

TOLERANCES

$d1$	$\leq .030"$ $\geq 1/32"$	$+0.000" - .001" (+0.000 - .025mm)$ $+0.000" - .002" (+0.000 - .050mm)$
$d2$		h6



Series 160M, 170M, 860M, 870M

.0200" - .2362"
(0.508mm - 6.000mm)

GENERAL PURPOSE
END MILLS

Stub Length - Square End

Solid submicron grain carbide end mill - center cutting

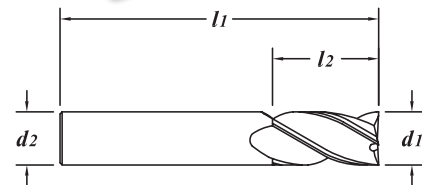
Shorter flute length for rigidity

Extremely versatile

TiAlN Coated - page 209

Standard Length - page 216

Extended length - page 236



(160M/860M) 2 Flute EDP#	(170M/870M) 4 Flute EDP#	$d1$ † Diameter			$d2$ Shank Diameter	$l1$ Overall Length	$l2$ Flute Length	1-11	12-24	25-49	50-100
Decimal				Metric							
01350	-	.0200	.0200"	0.508	1/8"	1-1/2"	.030"	18.40	17.60	16.80	16.00
01360	-	.0210	.0210"	0.533	1/8"	1-1/2"	.032"	18.40	17.60	16.80	16.00
01370	-	.0220	.0220"	0.559	1/8"	1-1/2"	.033"	18.18	17.39	16.60	15.81
01380	-	.0230	.0230"	0.584	1/8"	1-1/2"	.035"	18.18	17.39	16.60	15.81
01390	-	.0240	.0240"	0.610	1/8"	1-1/2"	.036"	18.18	17.39	16.60	15.81
01400	-	.0250	.0250"	0.635	1/8"	1-1/2"	.038"	17.15	16.40	15.66	14.91
01410	-	.0260	.0260"	0.660	1/8"	1-1/2"	.039"	17.15	16.40	15.66	14.91
01420	-	.0270	.0270"	0.686	1/8"	1-1/2"	.041"	15.38	14.71	14.04	13.37
01430	-	.0280	.0280"	0.711	1/8"	1-1/2"	.042"	15.38	14.71	14.04	13.37
01440	-	.0290	.0290"	0.737	1/8"	1-1/2"	.044"	15.38	14.71	14.04	13.37
01450	-	.0300	.0300"	0.762	1/8"	1-1/2"	.045"	15.38	14.71	14.04	13.37
01010	02010	.0312	1/32"	0.792	1/8"	1-1/2"	1/16"	11.19	10.70	10.22	9.73
01510	02510	.0394		1.000	3.0	38	2	11.75	11.24	10.73	10.22
01020	02020	.0469	3/64"	1.191	1/8"	1-1/2"	3/32"	11.19	10.70	10.22	9.73
01520	02520	.0591		1.500	3.0	38	3	11.75	11.24	10.73	10.22
01030	02030	.0625	1/16"	1.588	1/8"	1-1/2"	1/8"	8.88	8.49	8.11	7.72
01530	02530	.0787		2.000	3.0	38	4	9.34	8.93	8.53	8.12
01040	02040	.0938	3/32"	2.383	1/8"	1-1/2"	3/16"	8.40	8.03	7.67	7.30
01540	02540	.0984		2.500	3.0	38	5	8.84	8.46	8.07	7.69
01550	02550	.1181		3.000	3.0	38	6	8.63	8.25	7.88	7.50
01050	02050	.1250	1/8"	3.175	1/8"	1-1/2"	1/4"	8.18	7.82	7.47	7.11
01560	02560	.1378		3.500	4.0	50	7	12.06	11.54	11.01	10.49
01060	02060	.1562	5/32"	3.967	3/16"	2"	5/16"	11.48	10.98	10.48	9.98
01570	02570	.1575		4.000	4.0	50	8	11.41	10.91	10.42	9.92
01580	02580	.1772		4.500	5.0	50	9.5	15.15	14.49	13.83	13.17
01070	02070	.1875	3/16"	4.763	3/16"	2"	3/8"	10.86	10.38	9.91	9.44
01590	02590	.1969		5.000	5.0	50	10	14.12	13.51	12.89	12.28
01080	02080	.2188	7/32"	5.558	1/4"	2"	7/16"	14.40	13.77	13.15	12.52
01600	02600	.2362		6.000	6.0	50	12	14.96	14.31	13.66	13.01

continued →

Series 160M, 170M, 860M, 870M (continued)

.2500" - 1.000"
(6.350mm - 25.400mm)

(160M/860M) 2 Flute EDP#	(170M/870M) 4 Flute EDP#	$d1$ † Diameter		$d2$ Shank Diameter	$l1$ Overall Length	$l2$ Flute Length	1-11	12-24	25-49	50-100
		Decimal	Metric							
01090	02090	.2500	1/4"	6.350	1/4"	2"	14.19	13.57	12.96	12.34
01610	02610	.2756		7.000	7.0	50	19.45	18.60	17.76	16.91
01100	02100	.3125	5/16"	7.938	5/16"	2"	19.42	18.58	17.73	16.89
01620	02620	.3150		8.000	8.0	50	20.41	19.53	18.64	17.75
01630	02630	.3543		9.000	9.0	50	25.22	24.12	23.03	21.93
01110	02110	.3750	3/8"	9.525	3/8"	2"	23.99	22.95	21.90	20.86
01640	02640	.3937		10.000	10.0	50	27.88	26.66	25.45	24.24
01650	02650	.4331		11.000	11.0	65	32.58	31.16	29.75	28.33
01120	02120	.4375	7/16"	11.113	7/16"	2-1/2"	29.66	28.37	27.08	25.79
01660	02660	.4724		12.000	12.0	65	41.63	39.82	38.01	36.20
01130	02130	.5000	1/2"	12.700	1/2"	2-1/2"	39.56	37.84	36.12	34.40
01140	02140	.6250	5/8"	15.875	5/8"	3"	75.61	72.33	69.04	65.75
-	02670	.6299		16.000	16.0	75	79.58	76.12	72.66	69.20
01150	02150	.7500	3/4"	19.050	3/4"	3"	108.76	104.03	99.30	94.57
-	02680	.7874		20.000	20.0	75	147.49	141.08	134.66	128.25
-	02160	1.000	1"	25.400	1"	3"	187.14	179.00	170.87	162.73



End Mill Manufacturing

TOLERANCES

$d1$	$+0.000" - .002" (+.000 - .050\text{mm})$
$d2$	$h6$

Series 160MA, 170MA, 860MA, 870MA

Stub Length - Square End
TiAlN Coating

Solid submicron grain carbide end mill - center cutting

Shorter flute length for rigidity

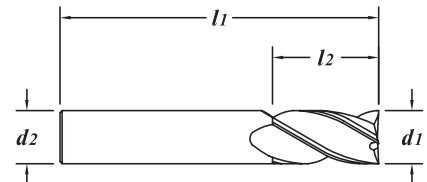
Dry or semi-dry machining

Extremely versatile

Uncoated - page 207

Standard Length - page 220

Extended length - page 239



(160MA/860MA) 2 Flute EDP#	(170MA/870MA) 4 Flute EDP#	$d1$ †			$d2$ Shank Diameter	$l1$ Overall Length	$l2$ Flute Length	1-11	12-24	25-49	50-100
		Decimal	Diameter	Metric							
01017	02017	.0312	1/32"	0.792	1/8"	1-1/2"	1/16"	13.88	13.28	12.67	12.07
01517	02517	.0394		1.000	3.0	38	2	14.47	13.84	13.21	12.58
01027	02027	.0469	3/64"	1.191	1/8"	1-1/2"	3/32"	13.88	13.28	12.67	12.07
01527	02527	.0591		1.500	3.0	38	3	14.47	13.84	13.21	12.58
01037	02037	.0625	1/16"	1.588	1/8"	1-1/2"	1/8"	11.58	11.08	10.57	10.07
01537	02537	.0787		2.000	3.0	38	4	12.04	11.52	10.99	10.47
01047	02047	.0938	3/32"	2.383	1/8"	1-1/2"	3/16"	11.10	10.62	10.13	9.65
01547	02547	.0984		2.500	3.0	38	5	11.53	11.03	10.53	10.03
01557	02557	.1181		3.000	3.0	38	6	11.30	10.81	10.32	9.83
01057	02057	.1250	1/8"	3.175	1/8"	1-1/2"	1/4"	10.86	10.38	9.91	9.44
01567	02567	.1378		3.500	4.0	50	7	14.75	14.11	13.47	12.83
01067	02067	.1562	5/32"	3.967	3/16"	2"	5/16"	14.16	13.54	12.93	12.31
01577	02577	.1575		4.000	4.0	50	8	14.12	13.51	12.89	12.28
01587	02587	.1772		4.500	5.0	50	9.5	19.35	18.51	17.67	16.83
01077	02077	.1875	3/16"	4.763	3/16"	2"	3/8"	13.56	12.97	12.38	11.79
01597	02597	.1969		5.000	5.0	50	10	18.31	17.51	16.72	15.92
01087	02087	.2188	7/32"	5.558	1/4"	2"	7/16"	18.61	17.80	16.99	16.18
01607	02607	.2362		6.000	6.0	50	12	19.15	18.32	17.48	16.65
01097	02097	.2500	1/4"	6.350	1/4"	2"	1/2"	18.40	17.60	16.80	16.00
01617	02617	.2756		7.000	7.0	50	12	25.44	24.33	23.23	22.12
01107	02107	.3125	5/16"	7.938	5/16"	2"	1/2"	25.42	24.31	23.21	22.10
01627	02627	.3150		8.000	8.0	50	12	26.43	25.28	24.13	22.98
01637	02637	.3543		9.000	9.0	50	14	31.21	29.85	28.50	27.14
01117	02117	.3750	3/8"	9.525	3/8"	2"	5/8"	29.97	28.67	27.36	26.06
01647	02647	.3937		10.000	10.0	50	16	34.67	33.17	31.66	30.15
01657	02657	.4331		11.000	11.0	65	19	42.03	40.21	38.38	36.55
01127	02127	.4375	7/16"	11.113	7/16"	2-1/2"	5/8"	39.11	37.41	35.71	34.01
01667	02667	.4724		12.000	12.0	65	19	51.08	48.86	46.64	44.42
01137	02137	.5000	1/2"	12.700	1/2"	2-1/2"	5/8"	49.01	46.88	44.75	42.62
01147	02147	.6250	5/8"	15.875	5/8"	3"	3/4"	86.58	82.82	79.05	75.29
-	02677	.6299		16.000	16.0	75	19	90.52	86.58	82.65	78.71
01157	02157	.7500	3/4"	19.050	3/4"	3"	1"	121.88	116.58	111.28	105.98
-	02687	.7874		20.000	20.0	75	25	168.16	160.85	153.54	146.23
-	02167	1.000	1"	25.400	1"	3"	1"	207.82	198.78	189.75	180.71

GENERAL PURPOSE
END MILLS

70

35

MATERIAL HARDNESS (Rc)

0

Series 170R, 870R

.0625" - .3150"
(1.588mm - 8.000mm)TECH
PAGES
282-283

TOLERANCES

d_1	$+0.000" - .002" (+.000 - .050\text{mm})$
d_2	$h6$
r	$+0.001" - .001" (+.025 - .025\text{mm})$

Stub Length - Corner Radius

Solid submicron grain carbide end mill - center cutting

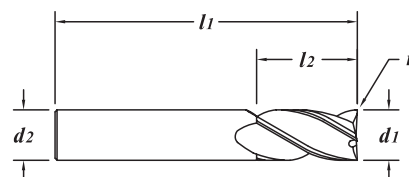
For stronger corners and part radius

Extremely versatile

TiALN Coating - page 212

Standard Length - page 222

Extended Length - page 241



EDP#	d_1 †			d_2 Shank Diameter	l_1 Overall Length	l_2 Flute Length	r Corner Radius	1-11	12-24	25-49	50-100
	Decimal	Diameter	Metric								
30701	.0625	1/16"	1.588	1/8"	1-1/2"	1/8"	.010"	10.47	10.01	9.56	9.10
30703	.0625	1/16"	1.588	1/8"	1-1/2"	1/8"	.015"	10.47	10.01	9.56	9.10
30705	.0938	3/32"	2.383	1/8"	1-1/2"	3/16"	.010"	9.88	9.45	9.02	8.59
30707	.0938	3/32"	2.383	1/8"	1-1/2"	3/16"	.015"	9.88	9.45	9.02	8.59
30709	.0938	3/32"	2.383	1/8"	1-1/2"	3/16"	.020"	9.88	9.45	9.02	8.59
30711	.1181		3.000	3.0	38	6	0.20	10.12	9.68	9.24	8.80
30713	.1181		3.000	3.0	38	6	0.50	10.12	9.68	9.24	8.80
30715	.1250	1/8"	3.175	1/8"	1-1/2"	1/4"	.010"	9.63	9.21	8.79	8.37
30717	.1250	1/8"	3.175	1/8"	1-1/2"	1/4"	.015"	9.63	9.21	8.79	8.37
30719	.1250	1/8"	3.175	1/8"	1-1/2"	1/4"	.020"	9.63	9.21	8.79	8.37
30721	.1250	1/8"	3.175	1/8"	1-1/2"	1/4"	.030"	9.63	9.21	8.79	8.37
30904	.1250	1/8"	3.175	1/8"	1-1/2"	1/4"	.040"	9.63	9.21	8.79	8.37
30909	.1562	5/32"	3.967	3/16"	2"	5/16"	.015"	13.48	12.89	12.31	11.72
30911	.1562	5/32"	3.967	3/16"	2"	5/16"	.030"	13.48	12.89	12.31	11.72
30913	.1562	5/32"	3.967	3/16"	2"	5/16"	.060"	13.48	12.89	12.31	11.72
30723	.1575		4.000	4.0	50	8	0.30	13.47	12.88	12.30	11.71
30725	.1575		4.000	4.0	50	8	0.50	13.47	12.88	12.30	11.71
30727	.1875	3/16"	4.763	3/16"	2"	3/8"	.010"	12.79	12.23	11.68	11.12
30729	.1875	3/16"	4.763	3/16"	2"	3/8"	.015"	12.79	12.23	11.68	11.12
30731	.1875	3/16"	4.763	3/16"	2"	3/8"	.020"	12.79	12.23	11.68	11.12
30733	.1875	3/16"	4.763	3/16"	2"	3/8"	.030"	12.79	12.23	11.68	11.12
30735	.1969		5.000	5.0	50	10	0.30	16.77	16.04	15.31	14.58
30737	.1969		5.000	5.0	50	10	0.50	16.77	16.04	15.31	14.58
30739	.2362		6.000	6.0	50	12	0.50	17.61	16.84	16.08	15.31
30741	.2362		6.000	6.0	50	12	0.80	17.61	16.84	16.08	15.31
30743	.2362		6.000	6.0	50	12	1.00	17.61	16.84	16.08	15.31
30745	.2362		6.000	6.0	50	12	1.50	17.61	16.84	16.08	15.31
30747	.2362		6.000	6.0	50	12	2.00	17.61	16.84	16.08	15.31
30749	.2500	1/4"	6.350	1/4"	2"	1/2"	.010"	16.69	15.96	15.24	14.51
30751	.2500	1/4"	6.350	1/4"	2"	1/2"	.015"	16.69	15.96	15.24	14.51
30753	.2500	1/4"	6.350	1/4"	2"	1/2"	.020"	16.69	15.96	15.24	14.51
30755	.2500	1/4"	6.350	1/4"	2"	1/2"	.030"	16.69	15.96	15.24	14.51
30757	.2500	1/4"	6.350	1/4"	2"	1/2"	.045"	16.69	15.96	15.24	14.51
30759	.2500	1/4"	6.350	1/4"	2"	1/2"	.060"	16.69	15.96	15.24	14.51
30761	.3125	5/16"	7.938	5/16"	2"	1/2"	.015"	22.83	21.84	20.84	19.85
30763	.3125	5/16"	7.938	5/16"	2"	1/2"	.020"	22.83	21.84	20.84	19.85
30765	.3125	5/16"	7.938	5/16"	2"	1/2"	.030"	22.83	21.84	20.84	19.85
30767	.3125	5/16"	7.938	5/16"	2"	1/2"	.045"	22.83	21.84	20.84	19.85
30769	.3125	5/16"	7.938	5/16"	2"	1/2"	.060"	22.83	21.84	20.84	19.85
30771	.3150		8.000	8.0	50	12	0.50	24.04	22.99	21.95	20.90
30773	.3150		8.000	8.0	50	12	0.80	24.04	22.99	21.95	20.90
30775	.3150		8.000	8.0	50	12	1.00	24.04	22.99	21.95	20.90
30777	.3150		8.000	8.0	50	12	1.50	24.04	22.99	21.95	20.90
30779	.3150		8.000	8.0	50	12	2.00	24.04	22.99	21.95	20.90
30781	.3150		8.000	8.0	50	12	2.50	24.04	22.99	21.95	20.90
30783	.3150		8.000	8.0	50	12	3.00	24.04	22.99	21.95	20.90

EDP#	$d1^{\dagger}$		Metric	$d2$ Shank Diameter	$l1$ Overall Length	$l2$ Flute Length	r Corner Radius	1-11	12-24	25-49	50-100
	Decimal	Diameter									
30785	.3750	3/8"	9.525	3/8"	2"	5/8"	.010"	28.20	26.97	25.75	24.52
30787	.3750	3/8"	9.525	3/8"	2"	5/8"	.015"	28.20	26.97	25.75	24.52
30789	.3750	3/8"	9.525	3/8"	2"	5/8"	.020"	28.20	26.97	25.75	24.52
30791	.3750	3/8"	9.525	3/8"	2"	5/8"	.030"	28.20	26.97	25.75	24.52
30793	.3750	3/8"	9.525	3/8"	2"	5/8"	.045"	28.20	26.97	25.75	24.52
30795	.3750	3/8"	9.525	3/8"	2"	5/8"	.060"	28.20	26.97	25.75	24.52
30797	.3937		10.000	10.0	50	16	0.50	32.81	31.38	29.96	28.53
30799	.3937		10.000	10.0	50	16	0.80	32.81	31.38	29.96	28.53
30801	.3937		10.000	10.0	50	16	1.00	32.81	31.38	29.96	28.53
30803	.3937		10.000	10.0	50	16	1.50	32.81	31.38	29.96	28.53
30805	.3937		10.000	10.0	50	16	2.00	32.81	31.38	29.96	28.53
30807	.3937		10.000	10.0	50	16	2.50	32.81	31.38	29.96	28.53
30809	.3937		10.000	10.0	50	16	3.00	32.81	31.38	29.96	28.53
30811	.3937		10.000	10.0	50	16	3.20	32.81	31.38	29.96	28.53
30813	.4375	7/16"	11.113	7/16"	2-1/2"	5/8"	.010"	34.89	33.37	31.86	30.34
30815	.4375	7/16"	11.113	7/16"	2-1/2"	5/8"	.015"	34.89	33.37	31.86	30.34
30817	.4375	7/16"	11.113	7/16"	2-1/2"	5/8"	.020"	34.89	33.37	31.86	30.34
30819	.4375	7/16"	11.113	7/16"	2-1/2"	5/8"	.030"	34.89	33.37	31.86	30.34
30821	.4375	7/16"	11.113	7/16"	2-1/2"	5/8"	.045"	34.89	33.37	31.86	30.34
30823	.4375	7/16"	11.113	7/16"	2-1/2"	5/8"	.060"	34.89	33.37	31.86	30.34
30825	.4375	7/16"	11.113	7/16"	2-1/2"	5/8"	.090"	34.89	33.37	31.86	30.34
30827	.4375	7/16"	11.113	7/16"	2-1/2"	5/8"	.125"	34.89	33.37	31.86	30.34
30829	.4724		12.000	12.0	65	19	0.50	48.94	46.82	44.69	42.56
30831	.4724		12.000	12.0	65	19	0.80	48.94	46.82	44.69	42.56
30833	.4724		12.000	12.0	65	19	1.00	48.94	46.82	44.69	42.56
30835	.4724		12.000	12.0	65	19	1.50	48.94	46.82	44.69	42.56
30837	.4724		12.000	12.0	65	19	2.00	48.94	46.82	44.69	42.56
30839	.4724		12.000	12.0	65	19	2.50	48.94	46.82	44.69	42.56
30841	.4724		12.000	12.0	65	19	3.00	48.94	46.82	44.69	42.56
30843	.4724		12.000	12.0	65	19	3.20	48.94	46.82	44.69	42.56
30845	.5000	1/2"	12.700	1/2"	2-1/2"	5/8"	.010"	46.52	44.50	42.47	40.45
30847	.5000	1/2"	12.700	1/2"	2-1/2"	5/8"	.015"	46.52	44.50	42.47	40.45
30849	.5000	1/2"	12.700	1/2"	2-1/2"	5/8"	.020"	46.52	44.50	42.47	40.45
30851	.5000	1/2"	12.700	1/2"	2-1/2"	5/8"	.030"	46.52	44.50	42.47	40.45
30853	.5000	1/2"	12.700	1/2"	2-1/2"	5/8"	.045"	46.52	44.50	42.47	40.45
30855	.5000	1/2"	12.700	1/2"	2-1/2"	5/8"	.060"	46.52	44.50	42.47	40.45
30857	.5000	1/2"	12.700	1/2"	2-1/2"	5/8"	.090"	46.52	44.50	42.47	40.45
30859	.5000	1/2"	12.700	1/2"	2-1/2"	5/8"	.125"	46.52	44.50	42.47	40.45
30861	.6250	5/8"	15.875	5/8"	3"	3/4"	.015"	88.99	85.12	81.25	77.38
30863	.6250	5/8"	15.875	5/8"	3"	3/4"	.020"	88.99	85.12	81.25	77.38
30865	.6250	5/8"	15.875	5/8"	3"	3/4"	.030"	88.99	85.12	81.25	77.38
30867	.6250	5/8"	15.875	5/8"	3"	3/4"	.045"	88.99	85.12	81.25	77.38
30869	.6250	5/8"	15.875	5/8"	3"	3/4"	.060"	88.99	85.12	81.25	77.38
30871	.6250	5/8"	15.875	5/8"	3"	3/4"	.090"	88.99	85.12	81.25	77.38
30873	.6299		16.000	16.0	75	19	0.50	93.62	89.55	85.48	81.41
30875	.6299		16.000	16.0	75	19	1.00	93.62	89.55	85.48	81.41
30877	.6299		16.000	16.0	75	19	2.00	93.62	89.55	85.48	81.41
30879	.6299		16.000	16.0	75	19	2.50	93.62	89.55	85.48	81.41
30881	.6299		16.000	16.0	75	19	3.00	93.62	89.55	85.48	81.41
30883	.6299		16.000	16.0	75	19	4.00	93.62	89.55	85.48	81.41
30885	.6299		16.000	16.0	75	19	5.00	93.62	89.55	85.48	81.41
30887	.7500	3/4"	19.050	3/4"	3"	1"	.015"	127.97	122.41	116.84	111.28
30889	.7500	3/4"	19.050	3/4"	3"	1"	.020"	127.97	122.41	116.84	111.28
30891	.7500	3/4"	19.050	3/4"	3"	1"	.030"	127.97	122.41	116.84	111.28
30893	.7500	3/4"	19.050	3/4"	3"	1"	.045"	127.97	122.41	116.84	111.28
30895	.7500	3/4"	19.050	3/4"	3"	1"	.060"	127.97	122.41	116.84	111.28
30897	.7500	3/4"	19.050	3/4"	3"	1"	.090"	127.97	122.41	116.84	111.28
30899	.7500	3/4"	19.050	3/4"	3"	1"	.125"	127.97	122.41	116.84	111.28
30901	.7500	3/4"	19.050	3/4"	3"	1"	.250"	127.97	122.41	116.84	111.28

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MATERIAL HARDNESS (Rc)

0

Series 170RA, 870RA

.0625" - .3150"
(1.588mm - 8.000mm)TECH
PAGES
282-283

TOLERANCES

d_1	$+0.000" - .002" (+.000 - .050\text{mm})$
d_2	$h6$
r	$+0.001" - .001" (+.025 - .025\text{mm})$

Stub Length - Corner Radius

TiAlN Coating

Solid submicron grain carbide end mill - center cutting

Dry or semi-dry machining

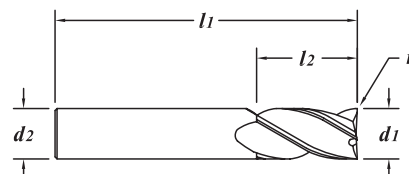
For stronger corners and part radius

Extremely versatile

Uncoated - page 210

Standard Length - page 225

Extended Length - page 244



EDP#	d_1 †		d_2	l_1	l_2	r	1-11	12-24	25-49	50-100
	Decimal	Diameter	Metric	Shank Diameter	Overall Length	Flute Length	Corner Radius			
30702	.0625	1/16"	1.588	1/8"	1-1/2"	1/8"	.010"	13.14	12.57	12.00
30704	.0625	1/16"	1.588	1/8"	1-1/2"	1/8"	.015"	13.14	12.57	12.00
30706	.0938	3/32"	2.383	1/8"	1-1/2"	3/16"	.010"	12.57	12.02	11.48
30708	.0938	3/32"	2.383	1/8"	1-1/2"	3/16"	.015"	12.57	12.02	11.48
30710	.0938	3/32"	2.383	1/8"	1-1/2"	3/16"	.020"	12.57	12.02	11.48
30712	.1181		3.000	3.0	38	6	0.20	12.81	12.25	11.70
30714	.1181		3.000	3.0	38	6	0.50	12.81	12.25	11.70
30716	.1250	1/8"	3.175	1/8"	1-1/2"	1/4"	.010"	12.32	11.78	11.25
30718	.1250	1/8"	3.175	1/8"	1-1/2"	1/4"	.015"	12.32	11.78	11.25
30720	.1250	1/8"	3.175	1/8"	1-1/2"	1/4"	.020"	12.32	11.78	11.25
30722	.1250	1/8"	3.175	1/8"	1-1/2"	1/4"	.030"	12.32	11.78	11.25
30906	.1250	1/8"	3.175	1/8"	1-1/2"	1/4"	.040"	12.32	11.78	11.25
30910	.1562	5/32"	3.967	3/16"	2"	5/16"	.015"	16.16	15.46	14.75
30912	.1562	5/32"	3.967	3/16"	2"	5/16"	.030"	16.16	15.46	14.75
30914	.1562	5/32"	3.967	3/16"	2"	5/16"	.060"	16.16	15.46	14.75
30724	.1575		4.000	4.0	50	8	0.30	16.15	15.44	14.74
30726	.1575		4.000	4.0	50	8	0.50	16.15	15.44	14.74
30728	.1875	3/16"	4.763	3/16"	2"	3/8"	.010"	15.48	14.81	14.13
30730	.1875	3/16"	4.763	3/16"	2"	3/8"	.015"	15.48	14.81	14.13
30732	.1875	3/16"	4.763	3/16"	2"	3/8"	.020"	15.48	14.81	14.13
30734	.1875	3/16"	4.763	3/16"	2"	3/8"	.030"	15.48	14.81	14.13
30736	.1969		5.000	5.0	50	10	0.30	20.95	20.04	19.13
30738	.1969		5.000	5.0	50	10	0.50	20.95	20.04	19.13
24117	.1969		5.000	5.0	50	16	0.30	25.05	23.97	22.88
30740	.2362		6.000	6.0	50	12	0.50	21.79	20.85	19.90
30742	.2362		6.000	6.0	50	12	0.80	21.79	20.85	19.90
30744	.2362		6.000	6.0	50	12	1.00	21.79	20.85	19.90
30746	.2362		6.000	6.0	50	12	1.50	21.79	20.85	19.90
30748	.2362		6.000	6.0	50	12	2.00	21.79	20.85	19.90
30750	.2500	1/4"	6.350	1/4"	2"	1/2"	.010"	20.91	20.00	19.09
30752	.2500	1/4"	6.350	1/4"	2"	1/2"	.015"	20.91	20.00	19.09
30754	.2500	1/4"	6.350	1/4"	2"	1/2"	.020"	20.91	20.00	19.09
30756	.2500	1/4"	6.350	1/4"	2"	1/2"	.030"	20.91	20.00	19.09
30758	.2500	1/4"	6.350	1/4"	2"	1/2"	.045"	20.91	20.00	19.09
30760	.2500	1/4"	6.350	1/4"	2"	1/2"	.060"	20.91	20.00	19.09
30762	.3125	5/16"	7.938	5/16"	2"	1/2"	.015"	28.82	27.57	26.31
30764	.3125	5/16"	7.938	5/16"	2"	1/2"	.020"	28.82	27.57	26.31
30766	.3125	5/16"	7.938	5/16"	2"	1/2"	.030"	28.82	27.57	26.31
30768	.3125	5/16"	7.938	5/16"	2"	1/2"	.045"	28.82	27.57	26.31
30770	.3125	5/16"	7.938	5/16"	2"	1/2"	.060"	28.82	27.57	26.31
30772	.3150		8.000	8.0	50	12	0.50	30.03	28.72	27.42
30774	.3150		8.000	8.0	50	12	0.80	30.03	28.72	27.42
30776	.3150		8.000	8.0	50	12	1.00	30.03	28.72	27.42
30778	.3150		8.000	8.0	50	12	1.50	30.03	28.72	27.42
30780	.3150		8.000	8.0	50	12	2.00	30.03	28.72	27.42
30782	.3150		8.000	8.0	50	12	2.50	30.03	28.72	27.42
30784	.3150		8.000	8.0	50	12	3.00	30.03	28.72	27.42

