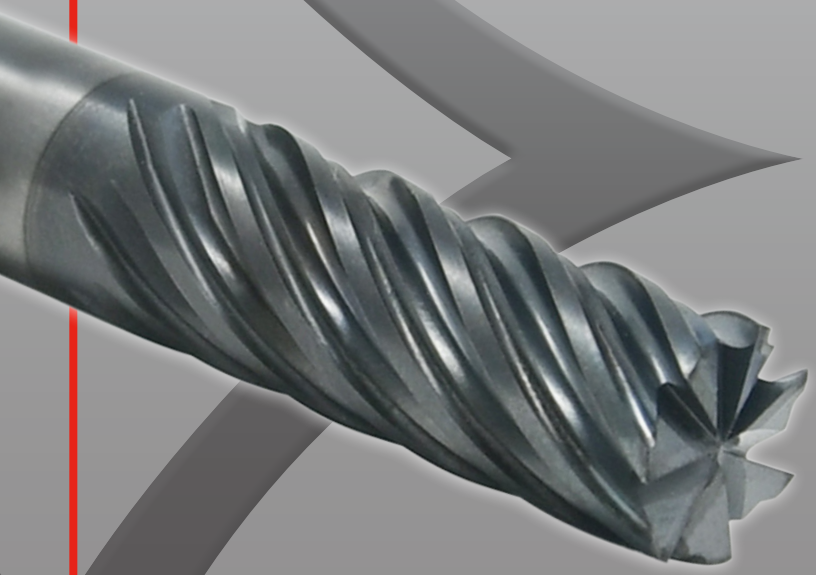
CLEVELAND

NEW 7 Flute Variable Index End Mill



- **Save Time**
- **Save Money**
- **Precision Performance**

Sizes:	3/8", 1/2", 5/8", 3/4", and 1"
Geometry:	Heavy Duty Various Lengths of Cut Corner Radii Chip Breaker and Standard Styles
Coating:	AlCrN
Materials:	Steels, Stainless Steel, and High Temp. Alloys
Application:	Ideal for High Efficiency Machining such as Trochoidal Milling

Look at this comparison!!

Comparison of Carbide End Mills

1/2" 7 flute Variable Index	**High Efficiency Machining**	**Cycle Time: 4 min., 3 sec.**
1/2" 4 flute Variable Index	Traditional Machining	Cycle Time: 10 min.
1/2" 4 flute General Purpose	Traditional Machining	Cycle Time: 14 min., 18 sec.

GREENFIELD INDUSTRIES GREENFIELD INDUSTRIES

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Styles: CEM-V3-7R

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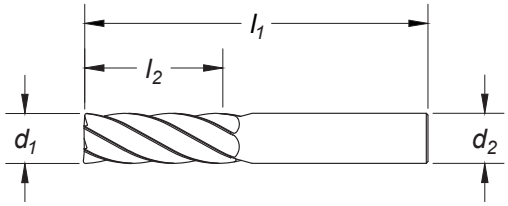
Note

Ideal for High Efficiency Machining (HEM)
Minimized chatter from unequal flute spacing.
**Weldon flats available 1/2" and larger.*

Solid Carbide | 7 Flute CC | Helix 38° | Radius End | Square End

Surface Treatment: AP/MAX



Feature

Use one tool for roughing and finishing operations.

