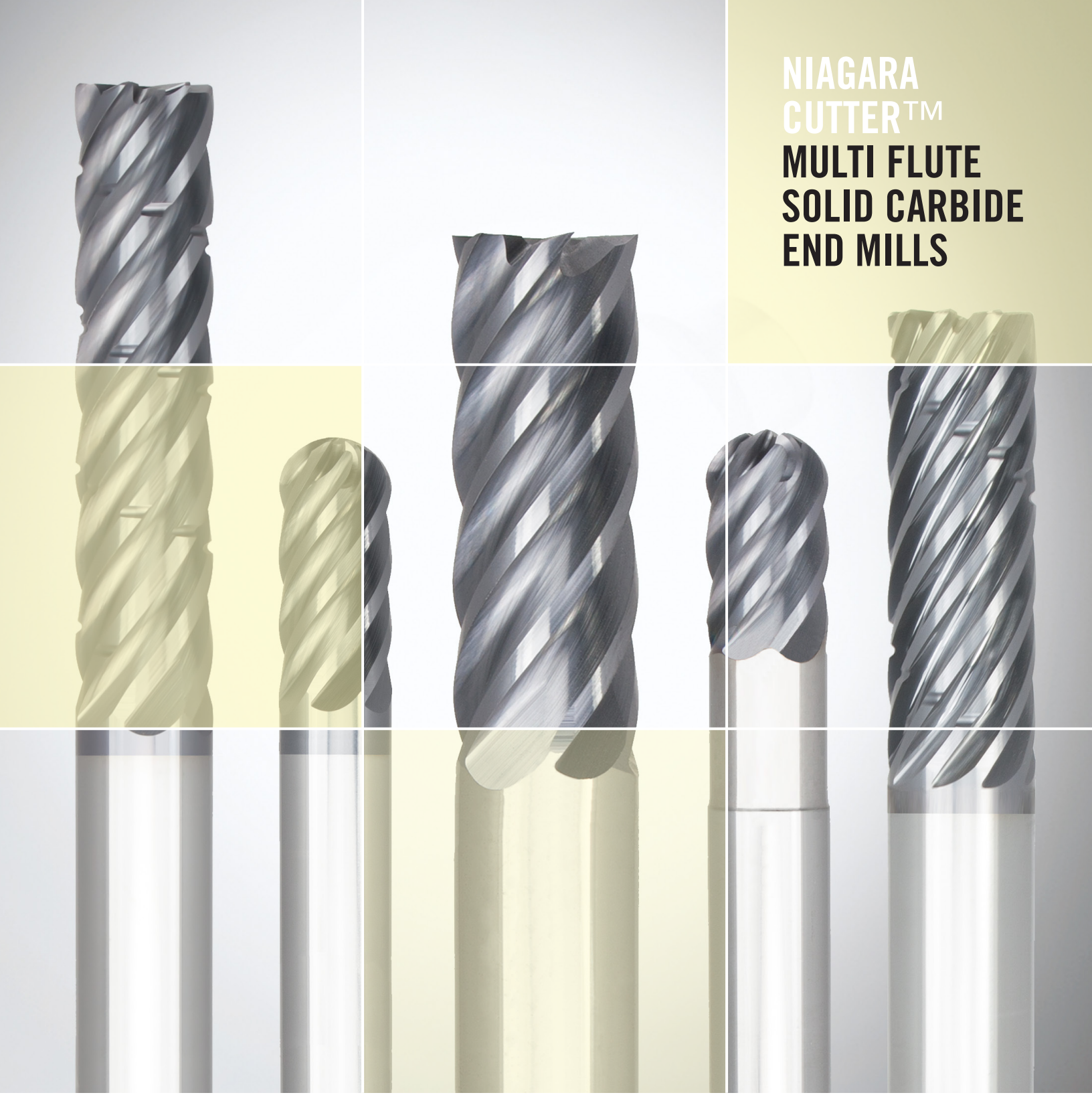
