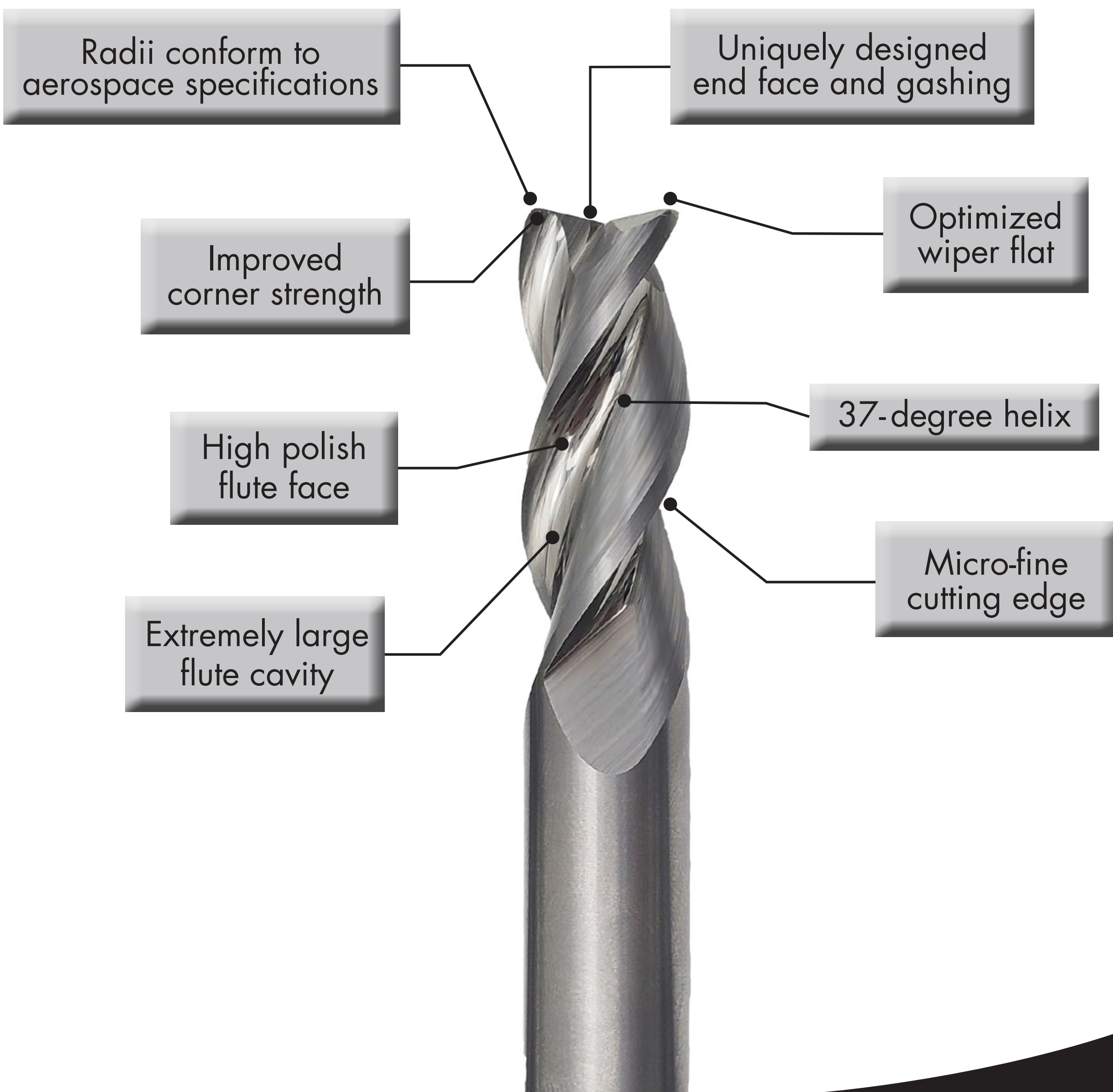
INTRODUCTION

M213 STREAKERS

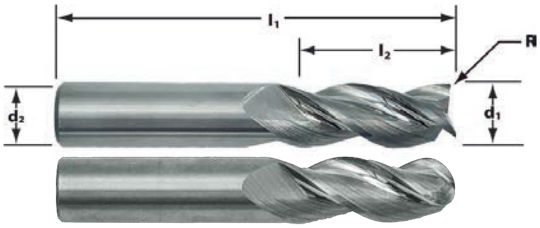
The M213 STREAKERS end mills are designed specifically for extreme tool paths often used in the high-performance machining of aluminum alloys. Our special end face and flute grinds create a free cutting action that allows for aggressive plunging and ramping moves.

- Plunge at high feed rates up to 1 x diameter without using a peck cycle.
- Mill deep slots – even over 1 x diameter deep – with great chip evacuation.
- Run steep ramp angles for high feed rates on entry moves.

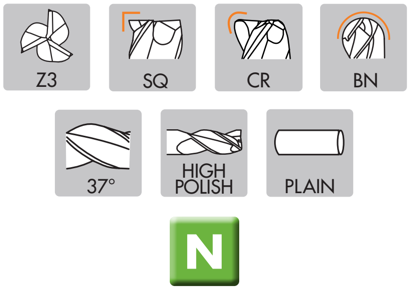
The M213 STREAKERS end mill does all this AND leaves a superior surface finish.



M213 STREAKERS



d1: -0.0001 / -0.0004 d2: -0.0001 / -0.0004
cr/ball nose: + / - 0.0015



For high-performance machining in aluminum alloys.

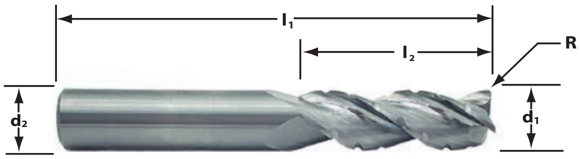
- 37-degree helix
- High polish flute face
- Optimized wiper flat
- Improved corner strength
- Extremely large flute cavity
- Extremely fine cutting edge
- Uniquely designed end face and gashing

Cutter Dia	Shank Dia	Length of Cut	Overall Length	Order Code	Order Code by Corner Radius							Order Code
d1	d2	l2	l1	SQ	.015 CR	.031 CR	.062 CR	.093 CR	.125 CR	.187 CR	.250 CR	BN
1/8	1/8	3/16	1-1/2	9163464	-	-	-	-	-	-	-	-
		1/4	1-1/2	9163465	9163466	-	-	-	-	-	-	-
		1/4	2	9163467	-	-	-	-	-	-	-	-
		3/8	1-1/2	9163468	9163469	-	-	-	-	-	-	9163658
		3/8	2	9163470	9163471	-	-	-	-	-	-	9163659
		1/2	2	9163472	-	-	-	-	-	-	-	9163660
		5/8	2	9163473	-	-	-	-	-	-	-	-
		3/4	2	9163474	-	-	-	-	-	-	-	-
		1	2	9163475	-	-	-	-	-	-	-	-
3/16	3/16	1/4	2	9163476	9163676	9163677	-	-	-	-	-	-
		3/8	2	9163477	-	-	-	-	-	-	-	9163661
		1/2	2	9163478	9163479	9163480	-	-	-	-	-	-
		5/8	2-1/2	9163481	9163482	9163483	-	-	-	-	-	9163662
		3/4	2-1/2	9163484	-	-	-	-	-	-	-	-
		1	2-1/2	9163485	-	-	-	-	-	-	-	-
1/4	1/4	3/8	2	9163486	9163487	9163488	-	-	-	-	-	-
		3/8	2-1/2	9163489	9163490	9163491	-	-	-	-	-	-
		1/2	2-1/2	9163492	-	-	-	-	-	-	-	9163663
		5/8	2-1/2	9163493	9163494	9163495	9163496	-	-	-	-	-
		3/4	2-1/2	9163497	9163498	9163499	9163500	-	-	-	-	9163664
		1	3	9163501	9163502	9163503	-	-	-	-	-	-
		1-1/4	3	9163504	-	9163505	-	-	-	-	-	-
		1-1/2	3	9163506	-	-	-	-	-	-	-	-
		1-3/4	4	9163507	-	-	-	-	-	-	-	-
		2	4	9163508	-	-	-	-	-	-	-	-
5/16	5/16	5/8	2-1/2	9163509	-	-	-	-	-	-	-	-
		13/16	2-1/2	9163510	9163511	9163512	-	-	-	-	-	9163665
		15/16	2-1/2	9163513	-	-	-	-	-	-	-	-
		1-1/4	3	9163514	-	-	-	-	-	-	-	-
		1-1/2	4	9163515	-	-	-	-	-	-	-	-