EDP#	$d1^{\dagger}$		Metric	$d2$ Shank Diameter	$l1$ Overall Length	$l2$ Flute Length	r Corner Radius	1-11	12-24	25-49	50-100
	Decimal	Diameter									
30786	.3750	3/8"	9.525	3/8"	2"	5/8"	.010"	34.19	32.70	31.22	29.73
30788	.3750	3/8"	9.525	3/8"	2"	5/8"	.015"	34.19	32.70	31.22	29.73
30790	.3750	3/8"	9.525	3/8"	2"	5/8"	.020"	34.19	32.70	31.22	29.73
30792	.3750	3/8"	9.525	3/8"	2"	5/8"	.030"	34.19	32.70	31.22	29.73
30794	.3750	3/8"	9.525	3/8"	2"	5/8"	.045"	34.19	32.70	31.22	29.73
30796	.3750	3/8"	9.525	3/8"	2"	5/8"	.060"	34.19	32.70	31.22	29.73
30798	.3937		10.000	10.0	50	16	0.50	39.59	37.87	36.15	34.43
30800	.3937		10.000	10.0	50	16	0.80	39.59	37.87	36.15	34.43
30802	.3937		10.000	10.0	50	16	1.00	39.59	37.87	36.15	34.43
30804	.3937		10.000	10.0	50	16	1.50	39.59	37.87	36.15	34.43
30806	.3937		10.000	10.0	50	16	2.00	39.59	37.87	36.15	34.43
30808	.3937		10.000	10.0	50	16	2.50	39.59	37.87	36.15	34.43
30810	.3937		10.000	10.0	50	16	3.00	39.59	37.87	36.15	34.43
30812	.3937		10.000	10.0	50	16	3.20	39.59	37.87	36.15	34.43
30814	.4375	7/16"	11.113	7/16"	2-1/2"	5/8"	.010"	44.34	42.42	40.49	38.56
30816	.4375	7/16"	11.113	7/16"	2-1/2"	5/8"	.015"	44.34	42.42	40.49	38.56
30818	.4375	7/16"	11.113	7/16"	2-1/2"	5/8"	.020"	44.34	42.42	40.49	38.56
30820	.4375	7/16"	11.113	7/16"	2-1/2"	5/8"	.030"	44.34	42.42	40.49	38.56
30822	.4375	7/16"	11.113	7/16"	2-1/2"	5/8"	.045"	44.34	42.42	40.49	38.56
30824	.4375	7/16"	11.113	7/16"	2-1/2"	5/8"	.060"	44.34	42.42	40.49	38.56
30826	.4375	7/16"	11.113	7/16"	2-1/2"	5/8"	.090"	44.34	42.42	40.49	38.56
30828	.4375	7/16"	11.113	7/16"	2-1/2"	5/8"	.125"	44.34	42.42	40.49	38.56
30830	.4724		12.000	12.0	65	19	0.50	58.41	55.87	53.33	50.79
30832	.4724		12.000	12.0	65	19	0.80	58.41	55.87	53.33	50.79
30834	.4724		12.000	12.0	65	19	1.00	58.41	55.87	53.33	50.79
30836	.4724		12.000	12.0	65	19	1.50	58.41	55.87	53.33	50.79
30838	.4724		12.000	12.0	65	19	2.00	58.41	55.87	53.33	50.79
30840	.4724		12.000	12.0	65	19	2.50	58.41	55.87	53.33	50.79
30842	.4724		12.000	12.0	65	19	3.00	58.41	55.87	53.33	50.79
30844	.4724		12.000	12.0	65	19	3.20	58.41	55.87	53.33	50.79
30846	.5000	1/2"	12.700	1/2"	2-1/2"	5/8"	.010"	55.96	53.53	51.09	48.66
30848	.5000	1/2"	12.700	1/2"	2-1/2"	5/8"	.015"	55.96	53.53	51.09	48.66
30850	.5000	1/2"	12.700	1/2"	2-1/2"	5/8"	.020"	55.96	53.53	51.09	48.66
30852	.5000	1/2"	12.700	1/2"	2-1/2"	5/8"	.030"	55.96	53.53	51.09	48.66
30854	.5000	1/2"	12.700	1/2"	2-1/2"	5/8"	.045"	55.96	53.53	51.09	48.66
30856	.5000	1/2"	12.700	1/2"	2-1/2"	5/8"	.060"	55.96	53.53	51.09	48.66
30858	.5000	1/2"	12.700	1/2"	2-1/2"	5/8"	.090"	55.96	53.53	51.09	48.66
30860	.5000	1/2"	12.700	1/2"	2-1/2"	5/8"	.125"	55.96	53.53	51.09	48.66
30862	.6250	5/8"	15.875	5/8"	3"	3/4"	.015"	99.94	95.59	91.25	86.90
30864	.6250	5/8"	15.875	5/8"	3"	3/4"	.020"	99.94	95.59	91.25	86.90
30866	.6250	5/8"	15.875	5/8"	3"	3/4"	.030"	99.94	95.59	91.25	86.90
30868	.6250	5/8"	15.875	5/8"	3"	3/4"	.045"	99.94	95.59	91.25	86.90
30870	.6250	5/8"	15.875	5/8"	3"	3/4"	.060"	99.94	95.59	91.25	86.90
30872	.6250	5/8"	15.875	5/8"	3"	3/4"	.090"	99.94	95.59	91.25	86.90
30874	.6299		16.000	16.0	75	19	0.50	104.56	100.01	95.47	90.92
30876	.6299		16.000	16.0	75	19	1.00	104.56	100.01	95.47	90.92
30878	.6299		16.000	16.0	75	19	2.00	104.56	100.01	95.47	90.92
30880	.6299		16.000	16.0	75	19	2.50	104.56	100.01	95.47	90.92
30882	.6299		16.000	16.0	75	19	3.00	104.56	100.01	95.47	90.92
30884	.6299		16.000	16.0	75	19	4.00	104.56	100.01	95.47	90.92
30886	.6299		16.000	16.0	75	19	5.00	104.56	100.01	95.47	90.92
30888	.7500	3/4"	19.050	3/4"	3"	1"	.015"	141.11	134.97	128.84	122.70
30890	.7500	3/4"	19.050	3/4"	3"	1"	.020"	141.11	134.97	128.84	122.70
30892	.7500	3/4"	19.050	3/4"	3"	1"	.030"	141.11	134.97	128.84	122.70
30894	.7500	3/4"	19.050	3/4"	3"	1"	.045"	141.11	134.97	128.84	122.70
30896	.7500	3/4"	19.050	3/4"	3"	1"	.060"	141.11	134.97	128.84	122.70
30898	.7500	3/4"	19.050	3/4"	3"	1"	.090"	141.11	134.97	128.84	122.70
30900	.7500	3/4"	19.050	3/4"	3"	1"	.125"	141.11	134.97	128.84	122.70
30902	.7500	3/4"	19.050	3/4"	3"	1"	.250"	141.11	134.97	128.84	122.70

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MATERIAL HARDNESS (Rc)

0

Series 180M, 190M, 980M, 990M



TOLERANCES

d_1	$\leq .030"$	$+0.000" - .001" (+0.000 - .025mm)$
	$\geq 1/32"$	$+0.000" - .002" (+0.000 - .050mm)$
d_2	h6	
ball radius	$+0.000" - .001" (+0.000 - .025mm)$	

Stub Length - Ball End

Solid submicron grain carbide end mill - center cutting

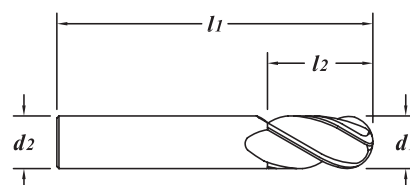
Shorter flute length for rigidity

Extremely versatile

TiAlN Coating - page 215

Standard Length - page 228

Extended length - page 247



(180M/980M) 2 Flute EDP#	(190M/990M) 4 Flute EDP#	d_1 †		d_2 Shank Diameter	l_1 Overall Length	l_2 Flute Length	1-11	12-24	25-49	50-100
		Decimal	Metric							
03350	-	.0200	.0200"	1/8"	1-1/2"	.030"	22.99	21.99	20.99	19.99
03400	-	.0250	.0250"	1/8"	1-1/2"	.038"	22.21	21.24	20.28	19.31
03450	-	.0300	.0300"	1/8"	1-1/2"	.045"	19.14	18.30	17.47	16.64
03010	04010	.0312	1/32"	1/8"	1-1/2"	1/16"	14.19	13.57	12.96	12.34
03510	04510	.0394	1.000	3.0	38	2	14.90	14.26	13.61	12.96
03020	04020	.0469	3/64"	1/8"	1-1/2"	3/32"	14.19	13.57	12.96	12.34
03520	-	.0591	1.500	3.0	38	3	14.90	14.26	13.61	12.96
03030	04030	.0625	1/16"	1/8"	1-1/2"	1/8"	10.47	10.01	9.56	9.10
03530	04530	.0787	2.000	3.0	38	4	11.01	10.53	10.05	9.57
03040	04040	.0938	3/32"	1/8"	1-1/2"	3/16"	9.88	9.45	9.02	8.59
03540	04540	.0984	2.500	3.0	38	5	10.38	9.93	9.48	9.03
03550	04550	.1181	3.000	3.0	38	6	10.12	9.68	9.24	8.80
03050	04050	.1250	1/8"	1/8"	1-1/2"	1/4"	9.63	9.21	8.79	8.37
03560	04560	.1378	3.500	4.0	50	7	14.17	13.55	12.94	12.32
03060	04060	.1562	5/32"	3/16"	2"	5/16"	13.48	12.89	12.31	11.72
03570	04570	.1575	4.000	4.0	50	8	13.47	12.88	12.30	11.71
03580	04580	.1772	4.500	5.0	50	9.5	17.80	17.03	16.25	15.48
03070	04070	.1875	3/16"	3/16"	2"	3/8"	12.79	12.23	11.68	11.12
03590	04590	.1969	5.000	5.0	50	10	16.77	16.04	15.31	14.58
03080	04080	.2188	7/32"	1/4"	2"	7/16"	16.96	16.23	15.49	14.75
03600	04600	.2362	6.000	6.0	50	12	17.61	16.84	16.08	15.31
03090	04090	.2500	1/4"	1/4"	2"	1/2"	16.69	15.96	15.24	14.51
03610	04610	.2756	7.000	7.0	50	12	23.03	22.03	21.03	20.03
03100	04100	.3125	5/16"	5/16"	2"	1/2"	22.83	21.84	20.84	19.85
03620	04620	.3150	8.000	8.0	50	12	24.04	22.99	21.95	20.90
03630	04630	.3543	9.000	9.0	50	14	29.68	28.39	27.10	25.81
03110	04110	.3750	3/8"	3/8"	2"	5/8"	28.20	26.97	25.75	24.52
03640	04640	.3937	10.000	10.0	50	16	32.81	31.38	29.96	28.53
03120	04120	.4375	7/16"	7/16"	2-1/2"	5/8"	34.89	33.37	31.86	30.34
03660	04660	.4724	12.000	12.0	65	19	48.94	46.82	44.69	42.56
03130	04130	.5000	1/2"	1/2"	2-1/2"	5/8"	46.52	44.50	42.47	40.45
03150	04150	.7500	3/4"	3/4"	3"	1"	127.97	122.41	116.84	111.28

MATERIAL HARDNESS (Rc)

70

35

0

TOLERANCES

d_1	$+0.000^{\circ} - .002^{\circ} (+.000 - .050\text{mm})$
d_2	$h6$
ball radius	$+0.000^{\circ} - .001^{\circ} (+.000 - .025\text{mm})$

Series 180MA, 190MA, 980MA, 990MA

**TECH
PAGES
282-283**
Stub Length - Ball End
TiALN Coating

Solid submicron grain carbide end mill - center cutting

Shorter flute length for rigidity

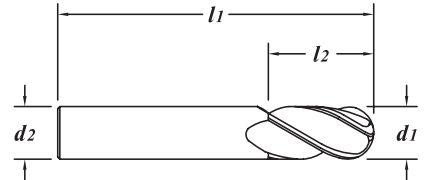
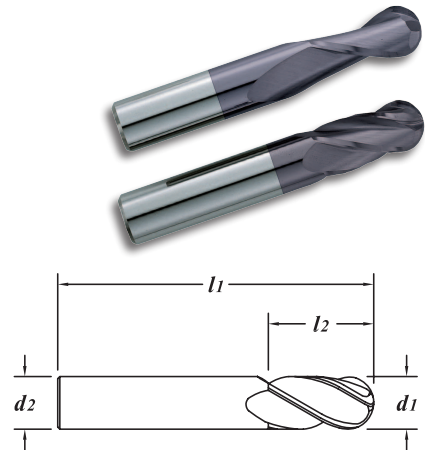
Dry or semi-dry machining

Extremely versatile

Uncoated - page 214

Standard Length - page 232

Extended length - page 250



(180MA/980MA) 2 Flute EDP#	(190MA/990MA) 4 Flute EDP#	d_1 †			d_2	l_1	l_2				
		Decimal	Diameter	Metric	Shank Diameter	Overall Length	Flute Length	1-11	12-24	25-49	50-100
03017	04017	.0312	1/32"	0.792	1/8"	1-1/2"	1/16"	16.91	16.17	15.44	14.70
03517	04517	.0394		1.000	3.0	38	2	17.61	16.84	16.08	15.31
03027	04027	.0469	3/64"	1.191	1/8"	1-1/2"	3/32"	16.91	16.17	15.44	14.70
03527	04527	.0591		1.500	3.0	38	3	17.61	16.84	16.08	15.31
03037	04037	.0625	1/16"	1.588	1/8"	1-1/2"	1/8"	13.14	12.57	12.00	11.43
03537	04537	.0787		2.000	3.0	38	4	13.70	13.10	12.51	11.91
03047	04047	.0938	3/32"	2.383	1/8"	1-1/2"	3/16"	12.57	12.02	11.48	10.93
03547	04547	.0984		2.500	3.0	38	5	13.09	12.52	11.95	11.38
03557	04557	.1181		3.000	3.0	38	6	12.81	12.25	11.70	11.14
03057	04057	.1250	1/8"	3.175	1/8"	1-1/2"	1/4"	12.32	11.78	11.25	10.71
03567	04567	.1378		3.500	4.0	50	7	16.87	16.14	15.40	14.67
03067	04067	.1562	5/32"	3.967	3/16"	2"	5/16"	16.16	15.46	14.75	14.05
03577	04577	.1575		4.000	4.0	50	8	16.15	15.44	14.74	14.04
03587	04587	.1772		4.500	5.0	50	9.5	22.00	21.04	20.09	19.13
03077	04077	.1875	3/16"	4.763	3/16"	2"	3/8"	15.48	14.81	14.13	13.46
03597	04597	.1969		5.000	5.0	50	10	20.95	20.04	19.13	18.22
03087	04087	.2188	7/32"	5.558	1/4"	2"	7/16"	21.16	20.24	19.32	18.40
03607	04607	.2362		6.000	6.0	50	12	21.79	20.85	19.90	18.95
03097	04097	.2500	1/4"	6.350	1/4"	2"	1/2"	20.91	20.00	19.09	18.18
03617	04617	.2756		7.000	7.0	50	12	29.04	27.78	26.51	25.25
03107	04107	.3125	5/16"	7.938	5/16"	2"	1/2"	28.82	27.57	26.31	25.06
03627	04627	.3150		8.000	8.0	50	12	30.03	28.72	27.42	26.11
03637	04637	.3543		9.000	9.0	50	14	35.68	34.13	32.58	31.03
03117	04117	.3750	3/8"	9.525	3/8"	2"	5/8"	34.19	32.70	31.22	29.73
03647	04647	.3937		10.000	10.0	50	16	39.59	37.87	36.15	34.43
03657	04657	.4331		11.000	11.0	65	19	47.18	45.13	43.08	41.03
03127	04127	.4375	7/16"	11.113	7/16"	2-1/2"	5/8"	44.34	42.42	40.49	38.56
03667	04667	.4724		12.000	12.0	65	19	58.41	55.87	53.33	50.79
03137	04137	.5000	1/2"	12.700	1/2"	2-1/2"	5/8"	55.96	53.53	51.09	48.66
-	04147	.6250	5/8"	15.875	5/8"	3"	3/4"	99.94	95.59	91.25	86.90
-	04157	.7500	3/4"	19.050	3/4"	3"	1"	141.11	134.97	128.84	122.70
-	04687	.7874		20.000	20.0	75	25	194.18	185.74	177.29	168.85

GENERAL PURPOSE
END MILLS

70

35

0

MATERIAL HARDNESS (Rc)

Series 220M, 223M, 230M, 820M, 823M, 830M

.0200" - .2362"
(0.508mm - 6.000mm)

TOLERANCES

$d1$	$\leq .030"$	$+0.000" - .001" (+0.000 - .025mm)$
	$\geq 1/32"$	$+0.000" - .002" (+0.000 - .050mm)$
$d2$	h6	

Standard Length - Square End

Solid submicron grain carbide end mill - center cutting

Extremely versatile

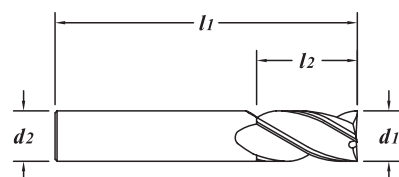
TiN Coating - page 218

TiCN Coating - page 219

TiAlN Coating - page 220

Stub Length - page 207

Extended length - page 236



(220M/820M) 2 Flute EDP#	(223M/823M) 3 Flute EDP#	(230M/830M) 4 Flute EDP#	$d1$ †		$d2$	$l1$	$l2$	1-11	12-24	25-49	50-100
			Decimal	Diameter	Metric	Shank Diameter	Overall Length	Flute Length			
11650	-	13650	.0200	.0200"	0.508	1/8"	1-1/2"	.060"	18.40	17.60	16.80
11660	-	-	.0210	.0210"	0.533	1/8"	1-1/2"	.063"	18.40	17.60	16.80
11670	-	-	.0220	.0220"	0.559	1/8"	1-1/2"	.066"	18.18	17.39	16.60
11680	-	-	.0230	.0230"	0.584	1/8"	1-1/2"	.069"	18.18	17.39	16.60
11690	-	-	.0240	.0240"	0.610	1/8"	1-1/2"	.072"	18.18	17.39	16.60
11700	-	13700	.0250	.0250"	0.635	1/8"	1-1/2"	.075"	17.15	16.40	15.66
11710	-	-	.0260	.0260"	0.660	1/8"	1-1/2"	.078"	17.15	16.40	15.66
11720	-	-	.0270	.0270"	0.686	1/8"	1-1/2"	.081"	15.38	14.71	14.04
11730	-	-	.0280	.0280"	0.711	1/8"	1-1/2"	.084"	15.38	14.71	14.04
11740	-	-	.0290	.0290"	0.737	1/8"	1-1/2"	.087"	15.38	14.71	14.04
11750	-	13750	.0300	.0300"	0.762	1/8"	1-1/2"	.090"	15.38	14.71	14.04
11010	12010	13010	.0312	1/32"	0.792	1/8"	1-1/2"	3/32"	11.19	10.70	10.22
45010	37010	46010	.0394		1.000	3.0	38	4	11.75	11.24	10.73
11020	12020	13020	.0469	3/64"	1.191	1/8"	1-1/2"	1/8"	11.19	10.70	10.22
45020	37020	46020	.0591		1.500	3.0	38	6	11.75	11.24	10.73
11030	12030	13030	.0625	1/16"	1.588	1/8"	1-1/2"	1/4"	10.38	9.93	9.48
11040	12040	13040	.0781	5/64"	1.984	1/8"	1-1/2"	1/4"	10.38	9.93	9.48
45030	37030	46030	.0787		2.000	3.0	38	8	10.89	10.42	9.94
11050	12050	13050	.0938	3/32"	2.383	1/8"	1-1/2"	3/8"	9.82	9.39	8.97
45040	37040	46040	.0984		2.500	3.0	38	12	10.30	9.86	9.41
11060	12060	13060	.1094	7/64"	2.779	1/8"	1-1/2"	3/8"	9.82	9.39	8.97
45050	37050	46050	.1181		3.000	3.0	38	12	9.52	9.11	8.69
11070	12070	13070	.1250	1/8"	3.175	1/8"	1-1/2"	1/2"	9.06	8.67	8.27
45060	37060	46060	.1378		3.500	4.0	50	12	14.09	13.48	12.86
11080	12080	13080	.1406	9/64"	3.571	3/16"	2"	9/16"	13.40	12.82	12.23
11090	12090	13090	.1562	5/32"	3.967	3/16"	2"	9/16"	13.40	12.82	12.23
45070	37070	46070	.1575		4.000	4.0	50	14	13.36	12.78	12.20
11100	12100	13100	.1719	11/64"	4.366	3/16"	2"	9/16"	13.40	12.82	12.23
45080	37080	46080	.1772		4.500	5.0	50	14	16.35	15.64	14.93
11110	12110	13110	.1875	3/16"	4.763	3/16"	2"	5/8"	12.72	12.17	11.61
NEW 92070	93070	94070	.1969		5.000	5.0	50	16	15.30	14.63	13.97
45090	37090	46090	.1969		5.000	5.0	65	16	15.59	14.92	14.24
11120	12120	13120	.2031	13/64"	5.159	1/4"	2-1/2"	5/8"	16.84	16.10	15.37
11130	12130	13130	.2188	7/32"	5.558	1/4"	2-1/2"	5/8"	16.84	16.10	15.37
11140	12140	13140	.2344	15/64"	5.954	1/4"	2-1/2"	3/4"	16.84	16.10	15.37
45100	37100	46100	.2362		6.000	6.0	65	19	16.09	15.39	14.69

Series 220M, 223M, 230M, 820M, 823M, 830M (continued)

.2500" - 1.250"
(6.350mm - 31.750mm)

GENERAL PURPOSE
END MILLS

(220M/820M) 2 Flute EDP#	(223M/823M) 3 Flute EDP#	(230M/830M) 4 Flute EDP#	d_1 † Diameter		d_2 Shank Diameter	l_1 Overall Length	l_2 Flute Length	1-11	12-24	25-49	50-100	
			Decimal		Metric							
11150	12150	13150	.2500	1/4"	6.350	1/4"	2-1/2"	3/4"	15.32	14.65	13.99	13.32
11160	12160	13160	.2656	17/64"	6.746	5/16"	2-1/2"	7/8"	26.88	25.71	24.54	23.37
45110	37110	46110	.2756		7.000	7.0	65	22	22.10	21.14	20.18	19.22
11170	12170	13170	.2812	9/32"	7.142	5/16"	2-1/2"	7/8"	26.88	25.71	24.54	23.37
11180	12180	13180	.2969	19/64"	7.541	5/16"	2-1/2"	7/8"	26.88	25.71	24.54	23.37
11190	12190	13190	.3125	5/16"	7.938	5/16"	2-1/2"	7/8"	21.49	20.56	19.62	18.69
45120	37120	46120	.3150		8.000	8.0	65	22	22.56	21.58	20.60	19.62
11200	12200	13200	.3281	21/64"	8.334	3/8"	2-1/2"	7/8"	31.83	30.45	29.06	27.68
11210	12210	13210	.3438	11/32"	8.733	3/8"	2-1/2"	7/8"	31.83	30.45	29.06	27.68
45130	37130	46130	.3543		9.000	9.0	65	22	28.11	26.88	25.66	24.44
11220	12220	13220	.3594	23/64"	9.129	3/8"	2-1/2"	7/8"	31.83	30.45	29.06	27.68
11230	12230	13230	.3750	3/8"	9.525	3/8"	2-1/2"	7/8"	26.78	25.62	24.45	23.29
11240	12240	13240	.3906	25/64"	9.921	7/16"	2-3/4"	7/8"	38.07	36.41	34.76	33.10
45140	37140	46140	.3937		10.000	10.0	70	25	32.58	31.16	29.75	28.33
11250	12250	13250	.4062	13/32"	10.317	7/16"	2-3/4"	7/8"	38.07	36.41	34.76	33.10
11260	12260	13260	.4219	27/64"	10.716	7/16"	2-3/4"	7/8"	38.07	36.41	34.76	33.10
45150	37150	46150	.4331		11.000	11.0	75	25	34.30	32.81	31.32	29.83
11270	12270	13270	.4375	7/16"	11.113	7/16"	2-3/4"	1"	32.66	31.24	29.82	28.40
11280	12280	13280	.4531	29/64"	11.509	1/2"	3"	1"	51.27	49.04	46.81	44.58
11290	-	13290	.4688	15/32"	11.908	1/2"	3"	1"	51.27	49.04	46.81	44.58
45160	37160	46160	.4724		12.000	12.0	75	25	45.03	43.08	41.12	39.16
11300	12300	13300	.4844	31/64"	12.304	1/2"	3"	1"	51.27	49.04	46.81	44.58
11310	12310	13310	.5000	1/2"	12.700	1/2"	3"	1"	42.87	41.01	39.14	37.28
45170	37170	46170	.5512		14.000	14.0	88	32	76.89	73.55	70.20	66.86
11320	12320	13320	.5625	9/16"	14.288	9/16"	3-1/2"	1-1/4"	73.24	70.06	66.87	63.69
11330	12330	13330	.6250	5/8"	15.875	5/8"	3-1/2"	1-1/4"	82.69	79.09	75.50	71.90
45180	37180	46180	.6299		16.000	16.0	88	38	86.83	83.05	79.28	75.50
11340	12340	13340	.6875	11/16"	17.463	3/4"	4"	1-1/2"	137.70	131.71	125.73	119.74
45190	37190	46190	.7087		18.000	18.0	100	38	127.31	121.77	116.24	110.70
11350	12350	13350	.7500	3/4"	19.050	3/4"	4"	1-1/2"	121.22	115.95	110.68	105.41
45200	37200	46200	.7874		20.000	20.0	100	38	161.85	154.81	147.78	140.74
45210	37210	46210	.8661		22.000	22.0	100	38	179.86	172.04	164.22	156.40
11360	12360	13360	.8750	7/8"	22.225	7/8"	4"	1-1/2"	174.46	166.87	159.29	151.70
45220	37220	46220	.9843		25.000	25.0	100	38	188.05	179.87	171.70	163.52
11370	12370	13370	1.000	1"	25.400	1"	4"	1-1/2"	181.37	173.48	165.60	157.71
-	-	13390	1.250	1-1/4"	31.750	1-1/4"	4-1/2"	2"	529.49	506.47	483.45	460.43

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MATERIAL HARDNESS (Rc)

0

Series 220MT, 230MT



TOLERANCES

d_1	$+0.000" - .002" (+.000 - .050\text{mm})$
d_2	$h6$

Standard Length - Square End

TiN Coating

Solid submicron grain carbide end mill - center cutting

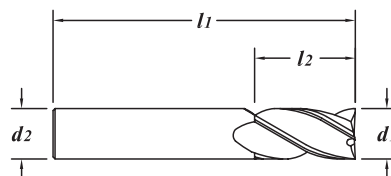
Improved lubricity

Extremely versatile

Uncoated - page 216

TiCN Coating - page 219

TiALN Coating - page 220



(220MT) 2 Flute EDP#	(230MT) 4 Flute EDP#	d_1 † Diameter			d_2 Shank Diameter	l_1 Overall Length	l_2 Flute Length	1-11	12-24	25-49	50-100
		Decimal		Metric							
11073	13073	.1250	1/8"	3.175	1/8"	1-1/2"	1/2"	10.66	10.20	9.73	9.27
11113	13113	.1875	3/16"	4.763	3/16"	2"	5/8"	14.28	13.66	13.04	12.42
11153	13153	.2500	1/4"	6.350	1/4"	2-1/2"	3/4"	18.53	17.72	16.92	16.11
11193	13193	.3125	5/16"	7.938	5/16"	2-1/2"	7/8"	25.79	24.67	23.55	22.43
11233	13233	.3750	3/8"	9.525	3/8"	2-1/2"	7/8"	31.08	29.73	28.38	27.03
11273	13273	.4375	7/16"	11.113	7/16"	2-3/4"	1"	37.88	36.23	34.59	32.94
11313	13313	.5000	1/2"	12.700	1/2"	3"	1"	48.10	46.01	43.92	41.83
11333	13333	.6250	5/8"	15.875	5/8"	3-1/2"	1-1/4"	90.70	86.76	82.81	78.87
11353	13353	.7500	3/4"	19.050	3/4"	4"	1-1/2"	130.41	124.74	119.07	113.40
-	13373	1.000	1"	25.400	1"	4"	1-1/2"	197.40	188.82	180.23	171.65