cutting diameter d_1 fractional	cutting diameter d_1 decimal	shank diameter d_2	length of cut l_2 (in)	overall length l_1 (in)	no. of flutes	corner radius	order number CEM-V3-7R AP/MAX
3/8	0.375	3/8	3/4	2-1/2	7	0.000	C76270
3/8	0.375	3/8	3/4	2-1/2	7	0.015	C76271
3/8	0.375	3/8	3/4	2-1/2	7	0.030	C76272
3/8	0.375	3/8	15/16	2-1/2	7	0.000	C76273
3/8	0.375	3/8	15/16	2-1/2	7	0.015	C76274
3/8	0.375	3/8	15/16	2-1/2	7	0.030	C76275
3/8	0.375	3/8	1-1/8	3	7	0.000	C76276
3/8	0.375	3/8	1-1/8	3	7	0.015	C76277
3/8	0.375	3/8	1-1/8	3	7	0.030	C76278
3/8	0.375	3/8	1-1/2	3-1/2	7	0.000	C76279
3/8	0.375	3/8	1-1/2	3-1/2	7	0.015	C76280
3/8	0.375	3/8	1-1/2	3-1/2	7	0.030	C76281
1/2	0.500	1/2	5/8	2 1/2	7	0.000	C76372
1/2	0.500	1/2	5/8	2 1/2	7	0.015	C76373
1/2	0.500	1/2	5/8	2 1/2	7	0.030	C76374
1/2	0.500	1/2	1	3	7	0.000	C76282
1/2	0.500	1/2	1	3	7	0.030	C76283
1/2	0.500	1/2	1	3	7	0.060	C76284
1/2	0.500	1/2	1	3	7	0.090	C76285
1/2	0.500	1/2	1-1/4	3	7	0.000	C76286
1/2	0.500	1/2	1-1/4	3	7	0.015	C76375
1/2	0.500	1/2	1-1/4	3	7	0.030	C76287
1/2	0.500	1/2	1-1/4	3	7	0.060	C76288
1/2	0.500	1/2	1-1/4	3	7	0.090	C76289
1/2	0.500	1/2	1-1/2	3-1/2	7	0.000	C76290
1/2	0.500	1/2	1-1/2	3-1/2	7	0.030	C76291
1/2	0.500	1/2	1-1/2	3-1/2	7	0.060	C76292
1/2	0.500	1/2	1-1/2	3-1/2	7	0.090	C76293
1/2	0.500	1/2	2	4	7	0.000	C76294
1/2	0.500	1/2	2	4	7	0.030	C76295
1/2	0.500	1/2	2	4	7	0.060	C76296
1/2	0.500	1/2	2	4	7	0.090	C76297
1/2	0.500	1/2	2-1/4	4	7	0.000	C76298
1/2	0.500	1/2	2-1/4	4	7	0.030	C76299
1/2	0.500	1/2	2-1/4	4	7	0.060	C76300
1/2	0.500	1/2	2-1/4	4	7	0.090	C76301
5/8	0.625	5/8	1-7/8	4	7	0.000	C76302
5/8	0.625	5/8	1-7/8	4	7	0.030	C76303
5/8	0.625	5/8	1-7/8	4	7	0.060	C76304
5/8	0.625	5/8	1-7/8	4	7	0.090	C76305
5/8	0.625	5/8	2-1/4	4	7	0.000	C76306
5/8	0.625	5/8	2-1/4	4	7	0.030	C76307
5/8	0.625	5/8	2-1/4	4	7	0.090	C76309
5/8	0.625	5/8	3	6	7	0.000	C76310
5/8	0.625	5/8	3	6	7	0.030	C76311
5/8	0.625	5/8	3	6	7	0.060	C76312
3/4	0.750	3/4	1-1/2	4	7	0.000	C76313
3/4	0.750	3/4	1-1/2	4	7	0.030	C76314
3/4	0.750	3/4	1-1/2	4	7	0.060	C76315
3/4	0.750	3/4	1-1/2	4	7	0.125	C76316
3/4	0.750	3/4	1-7/8	4	7	0.000	C76317

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Styles: CEM-V3-7R

Variable Index
Ferrous Materials

cutting diameter d_1 fractional	cutting diameter d_1 decimal	shank diameter d_2	length of cut l_2 (in)	overall length l_1 (in)	no. of flutes	corner radius	order number CEM-V3-7R AP/MAX
3/4	0.750	3/4	1-7/8	4	7	0.030	C76318
3/4	0.750	3/4	1-7/8	4	7	0.060	C76319
3/4	0.750	3/4	1-7/8	4	7	0.090	C76320
3/4	0.750	3/4	1-7/8	4	7	0.125	C76321
3/4	0.750	3/4	2-1/4	5	7	0.000	C76322
3/4	0.750	3/4	2-1/4	5	7	0.030	C76323
3/4	0.750	3/4	2-1/4	5	7	0.060	C76324
3/4	0.750	3/4	2-1/4	5	7	0.090	C76325
3/4	0.750	3/4	2-1/4	5	7	0.125	C76326
3/4	0.750	3/4	2-5/8	5	7	0.000	C76327
3/4	0.750	3/4	2-5/8	5	7	0.030	C76328
3/4	0.750	3/4	2-5/8	5	7	0.060	C76329
3/4	0.750	3/4	2-5/8	5	7	0.090	C76330
3/4	0.750	3/4	2-5/8	5	7	0.125	C76331
3/4	0.750	3/4	3	6	7	0.000	C76332
3/4	0.750	3/4	3	6	7	0.030	C76333
3/4	0.750	3/4	3	6	7	0.060	C76334
3/4	0.750	3/4	3	6	7	0.125	C76335
1	1.000	1	3	6	7	0.000	C76341
1	1.000	1	3	6	7	0.030	C76342
1	1.000	1	3	6	7	0.060	C76343
1	1.000	1	3	6	7	0.125	C76344
1	1.000	1	3-1/2	6	7	0.000	C76345
1	1.000	1	3-1/2	6	7	0.030	C76346
1	0.375	1	3-1/2	6	7	0.060	C76347
1	0.375	1	3-1/2	6	7	0.125	C76348