M213 STREAKERS

Cutter Dia	Shank Dia	Length of Cut	Overall Length	Order Code	Order Code by Corner Radius							Order Code
d1	d2	l2	l1	SQ	.015 CR	.031 CR	.062 CR	.093 CR	.125 CR	.187 CR	.250 CR	BN
3/8	3/8	1/2	2	9163516	9163517	9163518	-	-	-	-	-	-
		1/2	2-1/2	9163519	9163520	9163521	-	-	-	-	-	-
		5/8	2-1/2	9163522	9163523	9163524	9163678	9163680	-	-	-	9163666
		3/4	2-1/2	9163525	-	-	-	-	-	-	-	-
		1	2-1/2	9163526	9163527	9163528	9163529	9163681	-	-	-	9163667
		1-1/4	3	9163530	9163531	9163532	9163533	9163682	9163534	-	-	9163673
		1-1/2	3-1/2	9163535	-	9163536	9163537	9163683	-	-	-	9163674
		2	4	9163538	-	-	-	-	-	-	-	-
		2-1/2	4-1/2	9163539	-	-	-	-	-	-	-	-
7/16	7/16	1	2-3/4	9163540	-	-	-	-	-	-	-	-
1/2	1/2	5/8	2-1/2	9163541	9163542	9163543	-	-	-	-	-	-
		5/8	3	9163544	9163545	9163546	9163547	9163548	9163549	-	-	9163668
		3/4	3	9163550	-	-	-	-	-	-	-	-
		1	3	9163551	9163552	9163553	9163554	9163555	9163556	-	-	9163669
		1-1/4	3	9163557	9163558	9163559	9163561	9163562	9163563	-	-	9163670
		1-5/8	4	9163564	9163565	9163566	9163567	9163568	9163569	-	-	-
		2	4	9163570	9163571	9163572	9163573	9163574	9163575	-	-	-
		2-1/4	4	9163576	-	-	-	-	-	-	-	-
		2-1/2	5	9163577	-	9163578	9163679	9163684	9163685	-	-	9163675
		2-1/2	6	9163579	-	-	-	-	-	-	-	-
		3-1/4	6	9163580	-	-	-	-	-	-	-	-
		4	8	9163581	-	-	-	-	-	-	-	-
5/8	5/8	3/4	3-1/2	9163582	-	9163583	-	-	9163584	-	-	-
		1-1/4	3-1/2	9163585	-	9163586	-	-	9163587	-	-	-
		1-5/8	4	9163588	9163589	9163590	-	-	9163591	-	-	9163671
		1-7/8	4	9163592	-	9163593	-	-	9163594	-	-	-
		2-1/8	5	9163595	-	-	-	-	-	-	-	-
		2-1/2	5	9163596	-	9163597	-	-	-	-	-	-
		3-1/4	6	9163598	-	-	-	-	-	-	-	-
3/4	3/4	1	4	9163599	-	9163600	9163601	9163602	9163603	9163604	9163605	-
		1-5/8	4	9163606	-	9163607	9163608	9163609	9163610	9163611	9163612	9163672
		2	5	9163613	-	-	-	-	9163614	-	-	-
		2-1/4	5	9163615	-	9163616	9163617	9163618	9163619	-	9163620	-
		2-1/2	5	9163621	-	9163622	9163623	-	9163624	9163625	9163626	-
		3	6	9163627	-	-	-	-	-	-	-	-
		3-1/4	6	9163628	-	9163629	-	-	9163630	-	-	-
		3-1/2	6	9163631	-	-	-	-	9163632	-	-	-
		4	7	9163633	-	-	-	-	-	-	-	-
		5	8	9163634	-	-	-	-	-	-	-	-
1	1	1-1/4	4	9163635	-	-	-	-	-	-	-	-
		1-1/2	4	9163636	-	9163637	9163638	9163639	9163640	-	9163641	-
		2	5	9163642	-	-	-	-	-	-	-	-
		2-1/2	5	9163643	-	9163644	9163645	9163646	9163647	-	9163648	-
		3-1/2	6	9163649	-	9163650	9163651	9163652	9163653	-	9163654	-
		4-1/4	7	9163655	-	9163656	-	-	-	-	-	-
		5-1/2	8	9163657	-	-	-	-	-	-	-	-

M213C STREAKERS



d1: -0.0001 / -0.0004 *d2: -0.0001 / -0.0004*
cr/ball nose: + / - 0.0015

For high-performance machining in aluminum alloys.

- › 37-degree helix
- › High polish flute face
- › Optimized wiper flat
- › Improved corner strength
- › Extremely large flute cavity
- › Extremely fine cutting edge
- › Uniquely designed end face and gashing
- › Advanced geometry to maximize chip control

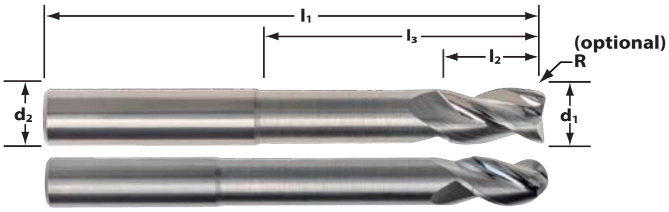
Cutter Dia d1	Shank Dia d2	Length of Cut l2	Overall Length l1	Order Code by Corner Radius				
				.015 CR	.031 CR	.062 CR	.093 CR	.125 CR
1/4	1/4	1/2	2-1/2	9163847		-	-	-
		3/4	2-1/2	9163848	-	-	-	-
		1	3	9163849	-	-	-	-
3/8	3/8	15/16	2-1/2	9163850	-	-	-	-
		1-1/8	3	9163851	-	-	-	-
		1-1/2	3-1/2	9163852	-	-	-	-
1/2	1/2	1-1/4	3	-	9163853	9163863	9163867	-
		1-1/2	3-1/2	-	9163854	-	-	-
		2	4	-	9163855	-	-	-
5/8	5/8	1-1/4	3-1/2	-	9163856	9163864	9163868	9163871
		1-7/8	4	-	9163857	-	-	-
3/4	3/4	1-5/8	4	-	9163859	9163865	9163869	9163872
		2-1/4	5	-	9163860	-	-	-
1	1	1-1/2	4	-	9163861	9163866	9163870	9163873
		2-1/4	5	-	9163862	-	-	-