TOLERANCES

$d1$	$+0.000^{\circ} -0.002^{\circ} (+.000 -0.050\text{mm})$
$d2$	$h6$

Series 220MC, 223MC, 230MC



Standard Length - Square End

TiCN Coating

Solid submicron grain carbide end mill - center cutting

Improved abrasion resistance and lubricity

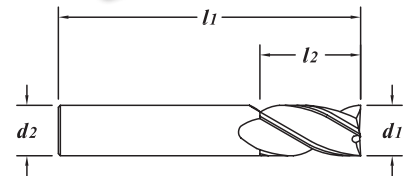
Extremely versatile

Uncoated - page 216

TiN Coating - page 218

TiAlN Coating - page 220

Extended length - page 238



(220MC) 2 Flute EDP#	(223MC) 3 Flute EDP#	(230MC) 4 Flute EDP#	$d1$ †		$d2$	$l1$	$l2$	1-11	12-24	25-49	50-100
			Decimal	Diameter	Metric	Shank Diameter	Overall Length	Flute Length			
11014	12014	13014	.0312	1/32"	0.792	1/8"	1-1/2"	3/32"	13.57	12.98	12.39
11024	12024	13024	.0469	3/64"	1.191	1/8"	1-1/2"	1/8"	13.57	12.98	12.39
11034	12034	13034	.0625	1/16"	1.588	1/8"	1-1/2"	1/4"	12.78	12.22	11.67
11044	12044	13044	.0781	5/64"	1.984	1/8"	1-1/2"	1/4"	12.78	12.22	11.67
11054	12054	13054	.0938	3/32"	2.383	1/8"	1-1/2"	3/8"	12.20	11.67	11.14
11064	12064	13064	.1094	7/64"	2.779	1/8"	1-1/2"	3/8"	12.20	11.67	11.14
11074	12074	13074	.1250	1/8"	3.175	1/8"	1-1/2"	1/2"	11.44	10.95	10.45
11084	12084	13084	.1406	9/64"	3.571	3/16"	2"	9/16"	15.78	15.09	14.41
11094	12094	13094	.1562	5/32"	3.967	3/16"	2"	9/16"	15.78	15.09	14.41
11104	12104	13104	.1719	11/64"	4.366	3/16"	2"	9/16"	15.78	15.09	14.41
11114	12114	13114	.1875	3/16"	4.763	3/16"	2"	5/8"	15.08	14.42	13.77
11124	12124	13124	.2031	13/64"	5.159	1/4"	2-1/2"	5/8"	21.65	20.71	19.77
11134	12134	13134	.2188	7/32"	5.558	1/4"	2-1/2"	5/8"	21.65	20.71	19.77
11144	12144	13144	.2344	15/64"	5.954	1/4"	2-1/2"	3/4"	21.65	20.71	19.77
11154	12154	13154	.2500	1/4"	6.350	1/4"	2-1/2"	3/4"	20.14	19.26	18.39
11164	12164	13164	.2656	17/64"	6.746	5/16"	2-1/2"	7/8"	33.32	31.87	30.42
11174	12174	13174	.2812	9/32"	7.142	5/16"	2-1/2"	7/8"	33.32	31.87	30.42
11184	12184	13184	.2969	19/64"	7.541	5/16"	2-1/2"	7/8"	33.32	31.87	30.42
11194	12194	13194	.3125	5/16"	7.938	5/16"	2-1/2"	7/8"	27.92	26.71	25.49
11204	12204	13204	.3281	21/64"	8.334	3/8"	2-1/2"	7/8"	38.27	36.61	34.94
11214	12214	13214	.3438	11/32"	8.733	3/8"	2-1/2"	7/8"	38.27	36.61	34.94
11224	12224	13224	.3594	23/64"	9.129	3/8"	2-1/2"	7/8"	38.27	36.61	34.94
11234	12234	13234	.3750	3/8"	9.525	3/8"	2-1/2"	7/8"	33.20	31.76	30.31
11244	12244	13244	.3906	25/64"	9.921	7/16"	2-3/4"	7/8"	45.79	43.80	41.81
11254	12254	13254	.4062	13/32"	10.317	7/16"	2-3/4"	7/8"	45.79	43.80	41.81
11264	-	13264	.4219	27/64"	10.716	7/16"	2-3/4"	7/8"	45.79	43.80	41.81
11274	12274	13274	.4375	7/16"	11.113	7/16"	2-3/4"	1"	40.41	38.65	36.90
11284	-	13284	.4531	29/64"	11.509	1/2"	3"	1"	59.00	56.43	53.87
11294	12294	13294	.4688	15/32"	11.908	1/2"	3"	1"	59.00	56.43	53.87
-	12304	13304	.4844	31/64"	12.304	1/2"	3"	1"	59.00	56.43	53.87
11314	12314	13314	.5000	1/2"	12.700	1/2"	3"	1"	50.62	48.42	46.22
11324	12324	13324	.5625	9/16"	14.288	9/16"	3-1/2"	1-1/4"	85.28	81.58	77.87
11334	12334	13334	.6250	5/8"	15.875	5/8"	3-1/2"	1-1/4"	94.73	90.61	86.49
11344	-	13344	.6875	11/16"	17.463	3/4"	4"	1-1/2"	151.46	144.87	138.29
11354	12354	13354	.7500	3/4"	19.050	3/4"	4"	1-1/2"	135.01	129.14	123.27
11364	-	13364	.8750	7/8"	22.225	7/8"	4"	1-1/2"	195.14	186.66	178.17
11374	12374	13374	1.000	1"	25.400	1"	4"	1-1/2"	202.04	193.26	184.47
-	-	13394	1.250	1-1/4"	31.750	1-1/4"	4-1/2"	2"	562.93	538.45	513.98

GENERAL PURPOSE
END MILLS

70

35

MATERIAL HARDNESS (Rc)

0

Series 220MA, 223MA, 230MA, 820MA, 823MA, 830MA

.0312" - .3594"
(0.792mm - 9.129mm)TECH
PAGES
282-283

TOLERANCES

$d1$	$+0.000" - .002" (+0.000 - .050mm)$
$d2$	$h6$

Standard Length - Square End

TiAlN Coating

Solid submicron grain carbide end mill - center cutting

Dry or semi-dry machining

Extremely versatile

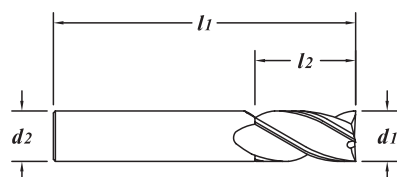
Uncoated - page 216

TiN Coating - page 218

TiCN Coating - page 219

Stub Length - page 209

Extended Length - page 239



(220MA/820MA) 2 Flute EDP#	(223MA/823MA) 3 Flute EDP#	(230MA/830MA) 4 Flute EDP#	$d1$ † Diameter			$d2$ Shank Diameter	$l1$ Overall Length	$l2$ Flute Length	1-11	12-24	25-49	50-100
			Decimal		Metric							
11017	12017	13017	.0312	1/32"	0.792	1/8"	1-1/2"	3/32"	13.88	13.28	12.67	12.07
45017	37017	46017	.0394		1.000	3.0	38	4	14.44	13.82	13.19	12.56
11027	12027	13027	.0469	3/64"	1.191	1/8"	1-1/2"	1/8"	13.88	13.28	12.67	12.07
45027	37027	46027	.0591		1.500	3.0	38	6	14.44	13.82	13.19	12.56
11037	12037	13037	.0625	1/16"	1.588	1/8"	1-1/2"	1/4"	13.09	12.52	11.95	11.38
11047	12047	13047	.0781	5/64"	1.984	1/8"	1-1/2"	1/4"	13.09	12.52	11.95	11.38
45037	37037	46037	.0787		2.000	3.0	38	8	13.58	12.99	12.40	11.81
11057	12057	13057	.0938	3/32"	2.383	1/8"	1-1/2"	3/8"	12.51	11.97	11.42	10.88
45047	37047	46047	.0984		2.500	3.0	38	12	13.02	12.45	11.89	11.32
11067	12067	13067	.1094	7/64"	2.779	1/8"	1-1/2"	3/8"	12.51	11.97	11.42	10.88
45057	37057	46057	.1181		3.000	3.0	38	12	12.22	11.69	11.16	10.63
11077	12077	13077	.1250	1/8"	3.175	1/8"	1-1/2"	1/2"	11.75	11.24	10.73	10.22
45067	37067	46067	.1378		3.500	4.0	50	12	16.78	16.05	15.32	14.59
11087	12087	13087	.1406	9/64"	3.571	3/16"	2"	9/16"	16.09	15.39	14.69	13.99
11097	12097	13097	.1562	5/32"	3.967	3/16"	2"	9/16"	16.09	15.39	14.69	13.99
45077	37077	46077	.1575		4.000	4.0	50	14	16.05	15.36	14.66	13.96
11107	12107	13107	.1719	11/64"	4.366	3/16"	2"	9/16"	16.09	15.39	14.69	13.99
45087	37087	46087	.1772		4.500	5.0	50	14	20.55	19.66	18.76	17.87
11117	12117	13117	.1875	3/16"	4.763	3/16"	2"	5/8"	15.39	14.72	14.05	13.38
92077	93077	94077	.1969		5.000	5.0	50	16	19.90	19.03	18.17	17.30
45097	37097	46097	.1969		5.000	5.0	65	16	21.15	20.23	19.31	18.39
11127	12127	13127	.2031	13/64"	5.159	1/4"	2-1/2"	5/8"	22.41	21.44	20.46	19.49
11137	12137	13137	.2188	7/32"	5.558	1/4"	2-1/2"	5/8"	22.41	21.44	20.46	19.49
11147	12147	13147	.2344	15/64"	5.954	1/4"	2-1/2"	3/4"	22.41	21.44	20.46	19.49
45107	37107	46107	.2362		6.000	6.0	65	19	21.64	20.70	19.76	18.82
11157	12157	13157	.2500	1/4"	6.350	1/4"	2-1/2"	3/4"	20.88	19.98	19.07	18.16
11167	12167	13167	.2656	17/64"	6.746	5/16"	2-1/2"	7/8"	35.20	33.67	32.14	30.61
45117	37117	46117	.2756		7.000	7.0	65	22	30.41	29.08	27.76	26.44
11177	12177	13177	.2812	9/32"	7.142	5/16"	2-1/2"	7/8"	35.20	33.67	32.14	30.61
11187	12187	13187	.2969	19/64"	7.541	5/16"	2-1/2"	7/8"	35.20	33.67	32.14	30.61
11197	12197	13197	.3125	5/16"	7.938	5/16"	2-1/2"	7/8"	29.82	28.52	27.23	25.93
45127	37127	46127	.3150		8.000	8.0	65	22	30.89	29.55	28.20	26.86
11207	12207	13207	.3281	21/64"	8.334	3/8"	2-1/2"	7/8"	40.15	38.40	36.66	34.91
11217	12217	13217	.3438	11/32"	8.733	3/8"	2-1/2"	7/8"	40.15	38.40	36.66	34.91
45137	37137	46137	.3543		9.000	9.0	65	22	36.42	34.84	33.25	31.67
11227	12227	13227	.3594	23/64"	9.129	3/8"	2-1/2"	7/8"	40.15	38.40	36.66	34.91

Series 220MA, 223MA, 230MA, 820MA, 823MA, 830MA (continued)

.3750" - 1.250"
(9.525mm - 31.750mm)

GENERAL PURPOSE
END MILLS

(220MA/820MA) 2 Flute EDP#	(223MA/823MA) 3 Flute EDP#	(230MA/830MA) 4 Flute EDP#	$d1$ † Diameter			$d2$ Shank Diameter	$l1$ Overall Length	$l2$ Flute Length	1-11	12-24	25-49	50-100
			Decimal		Metric							
11237	12237	13237	.3750	3/8"	9.525	3/8"	2-1/2"	7/8"	35.08	33.55	32.03	30.50
11247	12247	13247	.3906	25/64"	9.921	7/16"	2-3/4"	7/8"	47.53	45.46	43.40	41.33
45147	37147	46147	.3937		10.000	10.0	70	25	42.03	40.21	38.38	36.55
11257	12257	13257	.4062	13/32"	10.317	7/16"	2-3/4"	7/8"	47.53	45.46	43.40	41.33
11267	12267	13267	.4219	27/64"	10.716	7/16"	2-3/4"	7/8"	47.53	45.46	43.40	41.33
45157	37157	46157	.4331		11.000	11.0	75	25	43.76	41.86	39.95	38.05
11277	12277	13277	.4375	7/16"	11.113	7/16"	2-3/4"	1"	42.14	40.30	38.47	36.64
11287	12287	13287	.4531	29/64"	11.509	1/2"	3"	1"	60.73	58.09	55.45	52.81
11297	12297	13297	.4688	15/32"	11.908	1/2"	3"	1"	60.73	58.09	55.45	52.81
45167	37167	46167	.4724		12.000	12.0	75	25	54.48	52.11	49.74	47.37
11307	12307	13307	.4844	31/64"	12.304	1/2"	3"	1"	60.73	58.09	55.45	52.81
11317	12317	13317	.5000	1/2"	12.700	1/2"	3"	1"	52.34	50.06	47.79	45.51
45177	37177	46177	.5512		14.000	14.0	88	32	90.56	86.63	82.69	78.75
11327	12327	13327	.5625	9/16"	14.288	9/16"	3-1/2"	1-1/4"	86.91	83.13	79.35	75.57
11337	12337	13337	.6250	5/8"	15.875	5/8"	3-1/2"	1-1/4"	96.37	92.18	87.99	83.80
45187	37187	46187	.6299		16.000	16.0	88	38	100.51	96.14	91.77	87.40
11347	12347	13347	.6875	11/16"	17.463	3/4"	4"	1-1/2"	153.85	147.16	140.47	133.78
45197	37197	46197	.7087		18.000	18.0	100	38	143.44	137.20	130.97	124.73
11357	12357	13357	.7500	3/4"	19.050	3/4"	4"	1-1/2"	137.37	131.40	125.42	119.45
45207	37207	46207	.7874		20.000	20.0	100	38	185.70	177.63	169.55	161.48
45217	37217	46217	.8661		22.000	22.0	100	38	203.69	194.83	185.98	177.12
11367	12367	13367	.8750	7/8"	22.225	7/8"	4"	1-1/2"	198.29	189.67	181.05	172.43
45227	37227	46227	.9843		25.000	25.0	100	38	211.89	202.68	193.46	184.25
11377	12377	13377	1.000	1"	25.400	1"	4"	1-1/2"	205.18	196.26	187.34	178.42
-	-	13397	1.250	1-1/4"	31.750	1-1/4"	4-1/2"	2"	564.03	539.51	514.98	490.46

70

35

MATERIAL HARDNESS (Rc)

0



End Mill Manufacturing

Series 220R, 223R, 230R, 820R, 823R, 830R

.0625" - .3125"
(1.588mm - 7.938mm)

TOLERANCES

d_1	$+0.000" - .002" (+.000 - .050\text{mm})$
d_2	$h6$
r	$+0.001" - .001" (+.025 - .025\text{mm})$

Standard Length - Corner Radius

Solid submicron grain carbide end mill - center cutting

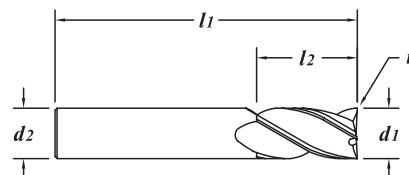
For stronger corners and part radius

Extremely versatile

TiAlN Coating - page 225

Stub Length - page 210

Extended Length - page 241



(220R/820R) 2 Flute EDP#	(223R/823R) 3 Flute EDP#	(230R/830R) 4 Flute EDP#	d_1 † Diameter			d_2 Shank Diameter	l_1 Overall Length	l_2 Flute Length	r Corner Radius	1-11	12-24	25-49	50-100
			Decimal		Metric								
79580	36100	80580	.0625	1/16"	1.588	1/8"	1-1/2"	1/4"	.010"	13.40	12.82	12.23	11.65
79590	36102	80590	.0625	1/16"	1.588	1/8"	1-1/2"	1/4"	.015"	13.40	12.82	12.23	11.65
79600	36104	80600	.0938	3/32"	2.383	1/8"	1-1/2"	3/8"	.010"	12.81	12.25	11.70	11.14
79610	36106	80610	.0938	3/32"	2.383	1/8"	1-1/2"	3/8"	.015"	12.81	12.25	11.70	11.14
79620	36108	80620	.0938	3/32"	2.383	1/8"	1-1/2"	3/8"	.020"	12.81	12.25	11.70	11.14
36500	36110	24070	.1181		3.000	3.0	38	12	0.20	12.22	11.69	11.16	10.63
36502	36112	24080	.1181		3.000	3.0	38	12	0.50	12.22	11.69	11.16	10.63
79000	36114	80000	.1250	1/8"	3.175	1/8"	1-1/2"	1/2"	.010"	11.63	11.12	10.62	10.11
79010	36116	80010	.1250	1/8"	3.175	1/8"	1-1/2"	1/2"	.015"	11.63	11.12	10.62	10.11
79020	36118	80020	.1250	1/8"	3.175	1/8"	1-1/2"	1/2"	.020"	11.63	11.12	10.62	10.11
79030	36120	80030	.1250	1/8"	3.175	1/8"	1-1/2"	1/2"	.030"	11.63	11.12	10.62	10.11
-	-	80035	.1250	1/8"	3.175	1/8"	1-1/2"	1/2"	.040"	11.63	11.12	10.62	10.11
36504	36122	24090	.1575		4.000	4.0	50	14	0.30	16.09	15.39	14.69	13.99
36506	36124	24100	.1575		4.000	4.0	50	14	0.50	16.09	15.39	14.69	13.99
79040	36126	80040	.1875	3/16"	4.763	3/16"	2"	5/8"	.010"	15.32	14.65	13.99	13.32
79050	36128	80050	.1875	3/16"	4.763	3/16"	2"	5/8"	.015"	15.32	14.65	13.99	13.32
79060	36130	80060	.1875	3/16"	4.763	3/16"	2"	5/8"	.020"	15.32	14.65	13.99	13.32
79070	36132	80070	.1875	3/16"	4.763	3/16"	2"	5/8"	.030"	15.32	14.65	13.99	13.32
36508	36134	24110	.1969		5.000	5.0	65	16	0.30	19.50	18.66	17.81	16.96
36510	36136	24120	.1969		5.000	5.0	65	16	0.50	19.50	18.66	17.81	16.96
36512	36138	24170	.2362		6.000	6.0	65	19	0.50	20.00	19.13	18.26	17.39
36514	36140	24180	.2362		6.000	6.0	65	19	0.80	20.00	19.13	18.26	17.39
36516	36142	24190	.2362		6.000	6.0	65	19	1.00	20.00	19.13	18.26	17.39
36518	36144	24200	.2362		6.000	6.0	65	19	1.50	20.00	19.13	18.26	17.39
36520	36146	24210	.2362		6.000	6.0	65	19	2.00	20.00	19.13	18.26	17.39
36522	36148	80090	.2500	1/4"	6.350	1/4"	2-1/2"	3/4"	.010"	19.03	18.21	17.38	16.55
79100	36150	80100	.2500	1/4"	6.350	1/4"	2-1/2"	3/4"	.015"	19.03	18.21	17.38	16.55
79110	36152	80110	.2500	1/4"	6.350	1/4"	2-1/2"	3/4"	.020"	19.03	18.21	17.38	16.55
79120	36154	80120	.2500	1/4"	6.350	1/4"	2-1/2"	3/4"	.030"	19.03	18.21	17.38	16.55
79130	36156	80130	.2500	1/4"	6.350	1/4"	2-1/2"	3/4"	.045"	19.03	18.21	17.38	16.55
79140	36158	80140	.2500	1/4"	6.350	1/4"	2-1/2"	3/4"	.060"	19.03	18.21	17.38	16.55
79160	36160	80160	.3125	5/16"	7.938	5/16"	2-1/2"	7/8"	.015"	24.94	23.86	22.77	21.69
79170	36162	80170	.3125	5/16"	7.938	5/16"	2-1/2"	7/8"	.020"	24.94	23.86	22.77	21.69
79180	36164	80180	.3125	5/16"	7.938	5/16"	2-1/2"	7/8"	.030"	24.94	23.86	22.77	21.69
79190	36166	80190	.3125	5/16"	7.938	5/16"	2-1/2"	7/8"	.045"	24.94	23.86	22.77	21.69
79200	36168	80200	.3125	5/16"	7.938	5/16"	2-1/2"	7/8"	.060"	24.94	23.86	22.77	21.69

Series 220R, 223R, 230R, 820R, 823R, 830R (continued)

.3150" - .6250"
(8.000mm - 15.875mm)

GENERAL PURPOSE
END MILLS

70

35

MATERIAL HARDNESS (Rc)

0

(220R/820R) 2 Flute EDP#	(223R/823R) 3 Flute EDP#	(230R/830R) 4 Flute EDP#	$d1$ † Diameter			$d2$ Shank Diameter	$l1$ Overall Length	$l2$ Flute Length	r Corner Radius	1-11	12-24	25-49	50-100
			Decimal		Metric								
36524	36170	24220	.3150		8.000	8.0	65	22	0.50	26.25	25.11	23.97	22.83
36526	36172	24230	.3150		8.000	8.0	65	22	0.80	26.25	25.11	23.97	22.83
36528	36174	24240	.3150		8.000	8.0	65	22	1.00	26.25	25.11	23.97	22.83
36530	36176	24250	.3150		8.000	8.0	65	22	1.50	26.25	25.11	23.97	22.83
36532	36178	24260	.3150		8.000	8.0	65	22	2.00	26.25	25.11	23.97	22.83
36534	36180	24270	.3150		8.000	8.0	65	22	2.50	26.25	25.11	23.97	22.83
36536	36182	24280	.3150		8.000	8.0	65	22	3.00	26.25	25.11	23.97	22.83
36538	36184	80220	.3750	3/8"	9.525	3/8"	2-1/2"	7/8"	.010"	30.53	29.21	27.88	26.55
79230	36186	80230	.3750	3/8"	9.525	3/8"	2-1/2"	7/8"	.015"	30.53	29.21	27.88	26.55
79240	36188	80240	.3750	3/8"	9.525	3/8"	2-1/2"	7/8"	.020"	30.53	29.21	27.88	26.55
79250	36190	80250	.3750	3/8"	9.525	3/8"	2-1/2"	7/8"	.030"	30.53	29.21	27.88	26.55
79260	36192	80260	.3750	3/8"	9.525	3/8"	2-1/2"	7/8"	.045"	30.53	29.21	27.88	26.55
79270	36194	80270	.3750	3/8"	9.525	3/8"	2-1/2"	7/8"	.060"	30.53	29.21	27.88	26.55
36540	36196	24290	.3937		10.000	10.0	70	25	0.50	37.48	35.85	34.22	32.59
36542	36198	24300	.3937		10.000	10.0	70	25	0.80	37.48	35.85	34.22	32.59
36544	36200	24310	.3937		10.000	10.0	70	25	1.00	37.48	35.85	34.22	32.59
36546	36202	24320	.3937		10.000	10.0	70	25	1.50	37.48	35.85	34.22	32.59
36548	36204	24330	.3937		10.000	10.0	70	25	2.00	37.48	35.85	34.22	32.59
36550	36206	24340	.3937		10.000	10.0	70	25	2.50	37.48	35.85	34.22	32.59
36552	36208	24350	.3937		10.000	10.0	70	25	3.00	37.48	35.85	34.22	32.59
36554	36210	24360	.3937		10.000	10.0	70	25	3.20	37.48	35.85	34.22	32.59
36556	36212	80700	.4375	7/16"	11.113	7/16"	2-3/4"	1"	.010"	37.58	35.95	34.31	32.68
36558	36214	80705	.4375	7/16"	11.113	7/16"	2-3/4"	1"	.015"	37.58	35.95	34.31	32.68
36560	36216	80710	.4375	7/16"	11.113	7/16"	2-3/4"	1"	.020"	37.58	35.95	34.31	32.68
36562	36218	80715	.4375	7/16"	11.113	7/16"	2-3/4"	1"	.030"	37.58	35.95	34.31	32.68
36564	36220	80720	.4375	7/16"	11.113	7/16"	2-3/4"	1"	.045"	37.58	35.95	34.31	32.68
36566	36222	80725	.4375	7/16"	11.113	7/16"	2-3/4"	1"	.060"	37.58	35.95	34.31	32.68
36568	36224	80730	.4375	7/16"	11.113	7/16"	2-3/4"	1"	.090"	37.58	35.95	34.31	32.68
36570	36226	80735	.4375	7/16"	11.113	7/16"	2-3/4"	1"	.125"	37.58	35.95	34.31	32.68
36572	36228	24370	.4724		12.000	12.0	75	25	0.50	59.70	57.10	54.51	51.91
36574	36230	24380	.4724		12.000	12.0	75	25	0.80	59.70	57.10	54.51	51.91
36576	36232	24390	.4724		12.000	12.0	75	25	1.00	59.70	57.10	54.51	51.91
36578	36234	24400	.4724		12.000	12.0	75	25	1.50	59.70	57.10	54.51	51.91
36580	36236	24410	.4724		12.000	12.0	75	25	2.00	59.70	57.10	54.51	51.91
36582	36238	24420	.4724		12.000	12.0	75	25	2.50	59.70	57.10	54.51	51.91
36584	36240	24430	.4724		12.000	12.0	75	25	3.00	59.70	57.10	54.51	51.91
36586	36242	24440	.4724		12.000	12.0	75	25	3.20	59.70	57.10	54.51	51.91
36588	36244	80290	.5000	1/2"	12.700	1/2"	3"	1"	.010"	56.83	54.36	51.89	49.42
79300	36246	80300	.5000	1/2"	12.700	1/2"	3"	1"	.015"	56.83	54.36	51.89	49.42
79310	36248	80310	.5000	1/2"	12.700	1/2"	3"	1"	.020"	56.83	54.36	51.89	49.42
79320	36250	80320	.5000	1/2"	12.700	1/2"	3"	1"	.030"	56.83	54.36	51.89	49.42
79330	36252	80330	.5000	1/2"	12.700	1/2"	3"	1"	.045"	56.83	54.36	51.89	49.42
79340	36254	80340	.5000	1/2"	12.700	1/2"	3"	1"	.060"	56.83	54.36	51.89	49.42
79350	36256	80350	.5000	1/2"	12.700	1/2"	3"	1"	.090"	56.83	54.36	51.89	49.42
79360	36258	80360	.5000	1/2"	12.700	1/2"	3"	1"	.125"	56.83	54.36	51.89	49.42
79370	36260	80370	.6250	5/8"	15.875	5/8"	3-1/2"	1-1/4"	.015"	91.92	87.92	83.93	79.93
79380	36262	80380	.6250	5/8"	15.875	5/8"	3-1/2"	1-1/4"	.020"	91.92	87.92	83.93	79.93
79390	36264	80390	.6250	5/8"	15.875	5/8"	3-1/2"	1-1/4"	.030"	91.92	87.92	83.93	79.93
79400	36266	80400	.6250	5/8"	15.875	5/8"	3-1/2"	1-1/4"	.045"	91.92	87.92	83.93	79.93
79410	36268	80410	.6250	5/8"	15.875	5/8"	3-1/2"	1-1/4"	.060"	91.92	87.92	83.93	79.93
79420	36270	80420	.6250	5/8"	15.875	5/8"	3-1/2"	1-1/4"	.090"	91.92	87.92	83.93	79.93

continued →

Series 220R, 223R, 230R, 820R, 823R, 830R (continued)

.6299" - 1.000"
(16.000mm - 25.400mm)

(220R/820R) 2 Flute EDP#	(223R/823R) 3 Flute EDP#	(230R/830R) 4 Flute EDP#	$d1$ † Diameter		$d2$ Shank Diameter	$l1$ Overall Length	$l2$ Flute Length	r Corner Radius	1-11	12-24	25-49	50-100	
			Decimal	Metric									
36590	36272	24450	.6299	16.000	16.0	88	38	0.50	96.50	92.30	88.11	83.91	
36592	36274	24460	.6299	16.000	16.0	88	38	1.00	96.50	92.30	88.11	83.91	
36594	36276	24470	.6299	16.000	16.0	88	38	2.00	96.50	92.30	88.11	83.91	
36596	36278	24480	.6299	16.000	16.0	88	38	2.50	96.50	92.30	88.11	83.91	
36598	36280	24490	.6299	16.000	16.0	88	38	3.00	96.50	92.30	88.11	83.91	
36600	36282	24500	.6299	16.000	16.0	88	38	4.00	96.50	92.30	88.11	83.91	
36602	36284	24510	.6299	16.000	16.0	88	38	5.00	96.50	92.30	88.11	83.91	
79440	36286	80440	.7500	3/4"	19.050	3/4"	4"	1-1/2"	.015"	135.27	129.39	123.51	117.63
79450	36288	80450	.7500	3/4"	19.050	3/4"	4"	1-1/2"	.020"	135.27	129.39	123.51	117.63
79460	36290	80460	.7500	3/4"	19.050	3/4"	4"	1-1/2"	.030"	135.27	129.39	123.51	117.63
79470	36292	80470	.7500	3/4"	19.050	3/4"	4"	1-1/2"	.045"	135.27	129.39	123.51	117.63
79480	36294	80480	.7500	3/4"	19.050	3/4"	4"	1-1/2"	.060"	135.27	129.39	123.51	117.63
79490	36296	80490	.7500	3/4"	19.050	3/4"	4"	1-1/2"	.090"	135.27	129.39	123.51	117.63
79500	36298	80500	.7500	3/4"	19.050	3/4"	4"	1-1/2"	.125"	135.27	129.39	123.51	117.63
79630	36300	80630	.7500	3/4"	19.050	3/4"	4"	1-1/2"	.250"	135.27	129.39	123.51	117.63
36604	36302	24520	.7874	20.000	20.0	100	38	0.50	190.44	182.16	173.88	165.60	
36606	36304	24530	.7874	20.000	20.0	100	38	1.00	190.44	182.16	173.88	165.60	
36608	36306	24540	.7874	20.000	20.0	100	38	2.00	190.44	182.16	173.88	165.60	
36610	36308	24550	.7874	20.000	20.0	100	38	3.00	190.44	182.16	173.88	165.60	
36612	36310	24560	.7874	20.000	20.0	100	38	5.00	190.44	182.16	173.88	165.60	
79510	36312	80510	1.000	1"	25.400	1"	4"	1-1/2"	.015"	234.65	224.44	214.24	204.04
79520	36314	80520	1.000	1"	25.400	1"	4"	1-1/2"	.020"	234.65	224.44	214.24	204.04
79530	36316	80530	1.000	1"	25.400	1"	4"	1-1/2"	.030"	234.65	224.44	214.24	204.04
79540	36318	80540	1.000	1"	25.400	1"	4"	1-1/2"	.045"	234.65	224.44	214.24	204.04
79550	36320	80550	1.000	1"	25.400	1"	4"	1-1/2"	.060"	234.65	224.44	214.24	204.04
79560	36322	80560	1.000	1"	25.400	1"	4"	1-1/2"	.090"	234.65	224.44	214.24	204.04
79570	36324	80570	1.000	1"	25.400	1"	4"	1-1/2"	.125"	234.65	224.44	214.24	204.04
79640	36326	80640	1.000	1"	25.400	1"	4"	1-1/2"	.250"	234.65	224.44	214.24	204.04