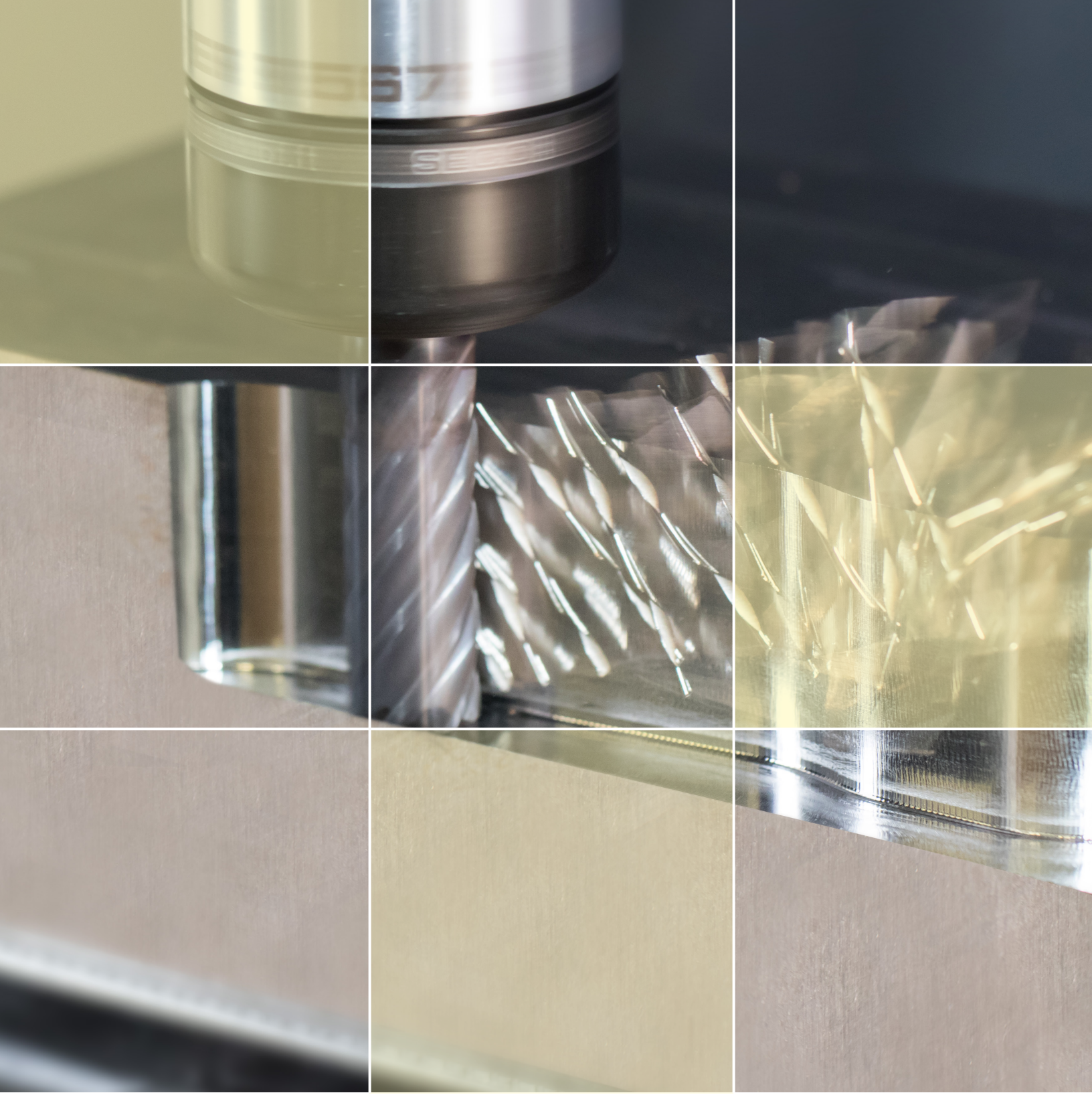