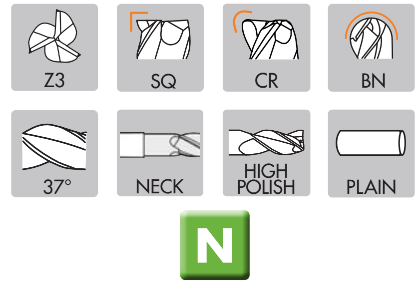
M213 Application Guide – Speed & Feed

ISO Code	Work Material	Type of Cut	Tool LC/ Dia.	Axial DOC	Radial DOC	Ramp Angle	Number of Flutes	Speed (SFM)	Feed (Inch per Tooth)								
									1/8	3/16	1/4	5/16	3/8	1/2	5/8	3/4	1
N	Aluminum alloys 2024, 6061, 7075 Magnesium alloys O-T6	Slotting	≤ 2	1 x D	1 x D	-	3	800	.0015	.0023	.0030	.0038	.0045	.0060	.0075	.0090	.0120
		Peripheral - Rough	≤ 2	1 x D	.75 x D	-	3	1000	.0020	.0030	.0040	.0050	.0060	.0080	.0100	.0120	.0160
		Peripheral - Rough	> 2 - 3	1 x D	.75 x D	-	3	1000	.0019	.0028	.0038	.0047	.0056	.0075	.0094	.0113	.0150
		Peripheral - Rough	> 3 - 4	1 x D	.75 x D	-	3	900	.0016	.0024	.0032	.0041	.0049	.0065	.0081	.0097	.0130
		Peripheral - Rough	> 4 - 5	1 x D	.75 x D	-	3	800	.0014	.0022	.0029	.0036	.0043	.0058	.0072	.0086	.0115
		Finish	≤ 2.5	2 x D	.015 x D	-	3	1200	.0007	.0010	.0014	.0017	.0020	.0027	.0034	.0041	.0054
		Helical Ramp	≤ 2	2 x D	1 x D	15 deg	3	800	.0015	.0023	.0030	.0038	.0045	.0060	.0075	.0090	.0120
		Straight Line Ramp	≤ 2	1 x D	1 x D	45 deg	3	800	.0010	.0015	.0020	.0025	.0030	.0040	.0050	.0060	.0080
	Aluminum alloys 2024, 6061, 7075 Hardened or Anodized	Slotting	≤ 2	1 x D	1 x D	-	3	780	.0014	.0020	.0027	.0034	.0041	.0055	.0068	.0082	.0109
		Peripheral - Rough	≤ 2	1 x D	.75 x D	-	3	950	.0020	.0029	.0039	.0049	.0059	.0078	.0098	.0117	.0156
		Peripheral - Rough	> 2 - 3	1 x D	.75 x D	-	3	950	.0018	.0027	.0037	.0046	.0055	.0073	.0092	.0110	.0147
		Peripheral - Rough	> 3 - 4	1 x D	.625 x D	-	3	855	.0016	.0024	.0032	.0039	.0047	.0063	.0079	.0095	.0126
		Peripheral - Rough	> 4 - 5	1 x D	.625 x D	-	3	760	.0014	.0021	.0028	.0035	.0042	.0056	.0070	.0084	.0112
		Finish	≤ 2.5	2 x D	.010 x D	-	3	1170	.0006	.0009	.0012	.0015	.0018	.0024	.0030	.0037	.0049
		Helical Ramp	≤ 2	2 x D	1 x D	15 deg	3	800	.0015	.0023	.0030	.0038	.0045	.0060	.0075	.0090	.0120
		Straight Line Ramp	≤ 2	1 x D	1 x D	45 deg	3	800	.0010	.0015	.0020	.0025	.0030	.0040	.0050	.0060	.0080
	High Silicon Aluminum Alloys A380, A390 Bhn 30-150 500kg	Slotting	≤ 2	.75 x D	1 x D	-	3	500	.0011	.0017	.0023	.0028	.0034	.0045	.0056	.0068	.0090
		Peripheral - Rough	≤ 2	1 x D	.5 x D	-	3	700	.0014	.0021	.0029	.0036	.0043	.0057	.0071	.0086	.0114
		Peripheral - Rough	> 2 - 3	1 x D	.5 x D	-	3	700	.0014	.0021	.0027	.0034	.0041	.0055	.0068	.0082	.0109
		Peripheral - Rough	> 3 - 4	1 x D	.4 x D	-	3	600	.0012	.0018	.0024	.0030	.0036	.0048	.0061	.0073	.0097
		Peripheral - Rough	> 4 - 5	1 x D	.4 x D	-	3	500	.0010	.0015	.0020	.0025	.0030	.0040	.0051	.0061	.0081
		Finish	≤ 2.5	2 x D	.015 x D	-	3	900	.0006	.0009	.0013	.0016	.0019	.0025	.0031	.0038	.0050
		Helical Ramp	≤ 2	2 x D	1 x D	15 deg	3	500	.0011	.0017	.0023	.0028	.0034	.0045	.0056	.0068	.0090
		Straight Line Ramp	≤ 2	1 x D	1 x D	45 deg	3	500	.0008	.0011	.0015	.0019	.0023	.0030	.0038	.0045	.0061
	High Silicon Aluminum alloys A380, A390 Anodized	Slotting	≤ 2	.75 x D	1 x D	-	3	488	.0010	.0015	.0020	.0025	.0030	.0040	.0050	.0060	.0080
		Peripheral - Rough	≤ 2	1 x D	.45 x D	-	3	690	.0014	.0021	.0029	.0036	.0043	.0057	.0071	.0086	.0114
		Peripheral - Rough	> 2 - 3	1 x D	.45 x D	-	3	690	.0014	.0021	.0027	.0034	.0041	.0055	.0068	.0082	.0109
		Peripheral - Rough	> 3 - 4	1 x D	.375 x D	-	3	621	.0012	.0018	.0024	.0030	.0036	.0048	.0061	.0073	.0097
		Peripheral - Rough	> 4 - 5	1 x D	.375 x D	-	3	552	.0010	.0015	.0020	.0025	.0030	.0040	.0051	.0061	.0081
		Finish	≤ 2.5	2 x D	.010 x D	-	3	878	.0006	.0008	.0011	.0014	.0017	.0022	.0028	.0034	.0045
		Helical Ramp	≤ 2	2 x D	1 x D	15 deg	3	488	.0010	.0015	.0020	.0025	.0030	.0040	.0050	.0060	.0080
		Straight Line Ramp	≤ 2	1 x D	1 x D	45 deg	3	488	.0007	.0010	.0013	.0017	.0020	.0027	.0033	.0040	.0053
	Copper, Brass 10-80 HRb	Slotting	≤ 2	.75 x D	1 x D	-	3	500	.0009	.0014	.0019	.0023	.0028	.0037	.0046	.0056	.0074
		Peripheral - Rough	≤ 2	1 x D	.75 x D	-	3	600	.0012	.0017	.0023	.0029	.0035	.0046	.0058	.0069	.0092