TOLERANCES

d_1	$+0.000" - .002" (+.000 - .050\text{mm})$
d_2	$h6$
r	$+0.011" - .001" (+.025 - .025\text{mm})$


**TECH
PAGES
282-283**
Series 220RA, 223RA, 230RA, 823RA, 830RA

.0625" - .3125"
(1.588mm - 7.938mm)

GENERAL PURPOSE
END MILLS

Standard Length - Corner Radius
TiAlN Coating

Solid submicron grain carbide end mill - center cutting

Dry or semi-dry machining

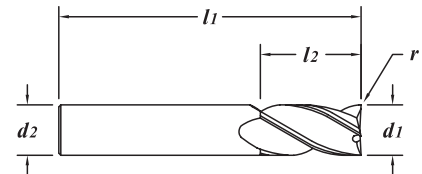
For stronger corners and part radius

Extremely versatile

Uncoated - page 222

Stub Length - page 212

Extended Length - page 244



70

35

MATERIAL HARDNESS (Rc)

0

(220RA) 2 Flute EDP#	(223RA/823RA) 3 Flute EDP#	(230RA/830RA) 4 Flute EDP#	d_1 † Diameter		d_2 Shank Diameter	l_1 Overall Length	l_2 Flute Length	r Corner Radius	1-11	12-24	25-49	50-100	
			Decimal	Metric									
79587	36101	80587	.0625	1/16"	1.588	1/8"	1-1/2"	1/4"	.010"	16.09	15.39	14.69	13.99
79597	36103	80597	.0625	1/16"	1.588	1/8"	1-1/2"	1/4"	.015"	16.09	15.39	14.69	13.99
79607	36105	80607	.0938	3/32"	2.383	1/8"	1-1/2"	3/8"	.010"	15.50	14.83	14.15	13.48
79617	36107	80617	.0938	3/32"	2.383	1/8"	1-1/2"	3/8"	.015"	15.50	14.83	14.15	13.48
79627	36109	80627	.0938	3/32"	2.383	1/8"	1-1/2"	3/8"	.020"	15.50	14.83	14.15	13.48
-	36111	24077	.1181		3.000	3.0	38	12	0.20	14.34	13.72	13.09	12.47
-	36113	24087	.1181		3.000	3.0	38	12	0.50	14.34	13.72	13.09	12.47
79007	36115	80007	.1250	1/8"	3.175	1/8"	1-1/2"	1/2"	.010"	14.32	13.70	13.07	12.45
79017	36117	80017	.1250	1/8"	3.175	1/8"	1-1/2"	1/2"	.015"	14.32	13.70	13.07	12.45
79027	36119	80027	.1250	1/8"	3.175	1/8"	1-1/2"	1/2"	.020"	14.32	13.70	13.07	12.45
79037	36121	80037	.1250	1/8"	3.175	1/8"	1-1/2"	1/2"	.030"	14.32	13.70	13.07	12.45
-	-	80038	.1250	1/8"	3.175	1/8"	1-1/2"	1/2"	.040"	14.32	13.70	13.07	12.45
-	36123	24097	.1575		4.000	4.0	50	14	0.30	18.78	17.96	17.15	16.33
-	36125	24107	.1575		4.000	4.0	50	14	0.50	18.78	17.96	17.15	16.33
79047	36127	80047	.1875	3/16"	4.763	3/16"	2"	5/8"	.010"	18.01	17.23	16.44	15.66
79057	36129	80057	.1875	3/16"	4.763	3/16"	2"	5/8"	.015"	18.01	17.23	16.44	15.66
79067	36131	80067	.1875	3/16"	4.763	3/16"	2"	5/8"	.020"	18.01	17.23	16.44	15.66
79077	36133	80077	.1875	3/16"	4.763	3/16"	2"	5/8"	.030"	18.01	17.23	16.44	15.66
-	-	24117	.1969		5.000	5.0	50	16	0.30	25.06	23.97	22.88	21.79
-	36135	24119	.1969		5.000	5.0	65	16	0.30	25.06	23.97	22.88	21.79
-	36137	24127	.1969		5.000	5.0	65	16	0.50	25.06	23.97	22.88	21.79
-	36139	24177	.2362		6.000	6.0	65	19	0.50	25.54	24.43	23.32	22.21
-	36141	24187	.2362		6.000	6.0	65	19	0.80	25.54	24.43	23.32	22.21
-	36143	24197	.2362		6.000	6.0	65	19	1.00	25.54	24.43	23.32	22.21
-	36145	24207	.2362		6.000	6.0	65	19	1.50	25.54	24.43	23.32	22.21
-	36147	24217	.2362		6.000	6.0	65	19	2.00	25.54	24.43	23.32	22.21
-	36149	80097	.2500	1/4"	6.350	1/4"	2-1/2"	3/4"	.010"	24.56	23.50	22.43	21.36
79107	36151	80107	.2500	1/4"	6.350	1/4"	2-1/2"	3/4"	.015"	24.56	23.50	22.43	21.36
79117	36153	80117	.2500	1/4"	6.350	1/4"	2-1/2"	3/4"	.020"	24.56	23.50	22.43	21.36
79127	36155	80127	.2500	1/4"	6.350	1/4"	2-1/2"	3/4"	.030"	24.56	23.50	22.43	21.36
79137	36157	80137	.2500	1/4"	6.350	1/4"	2-1/2"	3/4"	.045"	24.56	23.50	22.43	21.36
79147	36159	80147	.2500	1/4"	6.350	1/4"	2-1/2"	3/4"	.060"	24.56	23.50	22.43	21.36
79167	36161	80167	.3125	5/16"	7.938	5/16"	2-1/2"	7/8"	.015"	33.29	31.85	30.40	28.95
79177	36163	80177	.3125	5/16"	7.938	5/16"	2-1/2"	7/8"	.020"	33.29	31.85	30.40	28.95
79187	36165	80187	.3125	5/16"	7.938	5/16"	2-1/2"	7/8"	.030"	33.29	31.85	30.40	28.95
79197	36167	80197	.3125	5/16"	7.938	5/16"	2-1/2"	7/8"	.045"	33.29	31.85	30.40	28.95
79207	36169	80207	.3125	5/16"	7.938	5/16"	2-1/2"	7/8"	.060"	33.29	31.85	30.40	28.95

continued →

Series 220RA, 223RA, 230RA, 823RA, 830RA (continued)

.3150" - .6299"
(8.000mm - 16.000mm)

(220RA) 2 Flute EDP#	(223RA/823RA) 3 Flute EDP#	(230RA/830RA) 4 Flute EDP#	d_1 †		d_2 Shank Diameter	l_1 Overall Length	l_2 Flute Length	r Corner Radius	1-11	12-24	25-49	50-100	
			Decimal	Metric									
-	36171	24227	.3150	8.000	8.0	65	22	0.50	34.55	33.04	31.54	30.04	
-	36173	24237	.3150	8.000	8.0	65	22	0.80	34.55	33.04	31.54	30.04	
-	36175	24247	.3150	8.000	8.0	65	22	1.00	34.55	33.04	31.54	30.04	
-	36177	24257	.3150	8.000	8.0	65	22	1.50	34.55	33.04	31.54	30.04	
-	36179	24267	.3150	8.000	8.0	65	22	2.00	34.55	33.04	31.54	30.04	
-	36181	24277	.3150	8.000	8.0	65	22	2.50	34.55	33.04	31.54	30.04	
-	36183	24287	.3150	8.000	8.0	65	22	3.00	34.55	33.04	31.54	30.04	
-	36185	80227	.3750	3/8"	9.525	3/8"	2-1/2"	7/8"	.010"	38.88	37.19	35.50	33.81
79237	36187	80237	.3750	3/8"	9.525	3/8"	2-1/2"	7/8"	.015"	38.88	37.19	35.50	33.81
79247	36189	80247	.3750	3/8"	9.525	3/8"	2-1/2"	7/8"	.020"	38.88	37.19	35.50	33.81
79257	36191	80257	.3750	3/8"	9.525	3/8"	2-1/2"	7/8"	.030"	38.88	37.19	35.50	33.81
79267	36193	80267	.3750	3/8"	9.525	3/8"	2-1/2"	7/8"	.045"	38.88	37.19	35.50	33.81
79277	36195	80277	.3750	3/8"	9.525	3/8"	2-1/2"	7/8"	.060"	38.88	37.19	35.50	33.81
-	36197	24297	.3937	10.000	10.0	70	25	0.50	46.94	44.90	42.86	40.82	
-	36199	24307	.3937	10.000	10.0	70	25	0.80	46.94	44.90	42.86	40.82	
-	36201	24317	.3937	10.000	10.0	70	25	1.00	46.94	44.90	42.86	40.82	
-	36203	24327	.3937	10.000	10.0	70	25	1.50	46.94	44.90	42.86	40.82	
-	36205	24337	.3937	10.000	10.0	70	25	2.00	46.94	44.90	42.86	40.82	
-	36207	24347	.3937	10.000	10.0	70	25	2.50	46.94	44.90	42.86	40.82	
-	36209	24357	.3937	10.000	10.0	70	25	3.00	46.94	44.90	42.86	40.82	
-	36211	24367	.3937	10.000	10.0	70	25	3.20	46.94	44.90	42.86	40.82	
-	36213	80279	.4375	7/16"	11.113	7/16"	2-3/4"	1"	.010"	47.01	44.97	42.92	40.88
-	36215	80281	.4375	7/16"	11.113	7/16"	2-3/4"	1"	.015"	47.01	44.97	42.92	40.88
-	36217	80283	.4375	7/16"	11.113	7/16"	2-3/4"	1"	.020"	47.01	44.97	42.92	40.88
-	36219	80285	.4375	7/16"	11.113	7/16"	2-3/4"	1"	.030"	47.01	44.97	42.92	40.88
-	36221	80287	.4375	7/16"	11.113	7/16"	2-3/4"	1"	.045"	47.01	44.97	42.92	40.88
-	36223	80289	.4375	7/16"	11.113	7/16"	2-3/4"	1"	.060"	47.01	44.97	42.92	40.88
-	36225	80291	.4375	7/16"	11.113	7/16"	2-3/4"	1"	.090"	47.01	44.97	42.92	40.88
-	36227	80293	.4375	7/16"	11.113	7/16"	2-3/4"	1"	.125"	47.01	44.97	42.92	40.88
-	36229	24377	.4724	12.000	12.0	75	25	0.50	69.13	66.12	63.12	60.11	
-	36231	24387	.4724	12.000	12.0	75	25	0.80	69.13	66.12	63.12	60.11	
-	36233	24397	.4724	12.000	12.0	75	25	1.00	69.13	66.12	63.12	60.11	
-	36235	24407	.4724	12.000	12.0	75	25	1.50	69.13	66.12	63.12	60.11	
-	36237	24417	.4724	12.000	12.0	75	25	2.00	69.13	66.12	63.12	60.11	
-	36239	24427	.4724	12.000	12.0	75	25	2.50	69.13	66.12	63.12	60.11	
-	36241	24437	.4724	12.000	12.0	75	25	3.00	69.13	66.12	63.12	60.11	
-	36243	24447	.4724	12.000	12.0	75	25	3.20	69.13	66.12	63.12	60.11	
-	36245	80297	.5000	1/2"	12.700	1/2"	3"	1"	.010"	66.32	63.44	60.55	57.67
79307	36247	80307	.5000	1/2"	12.700	1/2"	3"	1"	.015"	66.32	63.44	60.55	57.67
79317	36249	80317	.5000	1/2"	12.700	1/2"	3"	1"	.020"	66.32	63.44	60.55	57.67
79327	36251	80327	.5000	1/2"	12.700	1/2"	3"	1"	.030"	66.32	63.44	60.55	57.67
79337	36253	80337	.5000	1/2"	12.700	1/2"	3"	1"	.045"	66.32	63.44	60.55	57.67
79347	36255	80347	.5000	1/2"	12.700	1/2"	3"	1"	.060"	66.32	63.44	60.55	57.67
79357	36257	80357	.5000	1/2"	12.700	1/2"	3"	1"	.090"	66.32	63.44	60.55	57.67
79367	36259	80367	.5000	1/2"	12.700	1/2"	3"	1"	.125"	66.32	63.44	60.55	57.67
79377	36261	80377	.6250	5/8"	15.875	5/8"	3-1/2"	1-1/4"	.015"	105.58	100.99	96.40	91.81
-	36263	80387	.6250	5/8"	15.875	5/8"	3-1/2"	1-1/4"	.020"	105.58	100.99	96.40	91.81
79397	36265	80397	.6250	5/8"	15.875	5/8"	3-1/2"	1-1/4"	.030"	105.58	100.99	96.40	91.81
79407	36267	80407	.6250	5/8"	15.875	5/8"	3-1/2"	1-1/4"	.045"	105.58	100.99	96.40	91.81
79417	36269	80417	.6250	5/8"	15.875	5/8"	3-1/2"	1-1/4"	.060"	105.58	100.99	96.40	91.81
79427	36271	80427	.6250	5/8"	15.875	5/8"	3-1/2"	1-1/4"	.090"	105.58	100.99	96.40	91.81
-	36273	24457	.6299	16.000	16.0	88	38	0.50	110.17	105.38	100.59	95.80	
-	36275	24467	.6299	16.000	16.0	88	38	1.00	110.17	105.38	100.59	95.80	
-	36277	24477	.6299	16.000	16.0	88	38	2.00	110.17	105.38	100.59	95.80	
-	36279	24487	.6299	16.000	16.0	88	38	2.50	110.17	105.38	100.59	95.80	
-	36281	24497	.6299	16.000	16.0	88	38	3.00	110.17	105.38	100.59	95.80	
-	36283	24507	.6299	16.000	16.0	88	38	4.00	110.17	105.38	100.59	95.80	
-	36285	24517	.6299	16.000	16.0	88	38	5.00	110.17	105.38	100.59	95.80	

Series 220RA, 223RA, 230RA, 823RA, 830RA (continued)

.7500" - 1.000"
(19.050mm - 25.400mm)

GENERAL PURPOSE
END MILLS

70

35

MATERIAL HARDNESS (Rc)

0

(220RA) 2 Flute EDP#	(223RA/823RA) 3 Flute EDP#	(230RA/830RA) 4 Flute EDP#	$d1$ † Diameter			$d2$ Shank Diameter	$l1$ Overall Length	$l2$ Flute Length	r Corner Radius	1-11	12-24	25-49	50-100
Decimal	Metric												
79447	36287	80447	.7500	3/4"	19.050	3/4"	4"	1-1/2"	.015"	151.41	144.83	138.24	131.66
79457	36289	80457	.7500	3/4"	19.050	3/4"	4"	1-1/2"	.020"	151.41	144.83	138.24	131.66
79467	36291	80467	.7500	3/4"	19.050	3/4"	4"	1-1/2"	.030"	151.41	144.83	138.24	131.66
79477	36293	80477	.7500	3/4"	19.050	3/4"	4"	1-1/2"	.045"	151.41	144.83	138.24	131.66
79487	36295	80487	.7500	3/4"	19.050	3/4"	4"	1-1/2"	.060"	151.41	144.83	138.24	131.66
79497	36297	80497	.7500	3/4"	19.050	3/4"	4"	1-1/2"	.090"	151.41	144.83	138.24	131.66
79507	36299	80507	.7500	3/4"	19.050	3/4"	4"	1-1/2"	.125"	151.41	144.83	138.24	131.66
79637	36301	80637	.7500	3/4"	19.050	3/4"	4"	1-1/2"	.250"	151.41	144.83	138.24	131.66
-	36303	24527	.7874		20.000	20.0	100	38	0.50	214.29	204.97	195.66	186.34
-	36305	24537	.7874		20.000	20.0	100	38	1.00	214.29	204.97	195.66	186.34
-	36307	24547	.7874		20.000	20.0	100	38	2.00	214.29	204.97	195.66	186.34
-	36309	24557	.7874		20.000	20.0	100	38	3.00	214.29	204.97	195.66	186.34
-	36311	24567	.7874		20.000	20.0	100	38	5.00	214.29	204.97	195.66	186.34
-	36313	80517	1.000	1"	25.400	1"	4"	1-1/2"	.015"	258.50	247.26	236.02	224.78
-	36315	80527	1.000	1"	25.400	1"	4"	1-1/2"	.020"	258.50	247.26	236.02	224.78
79537	36317	80537	1.000	1"	25.400	1"	4"	1-1/2"	.030"	258.50	247.26	236.02	224.78
-	36319	80547	1.000	1"	25.400	1"	4"	1-1/2"	.045"	258.50	247.26	236.02	224.78
79557	36321	80557	1.000	1"	25.400	1"	4"	1-1/2"	.060"	258.50	247.26	236.02	224.78
-	36323	80567	1.000	1"	25.400	1"	4"	1-1/2"	.090"	258.50	247.26	236.02	224.78
79577	36325	80577	1.000	1"	25.400	1"	4"	1-1/2"	.125"	258.50	247.26	236.02	224.78
79647	36327	80647	1.000	1"	25.400	1"	4"	1-1/2"	.250"	258.50	247.26	236.02	224.78



End Mill Manufacturing

Series 320M, 323M, 330M, 920M, 923M, 930M

.0200" - .2656"
(0.508mm - 6.746mm)



TOLERANCES

d_1	$\leq .030"$ $\geq 1/32"$	$+0.000" - .001"$ (+.000 - .025mm)
d_2	h6	
ball radius	$+0.000" - .001"$ (+.000 - .025mm)	

Standard Length - Ball End

Solid submicron grain carbide end mill - center cutting

Extremely versatile

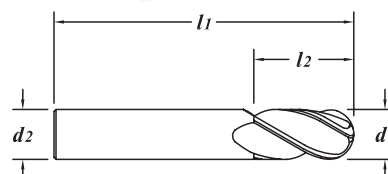
TiN Coating - page 230

TiCN Coating - page 231

TiALN Coating - page 232

Stub Length - page 214

Extended length - page 247



(320M/920M) 2 Flute EDP#	(323M/923M) 3 Flute EDP#	(330M/930M) 4 Flute EDP#	d_1 † Diameter			d_2 Shank Diameter	l_1 Overall Length	l_2 Flute Length	1-11	12-24	25-49	50-100
			Decimal		Metric							
16650	-	-	.0200	.0200"	0.508	1/8"	1-1/2"	.060"	22.99	21.99	20.99	19.99
16700	-	-	.0250	.0250"	0.635	1/8"	1-1/2"	.075"	22.21	21.24	20.28	19.31
16750	-	-	.0300	.0300"	0.762	1/8"	1-1/2"	.090"	19.14	18.30	17.47	16.64
16010	17010	18010	.0312	1/32"	0.792	1/8"	1-1/2"	3/32"	14.19	13.57	12.96	12.34
47010	38010	48010	.0394		1.000	3.0	38	4	14.90	14.26	13.61	12.96
16020	17020	18020	.0469	3/64"	1.191	1/8"	1-1/2"	1/8"	14.19	13.57	12.96	12.34
47020	38020	48020	.0591		1.500	3.0	38	6	14.90	14.26	13.61	12.96
16030	17030	18030	.0625	1/16"	1.588	1/8"	1-1/2"	1/4"	13.40	12.82	12.23	11.65
16040	17040	18040	.0781	5/64"	1.984	1/8"	1-1/2"	1/4"	13.40	12.82	12.23	11.65
47030	38030	48030	.0787		2.000	3.0	38	8	14.05	13.44	12.83	12.22
16050	17050	18050	.0938	3/32"	2.383	1/8"	1-1/2"	3/8"	12.81	12.25	11.70	11.14
47040	38040	48040	.0984		2.500	3.0	38	12	13.47	12.88	12.30	11.71
16060	17060	18060	.1094	7/64"	2.779	1/8"	1-1/2"	3/8"	12.81	12.25	11.70	11.14
47050	38050	48050	.1181		3.000	3.0	38	12	12.22	11.69	11.16	10.63
16070	17070	18070	.1250	1/8"	3.175	1/8"	1-1/2"	1/2"	11.63	11.12	10.62	10.11
47060	38060	48060	.1378		3.500	4.0	50	12	17.94	17.16	16.38	15.60
16080	17080	18080	.1406	9/64"	3.571	3/16"	2"	9/16"	17.05	16.31	15.57	14.83
16090	17090	18090	.1562	5/32"	3.967	3/16"	2"	9/16"	17.05	16.31	15.57	14.83
47070	38070	48070	.1575		4.000	4.0	50	14	16.09	15.39	14.69	13.99
16100	17100	18100	.1719	11/64"	4.366	3/16"	2"	9/16"	17.05	16.31	15.57	14.83
47080	38080	48080	.1772		4.500	5.0	50	14	20.25	19.37	18.49	17.61
16110	17110	18110	.1875	3/16"	4.763	3/16"	2"	5/8"	15.32	14.65	13.99	13.32
97070	98070	99070	.1969		5.000	5.0	50	16	18.61	17.80	16.99	16.18
47090	38090	48090	.1969		5.000	5.0	65	16	19.50	18.66	17.81	16.96
16120	17120	18120	.2031	13/64"	5.159	1/4"	2-1/2"	5/8"	19.84	18.98	18.11	17.25
16130	17130	18130	.2188	7/32"	5.558	1/4"	2-1/2"	5/8"	19.84	18.98	18.11	17.25
16140	17140	18140	.2344	15/64"	5.954	1/4"	2-1/2"	3/4"	19.84	18.98	18.11	17.25
47100	38100	48100	.2362		6.000	6.0	65	19	20.00	19.13	18.26	17.39
16150	17150	18150	.2500	1/4"	6.350	1/4"	2-1/2"	3/4"	19.03	18.21	17.38	16.55
16160	17160	18160	.2656	17/64"	6.746	5/16"	2-1/2"	7/8"	29.79	28.49	27.20	25.90

Series 320M, 323M, 330M, 920M, 923M, 930M (continued)

.2756" - 1.000"
(7.00mm - 25.40mm)

GENERAL PURPOSE
END MILLS

(320M/920M) 2 Flute EDP#	(323M/923M) 3 Flute EDP#	(330M/930M) 4 Flute EDP#	d_1 † Diameter			d_2 Shank Diameter	l_1 Overall Length	l_2 Flute Length	1-11	12-24	25-49	50-100
			Decimal		Metric							
47110	38110	48110	.2756		7.000	7.0	65	22	25.67	24.55	23.44	22.32
16170	17170	18170	.2812	9/32"	7.142	5/16"	2-1/2"	7/8"	29.79	28.49	27.20	25.90
16180	-	18180	.2969	19/64"	7.541	5/16"	2-1/2"	7/8"	29.79	28.49	27.20	25.90
16190	17190	18190	.3125	5/16"	7.938	5/16"	2-1/2"	7/8"	24.94	23.86	22.77	21.69
47120	38120	48120	.3150		8.000	8.0	65	22	26.25	25.11	23.97	22.83
16200	17200	18200	.3281	21/64"	8.334	3/8"	2-1/2"	7/8"	35.65	34.10	32.55	31.00
16210	17210	18210	.3438	11/32"	8.733	3/8"	2-1/2"	7/8"	35.65	34.10	32.55	31.00
47130	38130	48130	.3543		9.000	9.0	65	22	32.07	30.68	29.28	27.89
16220	-	18220	.3594	23/64"	9.129	3/8"	2-1/2"	7/8"	35.65	34.10	32.55	31.00
16230	17230	18230	.3750	3/8"	9.525	3/8"	2-1/2"	7/8"	30.53	29.21	27.88	26.55
16240	17240	18240	.3906	25/64"	9.921	7/16"	2-3/4"	7/8"	43.87	41.97	40.06	38.15
47140	38140	48140	.3937		10.000	10.0	70	25	37.48	35.85	34.22	32.59
16250	17250	18250	.4062	13/32"	10.317	7/16"	2-3/4"	7/8"	43.87	41.97	40.06	38.15
16260	17260	18260	.4219	27/64"	10.716	7/16"	2-3/4"	7/8"	43.87	41.97	40.06	38.15
47150	38150	48150	.4331		11.000	11.0	75	25	39.46	37.74	36.03	34.31
16270	17270	18270	.4375	7/16"	11.113	7/16"	2-3/4"	1"	37.58	35.95	34.31	32.68
16280	-	18280	.4531	29/64"	11.509	1/2"	3"	1"	62.84	60.10	57.37	54.64
16290	17290	18290	.4688	15/32"	11.908	1/2"	3"	1"	62.84	60.10	57.37	54.64
47160	38160	48160	.4724		12.000	12.0	75	25	59.70	57.10	54.51	51.91
16300	-	18300	.4844	31/64"	12.304	1/2"	3"	1"	62.84	60.10	57.37	54.64
16310	17310	18310	.5000	1/2"	12.700	1/2"	3"	1"	56.83	54.36	51.89	49.42
47170	38170	48170	.5512		14.000	14.0	88	32	86.91	83.13	79.35	75.57
16320	17320	18320	.5625	9/16"	14.288	9/16"	3-1/2"	1-1/4"	82.78	79.18	75.58	71.98
16330	17330	18330	.6250	5/8"	15.875	5/8"	3-1/2"	1-1/4"	91.92	87.92	83.93	79.93
47180	38180	48180	.6299		16.000	16.0	88	38	96.50	92.30	88.11	83.91
16340	17340	18340	.6875	11/16"	17.463	3/4"	4"	1-1/2"	153.02	146.37	139.71	133.06
47190	-	48190	.7087		18.000	18.0	100	38	142.01	135.84	129.66	123.49
16350	17350	18350	.7500	3/4"	19.050	3/4"	4"	1-1/2"	135.27	129.39	123.51	117.63
47200	38200	48200	.7874		20.000	20.0	100	38	190.44	182.16	173.88	165.60
47210	-	48210	.8661		22.000	22.0	100	38	211.55	202.36	193.16	183.96
16360	17360	18360	.8750	7/8"	22.225	7/8"	4"	1-1/2"	216.72	207.30	197.87	188.45
47220	-	-	.9843		25.000	25.0	100	38	221.77	212.12	202.48	192.84
16370	17370	18370	1.000	1"	25.400	1"	4"	1-1/2"	234.65	224.44	214.24	204.04

70

35

MATERIAL HARDNESS (Rc)

0

Series 320MT, 330MT



TOLERANCES

d_1	+0.000" - .002" (+.000 - .050mm)
d_2	h6
ball radius	+0.000" - .001" (+.000 - .025mm)

Standard Length - Ball End

TiN Coating

Solid submicron grain carbide end mill - center cutting

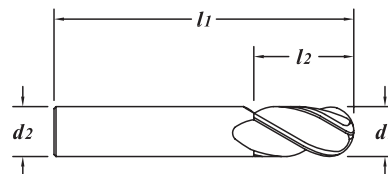
Improved lubricity

Extremely versatile

Uncoated - page 228

TiCN Coating - page 231

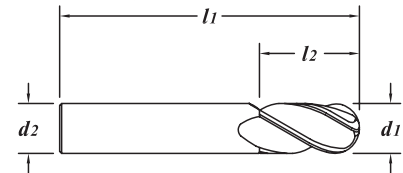
TiAlN Coating - page 232



(320MT) 2 Flute EDP#	(330MT) 4 Flute EDP#	d_1 †			d_2 Shank Diameter	l_1 Overall Length	l_2 Flute Length	1-11	12-24	25-49	50-100
		Decimal		Metric							
16073	18073	.1250	1/8"	3.175	1/8"	1-1/2"	1/2"	13.20	12.63	12.05	11.48
16113	18113	.1875	3/16"	4.763	3/16"	2"	5/8"	16.92	16.18	15.45	14.71
16153	18153	.2500	1/4"	6.350	1/4"	2-1/2"	3/4"	22.23	21.26	20.30	19.33
16193	18193	.3125	5/16"	7.938	5/16"	2-1/2"	7/8"	29.27	28.00	26.72	25.45
16233	18233	.3750	3/8"	9.525	3/8"	2-1/2"	7/8"	34.86	33.34	31.83	30.31
16273	18273	.4375	7/16"	11.113	7/16"	2-3/4"	1"	42.78	40.92	39.06	37.20
16313	18313	.5000	1/2"	12.700	1/2"	3"	1"	62.07	59.37	56.67	53.97
16333	18333	.6250	5/8"	15.875	5/8"	3-1/2"	1-1/4"	99.94	95.59	91.25	86.90
16353	18353	.7500	3/4"	19.050	3/4"	4"	1-1/2"	144.44	138.16	131.88	125.60
16373	18373	1.000	1"	25.400	1"	4"	1-1/2"	250.69	239.79	228.89	217.99