NIAGARA CUTTER™
MULTI FLUTE SOLID CARBIDE END MILLS

ACHIEVE EFFICIENT OPTIMIZED ROUGHING

Niagara Cutter
A SECO TOOLS COMPANY



UNSURPASSED CHIP CONTROL

A NEW LEVEL OF PERFORMANCE

Achieve unsurpassed chip control in optimized roughing with our expanded line of Niagara Cutter™ Multi Flute end mills. Innovative engineering, such as a new, advanced chip splitter design, ensures that you can thrive even in applications requiring depths of cut up to 3 times the diameter of the tool.

This product series now offers smaller diameters down to 1/8", necked versions with extended reaches and even a new ball nose option for those demanding 3D applications that require optimal performance and tool life. Thanks to the introduction of over 80 new tools, this extensive product range has all you need to master the art of optimized roughing.

RANGE OVERVIEW

S638/S638R - Square & Radius
- 2 and 2.5 x D flute length 0.125"- 1.00"
- Cylindrical shank, dead sharp and radius 0.010", 0.015", 0.030", 0.060", 0.090", 0.120" & 0.190"

SN638/SN638R - Necked Series
- 2 x D flute length and 4 x D reach length 0.375" - 1.000"
- Cylindrical shank, standard aerospace radii 0.015", 0.030", 0.060", 0.120" & 0.250"

SB638/SBN638 - Ball Nose Series
- 1 and approx 2.5 x D flute length 0.250"- 1.000"
- Necked version - 1 x D flute length and 3 x D reach length
- Cylindrical shank

S738/S738R - Chamfer & Radius
- 1.5, 2.5 and 4 x D flute length 0.250" - 0.500"
- Cylindrical shank, chamfer and radius 0.015", 0.030" & 0.060"

S938/S938R - Chamfer & Radius
- 1.5, 2.5 and 4 x D flute length 0.250" - 0.500"
- Cylindrical shank, chamfer and radius 0.015", 0.030" & 0.060"

SCS638/SCS638R, SCS738R, SCS938R - Advanced Chip Splitters
- Approx. 3.2 x D flute length
- Cylindrical shank 0.250" - 1.000"

KEY BENEFITS
- Increased chip evacuation in deep pocket applications
- AlTiN coating increases tool life
- Smoother cutting for an improved surface finish
- High heat abrasion resistance
- Stronger cutting edge

6 TIPS OPTIMIZED ROUGHING

Optimized Roughing can be highly effective for machining part features such as pockets with challenging corners as well as any straight walls two times the diameter of your end mill and require long axial depths of cuts. This strategy enables you to machine pockets three to four times faster than conventional methods while also dramatically extending the life of your tools. Achieving the best possible results with today's Optimized Roughing strategy does require adhering to a few specific guidelines.

1. CHOOSE AN APPROPRIATE STEPOVER

Optimized Roughing typically employs end mills with 5- to 9-flutes. End mills with fewer flutes have more space for chip formation, thus can utilize larger step-overs. Although the step-over of tools with fewer flutes can be higher, the traverse rate of the tool is decreased. Therefore, a balance must be struck where the optimum step-over and feed rate are utilized for each type of tool. The cutting data in this brochure has been specified based on extensive testing and experience and should serve as a good starting point for your application.

2. USE STRONG, SECURE TOOLHOLDERS & FIXTURING

High-precision holders are crucial when Optimized Roughing to achieve maximum tool life. Run-out needs to be kept to less than 0.0004" to maximize tool life. This type of precision can be achieved by most shrink fit holders, milling chucks, high precision collet chucks and select manufacturer's end mill holders. A precise holder ensures the accuracy of the process, whereas a less secure holder will cause undesirable levels of vibration while Optimized Roughing at high feed rates.

3. MAKE SURE YOUR MACHINE IS CAPABLE OF PERFORMING

Machine tools used for Optimized Roughing not only need to be able to achieve extremely high feed rates, but also need to be able to process thousands of lines of code in a matter of seconds. This requires advanced look-ahead capabilities and processing systems found in newer machine tools. Rigidity throughout the machine tool from the spindle bearings all the way through to the ball screws ensures smooth cutting, consistent tool life and unsurpassed part quality.

4. CHOOSE A SUITABLE PROGRAMMING METHOD

It is nearly impossible to program an Optimized Roughing strategy manually. Many companies provide state-of-the-art programming software. Careful consideration must be made when choosing the right software or software add on. Not all software is created equal. For example, a programming software designed only for complex 3D high speed milling may not be able to perform the complex radial moves inside of tight corners to maintain a consistent angle of engagement. This is one of the many keys to successful Optimized Roughing strategies.

5. SELECT THE RIGHT DEPTH OF CUT

Take advantage of the full flute length of the tool selected for the specific application. Maximizing depth of cuts above 2 times the diameter of the tool is common when Optimized Roughing. Smaller radial step-overs make such depths of the cut possible. A larger step-over would increase the amount of heat in the cut, which in-turn will have a negative effect on tool life and performance. Therefore, rpm and feed rates must be reduced. A cut that is too deep, over 3 x D for instance, can create cutting pressures greater than what the tool can bear and possibly cause deflection. In this circumstance, chip splitters can minimize radial cutting pressure reducing deflection and aiding in chip control.