		Peripheral - Rough	> 2 - 3	1 x D	.75 x D	-	3	600	.0011	.0017	.0022	.0028	.0033	.0045	.0056	.0067	.0089
		Peripheral - Rough	> 3 - 4	1 x D	.75 x D	-	3	500	.0010	.0014	.0019	.0024	.0029	.0039	.0048	.0058	.0077
		Peripheral - Rough	> 4 - 5	1 x D	.75 x D	-	3	450	.0008	.0012	.0017	.0021	.0025	.0033	.0041	.0050	.0066
		Finish	≤ 2.5	2 x D	.015 x D	-	3	650	.0005	.0008	.0011	.0013	.0016	.0021	.0026	.0032	.0042
		Helical Ramp	≤ 2	2 x D	1 x D	15 deg	3	500	.0009	.0014	.0019	.0023	.0028	.0037	.0046	.0056	.0074
		Straight Line Ramp	≤ 2	1 x D	1 x D	25 deg	3	500	.0006	.0009	.0012	.0016	.0019	.0025	.0031	.0037	.0050
	Copper alloys, Brass Alloys 81-100 HRb	Slotting	≤ 2	.75 x D	1 x D	-	3	488	.0009	.0014	.0018	.0023	.0027	.0036	.0045	.0054	.0072
		Peripheral - Rough	≤ 2	1 x D	.75 x D	-	3	590	.0012	.0017	.0023	.0029	.0035	.0046	.0058	.0069	.0092
		Peripheral - Rough	> 2 - 3	1 x D	.75 x D	-	3	590	.0011	.0017	.0022	.0028	.0033	.0044	.0055	.0066	.0088
		Peripheral - Rough	> 3 - 4	1 x D	.625 x D	-	3	492	.0009	.0014	.0019	.0024	.0028	.0038	.0047	.0057	.0075
		Peripheral - Rough	> 4 - 5	1 x D	.625 x D	-	3	443	.0008	.0012	.0016	.0020	.0024	.0032	.0040	.0048	.0064
		Finish	≤ 2.5	2 x D	.010 x D	-	3	634	.0005	.0007	.0010	.0012	.0015	.0020	.0024	.0029	.0039
		Helical Ramp	≤ 2	2 x D	1 x D	15 deg	3	488	.0009	.0014	.0018	.0023	.0027	.0036	.0045	.0054	.0072
		Straight Line Ramp	≤ 2	1 x D	1 x D	25 deg	3	488	.0006	.0009	.0012	.0015	.0018	.0024	.0030	.0036	.0048
	Bronze Bhn 166-186	Slotting	≤ 2	.75 x D	1 x D	-	3	500	.0009	.0013	.0018	.0022	.0026	.0035	.0044	.0053	.0070
		Peripheral - Rough	≤ 2	1 x D	.5 x D	-	3	600	.0011	.0017	.0022	.0028	.0033	.0044	.0055	.0066	.0088
		Peripheral - Rough	> 2 - 3	1 x D	.5 x D	-	3	600	.0010	.0016	.0021	.0026	.0031	.0042	.0052	.0063	.0084
		Peripheral - Rough	> 3 - 4	1 x D	.4 x D	-	3	500	.0009	.0013	.0018	.0022	.0026	.0035	.0044	.0053	.0070
		Peripheral - Rough	> 4 - 5	1 x D	.4 x D	-	3	450	.0007	.0011	.0015	.0019	.0022	.0030	.0037	.0045	.0059
		Finish	≤ 2.5	2 x D	.015 x D	-	3	650	.0005	.0007	.0010	.0012	.0014	.0019	.0024	.0029	.0038
		Helical Ramp	≤ 2	2 x D	1 x D	12 deg	3	500	.0009	.0013	.0018	.0022	.0026	.0035	.0044	.0053	.0070
		Straight Line Ramp	≤ 2	1 x D	1 x D	20 deg	3	500	.0006	.0009	.0012	.0015	.0018	.0023	.0029	.0035	.0047
	Bronze High Tin Bronze, Manganese Bronze Work Hardened Bronze Bhn 187-212	Slotting	≤ 2	.75 x D	1 x D	-	3	488	.0009	.0013	.0017	.0021	.0026	.0034	.0043	.0051	.0068
		Peripheral - Rough	≤ 2	1 x D	.45 x D	-	3	590	.0011	.0017	.0022	.0028	.0033	.0044	.0055	.0066	.0088
		Peripheral - Rough	> 2 - 3	1 x D	.45 x D	-	3	590	.0010	.0016	.0021	.0026	.0031	.0042	.0052	.0063	.0084
		Peripheral - Rough	> 3 - 4	1 x D	.375 x D	-	3	492	.0009	.0013	.0018	.0022	.0026	.0035	.0044	.0053	.0070
		Peripheral - Rough	> 4 - 5	1 x D	.375 x D	-	3	443	.0007	.0011	.0015	.0019	.0022	.0030	.0037	.0045	.0059
		Finish	≤ 2.5	2 x D	.010 x D	-	3	634	.0004	.0007	.0009	.0011	.0013	.0018	.0022	.0026	.0035
		Helical Ramp	≤ 2	2 x D	1 x D	12 deg	3	488	.0009	.0013	.0017	.0021	.0026	.0034	.0043	.0051	.0068
		Straight Line Ramp	≤ 2	1 x D	1 x D	20 deg	3	488	.0006	.0009	.0011	.0014	.0017	.0023	.0029	.0034	.0046
	Composites, Plastics, Fiberglass	Slotting	≤ 2	1 x D	1 x D	-	3	500	.0011	.0017	.0023	.0028	.0034	.0045	.0056	.0068	.0090
		Peripheral - Rough	≤ 2	1 x D	.75 x D	-	3	700	.0014	.0021	.0029	.0036	.0043	.0057	.0071	.0086	.0114
		Peripheral - Rough	> 2 - 3	1 x D	.75 x D	-	3	700	.0014	.0021	.0027	.0034	.0041	.0055	.0068	.0082	.0109
		Peripheral - Rough	> 3 - 4	1 x D	.75 x D	-	3	600	.0012	.0018	.0024	.0030	.0036	.0048	.0061	.0073	.0097
		Peripheral - Rough	> 4 - 5	1 x D	.75 x D	-	3	500	.0010	.0015	.0020	.0025	.0030	.0040	.0051	.0061	.0081
		Finish	≤ 2.5	2 x D	.015 x D	-	3	900	.0006	.0009	.0013	.0016	.0019	.0025	.0031	.0038	.0050
		Helical Ramp	≤ 2	2 x D	1 x D	15 deg	3	500	.0011	.0017	.0023	.0028	.0034	.0045	.0056	.0068	.0090
		Straight Line Ramp	≤ 2	1 x D	1 x D	45 deg	3	500	.0008	.0011	.0015	.0019	.0023	.0030	.0038	.0045	.0061