TOLERANCES

d_1	$+0.000" - .002" (+.000 - .050\text{mm})$
d_2	$h6$
ball radius	$+0.000" - .001" (+.000 - .025\text{mm})$


Series 320MC, 323MC, 330MC

Standard Length - Ball End
TiCN Coating

Solid submicron grain carbide end mill - center cutting

Improved abrasion resistance and lubricity

Extremely versatile

Uncoated - page 228

TiN Coating - page 230

TiAlN Coating - page 232

Extended length - page 249

(320MC) 2 Flute EDP#	(323MC) 3 Flute EDP#	(330MC) 4 Flute EDP#	$d1$ † Diameter			$d2$ Shank Diameter	$l1$ Overall Length	$l2$ Flute Length	1-11	12-24	25-49	50-100
			Decimal		Metric							
16014	17014	18014	.0312	1/32"	0.792	1/8"	1-1/2"	3/32"	16.56	15.84	15.12	14.40
16024	17024	18024	.0469	3/64"	1.191	1/8"	1-1/2"	1/8"	16.56	15.84	15.12	14.40
16034	17034	18034	.0625	1/16"	1.588	1/8"	1-1/2"	1/4"	15.78	15.09	14.41	13.72
16044	17044	18044	.0781	5/64"	1.984	1/8"	1-1/2"	1/4"	15.78	15.09	14.41	13.72
16054	17054	18054	.0938	3/32"	2.383	1/8"	1-1/2"	3/8"	15.18	14.52	13.86	13.20
16064	17064	18064	.1094	7/64"	2.779	1/8"	1-1/2"	3/8"	15.18	14.52	13.86	13.20
16074	17074	18074	.1250	1/8"	3.175	1/8"	1-1/2"	1/2"	14.00	13.39	12.78	12.17
16084	17084	18084	.1406	9/64"	3.571	3/16"	2"	9/16"	19.45	18.60	17.76	16.91
16094	17094	18094	.1562	5/32"	3.967	3/16"	2"	9/16"	19.45	18.60	17.76	16.91
16104	-	18104	.1719	11/64"	4.366	3/16"	2"	9/16"	19.45	18.60	17.76	16.91
16114	17114	18114	.1875	3/16"	4.763	3/16"	2"	5/8"	17.69	16.92	16.15	15.38
16124	17124	18124	.2031	13/64"	5.159	1/4"	2-1/2"	5/8"	24.64	23.57	22.50	21.43
16134	17134	18134	.2188	7/32"	5.558	1/4"	2-1/2"	5/8"	24.64	23.57	22.50	21.43
16144	17144	18144	.2344	15/64"	5.954	1/4"	2-1/2"	3/4"	24.64	23.57	22.50	21.43
16154	17154	18154	.2500	1/4"	6.350	1/4"	2-1/2"	3/4"	23.84	22.80	21.77	20.73
-	17164	18164	.2656	17/64"	6.746	5/16"	2-1/2"	7/8"	36.21	34.64	33.06	31.49
16174	17174	18174	.2812	9/32"	7.142	5/16"	2-1/2"	7/8"	36.21	34.64	33.06	31.49
-	-	18184	.2969	19/64"	7.541	5/16"	2-1/2"	7/8"	36.21	34.64	33.06	31.49
16194	17194	18194	.3125	5/16"	7.938	5/16"	2-1/2"	7/8"	31.42	30.05	28.69	27.32
16204	-	-	.3281	21/64"	8.334	3/8"	2-1/2"	7/8"	42.10	40.27	38.44	36.61
-	17214	18214	.3438	11/32"	8.733	3/8"	2-1/2"	7/8"	42.10	40.27	38.44	36.61
16224	-	18224	.3594	23/64"	9.129	3/8"	2-1/2"	7/8"	42.10	40.27	38.44	36.61
16234	17234	18234	.3750	3/8"	9.525	3/8"	2-1/2"	7/8"	36.97	35.37	33.76	32.15
16244	-	18244	.3906	25/64"	9.921	7/16"	2-3/4"	7/8"	51.57	49.32	47.08	44.84
16254	17254	18254	.4062	13/32"	10.317	7/16"	2-3/4"	7/8"	51.57	49.32	47.08	44.84
-	-	18264	.4219	27/64"	10.716	7/16"	2-3/4"	7/8"	51.57	49.32	47.08	44.84
16274	17274	18274	.4375	7/16"	11.113	7/16"	2-3/4"	1"	45.31	43.34	41.37	39.40
-	-	18284	.4531	29/64"	11.509	1/2"	3"	1"	70.58	67.51	64.44	61.37
-	17294	18294	.4688	15/32"	11.908	1/2"	3"	1"	70.58	67.51	64.44	61.37
16304	17304	18304	.4844	31/64"	12.304	1/2"	3"	1"	70.58	67.51	64.44	61.37
16314	17314	18314	.5000	1/2"	12.700	1/2"	3"	1"	64.58	61.78	58.97	56.16
16324	17324	18324	.5625	9/16"	14.288	9/16"	3-1/2"	1-1/4"	94.79	90.67	86.55	82.43
16334	17334	18334	.6250	5/8"	15.875	5/8"	3-1/2"	1-1/4"	103.97	99.45	94.93	90.41
-	17344	-	.6875	11/16"	17.463	3/4"	4"	1-1/2"	166.77	159.52	152.27	145.02
16354	17354	18354	.7500	3/4"	19.050	3/4"	4"	1-1/2"	149.03	142.55	136.07	129.59
16364	17364	18364	.8750	7/8"	22.225	7/8"	4"	1-1/2"	237.39	227.07	216.75	206.43
16374	17374	18374	1.000	1"	25.400	1"	4"	1-1/2"	255.33	244.23	233.13	222.03

GENERAL PURPOSE
END MILLS

70

35

MATERIAL HARDNESS (Rc)

0

Series 320MA, 323MA, 330MA, 920MA, 923MA, 930MA

.0312" - .3150"
(0.792mm - 8.000mm)

TOLERANCES

d_1	+0.000" -0.002" (+0.000 -0.050mm)
d_2	h6
ball radius	+0.000" -0.001" (+0.000 -0.025mm)

Standard Length - Ball End

TiAlN Coating

Solid submicron grain carbide end mill - center cutting

Dry or semi-dry machining

Extremely versatile

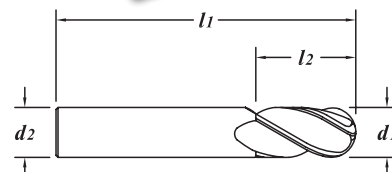
Uncoated - page 228

TiN Coating - page 230

TiCN Coating - page 231

Stub Length - page 215

Extended length - page 250



(320MA/920MA) 2 Flute EDP#	(323MA/923MA) 3 Flute EDP#	(330MA/930MA) 4 Flute EDP#	d_1 † Diameter			d_2 Shank Diameter	l_1 Overall Length	l_2 Flute Length	1-11	12-24	25-49	50-100
			Decimal		Metric							
16017	17017	18017	.0312	1/32"	0.792	1/8"	1-1/2"	3/32"	16.87	16.14	15.40	14.67
47017	38017	48017	.0394		1.000	3.0	38	4	17.60	16.83	16.07	15.30
16027	17027	18027	.0469	3/64"	1.191	1/8"	1-1/2"	1/8"	16.87	16.14	15.40	14.67
47027	38027	48027	.0591		1.500	3.0	38	6	17.60	16.83	16.07	15.30
16037	17037	18037	.0625	1/16"	1.588	1/8"	1-1/2"	1/4"	16.09	15.39	14.69	13.99
16047	17047	18047	.0781	5/64"	1.984	1/8"	1-1/2"	1/4"	16.09	15.39	14.69	13.99
47037	38037	48037	.0787		2.000	3.0	38	8	16.76	16.03	15.30	14.57
16057	17057	18057	.0938	3/32"	2.383	1/8"	1-1/2"	3/8"	15.50	14.83	14.15	13.48
47047	38047	48047	.0984		2.500	3.0	38	12	16.15	15.44	14.74	14.04
16067	17067	18067	.1094	7/64"	2.779	1/8"	1-1/2"	3/8"	15.50	14.83	14.15	13.48
47057	38057	48057	.1181		3.000	3.0	38	12	14.90	14.26	13.61	12.96
16077	17077	18077	.1250	1/8"	3.175	1/8"	1-1/2"	1/2"	14.32	13.70	13.07	12.45
47067	38067	48067	.1378		3.500	4.0	50	12	20.62	19.72	18.83	17.93
16087	17087	18087	.1406	9/64"	3.571	3/16"	2"	9/16"	19.77	18.91	18.05	17.19
16097	17097	18097	.1562	5/32"	3.967	3/16"	2"	9/16"	19.77	18.91	18.05	17.19
47077	38077	48077	.1575		4.000	4.0	50	14	18.78	17.96	17.15	16.33
16107	17107	18107	.1719	11/64"	4.366	3/16"	2"	9/16"	19.77	18.91	18.05	17.19
47087	38087	48087	.1772		4.500	5.0	50	14	24.45	23.39	22.32	21.26
16117	17117	18117	.1875	3/16"	4.763	3/16"	2"	5/8"	18.01	17.23	16.44	15.66
97077	98077	99077	.1969		5.000	5.0	50	16	22.80	21.81	20.82	19.83
47097	38097	48097	.1969		5.000	5.0	65	16	25.06	23.97	22.88	21.79
16127	17127	18127	.2031	13/64"	5.159	1/4"	2-1/2"	5/8"	25.40	24.30	23.19	22.09
16137	17137	18137	.2188	7/32"	5.558	1/4"	2-1/2"	5/8"	25.40	24.30	23.19	22.09
16147	17147	18147	.2344	15/64"	5.954	1/4"	2-1/2"	3/4"	25.40	24.30	23.19	22.09
47107	38107	48107	.2362		6.000	6.0	65	19	25.54	24.43	23.32	22.21
16157	17157	18157	.2500	1/4"	6.350	1/4"	2-1/2"	3/4"	24.56	23.50	22.43	21.36
16167	17167	18167	.2656	17/64"	6.746	5/16"	2-1/2"	7/8"	38.10	36.44	34.79	33.13
47117	38117	48117	.2756		7.000	7.0	65	22	33.96	32.48	31.01	29.53
16177	17177	18177	.2812	9/32"	7.142	5/16"	2-1/2"	7/8"	38.10	36.44	34.79	33.13
16187	17187	18187	.2969	19/64"	7.541	5/16"	2-1/2"	7/8"	38.10	36.44	34.79	33.13
16197	17197	18197	.3125	5/16"	7.938	5/16"	2-1/2"	7/8"	33.29	31.85	30.40	28.95
47127	38127	48127	.3150		8.000	8.0	65	22	34.55	33.04	31.54	30.04

Series 320MA, 323MA, 330MA, 920MA, 923MA, 930MA (continued)

.3281" - 1.000"
(8.334mm - 25.400mm)

GENERAL PURPOSE
END MILLS

(320MA/920MA) 2 Flute EDP#	(323MA/923MA) 3 Flute EDP#	(330MA/930MA) 4 Flute EDP#	$d1$ † Diameter			$d2$ Shank Diameter	$l1$ Overall Length	$l2$ Flute Length	1-11	12-24	25-49	50-100
Decimal					Metric							
16207	17207	18207	.3281	21/64"	8.334	3/8"	2-1/2"	7/8"	43.98	42.06	40.15	38.24
16217	17217	18217	.3438	11/32"	8.733	3/8"	2-1/2"	7/8"	43.98	42.06	40.15	38.24
47137	38137	48137	.3543		9.000	9.0	65	22	40.38	38.62	36.87	35.11
16227	17227	18227	.3594	23/64"	9.129	3/8"	2-1/2"	7/8"	43.98	42.06	40.15	38.24
16237	17237	18237	.3750	3/8"	9.525	3/8"	2-1/2"	7/8"	38.88	37.19	35.50	33.81
16247	17247	18247	.3906	25/64"	9.921	7/16"	2-3/4"	7/8"	53.30	50.99	48.67	46.35
47147	38147	48147	.3937		10.000	10.0	70	25	46.94	44.90	42.86	40.82
16257	17257	18257	.4062	13/32"	10.317	7/16"	2-3/4"	7/8"	53.30	50.99	48.67	46.35
16267	-	18267	.4219	27/64"	10.716	7/16"	2-3/4"	7/8"	53.30	50.99	48.67	46.35
47157	38157	48157	.4331		11.000	11.0	75	25	48.91	46.78	44.66	42.53
16277	17277	18277	.4375	7/16"	11.113	7/16"	2-3/4"	1"	47.01	44.97	42.92	40.88
16287	17287	18287	.4531	29/64"	11.509	1/2"	3"	1"	72.31	69.17	66.02	62.88
16297	17297	18297	.4688	15/32"	11.908	1/2"	3"	1"	72.31	69.17	66.02	62.88
47167	38167	48167	.4724		12.000	12.0	75	25	69.13	66.12	63.12	60.11
16307	17307	18307	.4844	31/64"	12.304	1/2"	3"	1"	72.31	69.17	66.02	62.88
16317	17317	18317	.5000	1/2"	12.700	1/2"	3"	1"	66.32	63.44	60.55	57.67
47177	38177	48177	.5512		14.000	14.0	88	32	100.57	96.20	91.82	87.45
16327	17327	18327	.5625	9/16"	14.288	9/16"	3-1/2"	1-1/4"	96.44	92.25	88.05	83.86
16337	17337	18337	.6250	5/8"	15.875	5/8"	3-1/2"	1-1/4"	105.58	100.99	96.40	91.81
47187	38187	48187	.6299		16.000	16.0	88	38	110.17	105.38	100.59	95.80
16347	17347	18347	.6875	11/16"	17.463	3/4"	4"	1-1/2"	169.14	161.79	154.43	147.08
47197	38197	48197	.7087		18.000	18.0	100	38	158.17	151.29	144.42	137.54
16357	17357	18357	.7500	3/4"	19.050	3/4"	4"	1-1/2"	151.41	144.83	138.24	131.66
47207	38207	48207	.7874		20.000	20.0	100	38	214.29	204.97	195.66	186.34
47217	38217	48217	.8661		22.000	22.0	100	38	235.39	225.16	214.92	204.69
-	17367	18367	.8750	7/8"	22.225	7/8"	4"	1-1/2"	240.57	230.11	219.65	209.19
47227	38227	48227	.9843		25.000	25.0	100	38	245.59	234.92	224.24	213.56
16377	17377	18377	1.000	1"	25.400	1"	4"	1-1/2"	258.50	247.26	236.02	224.78

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MATERIAL HARDNESS (Rc)

Series 222M, 234M, 334MA



TOLERANCES

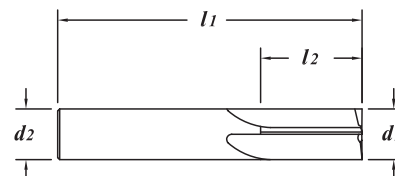
d_1	+0.000" - .002" (+.000 - .050mm)
d_2	h6
ball radius	+0.000" - .001" (+.000 - .025mm)

Standard Length - Straight Flute - Square End

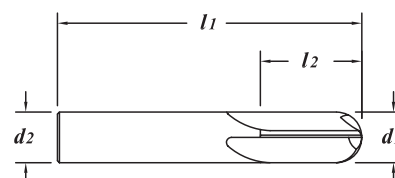
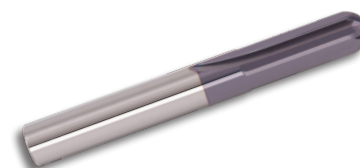
Solid submicron grain carbide end mill - center cutting

For cutting high Rc materials

Helps to hold perpendicularity



(222M) 2 Flute EDP#	(234M) 4 Flute EDP#	d_1 †		d_2	l_1	l_2	1-11	12-24	25-49	50-100
		Decimal	Diameter	Metric	Shank Diameter	Overall Length	Flute Length			
81070	82070	.1250	1/8"	3.175	1/8"	1-1/2"	1/2"	10.07	9.64	9.20
81110	82110	.1875	3/16"	4.763	3/16"	2"	5/8"	14.12	13.51	12.89
81150	82150	.2500	1/4"	6.350	1/4"	2-1/2"	3/4"	17.03	16.29	15.55
81190	82190	.3125	5/16"	7.938	5/16"	2-1/2"	7/8"	23.87	22.84	21.80
81230	82230	.3750	3/8"	9.525	3/8"	2-1/2"	7/8"	29.74	28.45	27.15
81270	82270	.4375	7/16"	11.113	7/16"	2-3/4"	1"	36.29	34.72	33.14
81310	82310	.5000	1/2"	12.700	1/2"	3"	1"	47.60	45.53	43.46
81330	82330	.6250	5/8"	15.875	5/8"	3-1/2"	1-1/4"	91.87	87.88	83.88
81350	82350	.7500	3/4"	19.050	3/4"	4"	1-1/2"	134.69	128.83	122.98
81370	82370	1.000	1"	25.400	1"	4"	1-1/2"	221.62	211.98	202.35



Standard Length - Straight Flute - Ball End

TiAlN Coating

Solid submicron grain carbide end mill - center cutting

For cutting high Rc materials

Helps to hold perpendicularity

(334MA) 4 Flute EDP#	d_1 †		d_2	l_1	l_2	1-11	12-24	25-49	50-100
	Decimal	Diameter	Metric	Shank Diameter	Overall Length	Flute Length			
84077	.1250	1/8"	3.175	1/8"	1-1/2"	1/2"	14.89	14.25	13.60
84115	.1875	3/16"	4.763	3/16"	2"	5/8"	19.02	18.19	17.37
84157	.2500	1/4"	6.350	1/4"	2-1/2"	3/4"	25.19	24.09	23.00
84237	.3750	3/8"	9.525	3/8"	2-1/2"	7/8"	40.01	38.27	36.53

TOLERANCES

$d1$	$+0.003" -0.000" (+0.075 -0.000mm)$
$d2$	$h6$



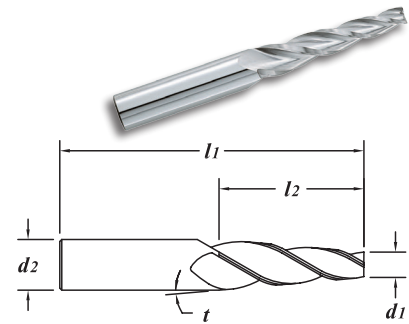
Series 273M, 373M

GENERAL PURPOSE
END MILLS

Standard Length - Tapered - Square End

Solid submicron grain carbide end mill - center cutting

Excellent for holding draft angles in mold and die applications



273M EDP#	$d2$ Shank Diameter	t Taper Per Side	$d1$ † Tip Diameter		$l1$ Overall Length	$l2$ Flute Length	1-11	12-24	25-49	50-100
			Decimal	Metric						
49010	1/4"	1°	.1250	1/8"	3"	1-1/2"	33.01	31.57	30.14	28.70
49020	1/4"	1° 30'	.1250	1/8"	3"	1-1/2"	33.01	31.57	30.14	28.70
49030	1/4"	2°	.1250	1/8"	3"	1"	33.01	31.57	30.14	28.70
49040	1/4"	3°	.1250	1/8"	3"	1-1/4"	33.01	31.57	30.14	28.70
49050	1/4"	5°	.1250	1/8"	3"	3/4"	33.01	31.57	30.14	28.70
49060	1/4"	7°	.1250	1/8"	3"	1/2"	33.01	31.57	30.14	28.70
49070	3/8"	1°	.1875	3/16"	3-1/2"	1-3/4"	49.58	47.42	45.27	43.11
49080	3/8"	1° 30'	.1875	3/16"	3-1/2"	1-3/4"	49.58	47.42	45.27	43.11
49090	3/8"	2°	.1875	3/16"	3-1/2"	1-3/4"	49.58	47.42	45.27	43.11
49100	3/8"	3°	.1562	5/32"	3-1/2"	1-3/4"	49.58	47.42	45.27	43.11
49110	3/8"	5°	.1250	1/8"	3-1/2"	1-1/2"	49.58	47.42	45.27	43.11
49120	3/8"	7°	.1562	5/32"	3-1/2"	1"	49.58	47.42	45.27	43.11
49130	1/2"	3°	.2500	1/4"	4"	2"	68.29	65.32	62.35	59.38
49140	1/2"	5°	.2500	1/4"	4"	1-1/2"	68.29	65.32	62.35	59.38
49150	1/2"	7°	.1875	3/16"	4"	1-5/16"	68.29	65.32	62.35	59.38

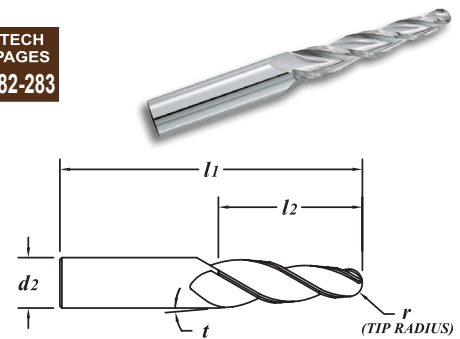


Standard Length - Tapered - Ball End

Solid submicron grain carbide end mill - center cutting

Excellent for holding draft angles in mold and die applications

Radius tolerance $+0.003" -0.000" (+0.075mm -0.000mm)$



373M EDP#	$d2$ Shank Diameter	t Taper Per Side	r † Tip Radius		$l1$ Overall Length	$l2$ Flute Length	1-11	12-24	25-49	50-100
			Decimal	Metric						
50010	1/4"	1°	.0620	.062"	3"	1-1/2"	36.62	35.02	33.43	31.84
50020	1/4"	1° 30'	.0620	.062"	3"	1-1/2"	36.62	35.02	33.43	31.84
50030	1/4"	2°	.0620	.062"	3"	1"	36.62	35.02	33.43	31.84
50040	1/4"	3°	.0620	.062"	3"	1-1/4"	36.62	35.02	33.43	31.84
50050	1/4"	5°	.0620	.062"	3"	3/4"	36.62	35.02	33.43	31.84
50060	1/4"	7°	.0620	.062"	3"	1/2"	36.62	35.02	33.43	31.84
50070	3/8"	1°	.0930	.093"	3-1/2"	1-3/4"	55.05	52.66	50.26	47.87
50080	3/8"	1° 30'	.0930	.093"	3-1/2"	1-3/4"	55.05	52.66	50.26	47.87
50090	3/8"	2°	.0930	.093"	3-1/2"	1-3/4"	55.05	52.66	50.26	47.87
50100	3/8"	3°	.0780	.078"	3-1/2"	1-3/4"	55.05	52.66	50.26	47.87
50110	3/8"	5°	.0620	.062"	3-1/2"	1-1/2"	55.05	52.66	50.26	47.87
50120	3/8"	7°	.0780	.078"	3-1/2"	1"	55.05	52.66	50.26	47.87
50130	1/2"	3°	.1250	.125"	4"	2"	78.50	75.09	71.67	68.26
50140	1/2"	5°	.1250	.125"	4"	1-1/2"	78.50	75.09	71.67	68.26
50150	1/2"	7°	.0930	.093"	4"	1-5/16"	78.50	75.09	71.67	68.26

Series 620M, 623M, 630M, 640M, 643M, 650M

.1181" - .3150"
(3.000mm - 8.000mm)



TOLERANCES

$d1$	$+0.000" - .002" (+0.000 - .050mm)$
$d2$	$h6$

Extra Length

Solid submicron grain carbide end mill - center cutting

Extended reach

Can be modified with a neck within 48 hours

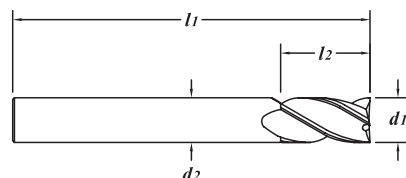
Extremely versatile

TiCN Coating - page 238

TiALN Coating - page 239

Stub Length - page 207

Standard length - page 216



(620M/640M) 2 Flute EDP#	(623M/643M) 3 Flute EDP#	(630M/650M) 4 Flute EDP#	$d1$ † Diameter			$d2$ Shank Diameter	$l1$ Overall Length	$l2$ Flute Length	1-11	12-24	25-49	50-100
			Decimal		Metric							
92010	93010	94010	.1181		3.000	3.0	50	16	12.72	12.17	11.61	11.06
92020	93020	94020	.1181		3.000	3.0	75	20	21.60	20.66	19.72	18.78
92030	93030	94030	.1181		3.000	3.0	75	25	21.60	20.66	19.72	18.78
41010	54510	42010	.1250	1/8"	3.175	1/8"	2"	5/8"	13.29	12.72	12.14	11.56
41020	54520	42020	.1250	1/8"	3.175	1/8"	3"	3/4"	20.53	19.64	18.74	17.85
41030	54530	42030	.1250	1/8"	3.175	1/8"	3"	1"	20.53	19.64	18.74	17.85
92040	93040	94040	.1575		4.000	4.0	50	16	13.36	12.78	12.20	11.62
92050	93050	94050	.1575		4.000	4.0	75	20	22.10	21.14	20.18	19.22
92060	93060	94060	.1575		4.000	4.0	75	25	22.10	21.14	20.18	19.22
41040	54540	42040	.1875	3/16"	4.763	3/16"	3"	1"	22.64	21.66	20.67	19.69
41050	54550	42050	.1875	3/16"	4.763	3/16"	3"	1-1/8"	22.64	21.66	20.67	19.69
41060	54560	42060	.1875	3/16"	4.763	3/16"	4"	1"	25.01	23.93	22.84	21.75
92080	93080	94080	.1969		5.000	5.0	75	20	23.84	22.80	21.77	20.73
92090	93090	94090	.1969		5.000	5.0	75	25	23.84	22.80	21.77	20.73
92100	93100	94100	.2362		6.000	6.0	75	25	27.62	26.42	25.22	24.02
92110	93110	94110	.2362		6.000	6.0	100	25	29.14	27.87	26.61	25.34
92120	93120	94120	.2362		6.000	6.0	100	32	29.14	27.87	26.61	25.34
92130	93130	94130	.2362		6.000	6.0	150	38	39.43	37.72	36.00	34.29
41070	54570	42070	.2500	1/4"	6.350	1/4"	3"	1"	26.22	25.08	23.94	22.80
41080	54580	42080	.2500	1/4"	6.350	1/4"	4"	1"	27.69	26.49	25.28	24.08
41090	54590	42090	.2500	1/4"	6.350	1/4"	4"	1-1/2"	27.69	26.49	25.28	24.08
41100	54600	42100	.2500	1/4"	6.350	1/4"	6"	1-1/2"	37.44	35.82	34.19	32.56
41110	54610	42110	.3125	5/16"	7.938	5/16"	3"	1"	32.36	30.95	29.55	28.14
41120	54620	42120	.3125	5/16"	7.938	5/16"	4"	1"	36.13	34.56	32.99	31.42
41130	54630	42130	.3125	5/16"	7.938	5/16"	4"	1-5/8"	36.13	34.56	32.99	31.42
41140	54640	42140	.3125	5/16"	7.938	5/16"	6"	1-1/2"	53.58	51.25	48.92	46.59
92140	93140	94140	.3150		8.000	8.0	75	25	34.09	32.60	31.12	29.64
92150	93150	94150	.3150		8.000	8.0	100	25	38.01	36.36	34.70	33.05
92160	93160	94160	.3150		8.000	8.0	100	41	38.01	36.36	34.70	33.05
92170	93170	94170	.3150		8.000	8.0	150	50	54.95	52.56	50.17	47.78

MATERIAL HARDNESS (Rc)

70

35

0

Series 620M, 623M, 630M, 640M, 643M, 650M (continued)

.3750" - 1.250"
(9.525mm - 31.750mm)