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Styles: CEM-V3-7RCB

Variable Index
Ferrous Materials

Note

Chip breaking geometry for improved High Efficiency Machining (HEM)
Ideal for High Efficiency Machining (HEM)
Minimized chatter from unequal flute spacing.
**Weldon flats available 1/2" and larger.*

Feature

Use one tool for roughing and finishing operations.

cutting diameter d_1 fractional	cutting diameter d_1 decimal	shank diameter d_2	length of cut l_2 (in)	overall length l_1 (in)	no. of flutes	corner radius	order number CEM-V3-7RCB AP/MAX
3/8	0.375	3/8	1-1/8	3	7	0.030	C76350
3/8	0.375	3/8	1-1/2	3-1/2	7	0.030	C76351
1/2	0.500	1/2	1-1/2	3-1/2	7	0.030	C76352
1/2	0.500	1/2	1-1/2	3-1/2	7	0.060	C76353
1/2	0.500	1/2	2	4	7	0.030	C76354
1/2	0.500	1/2	2	4	7	0.060	C76355
5/8	0.625	5/8	1-7/8	4	7	0.030	C76356
5/8	0.625	5/8	1-7/8	4	7	0.060	C76357
5/8	0.625	5/8	3	6	7	0.030	C76358
5/8	0.625	5/8	3	6	7	0.060	C76359
3/4	0.750	3/4	1-1/2	4	7	0.030	C76360
3/4	0.750	3/4	1-1/2	4	7	0.060	C76361
3/4	0.750	3/4	2-1/4	5	7	0.030	C76364
3/4	0.750	3/4	2-1/4	5	7	0.060	C76365
3/4	0.750	3/4	2-5/8	5	7	0.030	C76366
3/4	0.750	3/4	2-5/8	5	7	0.060	C76367
3/4	0.750	3/4	3	6	7	0.030	C76368
3/4	0.750	3/4	3	6	7	0.060	C76369
1	1.000	1	3	6	7	0.030	C76370
1	1.000	1	3	6	7	0.060	C76371

Operating Parameters

The new Cleveland CEM-V3-7R High Performance 7 Flute Variable Index End Mills were specifically designed to excel at HEM Trochoidal Milling. High Efficiency Milling (HEM) is a style of machining that features high axial depths of cut and low radial depths of cut. One common type of HEM is Trochoidal Milling. The modified cutting depths in Trochoidal Milling allow the CNC Machine to implement a spiral machining pattern that reduces tool load and wear in a part. This is accomplished by allowing the end mill to alternate between repeated short cutting times within a part and longer spiral rotations outside of the part. Trochoidal Milling uses a much smaller tool diameter than one would typically use in slotting applications. By implementing this smaller tool, a wider slot in the part is created, allowing additional space for the chips produced and the spiral tool path of the end mill.

The process of Trochoidal Milling developed as a result of the theory of chip thinning. This theory holds that tools have an ideal chip load that creates chips with the perfect size and width. To prevent chips from thinning in the cut outside of this ideal range, it is best to maintain a higher chip load in the milling operation to maintain this ideal chip thickness. This need to maintain a higher and ever changing chip load while milling a part requires that HEM Trochoidal Milling only be attempted on CNC Machines with Trochoidal Milling capabilities.

Benefits:

- Lower heat and cycle times for machining applications.
- Better end mill tool life and accuracy.
- The ability to use one tool for multiple applications and different slots.

Challenges:

Trochoidal Milling must be used on a CNC Machine capable of running the changing feed rates necessary in this process with software adept at generating HEM Tool Paths.