** D = Tool Diameter The M213 excels at plunge milling, please refer to page 11 for speed, feed and peck info. Tool LC/Dia equals amount of tool projection from the holder.**

M213N STREAKERS





d1: -0.0001 / -0.0004 d2: -0.0001 / -0.0004
cr/ball nose: + / - 0.0015

For high-performance machining in aluminum alloys.

- › 37-degree helix
- › High polish flute face
- › Optimized wiper flat
- › Improved corner strength
- › Extremely large flute cavity
- › Extremely fine cutting edge
- › Uniquely designed end face and gashing

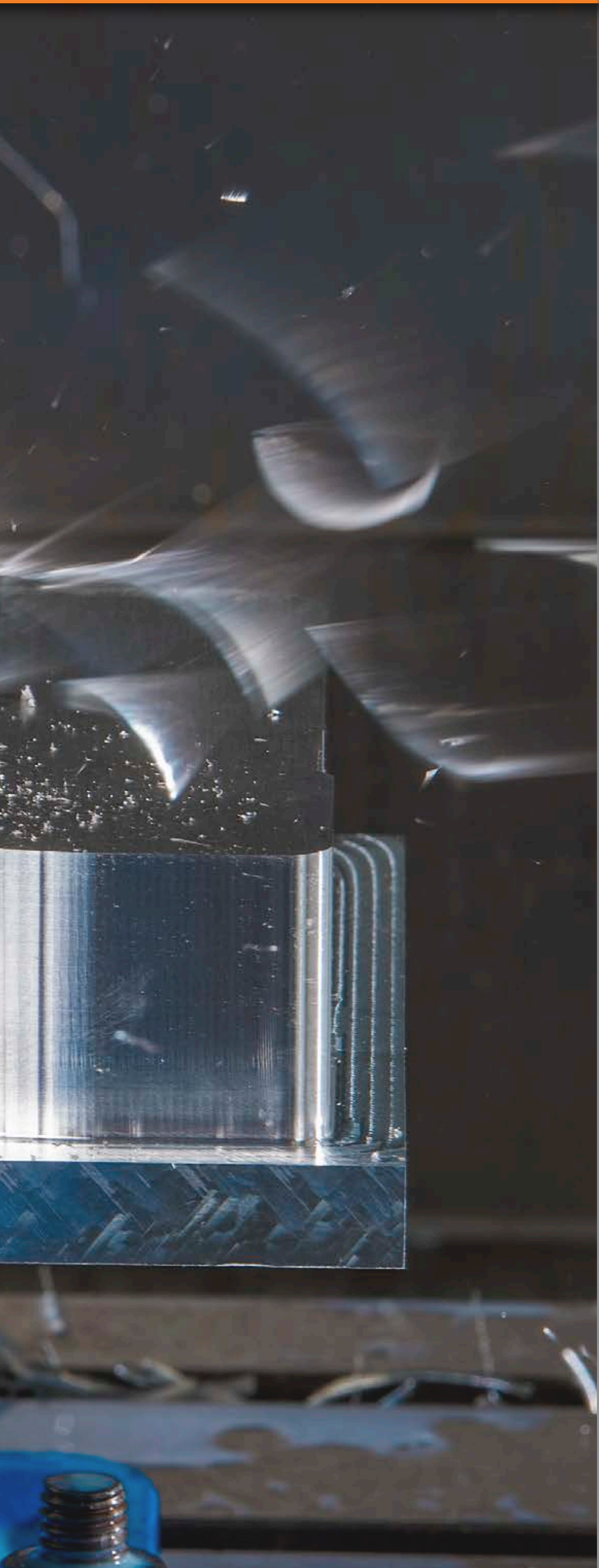
Cutter Dia d1	Shank Dia d2	Length of Cut l2	Reach LBS l3	Overall Length l1	Order Code SQ	Order Code by Corner Radius .015 CR	.031 CR	.062 CR	.093 CR	.125 CR	.187 CR	.250 CR	Order Code BN
1/8	1/8	3/16	3/4	2-1/2	9163686	9163718	-	-	-	-	-	-	9163815
			5/8	3	9163687	9163719	-	-	-	-	-	-	9163816
			1	3	9163688	9163720	-	-	-	-	-	-	9163817
3/16	3/16	1/4	3/4	2-1/2	9163689	9163721	9163736	-	-	-	-	-	9163818
			1	3	9163690	9163722	9163737	-	-	-	-	-	9163819
1/4	1/4	3/8	7/8	2-1/2	9163691	9163723	9163738	9163765	-	-	-	-	9163820
			1-3/8	3	9163692	9163724	9163739	-	-	-	-	-	9163821
			1-5/8	3	9163693	9163725	9163740	9163766	-	-	-	-	9163822
			2-1/4	4	9163694	9163726	9163741	-	-	-	-	-	9163823
3/8	3/8	5/8	1-1/8	2-1/2	9163695	9163727	9163742	9163767	9163784	-	-	-	9163824
			1-1/4	3	9163696	9163728	9163743	9163768	-	-	-	-	9163825
			1-5/8	3	9163697	9163729	9163744	9163769	-	-	-	-	9163826
			2-1/4	4	9163698	9163730	9163745	-	-	-	-	-	9163827
			2-1/2	5	9163699	-	9163746	9163770	-	-	-	-	9163828
			3-1/8	6	9163700	9163731	9163747	-	-	-	-	-	9163829
1/2	1/2	5/8	1-3/8	3	9163701	9163732	9163748	9163771	9163785	9163791	-	-	9163830
			1-3/4	3-1/2	9163702	-	9163749	9163772	-	9163792	-	-	9163831
		3/4	2-1/4	4	9163703	9163733	9163750	9163773	9163786	9163793	-	-	9163832
			2-3/4	4-1/2	9163704	-	9163751	9163774	-	9163794	-	-	9163833
			3-1/4	5	9163705	9163734	9163752	9163775	-	9163795	-	-	9163834
			3-3/4	5	9163706	-	9163753	-	-	-	-	-	9163835
			4-1/4	6	9163707	9163735	9163754	9163776	9163787	9163796	-	-	9163836
5/8	5/8	3/4	1-3/4	4	9163708	-	9163755	-	-	9163797	-	-	9163837
			2-3/8	5	9163709	-	9163756	9163777	9163788	9163798	-	-	9163838
			3-3/8	6	9163710	-	9163757	-	-	9163799	-	-	9163839
3/4	3/4	1	1-3/4	4	9163711	-	9163758	9163778	9163789	9163800	9163807	9163809	9163840
			2-3/8	5	9163712	-	9163759	9163779	-	9163801	-	-	9163841
			3-3/8	6	9163713	-	9163760	9163780	9163790	9163802	9163808	9163810	9163842
			5	7	9163714	-	9163761	9163781	-	9163803	-	9163811	9163843
1	1	1-1/4	2-5/8	5	9163715	-	9163762	9163782	-	9163804	-	9163812	9163844
			3-3/8	6	9163716	-	9163763	-	-	9163805	-	9163813	9163845
			4-3/8	7	9163717	-	9163764	9163783	-	9163806	-	9163814	9163846