GENERAL PURPOSE
END MILLS

(620M/640M) 2 Flute EDP#	(623M/643M) 3 Flute EDP#	(630M/650M) 4 Flute EDP#	$d1$ † Diameter		$d2$ Shank Diameter	$l1$ Overall Length	$l2$ Flute Length	1-11	12-24	25-49	50-100	
			Decimal	Metric								
41150	54650	42150	.3750	3/8"	9.525	3/8"	3"	1"	36.41	34.83	33.24	31.66
41160	54660	42160	.3750	3/8"	9.525	3/8"	4"	1"	39.97	38.24	36.50	34.76
41170	54670	42170	.3750	3/8"	9.525	3/8"	4"	2"	39.97	38.24	36.50	34.76
41180	54680	42180	.3750	3/8"	9.525	3/8"	6"	1-1/2"	58.26	55.73	53.19	50.66
41190	54690	42190	.3750	3/8"	9.525	3/8"	6"	3"	58.26	55.73	53.19	50.66
92180	93180	94180	.3937		10.000	10.0	75	25	39.53	37.81	36.09	34.37
92190	93190	94190	.3937		10.000	10.0	100	25	50.96	48.74	46.53	44.31
92200	93200	94200	.3937		10.000	10.0	100	50	50.96	48.74	46.53	44.31
92210	93210	94210	.3937		10.000	10.0	150	38	67.03	64.12	61.20	58.29
92220	93220	94220	.3937		10.000	10.0	150	75	67.03	64.12	61.20	58.29
41200	54700	42200	.4375	7/16"	11.113	7/16"	4"	1"	55.03	52.64	50.24	47.85
41210	54710	42210	.4375	7/16"	11.113	7/16"	4"	2"	55.03	52.64	50.24	47.85
41220	54720	42220	.4375	7/16"	11.113	7/16"	6"	1-1/2"	73.15	69.97	66.79	63.61
41230	54730	42230	.4375	7/16"	11.113	7/16"	6"	3"	73.15	69.97	66.79	63.61
92230	93230	94230	.4724		12.000	12.0	100	25	62.07	59.37	56.67	53.97
92240	93240	94240	.4724		12.000	12.0	100	50	62.07	59.37	56.67	53.97
92250	93250	94250	.4724		12.000	12.0	150	50	84.63	80.95	77.27	73.59
92260	93260	94260	.4724		12.000	12.0	150	75	84.63	80.95	77.27	73.59
41240	54740	42240	.5000	1/2"	12.700	1/2"	4"	1"	58.54	55.99	53.45	50.90
41250	54750	42250	.5000	1/2"	12.700	1/2"	4"	2"	58.54	55.99	53.45	50.90
41260	54760	42260	.5000	1/2"	12.700	1/2"	6"	1-1/2"	84.63	80.95	77.27	73.59
41270	54770	42270	.5000	1/2"	12.700	1/2"	6"	3"	84.63	80.95	77.27	73.59
92270	93270	94270	.5512		14.000	14.0	100	25	85.20	81.50	77.79	74.09
92280	93280	94280	.5512		14.000	14.0	100	50	85.20	81.50	77.79	74.09
92290	93290	94290	.5512		14.000	14.0	150	50	111.09	106.26	101.43	96.60
92300	93300	94300	.5512		14.000	14.0	150	75	111.09	106.26	101.43	96.60
41280	54780	42280	.5625	9/16"	14.288	9/16"	6"	2"	111.10	106.27	101.44	96.61
41290	54790	42290	.5625	9/16"	14.288	9/16"	6"	3"	111.10	106.27	101.44	96.61
41300	54800	42300	.6250	5/8"	15.875	5/8"	6"	2"	120.62	115.38	110.13	104.89
41310	54810	42310	.6250	5/8"	15.875	5/8"	6"	3"	120.62	115.38	110.13	104.89
92310	93310	94310	.6299		16.000	16.0	150	50	120.62	115.38	110.13	104.89
92320	93320	94320	.6299		16.000	16.0	150	75	120.62	115.38	110.13	104.89
92330	93330	94330	.7087		18.000	18.0	150	50	181.37	173.48	165.60	157.71
92340	93340	94340	.7087		18.000	18.0	150	75	181.37	173.48	165.60	157.71
41320	54820	42320	.7500	3/4"	19.050	3/4"	6"	2"	192.17	183.81	175.46	167.10
41330	54830	42330	.7500	3/4"	19.050	3/4"	6"	3"	192.17	183.81	175.46	167.10
92350	93350	94350	.7874		20.000	20.0	150	50	202.43	193.63	184.83	176.03
92360	93360	94360	.7874		20.000	20.0	150	75	202.43	193.63	184.83	176.03
92370	93370	94370	.9843		25.000	25.0	150	50	311.94	298.38	284.81	271.25
-	93380	94380	.9843		25.000	25.0	150	75	311.94	298.38	284.81	271.25
41340	54840	42340	1.000	1"	25.400	1"	6"	2"	326.69	312.49	298.28	284.08
41350	54850	42350	1.000	1"	25.400	1"	6"	3"	326.69	312.49	298.28	284.08
-	-	42360	1.000	1"	25.400	1"	6"	4"	343.87	328.92	313.97	299.02
-	-	42390	1.250	1-1/4"	31.750	1-1/4"	6"	3"	693.11	662.97	632.84	602.70

70

35

MATERIAL HARDNESS (Rc)

0

Series 620MC, 623MC, 630MC



TOLERANCES

$d1$	+0.00" - .002" (+.000 - .050mm)
$d2$	h6

Extra Length

TiCN Coating

Solid submicron grain carbide end mill - center cutting

Extended reach

Improved abrasion resistance and lubricity

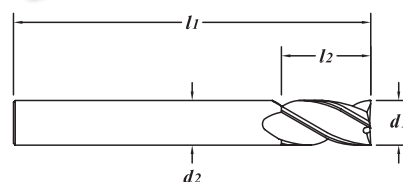
Can be modified with a neck within 48 hours

Extremely versatile

Uncoated - page 236

TiALN Coating - page 239

Standard length - page 219



(620MC) 2 Flute EDP#	(623MC) 3 Flute EDP#	(630MC) 4 Flute EDP#	$d1$ †			$d2$	$l1$	$l2$	1-11	12-24	25-49	50-100
			Decimal	Diameter	Metric	Shank Diameter	Overall Length	Flute Length				
41014	54514	42014	.1250	1/8"	3.175	1/8"	2"	5/8"	15.66	14.98	14.30	13.62
41024	54524	42024	.1250	1/8"	3.175	1/8"	3"	3/4"	23.40	22.39	21.37	20.35
41034	54534	42034	.1250	1/8"	3.175	1/8"	3"	1"	23.40	22.39	21.37	20.35
41044	54544	42044	.1875	3/16"	4.763	3/16"	3"	1"	25.98	24.85	23.72	22.59
41054	54554	42054	.1875	3/16"	4.763	3/16"	3"	1-1/8"	25.98	24.85	23.72	22.59
41064	54564	42064	.1875	3/16"	4.763	3/16"	4"	1"	28.87	27.61	26.36	25.10
41074	54574	42074	.2500	1/4"	6.350	1/4"	3"	1"	31.06	29.71	28.36	27.01
41084	54584	42084	.2500	1/4"	6.350	1/4"	4"	1"	32.90	31.47	30.04	28.61
41094	54594	42094	.2500	1/4"	6.350	1/4"	4"	1-1/2"	32.90	31.47	30.04	28.61
41104	54604	42104	.2500	1/4"	6.350	1/4"	6"	1-1/2"	46.47	44.45	42.43	40.41
41114	54614	42114	.3125	5/16"	7.938	5/16"	3"	1"	38.81	37.13	35.44	33.75
41124	54624	42124	.3125	5/16"	7.938	5/16"	4"	1"	44.11	42.20	40.28	38.36
41134	54634	42134	.3125	5/16"	7.938	5/16"	4"	1-5/8"	44.11	42.20	40.28	38.36
41144	54644	42144	.3125	5/16"	7.938	5/16"	6"	1-1/2"	64.37	61.57	58.77	55.97
41154	54654	42154	.3750	3/8"	9.525	3/8"	3"	1"	42.85	40.99	39.12	37.26
41164	54664	42164	.3750	3/8"	9.525	3/8"	4"	1"	48.01	45.93	43.84	41.75
41174	54674	42174	.3750	3/8"	9.525	3/8"	4"	2"	48.01	45.93	43.84	41.75
41184	54684	42184	.3750	3/8"	9.525	3/8"	6"	1-1/2"	69.07	66.07	63.06	60.06
41194	54694	42194	.3750	3/8"	9.523	3/8"	6"	3"	69.07	66.07	63.06	60.06
41204	54704	42204	.4375	7/16"	11.113	7/16"	4"	1"	64.68	61.86	59.05	56.24
41214	54714	42214	.4375	7/16"	11.113	7/16"	4"	2"	64.68	61.86	59.05	56.24
41224	54724	42224	.4375	7/16"	11.113	7/16"	6"	1-1/2"	86.83	83.05	79.28	75.50
-	54734	42234	.4375	7/16"	11.113	7/16"	6"	3"	86.83	83.05	79.28	75.50
41244	54744	42244	.5000	1/2"	12.700	1/2"	4"	1"	68.17	65.21	62.24	59.28
41254	54754	42254	.5000	1/2"	12.700	1/2"	4"	2"	68.17	65.21	62.24	59.28
41264	54764	42264	.5000	1/2"	12.700	1/2"	6"	1-1/2"	98.30	94.03	89.75	85.48
41274	54774	42274	.5000	1/2"	12.700	1/2"	6"	3"	98.30	94.03	89.75	85.48
41284	54784	42284	.5625	9/16"	14.288	9/16"	6"	2"	127.97	122.41	116.84	111.28
41294	-	42294	.5625	9/16"	14.288	9/16"	6"	3"	127.97	122.41	116.84	111.28
41304	54804	42304	.6250	5/8"	15.875	5/8"	6"	2"	137.49	131.52	125.54	119.56
41314	54814	42314	.6250	5/8"	15.875	5/8"	6"	3"	137.49	131.52	125.54	119.56
41324	54824	42324	.7500	3/4"	19.050	3/4"	6"	2"	211.43	202.24	193.04	183.85
41334	54834	42334	.7500	3/4"	19.050	3/4"	6"	3"	211.43	202.24	193.04	183.85
41344	54844	42344	1.000	1"	25.400	1"	6"	2"	353.97	338.58	323.19	307.80
41354	54854	42354	1.000	1"	25.400	1"	6"	3"	353.97	338.58	323.19	307.80
-	-	42364	1.000	1"	25.400	1"	6"	4"	371.14	355.00	338.87	322.73
-	-	42394	1.250	1-1/4"	31.750	1-1/4"	6"	3"	730.89	699.12	667.34	635.56

TOLERANCES

$d1$	$+0.000^{\circ} -0.002^{\circ} (+.000 -0.050\text{mm})$
$d2$	$h6$

Series 620MA, 623MA, 630MA, 640MA, 643MA, 650MA


.1181" - .3150"
(3.000mm - 8.000mm)

Extra Length
TiAlN Coating

Solid submicron grain carbide end mill - center cutting

Extended reach

Dry or semi-dry machining

Can be modified with a neck within 48 hours

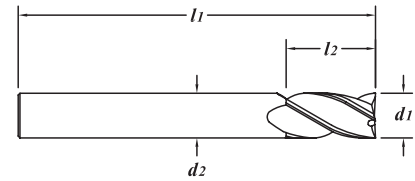
Extremely versatile

Uncoated - page 236

TiCN Coating - page 238

Stub Length - page 209

Standard length - page 220



(620MA/640MA) 2 Flute EDP#	(623MA/643MA) 3 Flute EDP#	(630MA/650MA) 4 Flute EDP#	$d1$ † Diameter		$d2$ Shank Diameter	$l1$ Overall Length	$l2$ Flute Length	1-11	12-24	25-49	50-100
			Decimal	Metric							
92017	93017	94017	.1181	3.000	3.0	50	16	14.85	14.20	13.56	12.91
92027	93027	94027	.1181	3.000	3.0	75	20	24.29	23.23	22.18	21.12
92037	93037	94037	.1181	3.000	3.0	75	25	24.29	23.23	22.18	21.12
41017	54517	42017	.1250	1/8"	3.175	1/8"	2"	16.01	15.31	14.62	13.92
41027	54527	42027	.1250	1/8"	3.175	1/8"	3"	23.82	22.78	21.75	20.71
41037	54537	42037	.1250	1/8"	3.175	1/8"	3"	23.82	22.78	21.75	20.71
92047	93047	94047	.1575	4.000	4.0	50	16	16.05	15.36	14.66	13.96
92057	93057	94057	.1575	4.000	4.0	75	20	26.28	25.14	23.99	22.85
92067	93067	94067	.1575	4.000	4.0	75	25	26.28	25.14	23.99	22.85
41047	54547	42047	.1875	3/16"	4.763	3/16"	3"	26.84	25.67	24.51	23.34
41057	54557	42057	.1875	3/16"	4.763	3/16"	3"	26.84	25.67	24.51	23.34
41067	54567	42067	.1875	3/16"	4.763	3/16"	4"	29.90	28.60	27.30	26.00
92087	93087	94087	.1969	5.000	5.0	75	20	29.37	28.09	26.82	25.54
92097	93097	94097	.1969	5.000	5.0	75	25	29.37	28.09	26.82	25.54
92107	93107	94107	.2362	6.000	6.0	75	25	33.15	31.71	30.27	28.83
92117	93117	94117	.2362	6.000	6.0	100	25	35.65	34.10	32.55	31.00
92127	93127	94127	.2362	6.000	6.0	100	32	35.65	34.10	32.55	31.00
92137	93137	94137	.2362	6.000	6.0	150	38	48.61	46.50	44.38	42.27
41077	54577	42077	.2500	1/4"	6.350	1/4"	3"	31.79	30.40	29.02	27.64
41087	54587	42087	.2500	1/4"	6.350	1/4"	4"	34.19	32.70	31.22	29.73
41097	54597	42097	.2500	1/4"	6.350	1/4"	4"	34.19	32.70	31.22	29.73
41107	54607	42107	.2500	1/4"	6.350	1/4"	6"	46.63	44.61	42.58	40.55
41117	54617	42117	.3125	5/16"	7.938	5/16"	3"	40.69	38.92	37.15	35.38
41127	54627	42127	.3125	5/16"	7.938	5/16"	4"	46.68	44.65	42.62	40.59
41137	54637	42137	.3125	5/16"	7.938	5/16"	4"	46.68	44.65	42.62	40.59
41147	54647	42147	.3125	5/16"	7.938	5/16"	6"	68.05	65.09	62.13	59.17
92147	93147	94147	.3150	8.000	8.0	75	25	42.38	40.54	38.69	36.85
92157	93157	94157	.3150	8.000	8.0	100	25	48.58	46.46	44.35	42.24
92167	93167	94167	.3150	8.000	8.0	100	41	48.58	46.46	44.35	42.24
92177	93177	94177	.3150	8.000	8.0	150	50	69.41	66.40	63.38	60.36

continued →

Series 620MA, 623MA, 630MA, 640MA, 643MA, 650MA (continued)

.3750" - 1.250"
(9.525mm - 31.750mm)

(620MA/640MA) 2 Flute EDP#	(623MA/643MA) 3 Flute EDP#	(630MA/650MA) 4 Flute EDP#	d_1 † Diameter			d_2 Shank Diameter	l_1 Overall Length	l_2 Flute Length	1-11	12-24	25-49	50-100
			Decimal		Metric							
41157	54657	42157	.3750	3/8"	9.525	3/8"	3"	1"	44.75	42.80	40.86	38.91
41167	54667	42167	.3750	3/8"	9.525	3/8"	4"	1"	50.55	48.36	46.16	43.96
41177	54677	42177	.3750	3/8"	9.525	3/8"	4"	2"	50.55	48.36	46.16	43.96
41187	54687	42187	.3750	3/8"	9.525	3/8"	6"	1-1/2"	72.73	69.56	66.40	63.24
41197	54697	42197	.3750	3/8"	9.525	3/8"	6"	3"	72.73	69.56	66.40	63.24
92187	93187	94187	.3937		10.000	10.0	75	25	48.98	46.85	44.72	42.59
92197	93197	94197	.3937		10.000	10.0	100	25	63.19	60.45	57.70	54.95
92207	93207	94207	.3937		10.000	10.0	100	50	63.19	60.45	57.70	54.95
92217	93217	94217	.3937		10.000	10.0	150	38	84.24	80.58	76.91	73.25
92227	93227	94227	.3937		10.000	10.0	150	75	84.24	80.58	76.91	73.25
41207	54707	42207	.4375	7/16"	11.113	7/16"	4"	1"	67.26	64.34	61.41	58.49
41217	54717	42217	.4375	7/16"	11.113	7/16"	4"	2"	67.26	64.34	61.41	58.49
41227	54727	42227	.4375	7/16"	11.113	7/16"	6"	1-1/2"	90.37	86.44	82.51	78.58
41237	54737	42237	.4375	7/16"	11.113	7/16"	6"	3"	90.37	86.44	82.51	78.58
92237	93237	94237	.4724		12.000	12.0	100	25	74.29	71.06	67.83	64.60
92247	93247	94247	.4724		12.000	12.0	100	50	74.29	71.06	67.83	64.60
92257	93257	94257	.4724		12.000	12.0	150	50	101.83	97.41	92.98	88.55
92267	93267	94267	.4724		12.000	12.0	150	75	101.83	97.41	92.98	88.55
41247	54747	42247	.5000	1/2"	12.700	1/2"	4"	1"	70.77	67.69	64.62	61.54
41257	54757	42257	.5000	1/2"	12.700	1/2"	4"	2"	70.77	67.69	64.62	61.54
41267	54767	42267	.5000	1/2"	12.700	1/2"	6"	1-1/2"	101.83	97.41	92.98	88.55
41277	54777	42277	.5000	1/2"	12.700	1/2"	6"	3"	101.83	97.41	92.98	88.55
92277	93277	94277	.5512		14.000	14.0	100	25	98.88	94.58	90.28	85.98
92287	93287	94287	.5512		14.000	14.0	100	50	98.88	94.58	90.28	85.98
-	93297	94297	.5512		14.000	14.0	150	50	131.39	125.68	119.96	114.25
92307	93307	94307	.5512		14.000	14.0	150	75	131.39	125.68	119.96	114.25
41287	54787	42287	.5625	9/16"	14.288	9/16"	6"	2"	131.39	125.68	119.96	114.25
-	54797	42297	.5625	9/16"	14.288	9/16"	6"	3"	131.39	125.68	119.96	114.25
41307	54807	42307	.6250	5/8"	15.875	5/8"	6"	2"	140.93	134.81	128.68	122.55
41317	54817	42317	.6250	5/8"	15.875	5/8"	6"	3"	140.93	134.81	128.68	122.55
92317	93317	94317	.6299		16.000	16.0	150	50	140.93	134.81	128.68	122.55
92327	93327	94327	.6299		16.000	16.0	150	75	140.93	134.81	128.68	122.55
-	-	94337	.7087		18.000	18.0	150	50	204.87	195.97	187.06	178.15
-	93347	94347	.7087		18.000	18.0	150	75	204.87	195.97	187.06	178.15
41327	54827	42327	.7500	3/4"	19.050	3/4"	6"	2"	215.67	206.29	196.92	187.54
41337	54837	42337	.7500	3/4"	19.050	3/4"	6"	3"	215.67	206.29	196.92	187.54
92357	93357	94357	.7874		20.000	20.0	150	50	232.97	222.84	212.71	202.58
92367	93367	94367	.7874		20.000	20.0	150	75	232.97	222.84	212.71	202.58
-	93377	94377	.9843		25.000	25.0	150	50	342.46	327.57	312.68	297.79
92387	93387	94387	.9843		25.000	25.0	150	75	342.46	327.57	312.68	297.79
41347	54847	42347	1.000	1"	25.400	1"	6"	2"	357.20	341.67	326.14	310.61
41357	54857	42357	1.000	1"	25.400	1"	6"	3"	357.20	341.67	326.14	310.61
-	-	42367	1.000	1"	25.400	1"	6"	4"	374.39	358.12	341.84	325.56
-	-	42397	1.250	1-1/4"	31.750	1-1/4"	6"	3"	732.22	700.38	668.55	636.71

TOLERANCES

$d1$	$+0.000^{\circ} - .002^{\circ}$ ($+0.000 - .050\text{mm}$)
$d2$	$h6$
r	$+0.011^{\circ} - .001^{\circ}$ ($+0.025 - .025\text{mm}$)


Series 630R

.1250" - .3125"
(3.175mm - 7.938mm)

GENERAL PURPOSE
END MILLS

Extra Length - Corner Radius

Solid submicron grain carbide end mill - center cutting

Extended reach

For stronger corners and part radius

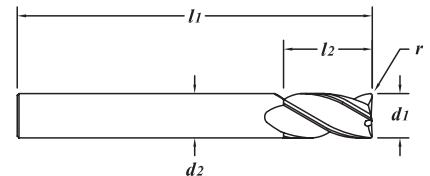
Can be modified with a neck within 48 hours

Extremely versatile

TiALN Coating - page 244

Stub length - page 210

Standard length - page 222



EDP#	$d1$ †		$d2$	$l1$	$l2$	r	1-11	12-24	25-49	50-100
	Decimal	Diameter	Metric	Shank Diameter	Overall Length	Flute Length	Corner Radius			
20100	.1250	1/8"	3.175	1/8"	3"	1"	.010"	24.15	23.10	22.05
20110	.1250	1/8"	3.175	1/8"	3"	1"	.015"	24.15	23.10	22.05
20120	.1250	1/8"	3.175	1/8"	3"	1"	.020"	24.15	23.10	22.05
20130	.1250	1/8"	3.175	1/8"	3"	1"	.030"	24.15	23.10	22.05
20140	.1250	1/8"	3.175	1/8"	3"	1"	.045"	24.15	23.10	22.05
20150	.1875	3/16"	4.763	3/16"	3"	1"	.010"	26.63	25.48	24.32
20160	.1875	3/16"	4.763	3/16"	3"	1"	.015"	26.63	25.48	24.32
20170	.1875	3/16"	4.763	3/16"	3"	1"	.020"	26.63	25.48	24.32
20180	.1875	3/16"	4.763	3/16"	3"	1"	.030"	26.63	25.48	24.32
20190	.1875	3/16"	4.763	3/16"	3"	1"	.045"	26.63	25.48	24.32
20200	.1875	3/16"	4.763	3/16"	3"	1"	.060"	26.63	25.48	24.32
20210	.1875	3/16"	4.763	3/16"	4"	1"	.010"	28.67	27.42	26.18
20220	.1875	3/16"	4.763	3/16"	4"	1"	.015"	28.67	27.42	26.18
20230	.1875	3/16"	4.763	3/16"	4"	1"	.020"	28.67	27.42	26.18
20240	.1875	3/16"	4.763	3/16"	4"	1"	.030"	28.67	27.42	26.18
20250	.1875	3/16"	4.763	3/16"	4"	1"	.045"	28.67	27.42	26.18
20260	.1875	3/16"	4.763	3/16"	4"	1"	.060"	28.67	27.42	26.18
20270	.2500	1/4"	6.350	1/4"	3"	1"	.010"	30.83	29.49	28.15
20280	.2500	1/4"	6.350	1/4"	3"	1"	.020"	30.83	29.49	28.15
20290	.2500	1/4"	6.350	1/4"	3"	1"	.030"	30.83	29.49	28.15
20300	.2500	1/4"	6.350	1/4"	3"	1"	.045"	30.83	29.49	28.15
20310	.2500	1/4"	6.350	1/4"	3"	1"	.060"	30.83	29.49	28.15
20320	.2500	1/4"	6.350	1/4"	4"	1"	.010"	32.43	31.02	29.61
20330	.2500	1/4"	6.350	1/4"	4"	1"	.020"	32.43	31.02	29.61
20340	.2500	1/4"	6.350	1/4"	4"	1"	.030"	32.43	31.02	29.61
20350	.2500	1/4"	6.350	1/4"	4"	1"	.045"	32.43	31.02	29.61
20360	.2500	1/4"	6.350	1/4"	4"	1"	.060"	32.43	31.02	29.61
20370	.2500	1/4"	6.350	1/4"	6"	1-1/2"	.010"	42.17	40.34	38.50
20380	.2500	1/4"	6.350	1/4"	6"	1-1/2"	.020"	42.17	40.34	38.50
20390	.2500	1/4"	6.350	1/4"	6"	1-1/2"	.030"	42.17	40.34	38.50
20400	.2500	1/4"	6.350	1/4"	6"	1-1/2"	.045"	42.17	40.34	38.50
20410	.2500	1/4"	6.350	1/4"	6"	1-1/2"	.060"	42.17	40.34	38.50
20420	.3125	5/16"	7.938	5/16"	4"	1-5/8"	.010"	42.49	40.65	38.80
20430	.3125	5/16"	7.938	5/16"	4"	1-5/8"	.020"	42.49	40.65	38.80
20440	.3125	5/16"	7.938	5/16"	4"	1-5/8"	.030"	42.49	40.65	38.80
20450	.3125	5/16"	7.938	5/16"	4"	1-5/8"	.045"	42.49	40.65	38.80
20460	.3125	5/16"	7.938	5/16"	4"	1-5/8"	.060"	42.49	40.65	38.80
20470	.3125	5/16"	7.938	5/16"	4"	1-5/8"	.090"	42.49	40.65	38.80
20480	.3125	5/16"	7.938	5/16"	4"	1-5/8"	.125"	42.49	40.65	38.80

continued →

Series 630R (continued)

.3750" - .6250"
(9.525mm - 15.875mm)

EDP#	$d1^{\dagger}$			$d2$	$l1$	$l2$	r	1-11	12-24	25-49	50-100
	Decimal	Diameter	Metric								
20490	.3750	3/8"	9.525	3/8"	4"	1"	.010"	47.01	44.97	42.92	40.88
20500	.3750	3/8"	9.525	3/8"	4"	1"	.020"	47.01	44.97	42.92	40.88
20510	.3750	3/8"	9.525	3/8"	4"	1"	.030"	47.01	44.97	42.92	40.88
20520	.3750	3/8"	9.525	3/8"	4"	1"	.045"	47.01	44.97	42.92	40.88
20530	.3750	3/8"	9.525	3/8"	4"	1"	.060"	47.01	44.97	42.92	40.88
20540	.3750	3/8"	9.525	3/8"	4"	1"	.090"	47.01	44.97	42.92	40.88
20550	.3750	3/8"	9.525	3/8"	4"	1"	.125"	47.01	44.97	42.92	40.88
20560	.3750	3/8"	9.525	3/8"	4"	2"	.010"	47.01	44.97	42.92	40.88
20570	.3750	3/8"	9.525	3/8"	4"	2"	.020"	47.01	44.97	42.92	40.88
20580	.3750	3/8"	9.525	3/8"	4"	2"	.030"	47.01	44.97	42.92	40.88
20590	.3750	3/8"	9.525	3/8"	4"	2"	.045"	47.01	44.97	42.92	40.88
20600	.3750	3/8"	9.525	3/8"	4"	2"	.060"	47.01	44.97	42.92	40.88
20610	.3750	3/8"	9.525	3/8"	4"	2"	.090"	47.01	44.97	42.92	40.88
20620	.3750	3/8"	9.525	3/8"	4"	2"	.125"	47.01	44.97	42.92	40.88
20630	.3750	3/8"	9.525	3/8"	6"	1-1/2"	.010"	64.57	61.77	58.96	56.15
20640	.3750	3/8"	9.525	3/8"	6"	1-1/2"	.020"	64.57	61.77	58.96	56.15
20650	.3750	3/8"	9.525	3/8"	6"	1-1/2"	.030"	64.57	61.77	58.96	56.15
20660	.3750	3/8"	9.525	3/8"	6"	1-1/2"	.045"	64.57	61.77	58.96	56.15
20670	.3750	3/8"	9.525	3/8"	6"	1-1/2"	.060"	64.57	61.77	58.96	56.15
20680	.3750	3/8"	9.525	3/8"	6"	1-1/2"	.090"	64.57	61.77	58.96	56.15
20690	.3750	3/8"	9.525	3/8"	6"	1-1/2"	.125"	64.57	61.77	58.96	56.15
20700	.5000	1/2"	12.700	1/2"	4"	1"	.015"	66.11	63.24	60.36	57.49
20710	.5000	1/2"	12.700	1/2"	4"	1"	.020"	66.11	63.24	60.36	57.49
20720	.5000	1/2"	12.700	1/2"	4"	1"	.030"	66.11	63.24	60.36	57.49
20730	.5000	1/2"	12.700	1/2"	4"	1"	.045"	66.11	63.24	60.36	57.49
20740	.5000	1/2"	12.700	1/2"	4"	1"	.060"	66.11	63.24	60.36	57.49
20750	.5000	1/2"	12.700	1/2"	4"	1"	.090"	66.11	63.24	60.36	57.49
20760	.5000	1/2"	12.700	1/2"	4"	1"	.125"	66.11	63.24	60.36	57.49
20770	.5000	1/2"	12.700	1/2"	4"	2"	.015"	66.11	63.24	60.36	57.49
20780	.5000	1/2"	12.700	1/2"	4"	2"	.020"	66.11	63.24	60.36	57.49
20790	.5000	1/2"	12.700	1/2"	4"	2"	.030"	66.11	63.24	60.36	57.49
20800	.5000	1/2"	12.700	1/2"	4"	2"	.045"	66.11	63.24	60.36	57.49
20810	.5000	1/2"	12.700	1/2"	4"	2"	.060"	66.11	63.24	60.36	57.49
20820	.5000	1/2"	12.700	1/2"	4"	2"	.090"	66.11	63.24	60.36	57.49
20830	.5000	1/2"	12.700	1/2"	4"	2"	.125"	66.11	63.24	60.36	57.49
20840	.5000	1/2"	12.700	1/2"	6"	1-1/2"	.015"	93.64	89.57	85.50	81.43
20850	.5000	1/2"	12.700	1/2"	6"	1-1/2"	.020"	93.64	89.57	85.50	81.43
20860	.5000	1/2"	12.700	1/2"	6"	1-1/2"	.030"	93.64	89.57	85.50	81.43
20870	.5000	1/2"	12.700	1/2"	6"	1-1/2"	.045"	93.64	89.57	85.50	81.43
20880	.5000	1/2"	12.700	1/2"	6"	1-1/2"	.060"	93.64	89.57	85.50	81.43
20890	.5000	1/2"	12.700	1/2"	6"	1-1/2"	.090"	93.64	89.57	85.50	81.43
20900	.5000	1/2"	12.700	1/2"	6"	1-1/2"	.125"	93.64	89.57	85.50	81.43
20910	.6250	5/8"	15.875	5/8"	6"	2"	.010"	137.70	131.71	125.73	119.74
20920	.6250	5/8"	15.875	5/8"	6"	2"	.015"	137.70	131.71	125.73	119.74
20930	.6250	5/8"	15.875	5/8"	6"	2"	.020"	137.70	131.71	125.73	119.74
20940	.6250	5/8"	15.875	5/8"	6"	2"	.030"	137.70	131.71	125.73	119.74
20950	.6250	5/8"	15.875	5/8"	6"	2"	.045"	137.70	131.71	125.73	119.74
20960	.6250	5/8"	15.875	5/8"	6"	2"	.060"	137.70	131.71	125.73	119.74
20970	.6250	5/8"	15.875	5/8"	6"	2"	.090"	137.70	131.71	125.73	119.74
20980	.6250	5/8"	15.875	5/8"	6"	2"	.125"	137.70	131.71	125.73	119.74