Material	Peripheral/Roughing HEM		Speed (SFM)	Feed (IPT)						
	Axial DOC	Radial DOC		3/16	1/4	3/8	1/2	5/8	3/4	1
Gray Cast Iron	≤ 3 x D	.1 x D	400	0.002	0.003	0.005	0.007	0.009	0.010	0.014
	3 x D - 4 x D	.08 x D		0.002	0.003	0.004	0.006	0.007	0.009	0.012
Malleable Cast Iron	≤ 3 x D	.08 x D	400	0.002	0.002	0.004	0.005	0.007	0.008	0.011
	3 x D - 4 x D			0.001	0.002	0.003	0.004	0.006	0.007	0.009
Low Carbon Steels	≤ 3 x D	.08 x D	500	0.002	0.003	0.005	0.007	0.009	0.011	0.015
	3 x D - 4 x D		450	0.002	0.003	0.004	0.006	0.007	0.010	0.012
Medium Carbon Steels	≤ 3 x D	.08 x D	450	0.002	0.003	0.005	0.007	0.008	0.010	0.014
	3 x D - 4 x D			0.002	0.003	0.004	0.006	0.007	0.009	0.012
Tool and Die Steels	≤ 3 x D	.08 x D	400	0.002	0.003	0.004	0.006	0.008	0.009	0.012
	3 x D - 4 x D			0.002	0.002	0.004	0.005	0.006	0.008	0.01
Austenitic Stainless Steels, FeNi Alloys, 300 Series Stainless Steels	≤ 3 x D	.08 x D	400	0.002	0.003	0.004	0.006	0.008	0.009	0.012
	3 x D - 4 x D	.07 x D	450	0.002	0.002	0.004	0.005	0.006	0.008	0.01
Martensitic and Ferritic Stainless Steels	≤ 3 x D	.08 x D	450	0.002	0.003	0.005	0.007	0.009	0.011	0.015
	3 x D - 4 x D			0.002	0.003	0.004	0.006	0.007	0.009	0.012
Precipitation Hardening Stainless Steels	≤ 3 x D	.08 x D	450	0.002	0.003	0.004	0.006	0.007	0.009	0.012
	3 x D - 4 x D	.07 x D	400	0.002	0.002	0.003	0.005	0.006	0.007	0.01
Titanium Alloys	≤ 3 x D	.1 x D	400	0.001	0.002	0.003	0.004	0.005	0.006	0.008
	3 x D - 4 x D	.08 x D		0.001	0.001	0.002	0.003	0.004	0.005	0.007
Difficult to Machine Titanium Alloys	≤ 2.5 x D	.08 x D	350	0.001	0.002	0.003	0.004	0.005	0.006	0.008
	2.5 x D - 4 x D	.06 x D	300	0.001	0.001	0.002	0.003	0.004	0.005	0.006
Hi Temp Alloys	≤ 1.5 x D	.07 x D	100	0.003	0.004	0.007	0.009	0.011	0.014	0.018
	1.5 x D - 3 x D	.06 x D		0.002	0.003	0.005	0.007	0.009	0.011	0.015

Material	Finishing		Speed (SFM)	Feed (IPT)						
	Axial DOC	Radial DOC		3/16	1/4	3/8	1/2	5/8	3/4	1
Gray Cast Iron	3 x D	.015 x D	450	0.001	0.001	0.002	0.002	0.003	0.003	0.005
Malleable Cast Iron			350	0.001	0.001	0.001	0.002	0.002	0.003	0.004
Low Carbon Steels			400	0.001	0.001	0.002	0.002	0.003	0.004	0.005
Medium Carbon Steels			400	0.001	0.001	0.001	0.002	0.003	0.003	0.005
Tool and Die Steels			350	0.001	0.001	0.001	0.002	0.002	0.003	0.004
Austenitic Stainless Steels, FeNi Alloys, 300 Series Stainless Steels			400	0.001	0.001	0.002	0.002	0.003	0.004	0.005
Martensitic and Ferritic Stainless Steels			400	0.001	0.001	0.001	0.002	0.003	0.003	0.005
Precipitation Hardening Stainless Steels			350	0.001	0.001	0.001	0.002	0.002	0.003	0.004
Titanium Alloys			350	0.001	0.001	0.001	0.001	0.002	0.002	0.003
Difficult to Machine Titanium Alloys		.01 x D	300	0.001	0.001	0.001	0.001	0.001	0.002	0.002
Hi Temp Alloys	2 x D		100	0.001	0.002	0.003	0.004	0.006	0.007	0.009