M213N Application Guide – Speed & Feed

ISO Code	Work Material	Type of Cut	Tool LBS/ Dia.	Axial DOC	Radial DOC	Ramp Angle	Number of Flutes	Speed (SFM)	Feed (Inch per Tooth)							
									1/8	3/16	1/4	3/8	1/2	5/8	3/4	1
N	Aluminum alloys 2024, 6061, 7075 Magnesium alloys O-T6	Slotting	>2-3	1 x D	1 x D	-	3	800	.0015	.0023	.0030	.0045	.0060	.0075	.0090	.0120
		Peripheral -Rough	>2-3	1 x D	.75 x D	-	3	1000	.0020	.0030	.0040	.0060	.0080	.0100	.0120	.0160
		Peripheral -Rough	>3-4	1 x D	.75 x D	-	3	1000	.0019	.0028	.0038	.0056	.0075	.0094	.0113	.0150
		Peripheral -Rough	>4-5	1 x D	.75 x D	-	3	900	.0016	.0024	.0032	.0049	.0065	.0081	.0097	.0130
		Peripheral -Rough	>5-6	1 x D	.625 x D	-	3	800	.0014	.0022	.0029	.0043	.0058	.0072	.0086	.0115
		Finish	>2-3	3 x D	.015 x D	-	3	1200	.0007	.0010	.0014	.0020	.0027	.0034	.0041	.0054
		Helical Ramp	>2-3	3 x D	1 x D	15 deg	3	800	.0015	.0023	.0030	.0045	.0060	.0075	.0090	.0120
		Straight Line Ramp	>2-3	1 x D	1 x D	45 deg	3	800	.0010	.0015	.0020	.0030	.0040	.0050	.0060	.0080
	Aluminum alloys 2024, 6061, 7075 Hardened or Anodized	Slotting	>2-3	1 x D	1 x D	-	3	780	.0014	.0020	.0027	.0041	.0055	.0068	.0082	.0109
		Peripheral -Rough	>2-3	1 x D	.75 x D	-	3	950	.0020	.0029	.0039	.0059	.0078	.0098	.0117	.0156
		Peripheral -Rough	>3-4	1 x D	.625 x D	-	3	950	.0018	.0027	.0037	.0055	.0073	.0092	.0110	.0147
		Peripheral -Rough	>4-5	1 x D	.625 x D	-	3	855	.0016	.0024	.0032	.0047	.0063	.0079	.0095	.0126
		Peripheral -Rough	>5-6	.75 x D	.5 x D	-	3	760	.0014	.0021	.0028	.0042	.0056	.0070	.0084	.0112
		Finish	>2-3	3 x D	.010 x D	-	3	1170	.0006	.0009	.0012	.0018	.0024	.0030	.0037	.0049
		Helical Ramp	>2-3	3 x D	1 x D	15 deg	3	780	.0014	.0020	.0027	.0041	.0055	.0068	.0082	.0109
		Straight Line Ramp	>2-3	1 x D	1 x D	45 deg	3	780	.0009	.0014	.0018	.0027	.0037	.0046	.0055	.0073
	High Silicon Aluminum Alloys A380, A390 Bhn 30-150 500kg	Slotting	>2-3	.75 x D	1 x D	-	3	500	.0011	.0017	.0023	.0034	.0045	.0056	.0068	.0090
		Peripheral -Rough	>2-3	1 x D	.5 x D	-	3	700	.0014	.0021	.0029	.0043	.0057	.0071	.0086	.0114
		Peripheral -Rough	>3-4	1 x D	.4 x D	-	3	700	.0014	.0021	.0027	.0041	.0055	.0068	.0082	.0109
		Peripheral -Rough	>4-5	1 x D	.4 x D	-	3	600	.0012	.0018	.0024	.0036	.0048	.0061	.0073	.0097
		Peripheral -Rough	>5-6	1 x D	.3 x D	-	3	500	.0010	.0015	.0020	.0030	.0040	.0051	.0061	.0081
		Finish	>2-3	3 x D	.015 x D	-	3	900	.0006	.0009	.0013	.0019	.0025	.0031	.0038	.0050
		Helical Ramp	>2-3	3 x D	1 x D	15 deg	3	500	.0011	.0017	.0023	.0034	.0045	.0056	.0068	.0090
		Straight Line Ramp	>2-3	1 x D	1 x D	45 deg	3	500	.0008	.0011	.0015	.0023	.0030	.0038	.0045	.0061
	High Silicon Aluminum alloys A380, A390 Anodized	Slotting	>2-3	.75 x D	1 x D	-	3	488	.0010	.0015	.0020	.0030	.0040	.0050	.0060	.0080
		Peripheral -Rough	>2-3	1 x D	.45 x D	-	3	690	.0014	.0021	.0029	.0043	.0057	.0071	.0086	.0114
		Peripheral -Rough	>3-4	1 x D	.375 x D	-	3	690	.0014	.0021	.0027	.0041	.0055	.0068	.0082	.0109
		Peripheral -Rough	>4-5	1 x D	.375 x D	-	3	621	.0012	.0018	.0024	.0036	.0048	.0061	.0073	.0097
		Peripheral -Rough	>5-6	.75 x D	.3 x D	-	3	552	.0010	.0015	.0020	.0030	.0040	.0051	.0061	.0081
		Finish	>2-3	3 x D	.010 x D	-	3	878	.0006	.0008	.0011	.0017	.0022	.0028	.0034	.0045
		Helical Ramp	>2-3	3 x D	1 x D	15 deg	3	488	.0010	.0015	.0020	.0030	.0040	.0050	.0060	.0080
		Straight Line Ramp	>2-3	1 x D	1 x D	45 deg	3	488	.0007	.0010	.0013	.0020	.0027	.0033	.0040	.0053
	Copper, Brass	Slotting	>2-3	.75 x D	1 x D	-	3	500	.0009	.0014	.0019	.0028	.0037	.0046	.0056	.0074
		Peripheral -Rough	>2-3	1 x D	.75 x D	-	3	600	.0012	.0017	.0023	.0035	.0046	.0058	.0069	.0092
		Peripheral -Rough	>3-4	1 x D	.75 x D	-	3	600	.0011	.0017	.0022	.0033	.0045	.0056	.0067	.0089
		Peripheral -Rough	>4-5	1 x D	.75 x D	-	3	500	.0010	.0014	.0019	.0029	.0039	.0048	.0058	.0077
		Peripheral -Rough	>5-6	1 x D	.625 x D	-	3	450	.0008	.0012	.0017	.0025	.0033	.0041	.0050	.0066
		Finish	>2-3	3 x D	.015 x D	-	3	650	.0005	.0008	.0011	.0016	.0021	.0026	.0032	.0042
		Helical Ramp	>2-3	3 x D	1 x D	15 deg	3	500	.0009	.0014	.0019	.0028	.0037	.0046	.0056	.0074
		Straight Line Ramp	>2-3	1 x D	1 x D	25 deg	3	500	.0006	.0009	.0012	.0019	.0025	.0031	.0037	.0050
	Copper alloys, Brass Alloys	Slotting	>2-3	.75 x D	1 x D	-	3	488	.0009	.0014	.0018	.0027	.0036	.0045	.0054	.0072
		Peripheral -Rough	>2-3	1 x D	.75 x D	-	3	590	.0012	.0017	.0023	.0035	.0046	.0058	.0069	.0092
		Peripheral -Rough	>3-4	1 x D	.625 x D	-	3	590	.0011	.0017	.0022	.0033	.0044	.0055	.0066	.0088
		Peripheral -Rough	>4-5	1 x D	.625 x D	-	3	492	.0009	.0014	.0019	.0028	.0038	.0047	.0057	.0075
		Peripheral -Rough	>5-6	.75 x D	.5 x D	-	3	443	.0008	.0012	.0016	.0024	.0032	.0040	.0048	.0064
		Finish	>2-3	3 x D	.010 x D	-	3	634	.0005	.0007	.0010	.0015	.0020	.0024	.0029	.0039
		Helical Ramp	>2-3	3 x D	1 x D	15 deg	3	488	.0009	.0014	.0018	.0027	.0036	.0045	.0054	.0072
		Straight Line Ramp	>2-3	1 x D	1 x D	25 deg	3	488	.0006	.0009	.0012	.0018	.0024	.0030	.0036	.0048
	Bronze	Slotting	>2-3	.75 x D	1 x D	-	3	500	.0009	.0013	.0018	.0026	.0035	.0044	.0053	.0070
		Peripheral -Rough	>2-3	1 x D	.5 x D	-	3	600	.0011	.0017	.0022	.0033	.0044	.0055	.0066	.0088
		Peripheral -Rough	>3-4	1 x D	.4 x D	-	3	600	.0010	.0016	.0021	.0031	.0042	.0052	.0063	.0084
		Peripheral -Rough	>4-5	1 x D	.4 x D	-	3	500	.0009	.0013	.0018	.0026	.0035	.0044	.0053	.0070
		Peripheral -Rough	>5-6	1 x D	.3 x D	-	3	450	.0007	.0011	.0015	.0022	.0030	.0037	.0045	.0059
		Finish	>2-3	3 x D	.015 x D	-	3	650	.0005	.0007	.0010	.0014	.0019	.0024	.0029	.0038
		Helical Ramp	>2-3	3 x D	1 x D	12 deg	3	500	.0009	.0013	.0018	.0026	.0035	.0044	.0053	.0070
		Straight Line Ramp	>2-3	1 x D	1 x D	20 deg	3	500	.0006	.0009	.0012	.0018	.0023	.0029	.0035	.0047
	Bronze High Tin Bronze, Manganese Bronze Work Hardened Bronze	Slotting	>2-3	.75 x D	1 x D	-	3	488	.0009	.0013	.0017	.0026	.0034	.0043	.0051	.0068
		Peripheral -Rough	>2-3	1 x D	.45 x D	-	3	590	.0011	.0017	.0022	.0033	.0044	.0055	.0066	.0088
		Peripheral -Rough	>3-4	1 x D	.375 x D	-	3	590	.0010	.0016	.0021	.0031	.0042	.0052	.0063	.0084
		Peripheral -Rough	>4-5	1 x D	.375 x D	-	3	492	.0009	.0013	.0018	.0026	.0035	.0044	.0053	.0070
		Peripheral -Rough	>5-6	.75 x D	.3 x D	-	3	443	.0007	.0011	.0015	.0022	.0030	.0037	.0045	.0059
		Finish	>2-3	3 x D	.010 x D	-	3	634	.0004	.0007	.0009	.0013	.0018	.0022	.0026	.0035
		Helical Ramp	>2-3	3 x D	1 x D	12 deg	3	488	.0009	.0013	.0017	.0026	.0034	.0043	.0051	.0068
		Straight Line Ramp	>2-3	1 x D	1 x D	20 deg	3	488	.0006	.0009	.0011	.0017	.0023	.0029	.0034	.0046
	Composites, Plastics, Fiberglass	Slotting	>2-3	1 x D	1 x D	-	3	500	.0011	.0017	.0023	.0034	.0045	.0056	.0068	.0090
		Peripheral - Rough	>2-3	1 x D	.75 x D	-	3	700	.0014	.0021	.0029	.0043	.0057	.0071	.0086	.0114
		Peripheral - Rough	>3-4	1 x D	.75 x D	-	3	700	.0014	.0021	.0027	.0041	.0055	.0068	.0082	.0109
		Peripheral - Rough	>4-5	1 x D	.75 x D	-	3	600	.0012	.0018	.0024	.0036	.0048	.0061	.0073	.0097
		Peripheral -Rough	>5-6	1 x D	.625 x D	-	3	500	.0010	.0015	.0020	.0030	.0040	.0051	.0061	.0081
		Finish	>2-3	3 x D	.015 x D	-	3	900	.0006	.0009	.0013	.0019	.0025	.0031	.0038	.0050
		Helical Entry	>2-3	3 x D	1 x D	15 deg	3	500	.0011	.0017	.0023	.0034	.0045	.0056	.0068	.0090
		Straight Line Ramp	>2-3	1 x D	1 x D	45 deg	3	500	.0008	.0011	.0015	.0023	.0030	.0038	.0045	.0061