MATERIAL HARDNESS (Rc)

70

35

0

EDP#	$d1$ †			$d2$	$l1$	$l2$	r	1-11	12-24	25-49	50-100
	Decimal	Diameter	Metric								
20990	.7500	3/4"	19.050	3/4"	6"	3"	.015"	225.98	216.15	206.33	196.50
21000	.7500	3/4"	19.050	3/4"	6"	3"	.020"	225.98	216.15	206.33	196.50
21010	.7500	3/4"	19.050	3/4"	6"	3"	.030"	225.98	216.15	206.33	196.50
21020	.7500	3/4"	19.050	3/4"	6"	3"	.045"	225.98	216.15	206.33	196.50
21030	.7500	3/4"	19.050	3/4"	6"	3"	.060"	225.98	216.15	206.33	196.50
21040	.7500	3/4"	19.050	3/4"	6"	3"	.090"	225.98	216.15	206.33	196.50
21050	.7500	3/4"	19.050	3/4"	6"	3"	.125"	225.98	216.15	206.33	196.50
21140	.7500	3/4"	19.050	3/4"	6"	3"	.250"	225.98	216.15	206.33	196.50
21060	1.000	1"	25.400	1"	6"	3"	.015"	384.26	367.55	350.85	334.14
21070	1.000	1"	25.400	1"	6"	3"	.020"	384.26	367.55	350.85	334.14
21080	1.000	1"	25.400	1"	6"	3"	.030"	384.26	367.55	350.85	334.14
21090	1.000	1"	25.400	1"	6"	3"	.045"	384.26	367.55	350.85	334.14
21100	1.000	1"	25.400	1"	6"	3"	.060"	384.26	367.55	350.85	334.14
21110	1.000	1"	25.400	1"	6"	3"	.090"	384.26	367.55	350.85	334.14
21120	1.000	1"	25.400	1"	6"	3"	.125"	384.26	367.55	350.85	334.14
21130	1.000	1"	25.400	1"	6"	3"	.250"	384.26	367.55	350.85	334.14



End Mill Reconditioning

70

35

MATERIAL HARDNESS (Rc)

0

Series 630RA

.1250" - .3125"
(3.175mm - 7.938mm)TECH
PAGES
282-283

TOLERANCES

d_1	+0.000" - .002" (+.000 - .050mm)
d_2	h6
r	+0.001" - .001" (+.025 - .025mm)

Extra Length - Corner Radius

TiAlN Coating

Solid submicron grain carbide end mill - center cutting

Extended reach

For stronger corners and part radius

Dry or semi-dry machining

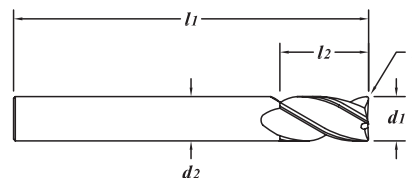
Can be modified with a neck within 48 hours

Extremely versatile

Uncoated - page 241

Stub length - page 212

Standard length - page 225



EDP#	d_1 † Diameter			d_2 Shank Diameter	l_1 Overall Length	l_2 Flute Length	r Corner Radius	1-11	12-24	25-49	50-100
	Decimal		Metric								
20107	.1250	1/8"	3.175	1/8"	3"	1"	.010"	27.44	26.25	25.05	23.86
20117	.1250	1/8"	3.175	1/8"	3"	1"	.015"	27.44	26.25	25.05	23.86
20127	.1250	1/8"	3.175	1/8"	3"	1"	.020"	27.44	26.25	25.05	23.86
20137	.1250	1/8"	3.175	1/8"	3"	1"	.030"	27.44	26.25	25.05	23.86
20147	.1250	1/8"	3.175	1/8"	3"	1"	.045"	27.44	26.25	25.05	23.86
20157	.1875	3/16"	4.763	3/16"	3"	1"	.010"	30.82	29.48	28.14	26.80
20167	.1875	3/16"	4.763	3/16"	3"	1"	.015"	30.82	29.48	28.14	26.80
20177	.1875	3/16"	4.763	3/16"	3"	1"	.020"	30.82	29.48	28.14	26.80
20187	.1875	3/16"	4.763	3/16"	3"	1"	.030"	30.82	29.48	28.14	26.80
20197	.1875	3/16"	4.763	3/16"	3"	1"	.045"	30.82	29.48	28.14	26.80
20207	.1875	3/16"	4.763	3/16"	3"	1"	.060"	30.82	29.48	28.14	26.80
20217	.1875	3/16"	4.763	3/16"	4"	1"	.010"	33.55	32.09	30.63	29.17
20227	.1875	3/16"	4.763	3/16"	4"	1"	.015"	33.55	32.09	30.63	29.17
20237	.1875	3/16"	4.763	3/16"	4"	1"	.020"	33.55	32.09	30.63	29.17
20247	.1875	3/16"	4.763	3/16"	4"	1"	.030"	33.55	32.09	30.63	29.17
20257	.1875	3/16"	4.763	3/16"	4"	1"	.045"	33.55	32.09	30.63	29.17
20267	.1875	3/16"	4.763	3/16"	4"	1"	.060"	33.55	32.09	30.63	29.17
20277	.2500	1/4"	6.350	1/4"	3"	1"	.010"	36.40	34.82	33.23	31.65
20287	.2500	1/4"	6.350	1/4"	3"	1"	.020"	36.40	34.82	33.23	31.65
20297	.2500	1/4"	6.350	1/4"	3"	1"	.030"	36.40	34.82	33.23	31.65
20307	.2500	1/4"	6.350	1/4"	3"	1"	.045"	36.40	34.82	33.23	31.65
20317	.2500	1/4"	6.350	1/4"	3"	1"	.060"	36.40	34.82	33.23	31.65
20327	.2500	1/4"	6.350	1/4"	4"	1"	.010"	38.96	37.27	35.57	33.88
20337	.2500	1/4"	6.350	1/4"	4"	1"	.020"	38.96	37.27	35.57	33.88
20347	.2500	1/4"	6.350	1/4"	4"	1"	.030"	38.96	37.27	35.57	33.88
20357	.2500	1/4"	6.350	1/4"	4"	1"	.045"	38.96	37.27	35.57	33.88
20367	.2500	1/4"	6.350	1/4"	4"	1"	.060"	38.96	37.27	35.57	33.88
20377	.2500	1/4"	6.350	1/4"	6"	1-1/2"	.010"	51.35	49.12	46.88	44.65
20387	.2500	1/4"	6.350	1/4"	6"	1-1/2"	.020"	51.35	49.12	46.88	44.65
20397	.2500	1/4"	6.350	1/4"	6"	1-1/2"	.030"	51.35	49.12	46.88	44.65
20407	.2500	1/4"	6.350	1/4"	6"	1-1/2"	.045"	51.35	49.12	46.88	44.65
20417	.2500	1/4"	6.350	1/4"	6"	1-1/2"	.060"	51.35	49.12	46.88	44.65
20427	.3125	5/16"	7.938	5/16"	4"	1-5/8"	.010"	53.06	50.75	48.45	46.14
20437	.3125	5/16"	7.938	5/16"	4"	1-5/8"	.020"	53.06	50.75	48.45	46.14
20447	.3125	5/16"	7.938	5/16"	4"	1-5/8"	.030"	53.06	50.75	48.45	46.14
20457	.3125	5/16"	7.938	5/16"	4"	1-5/8"	.045"	53.06	50.75	48.45	46.14
20467	.3125	5/16"	7.938	5/16"	4"	1-5/8"	.060"	53.06	50.75	48.45	46.14
20477	.3125	5/16"	7.938	5/16"	4"	1-5/8"	.090"	53.06	50.75	48.45	46.14
20487	.3125	5/16"	7.938	5/16"	4"	1-5/8"	.125"	53.06	50.75	48.45	46.14

EDP#	$d1$ † Diameter			$d2$ Shank Diameter	$l1$ Overall Length	$l2$ Flute Length	r Corner Radius	1-11	12-24	25-49	50-100
	Decimal		Metric								
20497	.3750	3/8"	9.525	3/8"	4"	1"	.010"	57.58	55.08	52.57	50.07
20507	.3750	3/8"	9.525	3/8"	4"	1"	.020"	57.58	55.08	52.57	50.07
20517	.3750	3/8"	9.525	3/8"	4"	1"	.030"	57.58	55.08	52.57	50.07
20527	.3750	3/8"	9.525	3/8"	4"	1"	.045"	57.58	55.08	52.57	50.07
20537	.3750	3/8"	9.525	3/8"	4"	1"	.060"	57.58	55.08	52.57	50.07
20547	.3750	3/8"	9.525	3/8"	4"	1"	.090"	57.58	55.08	52.57	50.07
20557	.3750	3/8"	9.525	3/8"	4"	1"	.125"	57.58	55.08	52.57	50.07
20567	.3750	3/8"	9.525	3/8"	4"	2"	.010"	57.58	55.08	52.57	50.07
20577	.3750	3/8"	9.525	3/8"	4"	2"	.020"	57.58	55.08	52.57	50.07
20587	.3750	3/8"	9.525	3/8"	4"	2"	.030"	57.58	55.08	52.57	50.07
20597	.3750	3/8"	9.525	3/8"	4"	2"	.045"	57.58	55.08	52.57	50.07
20607	.3750	3/8"	9.525	3/8"	4"	2"	.060"	57.58	55.08	52.57	50.07
20617	.3750	3/8"	9.525	3/8"	4"	2"	.090"	57.58	55.08	52.57	50.07
20627	.3750	3/8"	9.525	3/8"	4"	2"	.125"	57.58	55.08	52.57	50.07
20637	.3750	3/8"	9.525	3/8"	6"	1-1/2"	.010"	79.72	76.25	72.79	69.32
20647	.3750	3/8"	9.525	3/8"	6"	1-1/2"	.020"	79.72	76.25	72.79	69.32
20657	.3750	3/8"	9.525	3/8"	6"	1-1/2"	.030"	79.72	76.25	72.79	69.32
20667	.3750	3/8"	9.525	3/8"	6"	1-1/2"	.045"	79.72	76.25	72.79	69.32
20677	.3750	3/8"	9.525	3/8"	6"	1-1/2"	.060"	79.72	76.25	72.79	69.32
20687	.3750	3/8"	9.525	3/8"	6"	1-1/2"	.090"	79.72	76.25	72.79	69.32
20697	.3750	3/8"	9.525	3/8"	6"	1-1/2"	.125"	79.72	76.25	72.79	69.32
21157	.4375	7/16"	11.113	7/16"	4"	1"	.010"	77.00	73.66	70.31	66.96
21167	.4375	7/16"	11.113	7/16"	4"	1"	.015"	77.00	73.66	70.31	66.96
21177	.4375	7/16"	11.113	7/16"	4"	1"	.020"	77.00	73.66	70.31	66.96
21187	.4375	7/16"	11.113	7/16"	4"	1"	.030"	77.00	73.66	70.31	66.96
21227	.4375	7/16"	11.113	7/16"	4"	1"	.125"	77.00	73.66	70.31	66.96
20707	.5000	1/2"	12.700	1/2"	4"	1"	.015"	78.37	74.97	71.56	68.15
20717	.5000	1/2"	12.700	1/2"	4"	1"	.020"	78.37	74.97	71.56	68.15
20727	.5000	1/2"	12.700	1/2"	4"	1"	.030"	78.37	74.97	71.56	68.15
20737	.5000	1/2"	12.700	1/2"	4"	1"	.045"	78.37	74.97	71.56	68.15
20747	.5000	1/2"	12.700	1/2"	4"	1"	.060"	78.37	74.97	71.56	68.15
20757	.5000	1/2"	12.700	1/2"	4"	1"	.090"	78.37	74.97	71.56	68.15
20767	.5000	1/2"	12.700	1/2"	4"	1"	.125"	78.37	74.97	71.56	68.15
20777	.5000	1/2"	12.700	1/2"	4"	2"	.015"	78.37	74.97	71.56	68.15
20787	.5000	1/2"	12.700	1/2"	4"	2"	.020"	78.37	74.97	71.56	68.15
20797	.5000	1/2"	12.700	1/2"	4"	2"	.030"	78.37	74.97	71.56	68.15
20807	.5000	1/2"	12.700	1/2"	4"	2"	.045"	78.37	74.97	71.56	68.15
20817	.5000	1/2"	12.700	1/2"	4"	2"	.060"	78.37	74.97	71.56	68.15
20827	.5000	1/2"	12.700	1/2"	4"	2"	.090"	78.37	74.97	71.56	68.15
20837	.5000	1/2"	12.700	1/2"	4"	2"	.125"	78.37	74.97	71.56	68.15
20847	.5000	1/2"	12.700	1/2"	6"	1-1/2"	.015"	110.84	106.02	101.20	96.38
20857	.5000	1/2"	12.700	1/2"	6"	1-1/2"	.020"	110.84	106.02	101.20	96.38
20867	.5000	1/2"	12.700	1/2"	6"	1-1/2"	.030"	110.84	106.02	101.20	96.38
20877	.5000	1/2"	12.700	1/2"	6"	1-1/2"	.045"	110.84	106.02	101.20	96.38
20887	.5000	1/2"	12.700	1/2"	6"	1-1/2"	.060"	110.84	106.02	101.20	96.38
20897	.5000	1/2"	12.700	1/2"	6"	1-1/2"	.090"	110.84	106.02	101.20	96.38
20907	.5000	1/2"	12.700	1/2"	6"	1-1/2"	.125"	110.84	106.02	101.20	96.38
20917	.6250	5/8"	15.875	5/8"	6"	2"	.010"	157.99	151.12	144.25	137.38
20927	.6250	5/8"	15.875	5/8"	6"	2"	.015"	157.99	151.12	144.25	137.38
20937	.6250	5/8"	15.875	5/8"	6"	2"	.020"	157.99	151.12	144.25	137.38
20947	.6250	5/8"	15.875	5/8"	6"	2"	.030"	157.99	151.12	144.25	137.38
20957	.6250	5/8"	15.875	5/8"	6"	2"	.045"	157.99	151.12	144.25	137.38
20967	.6250	5/8"	15.875	5/8"	6"	2"	.060"	157.99	151.12	144.25	137.38
20977	.6250	5/8"	15.875	5/8"	6"	2"	.090"	157.99	151.12	144.25	137.38
20987	.6250	5/8"	15.875	5/8"	6"	2"	.125"	157.99	151.12	144.25	137.38

70

35

MATERIAL HARDNESS (Rc)

0

continued →

Series 630RA (continued)

.7500" - 1.000"
(19.050mm - 25.400mm)

EDP#	$d1$ †			$d2$ Shank Diameter	$l1$ Overall Length	$l2$ Flute Length	r Corner Radius	1-11	12-24	25-49	50-100
	Decimal	Diameter	Metric								
20997	.7500	3/4"	19.050	3/4"	6"	3"	.015"	249.47	238.62	227.78	216.93
21007	.7500	3/4"	19.050	3/4"	6"	3"	.020"	249.47	238.62	227.78	216.93
21017	.7500	3/4"	19.050	3/4"	6"	3"	.030"	249.47	238.62	227.78	216.93
21027	.7500	3/4"	19.050	3/4"	6"	3"	.045"	249.47	238.62	227.78	216.93
21037	.7500	3/4"	19.050	3/4"	6"	3"	.060"	249.47	238.62	227.78	216.93
21047	.7500	3/4"	19.050	3/4"	6"	3"	.090"	249.47	238.62	227.78	216.93
21057	.7500	3/4"	19.050	3/4"	6"	3"	.125"	249.47	238.62	227.78	216.93
21147	.7500	3/4"	19.050	3/4"	6"	3"	.250"	249.47	238.62	227.78	216.93
21067	1.000	1"	25.400	1"	6"	3"	.015"	414.81	396.77	378.74	360.70
21077	1.000	1"	25.400	1"	6"	3"	.020"	414.81	396.77	378.74	360.70
21087	1.000	1"	25.400	1"	6"	3"	.030"	414.81	396.77	378.74	360.70
21097	1.000	1"	25.400	1"	6"	3"	.045"	414.81	396.77	378.74	360.70
21107	1.000	1"	25.400	1"	6"	3"	.060"	414.81	396.77	378.74	360.70
21117	1.000	1"	25.400	1"	6"	3"	.090"	414.81	396.77	378.74	360.70
21127	1.000	1"	25.400	1"	6"	3"	.125"	414.81	396.77	378.74	360.70
21137	1.000	1"	25.400	1"	6"	3"	.250"	414.81	396.77	378.74	360.70



TOLERANCES

d_1	+0.000" - .002" (+.000 - .050mm)
d_2	h6
ball radius	+0.000" - .001" (+.000 - .025mm)


Series 720M, 723M, 730M, 740M, 743M, 750M

.1181" - .3150"
(3.000mm - 8.000mm)

GENERAL PURPOSE
END MILLS

Extra Length - Ball End

Solid submicron grain carbide end mill - center cutting

Extended reach

Can be modified with a neck within 48 hours

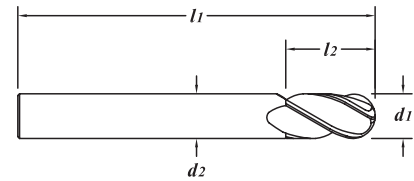
Extremely versatile

TiCN Coating - page 249

TiAlN Coating - page 250

Stub Length - page 214

Standard length - page 228



(720M/740M) 2 Flute EDP#	(723M/743M) 3 Flute EDP#	(730M/750M) 4 Flute EDP#	d_1 † Diameter		d_2 Shank Diameter	l_1 Overall Length	l_2 Flute Length	1-11	12-24	25-49	50-100
Decimal	Metric										
97010	98010	99010	.1181	3.000	3.0	50	16	15.43	14.76	14.09	13.42
97020	98020	99020	.1181	3.000	3.0	75	20	25.42	24.31	23.21	22.10
97030	98030	99030	.1181	3.000	3.0	75	25	25.42	24.31	23.21	22.10
43010	55510	44010	.1250	1/8"	3.175	1/8"	2"	15.65	14.97	14.29	13.61
43020	55520	44020	.1250	1/8"	3.175	1/8"	3"	24.15	23.10	22.05	21.00
43030	55530	44030	.1250	1/8"	3.175	1/8"	3"	24.15	23.10	22.05	21.00
97040	98040	99040	.1575	4.000	4.0	50	16	16.09	15.39	14.69	13.99
97050	98050	99050	.1575	4.000	4.0	75	20	25.96	24.83	23.70	22.57
97060	98060	99060	.1575	4.000	4.0	75	25	25.96	24.83	23.70	22.57
43040	55540	44040	.1875	3/16"	4.763	3/16"	3"	26.63	25.48	24.32	23.16
43050	55550	44050	.1875	3/16"	4.763	3/16"	3"	26.63	25.48	24.32	23.16
43060	55560	44060	.1875	3/16"	4.763	3/16"	4"	28.67	27.42	26.18	24.93
97080	98080	99080	.1969	5.000	5.0	75	20	28.04	26.82	25.60	24.38
97090	98090	99090	.1969	5.000	5.0	75	25	28.04	26.82	25.60	24.38
97100	98100	99100	.2362	6.000	6.0	75	25	32.45	31.04	29.63	28.22
97110	98110	99110	.2362	6.000	6.0	100	25	34.16	32.67	31.19	29.70
97120	98120	99120	.2362	6.000	6.0	100	32	34.16	32.67	31.19	29.70
97130	98130	99130	.2362	6.000	6.0	150	38	44.39	42.46	40.53	38.60
43070	55570	44070	.2500	1/4"	6.350	1/4"	3"	30.83	29.49	28.15	26.81
43080	55580	44080	.2500	1/4"	6.350	1/4"	4"	32.43	31.02	29.61	28.20
43090	55590	44090	.2500	1/4"	6.350	1/4"	4"	32.43	31.02	29.61	28.20
43100	55600	44100	.2500	1/4"	6.350	1/4"	6"	42.17	40.34	38.50	36.67
43110	55610	44110	.3125	5/16"	7.938	5/16"	3"	38.09	36.43	34.78	33.12
43120	55620	44120	.3125	5/16"	7.938	5/16"	4"	42.49	40.65	38.80	36.95
43130	55630	44130	.3125	5/16"	7.938	5/16"	4"	42.49	40.65	38.80	36.95
43140	55640	44140	.3125	5/16"	7.938	5/16"	6"	63.05	60.31	57.57	54.83
97140	98140	99140	.3150	8.000	8.0	75	25	40.09	38.35	36.60	34.86
97150	98150	99150	.3150	8.000	8.0	100	25	44.75	42.80	40.86	38.91
97160	98160	99160	.3150	8.000	8.0	100	41	44.75	42.80	40.86	38.91
97170	98170	99170	.3150	8.000	8.0	150	50	64.70	61.89	59.07	56.26

continued →

Series 720M, 723M, 730M, 740M, 743M, 750M (continued)

.3750" - 1.000"
(9.525mm - 25.400mm)

(720M/740M) 2 Flute EDP#	(723M/743M) 3 Flute EDP#	(730M/750M) 4 Flute EDP#	d_1 † Diameter			d_2 Shank Diameter	l_1 Overall Length	l_2 Flute Length	1-11	12-24	25-49	50-100
			Decimal		Metric							
43150	55650	44150	.3750	3/8"	9.525	3/8"	3"	1"	42.85	40.99	39.12	37.26
43160	55660	44160	.3750	3/8"	9.525	3/8"	4"	1"	47.01	44.97	42.92	40.88
43170	55670	44170	.3750	3/8"	9.525	3/8"	4"	2"	47.01	44.97	42.92	40.88
43180	55680	44180	.3750	3/8"	9.525	3/8"	6"	1-1/2"	65.26	62.43	59.59	56.75
43190	55690	44190	.3750	3/8"	9.525	3/8"	6"	3"	65.26	62.43	59.59	56.75
97180	98180	99180	.3937		10.000	10.0	75	25	46.30	44.29	42.27	40.26
97190	98190	99190	.3937		10.000	10.0	100	25	60.69	58.05	55.41	52.77
97200	98200	99200	.3937		10.000	10.0	100	50	60.69	58.05	55.41	52.77
97210	98210	99210	.3937		10.000	10.0	150	38	78.06	74.67	71.27	67.88
97220	98220	99220	.3937		10.000	10.0	150	75	78.06	74.67	71.27	67.88
43200	55700	44200	.4375	7/16"	11.113	7/16"	4"	1"	64.72	61.91	59.09	56.28
43210	55710	44210	.4375	7/16"	11.113	7/16"	4"	2"	64.72	61.91	59.09	56.28
43220	-	44220	.4375	7/16"	11.113	7/16"	6"	1-1/2"	84.13	80.48	76.82	73.16
43230	-	44230	.4375	7/16"	11.113	7/16"	6"	3"	84.13	80.48	76.82	73.16
97230	98230	99230	.4724		12.000	12.0	100	25	69.67	66.64	63.61	60.58
97240	98240	99240	.4724		12.000	12.0	100	50	69.67	66.64	63.61	60.58
97250	98250	99250	.4724		12.000	12.0	150	50	93.62	89.55	85.48	81.41
97260	98260	99260	.4724		12.000	12.0	150	75	93.62	89.55	85.48	81.41
43240	55740	44240	.5000	1/2"	12.700	1/2"	4"	1"	66.11	63.24	60.36	57.49
43250	55750	44250	.5000	1/2"	12.700	1/2"	4"	2"	66.11	63.24	60.36	57.49
43260	55760	44260	.5000	1/2"	12.700	1/2"	6"	1-1/2"	93.64	89.57	85.50	81.43
43270	55770	44270	.5000	1/2"	12.700	1/2"	6"	3"	93.64	89.57	85.50	81.43
97270	98270	-	.5512		14.000	14.0	100	25	96.27	92.08	87.90	83.71
97280	-	-	.5512		14.000	14.0	100	50	96.27	92.08	87.90	83.71
97290	-	99290	.5512		14.000	14.0	150	50	130.67	124.99	119.31	113.63
97300	98300	-	.5512		14.000	14.0	150	75	130.67	124.99	119.31	113.63
43280	55780	44280	.5625	9/16"	14.288	9/16"	6"	2"	130.66	124.98	119.30	113.62
-	55790	44290	.5625	9/16"	14.288	9/16"	6"	3"	130.66	124.98	119.30	113.62
43300	55800	44300	.6250	5/8"	15.875	5/8"	6"	2"	137.70	131.71	125.73	119.74
43310	55810	44310	.6250	5/8"	15.875	5/8"	6"	3"	137.70	131.71	125.73	119.74
97310	98310	99310	.6299		16.000	16.0	150	50	137.68	131.69	125.71	119.72
97320	98320	99320	.6299		16.000	16.0	150	75	137.68	131.69	125.71	119.72
97340	98340	99340	.7087		18.000	18.0	150	75	211.80	202.59	193.38	184.17
43320	55820	44320	.7500	3/4"	19.050	3/4"	6"	2"	225.98	216.15	206.33	196.50
43330	55830	44330	.7500	3/4"	19.050	3/4"	6"	3"	225.98	216.15	206.33	196.50
97350	98350	99350	.7874		20.000	20.0	150	50	232.88	222.75	212.63	202.50
97360	98360	99360	.7874		20.000	20.0	150	75	232.88	222.75	212.63	202.50
-	98370	-	.9843		25.000	25.0	150	50	369.52	353.45	337.39	321.32
97380	98380	-	.9843		25.000	25.0	150	75	369.52	353.45	337.39	321.32
43340	55840	44340	1.000	1"	25.400	1"	6"	2"	384.26	367.55	350.85	334.14
43350	55850	44350	1.000	1"	25.400	1"	6"	3"	384.26	367.55	350.85	334.14

TOLERANCES

d_1	+0.000" - .002" (+.000 - .050mm)
d_2	h6
ball radius	+0.000" - .001" (+.000 - .025mm)


Series 720MC, 723MC, 730MC

GENERAL PURPOSE
END MILLS

Extra Length - Ball End

TiCN Coating

Solid submicron grain carbide end mill - center cutting

Extended reach

Improved abrasion resistance and lubricity

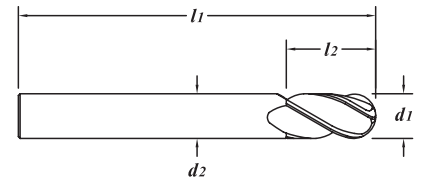
Can be modified with a neck within 48 hours

Extremely versatile

Uncoated - page 247

TiALN Coating - page 250

Standard length - page 231



(720MC) 2 Flute EDP#	(723MC) 3 Flute EDP#	(730MC) 4 Flute EDP#	d_1 †			d_2	l_1	l_2				
			Decimal	Diameter	Metric	Shank Diameter	Overall Length	Flute Length				
43014	55514	44014	.1250	1/8"	3.175	1/8"	2"	5/8"	18.01	17.23	16.44	15.66
43024	55524	44024	.1250	1/8"	3.175	1/8"	3"	3/4"	27.05	25.87	24.70	23.52
43034	55534	44034	.1250	1/8"	3.175	1/8"	3"	1"	27.05	25.87	24.70	23.52
43044	55544	44044	.1875	3/16"	4.763	3/16"	3"	1"	29.95	28.64	27.34	26.04
43054	55554	44054	.1875	3/16"	4.763	3/16"	3"	1-1/8"	29.95	28.64	27.34	26.04
43064	55564	44064	.1875	3/16"	4.763	3/16"	4"	1"	32.53	31.12	29.70	28.29
43074	55574	44074	.2500	1/4"	6.350	1/4"	3"	1"	35.65	34.10	32.55	31.00
43084	55584	44084	.2500	1/4"	6.350	1/4"	4"	1"	37.65	36.01	34.38	32.74
43094	55594	44094	.2500	1/4"	6.350	1/4"	4"	1-1/2"	37.65	36.01	34.38	32.74
43104	55604	44104	.2500	1/4"	6.350	1/4"	6"	1-1/2"	51.16	48.94	46.71	44.49
43114	55614	44114	.3125	5/16"	7.938	5/16"	3"	1"	44.55	42.61	40.68	38.74
43124	55624	44124	.3125	5/16"	7.938	5/16"	4"	1"	50.52	48.32	46.13	43.93
43134	-	44134	.3125	5/16"	7.938	5/16"	4"	1-5/8"	50.52	48.32	46.13	43.93
43144	55644	44144	.3125	5/16"	7.938	5/16"	6"	1-1/2"	73.85	70.64	67.43	64.22
43154	55654	44154	.3750	3/8"	9.525	3/8"	3"	1"	49.29	47.15	45.00	42.86
43164	55664	44164	.3750	3/8"	9.525	3/8"	4"	1"	55.04	52.65	50.25	47.86
43174	55674	44174	.3750	3/8"	9.525	3/8"	4"	2"	55.04	52.65	50.25	47.86
43184	55684	44184	.3750	3/8"	9.525	3/8"	6"	1-1/2"	76.07	72.77	69.46	66.15
-	55694	44194	.3750	3/8"	9.525	3/8"	6"	3"	76.07	72.77	69.46	66.15
-	-	44204	.4375	7/16"	11.113	7/16"	4"	1"	74.39	71.16	67.92	64.69
-	-	44214	.4375	7/16"	11.113	7/16"	4"	2"	74.39	71.16	67.92	64.69
43224	55724	44224	.4375	7/16"	11.113	7/16"	6"	1-1/2"	97.80	93.54	89.29	85.04
-	-	44234	.4375	7/16"	11.113	7/16"	6"	3"	97.80	93.54	89.29	85.04
43244	55744	44244	.5000	1/2"	12.700	1/2"	4"	1"	75.77	72.48	69.18	65.89
43254	55754	44254	.5000	1/2"	12.700	1/2"	4"	2"	75.77	72.48	69.18	65.89
43264	55764	44264	.5000	1/2"	12.700	1/2"	6"	1-1/2"	107.32	102.65	97.99	93.32
43274	55774	44274	.5000	1/2"	12.700	1/2"	6"	3"	107.32	102.65	97.99	93.32
-	-	44284	.5625	9/16"	14.288	9/16"	6"	2"	147.57	141.15	134.74	128.32
-	-	44294	.5625	9/16"	14.288	9/16"	6"	3"	147.57	141.15	134.74	128.32
43304	55804	44304	.6250	5/8"	15.875	5/8"	6"	2"	154.56	147.84	141.12	134.40
-	-	44314	.6250	5/8"	15.875	5/8"	6"	3"	154.56	147.84	141.12	134.40
43324	55824	44324	.7500	3/4"	19.050	3/4"	6"	2"	245.24	234.58	223.91	213.25
43334	55834	44334	.7500	3/4"	19.050	3/4"	6"	3"	245.24	234.58	223.91	213.25
-	55844	44344	1.000	1"	25.400	1"	6"	2"	411.55	393.66	375.76	357.87
43354	55854	44354	1.000	1"	25.400	1"	6"	3"	411.55	393.66	375.76	357.87

70

35

MATERIAL HARDNESS (Rc)

0

Series 720MA, 723MA, 730MA, 740MA, 743MA, 750MA

.1181" - .3150"
(3.000mm - 8.000mm)TECH
PAGES
282-283

TOLERANCES

d_1	+0.000" - .002" (+0.000 - .050mm)
d_2	h6
ball radius	+0.000" - .001" (+0.000 - .025mm)

Extra Length - Ball End

TiAlN Coating

Solid submicron grain carbide end mill - center cutting

Extended reach

Dry or semi-dry machining

Can be modified with a neck within 48 hours

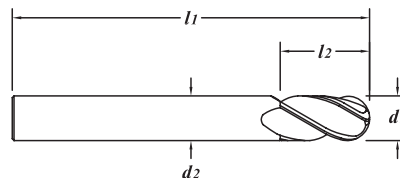
Extremely versatile

Uncoated - page 247

TiCN Coating - page 249

Stub Length - page 215

Standard length - page 232



(720MA/740MA) 2 Flute EDP#	(723MA/743MA) 3 Flute EDP#	(730MA/750MA) 4 Flute EDP#	d_1 † Diameter		d_2 Shank Diameter	l_1 Overall Length	l_2 Flute Length	1-11	12-24	25-49	50-100
			Decimal	Metric							
97017	98017	99017	.1181	3.000	3.0	50	16	17.58	16.82	16.05	15.29
97027	98027	99027	.1181	3.000	3.0	75	20	28.11	26.88	25.66	24.44
97037	98037	99037	.1181	3.000	3.0	75	25	28.11	26.88	25.66	24.44
43017	55517	44017	.1250	1/8"	3.175	1/8"	2"	18.32	17.52	16.73	15.93
43027	55527	44027	.1250	1/8"	3.175	1/8"	3"	27.44	26.25	25.05	23.86
43037	55537	44037	.1250	1/8"	3.175	1/8"	3"	27.44	26.25	25.05	23.86
97047	98047	99047	.1575	4.000	4.0	50	16	18.78	17.96	17.15	16.33
97057	98057	99057	.1575	4.000	4.0	75	20	30.15	28.84	27.53	26.22
97067	98067	99067	.1575	4.000	4.0	75	25	30.15	28.84	27.53	26.22
43047	55547	44047	.1875	3/16"	4.763	3/16"	3"	30.82	29.48	28.14	26.80
43057	55557	44057	.1875	3/16"	4.763	3/16"	3"	30.82	29.48	28.14	26.80
43067	55567	44067	.1875	3/16"	4.763	3/16"	4"	33.55	32.09	30.63	29.17
97087	98087	99087	.1969	5.000	5.0	75	20	33.58	32.12	30.66	29.20
97097	98097	99097	.1969	5.000	5.0	75	25	33.58	32.12	30.66	29.20
97107	98107	99107	.2362	6.000	6.0	75	25	38.00	36.34	34.69	33.04
97117	98117	99117	.2362	6.000	6.0	100	25	40.65	38.89	37.12	35.35
97127	98127	99127	.2362	6.000	6.0	100	32	40.65	38.89	37.12	35.35
97137	98137	99137	.2362	6.000	6.0	150	38	53.56	51.23	48.90	46.57
43077	55577	44077	.2500	1/4"	6.350	1/4"	3"	36.40	34.82	33.23	31.65
43087	55587	44087	.2500	1/4"	6.350	1/4"	4"	38.96	37.27	35.57	33.88
43097	55597	44097	.2500	1/4"	6.350	1/4"	4"	38.96	37.27	35.57	33.88
43107	55607	44107	.2500	1/4"	6.350	1/4"	6"	51.35	49.12	46.88	44.65
43117	-	44117	.3125	5/16"	7.938	5/16"	3"	46.41	44.40	42.38	40.36
43127	55627	44127	.3125	5/16"	7.938	5/16"	4"	53.06	50.75	48.45	46.14
43137	55637	44137	.3125	5/16"	7.938	5/16"	4"	53.06	50.75	48.45	46.14
43147	55647	44147	.3125	5/16"	7.938	5/16"	6"	77.50	74.13	70.76	67.39
97147	98147	99147	.3150	8.000	8.0	75	25	48.39	46.29	44.18	42.08
97157	98157	99157	.3150	8.000	8.0	100	25	55.28	52.88	50.47	48.07
97167	98167	99167	.3150	8.000	8.0	100	41	55.28	52.88	50.47	48.07
97177	98177	99177	.3150	8.000	8.0	150	50	79.15	75.71	72.27	68.83

Series 720MA, 723MA, 730MA, 740MA, 743MA, 750MA (continued)

.3750" - 1.000"
(9.525mm - 25.400mm)

GENERAL PURPOSE
END MILLS

(720MA/740MA) 2 Flute EDP#	(723MA/743MA) 3 Flute EDP#	(730MA/750MA) 4 Flute EDP#	$d1$ † Diameter			$d2$ Shank Diameter	$l1$ Overall Length	$l2$ Flute Length	1-11	12-24	25-49	50-100
Decimal	Metric											
43157	55657	44157	.3750	3/8"	9.525	3/8"	3"	1"	51.16	48.94	46.71	44.49
43167	55667	44167	.3750	3/8"	9.525	3/8"	4"	1"	57.58	55.08	52.57	50.07
43177	55677	44177	.3750	3/8"	9.525	3/8"	4"	2"	57.58	55.08	52.57	50.07
43187	55687	44187	.3750	3/8"	9.525	3/8"	6"	1-1/2"	79.72	76.25	72.79	69.32
43197	55697	44197	.3750	3/8"	9.525	3/8"	6"	3"	79.72	76.25	72.79	69.32
97187	98187	99187	.3937		10.000	10.0	75	25	55.78	53.35	50.93	48.50
97197	98197	99197	.3937		10.000	10.0	100	25	72.90	69.73	66.56	63.39
97207	98207	99207	.3937		10.000	10.0	100	50	72.90	69.73	66.56	63.39
97217	98217	99217	.3937		10.000	10.0	150	38	95.24	91.10	86.96	82.82
97227	98227	99227	.3937		10.000	10.0	150	75	95.24	91.10	86.96	82.82
43207	-	44207	.4375	7/16"	11.113	7/16"	4"	1"	77.00	73.66	70.31	66.96
-	55717	44217	.4375	7/16"	11.113	7/16"	4"	2"	77.00	73.66	70.31	66.96
43227	-	44227	.4375	7/16"	11.113	7/16"	6"	1-1/2"	101.35	96.94	92.54	88.13
43237	55737	44237	.4375	7/16"	11.113	7/16"	6"	3"	101.35	96.94	92.54	88.13
97237	-	99237	.4724		12.000	12.0	100	25	81.89	78.33	74.77	71.21
97247	98247	99247	.4724		12.000	12.0	100	50	81.89	78.33	74.77	71.21
97257	98257	99257	.4724		12.000	12.0	150	50	110.84	106.02	101.20	96.38
97267	98267	99267	.4724		12.000	12.0	150	75	110.84	106.02	101.20	96.38
43247	55747	44247	.5000	1/2"	12.700	1/2"	4"	1"	78.37	74.97	71.56	68.15
43257	55757	44257	.5000	1/2"	12.700	1/2"	4"	2"	78.37	74.97	71.56	68.15
43267	55767	44267	.5000	1/2"	12.700	1/2"	6"	1-1/2"	110.84	106.02	101.20	96.38
43277	55777	44277	.5000	1/2"	12.700	1/2"	6"	3"	110.84	106.02	101.20	96.38
97277	-	99277	.5512		14.000	14.0	100	25	109.96	105.18	100.40	95.62
-	-	99287	.5512		14.000	14.0	100	50	109.96	105.18	100.40	95.62
97297	-	99297	.5512		14.000	14.0	150	50	150.97	144.41	137.84	131.28
-	-	99307	.5512		14.000	14.0	150	75	150.97	144.41	137.84	131.28
43287	-	44287	.5625	9/16"	14.288	9/16"	6"	2"	150.97	144.41	137.84	131.28
43297	-	44297	.5625	9/16"	14.288	9/16"	6"	3"	150.97	144.41	137.84	131.28
43307	55807	44307	.6250	5/8"	15.875	5/8"	6"	2"	157.99	151.12	144.25	137.38
43317	55817	44317	.6250	5/8"	15.875	5/8"	6"	3"	157.99	151.12	144.25	137.38
97317	98317	99317	.6299		16.000	16.0	150	50	157.99	151.12	144.25	137.38
97327	98327	99327	.6299		16.000	16.0	150	75	157.99	151.12	144.25	137.38
-	98337	99337	.7087		18.000	18.0	150	50	235.32	225.09	214.86	204.63
-	-	99347	.7087		18.000	18.0	150	75	235.32	225.09	214.86	204.63
43327	55827	44327	.7500	3/4"	19.050	3/4"	6"	2"	249.47	238.62	227.78	216.93
43337	55837	44337	.7500	3/4"	19.050	3/4"	6"	3"	249.47	238.62	227.78	216.93
97357	98357	99357	.7874		20.000	20.0	150	50	263.43	251.98	240.52	229.07
97367	98367	99367	.7874		20.000	20.0	150	75	263.43	251.98	240.52	229.07
-	-	99377	.9843		25.000	25.0	150	50	400.04	382.65	365.25	347.86
-	-	99387	.9843		25.000	25.0	150	75	400.04	382.65	365.25	347.86
-	55847	44347	1.000	1"	25.400	1"	6"	2"	414.81	396.77	378.74	360.70
43357	55857	44357	1.000	1"	25.400	1"	6"	3"	414.81	396.77	378.74	360.70

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35

MATERIAL HARDNESS (Rc)

0

Series 425M, 435M, 435MA



TOLERANCES

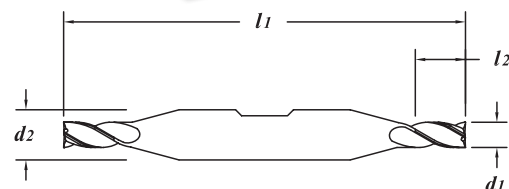
d_1	+0.000" -0.002" (+0.00 -0.050mm)
d_2	-0.001" -0.0005" (-0.025 -0.0127mm)

Standard Length - Double End - 3/8" Shank

Solid submicron grain carbide end mill - center cutting

Common 3/8" diameter shank with weldon flat

For strength and adaptability when converting from high speed steel



(425M) 2 Flute EDP#	(435M) 4 Flute EDP#	d_1 † Diameter		d_2 Shank Diameter	l_1 Overall Length	l_2 Flute Length	1-11	12-24	25-49	50-100	
		Decimal	Metric								
33010	34010	.1250	1/8"	3.175	3/8"	3"	3/8"	39.46	37.74	36.03	34.31
33020	34020	.1562	5/32"	3.967	3/8"	3"	7/16"	39.46	37.74	36.03	34.31
33030	34030	.1875	3/16"	4.763	3/8"	3"	1/2"	39.46	37.74	36.03	34.31
33050	34050	.2500	1/4"	6.350	3/8"	3"	5/8"	39.46	37.74	36.03	34.31
-	34060	.2812	9/32"	7.142	3/8"	4"	11/16"	45.34	43.37	41.40	39.43
-	34070	.3125	5/16"	7.938	3/8"	4"	3/4"	45.34	43.37	41.40	39.43
-	34090	.3750	3/8"	9.525	3/8"	4"	3/4"	45.34	43.37	41.40	39.43



Standard Length - Double End - 3/8" Shank

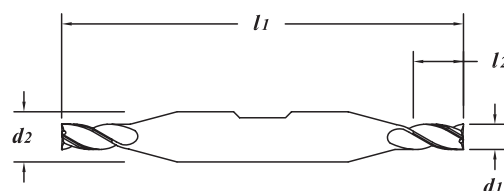
TiAlN Coated

Solid submicron grain carbide end mill - center cutting

Common 3/8" diameter shank with weldon flat

For strength and adaptability when converting from high speed steel

Dry or semi-dry machining



(435MA) 4 Flute EDP#	d_1 † Diameter		d_2 Shank Diameter	l_1 Overall Length	l_2 Flute Length	1-11	12-24	25-49	50-100	
	Decimal	Metric								
34017	.1250	1/8"	3.175	3/8"	3"	3/8"	51.93	49.68	47.42	45.16
34027	.1562	5/32"	3.967	3/8"	3"	7/16"	51.93	49.68	47.42	45.16
34037	.1875	3/16"	4.763	3/8"	3"	1/2"	51.93	49.68	47.42	45.16
34047	.2188	7/32"	5.558	3/8"	3"	9/16"	51.93	49.68	47.42	45.16
34057	.2500	1/4"	6.350	3/8"	3"	5/8"	51.93	49.68	47.42	45.16
34067	.2812	9/32"	7.142	3/8"	4"	11/16"	61.17	58.51	55.85	53.19
34077	.3125	5/16"	7.938	3/8"	4"	3/4"	61.17	58.51	55.85	53.19
34097	.3750	3/8"	9.525	3/8"	4"	3/4"	61.17	58.51	55.85	53.19

TOLERANCES

d_1	+0.000" -0.002" (+.000 - .050mm)
d_2	-0.0001" -0.0005" (-.0025 - .0127mm)
ball radius	+0.000" -0.001" (+.000 - .025mm)



Series **535M, 535MA**

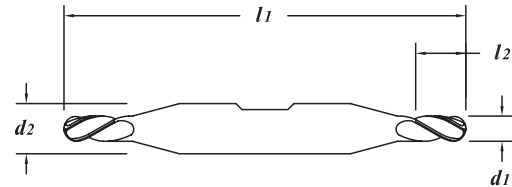
GENERAL PURPOSE
END MILLS

Standard Length - Double End - 3/8" Shank - Ball End

Solid submicron grain carbide end mill - center cutting

Common 3/8" diameter shank with weldon flat

For strength and adaptability when converting from high speed steel



EDP#	d_1 †		d_2 Shank Diameter	l_1 Overall Length	l_2 Flute Length	1-11	12-24	25-49	50-100
	Decimal	Diameter Metric							
36010	.1250	1/8"	3.175	3"	3/8"	46.41	44.40	42.38	40.36
36030	.1875	3/16"	4.763	3"	1/2"	46.41	44.40	42.38	40.36



Standard Length - Double End - 3/8" Shank - Ball End

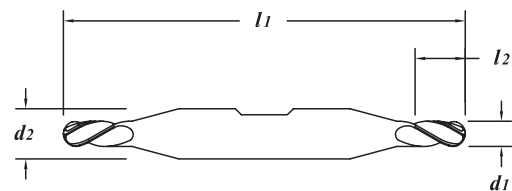
TiALN Coated

Solid submicron grain carbide end mill - center cutting

Common 3/8" diameter shank with weldon flat

For strength and adaptability when converting from high speed steel

Dry or semi-dry machining



EDP#	d_1 †		d_2 Shank Diameter	l_1 Overall Length	l_2 Flute Length	1-11	12-24	25-49	50-100
	Decimal	Diameter Metric							
36017	.1250	1/8"	3.175	3"	3/8"	58.88	56.32	53.76	51.20
36027	.1562	5/32"	3.967	3"	7/16"	58.88	56.32	53.76	51.20
36037	.1875	3/16"	4.763	3"	1/2"	58.88	56.32	53.76	51.20
36057	.2500	1/4"	6.350	3"	5/8"	58.88	56.32	53.76	51.20
36077	.3125	5/16"	7.938	4"	3/4"	69.15	66.14	63.14	60.13

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MATERIAL HARDNESS (Rc)

0



TECH
PAGES
282-283

TOLERANCES

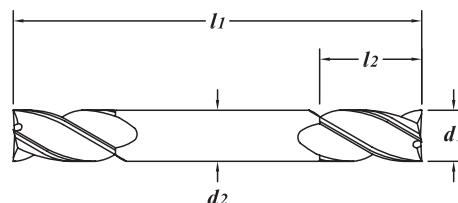
$d1$	$+0.000" - .002" (+.000 - .050\text{mm})$
$d2$	$h6$

Standard Length - Double End

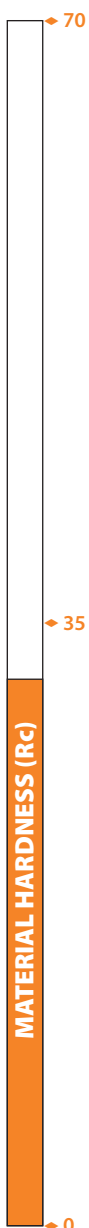
Solid submicron grain carbide end mill - center cutting

Extremely versatile

TiALN Coating - page 255



EDP#	$d1$ †		$d2$ Shank Diameter	$l1$ Overall Length	$l2$ Flute Length	1-11	12-24	25-49	50-100	
	Decimal	Metric								
30030	.0625	1/16"	1.588	1/8"	2"	3/16"	23.89	22.85	21.81	20.77
30040	.0938	3/32"	2.383	1/8"	2"	1/4"	23.89	22.85	21.81	20.77
30050	.1250	1/8"	3.175	1/8"	2"	3/8"	17.26	16.51	15.76	15.01
30060	.1562	5/32"	3.967	3/16"	2-1/2"	7/16"	24.66	23.58	22.51	21.44
30070	.1875	3/16"	4.763	3/16"	2-1/2"	1/2"	20.63	19.73	18.84	17.94
30090	.2500	1/4"	6.350	1/4"	2-1/2"	5/8"	25.02	23.94	22.85	21.76
30100	.3125	5/16"	7.938	5/16"	3-1/2"	3/4"	32.66	31.24	29.82	28.40
30110	.3750	3/8"	9.525	3/8"	3-1/2"	3/4"	42.18	40.35	38.51	36.68
30130	.5000	1/2"	12.700	1/2"	4"	1"	67.36	64.43	61.50	58.57



TOLERANCES

$d1$	$+0.000^{\circ} -0.002^{\circ} (+.000 -0.050\text{mm})$
$d2$	$h6$



TECH
PAGES
282-283

Series 430MA, 450MA

GENERAL PURPOSE
END MILLS

Standard Length - Double End

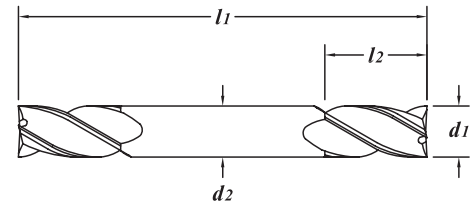
TiALN Coating

Solid submicron grain carbide end mill - center cutting

Dry or semi-dry machining

Extremely versatile

Uncoated - page 254



(430MA/450MA) EDP#	$d1$ † Diameter		$d2$ Shank Diameter	$l1$ Overall Length	$l2$ Flute Length	1-11	12-24	25-49	50-100	
	Decimal	Metric								
30017	.0312	1/32"	0.792	1/8"	2"	3/32"	27.92	26.71	25.49	24.28
30027	.0469	3/64"	1.191	1/8"	2"	1/8"	27.92	26.71	25.49	24.28
30037	.0625	1/16"	1.588	1/8"	2"	3/16"	27.92	26.71	25.49	24.28
30047	.0938	3/32"	2.383	1/8"	2"	1/4"	27.92	26.71	25.49	24.28
30057	.1250	1/8"	3.175	1/8"	2"	3/8"	21.30	20.37	19.45	18.52
30067	.1562	5/32"	3.967	3/16"	2-1/2"	7/16"	30.94	29.59	28.25	26.90
30077	.1875	3/16"	4.763	3/16"	2-1/2"	1/2"	26.93	25.76	24.59	23.42
30087	.2188	7/32"	5.558	1/4"	2-1/2"	9/16"	35.80	34.24	32.69	31.13
30607	.2362		6.000	6.0	65	16	34.65	33.14	31.64	30.13
30097	.2500	1/4"	6.350	1/4"	2-1/2"	5/8"	33.37	31.92	30.47	29.02
30107	.3125	5/16"	7.938	5/16"	3-1/2"	3/4"	48.50	46.39	44.28	42.17
30117	.3750	3/8"	9.525	3/8"	3-1/2"	3/4"	58.04	55.52	52.99	50.47
30127	.4375	7/16"	11.113	7/16"	4"	7/8"	78.30	74.90	71.49	68.09
30137	.5000	1/2"	12.700	1/2"	4"	1"	85.71	81.98	78.26	74.53

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MATERIAL HARDNESS (Rc)

0



TECH
PAGES
282-283

TOLERANCES

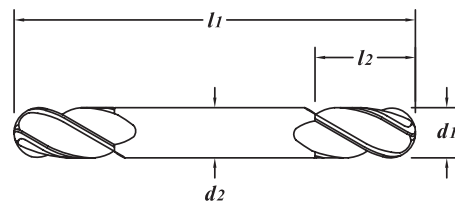
d_1	$+0.000" - .002" (+.000 - .050\text{mm})$
d_2	$h6$
ball radius	$+0.000" - .001" (+.000 - .025\text{mm})$

Standard Length - Double End - Ball End

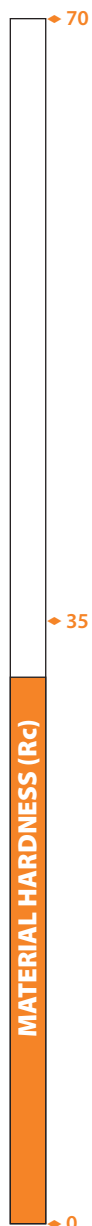
Solid submicron grain carbide end mill - center cutting

Extremely versatile

TiALN Coating - page 257



EDP#	d_1 †		d_2	l_1	l_2	1-11	12-24	25-49	50-100	
	Decimal	Diameter Metric								
32050	.1250	1/8"	3.175	1/8"	2"	3/8"	19.83	18.96	18.10	17.24
32070	.1875	3/16"	4.763	3/16"	2-1/2"	1/2"	24.29	23.23	22.18	21.12
32090	.2500	1/4"	6.350	1/4"	2-1/2"	5/8"	28.82	27.57	26.31	25.06
32110	.3750	3/8"	9.525	3/8"	3-1/2"	3/4"	48.54	46.43	44.32	42.21
32130	.5000	1/2"	12.700	1/2"	4"	1"	77.46	74.10	70.73	67.36



TOLERANCES

d_1	+0.000" - .002" (+.000 - .050mm)
d_2	h6
ball radius	+0.000" - .001" (+.000 - .025mm)



TECH
PAGES
282-283

Series **530MA**

GENERAL PURPOSE
END MILLS

Standard Length - Double End - Ball End

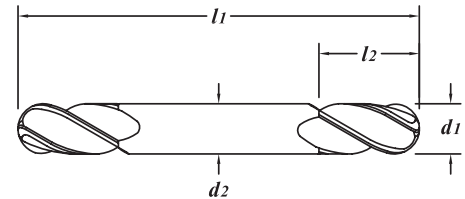
TiAlN Coating

Solid submicron grain carbide end mill - center cutting

Dry or semi-dry machining

Extremely versatile

Uncoated - page 256



EDP#	$d1$ †			$d2$ Shank Diameter	$l1$ Overall Length	$l2$ Flute Length	1-11	12-24	25-49	50-100
	Decimal	Diameter	Metric							
32017	.0312	1/32"	0.792	1/8"	2"	3/32"	31.52	30.15	28.78	27.41
32027	.0469	3/64"	1.191	1/8"	2"	1/8"	31.52	30.15	28.78	27.41
32037	.0625	1/16"	1.588	1/8"	2"	3/16"	31.52	30.15	28.78	27.41
32047	.0938	3/32"	2.383	1/8"	2"	1/4"	31.52	30.15	28.78	27.41
32057	.1250	1/8"	3.175	1/8"	2"	3/8"	23.87	22.84	21.80	20.76
32067	.1562	5/32"	3.967	3/16"	2-1/2"	7/16"	34.65	33.14	31.64	30.13
32077	.1875	3/16"	4.763	3/16"	2-1/2"	1/2"	30.58	29.25	27.92	26.59
32097	.2500	1/4"	6.350	1/4"	2-1/2"	5/8"	37.16	35.54	33.93	32.31
32117	.3750	3/8"	9.525	3/8"	3-1/2"	3/4"	64.38	61.58	58.78	55.98
32137	.5000	1/2"	12.700	1/2"	4"	1"	95.82	91.65	87.49	83.32

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MATERIAL HARDNESS (Rc)

0

Series 280M, 290M, 380M, 390M

TECH
PAGES
282-283

TOLERANCES

d_1	$+0.011" -0.000" (+0.25 -0.00mm)$
d_2	$h6$

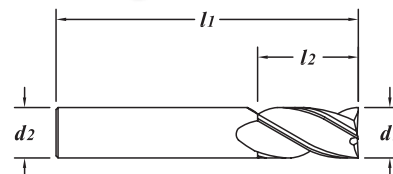
Standard Length - N/C Tolerance - Square End

Solid submicron grain carbide end mill - center cutting

Excellent for keyways

Tight tolerance for precision machining

For use when matching tools are necessary



(280M) 2 Flute EDP#	(290M) 4 Flute EDP#	d_1 †		d_2	l_1	l_2	1-11	12-24	25-49	50-100
		Decimal	Diameter	Metric	Shank Diameter	Overall Length	Flute Length			
25010	26010	.0625	1/16"	1.588	1/8"	1-1/2"	1/4"	14.74	14.10	13.46
25020	26020	.0938	3/32"	2.383	1/8"	1-1/2"	5/16"	13.97	13.37	12.76
25030	26030	.1250	1/8"	3.175	1/8"	1-1/2"	1/2"	13.56	12.97	12.38
25040	26040	.1875	3/16"	4.763	3/16"	2"	9/16"	18.03	17.25	16.46
25050	26050	.2500	1/4"	6.350	1/4"	2-1/2"	3/4"	20.73	19.83	18.93
* 25070	* 26070	.3750	3/8"	9.525	3/8"	2-1/2"	7/8"	38.10	36.44	34.79
* 25090	* 26090	.5000	1/2"	12.700	1/2"	3"	1"	61.03	58.38	55.72
-	* 26100	.6250	5/8"	15.875	5/8"	3-1/2"	1-1/4"	108.64	103.92	99.19
										94.47

TECH
PAGES
282-283

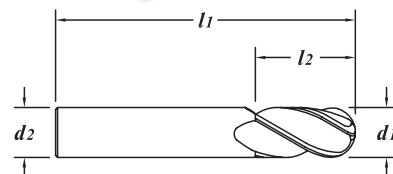
Standard Length - N/C Tolerance - Ball End

Solid submicron grain carbide end mill - center cutting

Excellent for keyways

Tight tolerance for precision machining

For use when matching tools are necessary

Ball radius tolerance $+0.0005" -0.0000" (+0.0127mm -0.0000mm)$ 

(380M) 2 Flute EDP#	(390M) 4 Flute EDP#	d_1 †		d_2	l_1	l_2	1-11	12-24	25-49	50-100
		Decimal	Diameter	Metric	Shank Diameter	Overall Length	Flute Length			
27010	28010	.0625	1/16"	1.588	1/8"	1-1/2"	1/4"	16.97	16.24	15.50
27030	28030	.1250	1/8"	3.175	1/8"	1-1/2"	1/2"	15.59	14.92	14.24
-	28040	.1875	3/16"	4.763	3/16"	2"	9/16"	20.73	19.83	18.93
27050	28050	.2500	1/4"	6.350	1/4"	2-1/2"	3/4"	23.87	22.84	21.80
-	28060	.3125	5/16"	7.938	5/16"	2-1/2"	7/8"	34.12	32.64	31.15
* 27070	* 28070	.3750	3/8"	9.525	3/8"	2-1/2"	7/8"	43.84	41.93	40.03
-	* 28090	.5000	1/2"	12.700	1/2"	3"	1"	70.21	67.16	64.10
-	* 28100	.6250	5/8"	15.875	5/8"	3-1/2"	1-1/4"	124.98	119.55	114.11
										108.68

* - Tools with weldon flats