** D = Tool Diameter The M213 excels at plunge milling, please refer to page 11 for speed, feed and peck info. Tool LC/Dia equals amount of tool projection from the holder.**

TECHNICAL RESOURCES



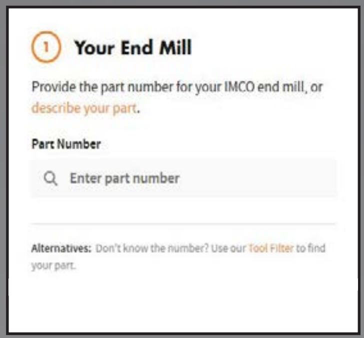
Toolbot

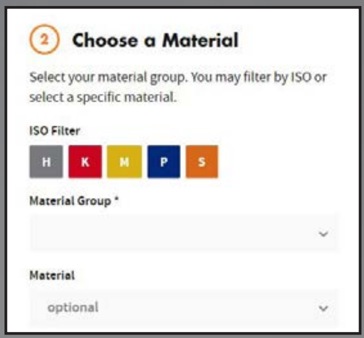
Check it before you wreck it.

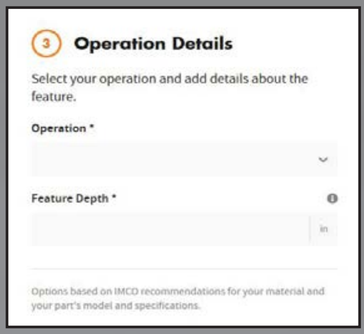
The brand new, easy to use online tool for dynamic speeds and feed from IMCO.

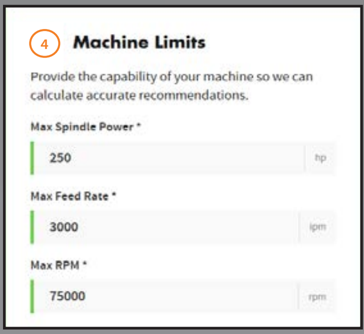
Simply input your part number or describe your tool, input select details about your application, confirm your machine details, and get ready to rock and roll with highly technical and in-depth speed and feed recommendations.

It's as easy as 1, 2, 3, 4!



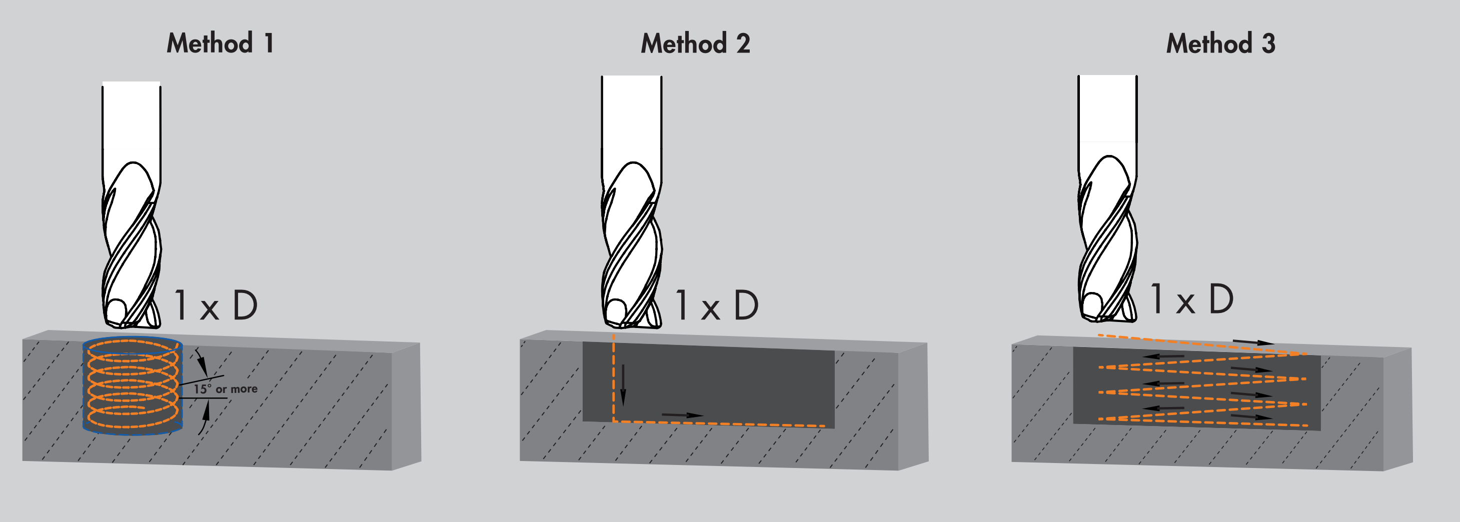






www.imcousa.com/resources/toolbot

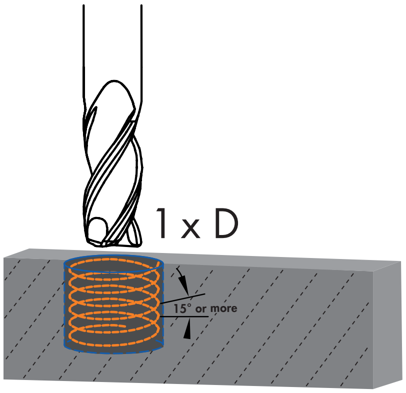
IMPROVED ENTRIES



The M213 STREAKERS series is designed to excel when using a variety of entry moves – helical ramping, plunging, and straight-line ramping. The M213 efficiently creates and evacuates the chips in all entry moves, allowing you to choose your tool path based on the part requirements and your programming needs.

METHOD 1: Helical Entry

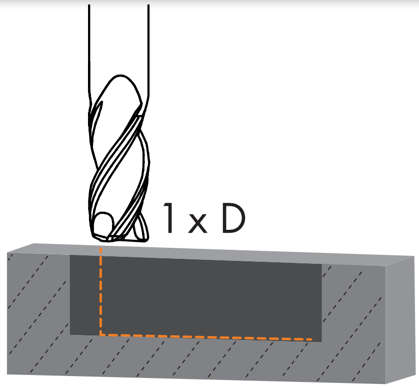
Helical ramping is a preferred entry method due to the lower impact and stress placed on the end mill, which increases tool life. Helical ramping also creates the entry pocket without increasing cycle time to the process and allows for milling to deeper Z depths. The M213 can helical ramp to the depth of the tool's length of cut.



Tool	Max Ramp Angle	SFM and Feed Rate	Max Ramp Depth	Max Hole Diameter
M213	15°	Please reference data in chart on page 7.	Equal to LOC	(D x 2) - (corner radius x 2)

METHOD 2: Plunging

A pre-drilled starter hole is no longer needed when milling with the M213 series. The end face geometry allows for a plunge move in the Z-axis up to 1 x diameter at feed rates that compare to a drill. Plunging to depth and milling that level at high feed rates keeps the metal removal rates high and saves the time of a tool change.

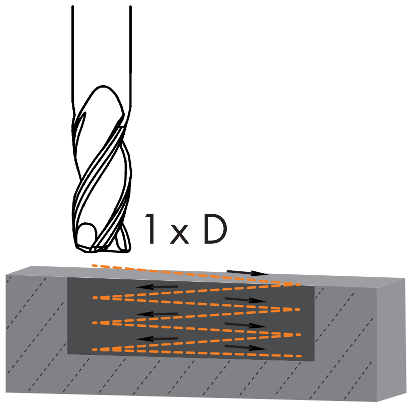


Tool	Max Ramp Angle	SFM	Feed	Max Ramp Depth	Max Peck Depth
M213	90°	Use slotting speed	Use slotting IPT x .9	1 x D	Up to 1 x D per peck

D = Tool Diameter

METHOD 3: Straight Line Ramping

The M213 end mill can straight-line ramp at an entry angle up to 45° which saves time using the traditional zig-zag entry tool path. Caution: machine horsepower requirements increase as the ramp angle increases. Once reaching the final Z depth, the M213 can slot up to 1 x D depth with no clogging.



Tool	Max Ramp Angle	SFM and Feed Rate	Max Ramp Depth	Max Ramp Length
M213	45°	Please reference data in chart on page 7.	1 x D	(1 x D) / drop per inch

D = Tool Diameter

Use this guide as an aid in determining maximum ramp length. ▶

Ramp Angle	Drop (per inch)
1°	0.0175
2°	0.035
2.5°	0.04375
3°	0.0525
3.5°	0.06125
5°	0.0875
10°	0.175

Ramp Angle	Drop (per inch)
15°	0.2625
20°	0.35
25°	0.4375
30°	0.525
35°	0.6125
40°	0.7
45°	0.7875

ADJUSTMENTS FOR BALL NOSE END MILLS

The speeds and feeds of ball nose end mills must be adjusted to ensure proper tool life. Adjustments are based on the amount of tool engagement.

If the depth of cut (ADOC) is <50% of the tool diameter:

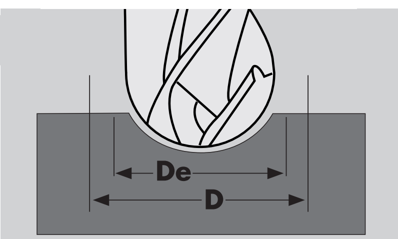
Adjustments must be made to determine the effective cutting diameter and to adjust for axial chip thinning. Follow these steps:

STEP 1: Use speed and feed values for slot cuts from the speed and feed charts for the appropriate material and tool diameter.

Note: Make an additional adjustment using the chart to the right if the tool projection exceeds 2.5 x the tool diameter.

Projection	Speed Adj	Feed Adj
> 2.5 to 3 x D	SFM x .95	IPT x .95
> 3 to 4 x D	SFM x .90	IPT x .90
> 4 to 5 x D	SFM x .80	IPT x .80
> 5 to 6 x D	SFM x .70	IPT x .70

STEP 2: Determine the effective cutting diameter (De) of the end mill based on the axial depth of cut. The effective cutting diameter will be used to make both speed and feed adjustments.



Use D when making shallow cuts with full radius

Ball Nose "Effective Diameter"

$$D = 2x\sqrt{R^2 - (R - ADOC)^2}$$

For easy reference, use the chart below.

Depth of Cut (ADOC)	1/8		1/4		3/8		1/2		3/4		1	
	Depth	De	Depth	De	Depth	De	Depth	De	Depth	De	Depth	De
10% of tool diameter	.013	.075	.025	.150	.038	.225	.050	.300	.075	.450	.100	.600
20% of tool diameter	.025	.100	.050	.200	.075	.300	.100	.400	.150	.600	.200	.800
30% of tool diameter	.038	.115	.075	.229	.113	.344	.150	.458	.225	.687	.300	.917
40% of tool diameter	.050	.123	.100	.245	.150	.367	.200	.490	.300	.73	.400	.980
50% of tool diameter	.063	.125	.125	.250	.186	.375	.250	.500	.375	.75	.500	1.00

STEP 3: Calculate speed based on using the effective cutting diameter. Use the standard to RPM conversion formula. Substitute the effective cutting diameter (De) for the actual tool diameter (D).

STEP 4: Calculate the adjusted feed rate based on the effective cutting diameter and the axial chip thinning formula.

$$RPM = (SFM \times 3.82) / De$$

D = Actual tool diameter
IPT = Feed rate from chart for slot milling
De = Effective cutting diameter

$$IPTadj = (D \times IPT) / De$$

The new feed rate is calculated:

$$IPM = RPM \times (Z \times IPT\,adj)$$

IPM = Inches per minute
Z = # of flutes
IPT adj = Adjusted chip load per tooth fractional

If the axial depth of cut (ADOC) is ≥50% of the tool diameter:

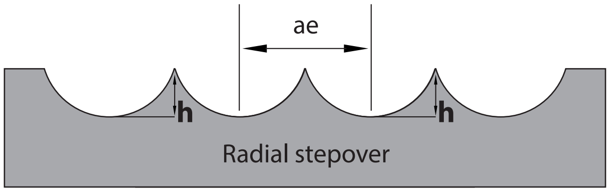
- Use the speed and feed values shown for the slotting operation in the speed and feed charts for the series of end mill being used.
- If the tool projection exceeds 2.5 x the tool diameter, adjust the slotting speeds and feeds by the chart for long reach tool adjustments.

SURFACE FINISH

Radial depth of cut (RDOC), or step-over, is based on the desired finish. The lighter the step-over, the lower the scallop height (material left uncut by the radius of the tool), and the better the finish. These charts calculate approximate scallop height using the following formula:

$$h \sim (ae^2) / (8R)$$

h = Scallop height
ae = Radial step-over
R = Radius of end mill
(tool diameter x .5)



Tool Diameter	Step-over % of OD	Step-over Actual	Approx Scallop Height
1/8	10%	.013	.0003
	20%	.025	.0013
	30%	.038	.0028
1/4	10%	.025	.0006
	20%	.050	.0025
	30%	.075	.0056
3/8	10%	.038	.0009
	20%	.075	.0038
	.30%	.113	.0084
1/2	10%	.050	.0013
	20%	.100	.0050
	30%	.150	.0113
3/4	10%	.075	.0019
	20%	.150	.0075
	30%	.225	.0169
1	10%	.100	.0025
	20%	.200	.0100
	30%	.300	.0225

IMCO Carbide Tool Inc.
28170 Cedar Park Blvd.
Perrysburg, OH 43551
www.imcousa.com

Member IMC Group

Power. Precision. Performance.

In USA call 1-800-765-4626
International 419-661-6313
Fax 419-661-6314
Email support@imcousa.com