6. FOLLOW RECOMMENDED CUTTING PARAMETERS

After meticulous research and years of firsthand experience, we have developed specific recommended cutting parameters. Always to be used as a starting point, cutting data is optimized per tool design, specifications and material groups. Modifications can be made depending on the application.

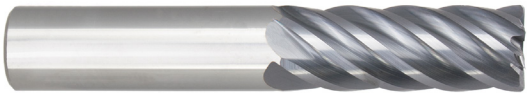
MULTI FLUTE
6-FLUTE SERIES

Niagara Cutter
A SECO TOOLS COMPANY

- Designed for Optimized and Peripheral Roughing and Finishing applications in Stainless Steel, Titanium and high temperature alloys
- Eccentric O.D. relief creating a stronger cutting edge
- Variable indexing to reduce harmonics providing smoother cutting and improved surface finish
- Increased radial depths as compared to the S738 & S938

SOLID CARBIDE | HELIX 38° | SQUARE END | RADIUS | CENTER CUTTING

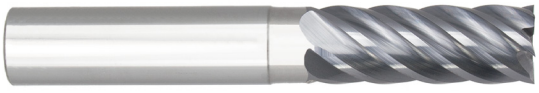
6-FLUTE SERIES S638 & S638R

PRODUCT NUMBER	DESCRIPTION	DIMENSIONS IN INCH				NUMBER OF FLUTES	COATING	RADIUS
		FLUTE DIA (DC)	SHANK DIA (DMM)	LOC (APMX)	OVERALL LENGTH (OAL)			
								
	S638							
N15378	S638-0.125-F3-S.0-Z6	1/8	1/4	5/16	2	6	AlTiN	-
N15380	S638-0.188-F3-S.0-Z6	3/16	1/4	1/2	2	6	AlTiN	-
N15382	S638-0.250-D3-S.0-Z6	1/4	1/4	5/8	2	6	AlTiN	-
N15388	S638-0.313-D2-S.0-Z6	5/16	5/16	3/4	2	6	AlTiN	-
N00524	S638-0.375-D1-S.0-Z6	3/8	3/8	1	2-1/2	6	AlTiN	-
N00457	S638-0.500-D1-S.0-Z6	1/2	1/2	1-1/4	3	6	AlTiN	-
N00465	S638-0.625-D1-S.0-Z6	5/8	5/8	1-5/8	3-1/2	6	AlTiN	-
N00473	S638-0.750-D1-S.0-Z6	3/4	3/4	1-3/4	4	6	AlTiN	-
N00479	S638-1.000-D1-S.0-Z6	1	1	2	5	6	AlTiN	-
								
	S638R							
N15379	S638R-0.125-F3-R010.0-Z6	1/8	1/4	5/16	2	6	AlTiN	0.010
N15381	S638R-0.188-F3-R010.0-Z6	3/16	1/4	1/2	2	6	AlTiN	0.010
N15383	S638R-0.250-D3-R015.0-Z6	1/4	1/4	5/8	2	6	AlTiN	0.015
N15384	S638R-0.250-D3-R030.0-Z6	1/4	1/4	5/8	2	6	AlTiN	0.030
N15389	S638R-0.313-D2-R015.0-Z6	5/16	5/16	3/4	2	6	AlTiN	0.015
N15390	S638R-0.313-D2-R030.0-Z6	5/16	5/16	3/4	2	6	AlTiN	0.030
N00455	S638R-0.375-D1-R015.0-Z6	3/8	3/8	1	2-1/2	6	AlTiN	0.015
N00456	S638R-0.375-D1-R030.0-Z6	3/8	3/8	1	2-1/2	6	AlTiN	0.030
N00458	S638R-0.500-D1-R015.0-Z6	1/2	1/2	1-1/4	3	6	AlTiN	0.015
N00459	S638R-0.500-D1-R030.0-Z6	1/2	1/2	1-1/4	3	6	AlTiN	0.030
N00462	S638R-0.500-D1-R060.0-Z6	1/2	1/2	1-1/4	3	6	AlTiN	0.060
N00463	S638R-0.500-D1-R090.0-Z6	1/2	1/2	1-1/4	3	6	AlTiN	0.090
N00464	S638R-0.500-D1-R120.0-Z6	1/2	1/2	1-1/4	3	6	AlTiN	0.120
N00466	S638R-0.625-D1-R015.0-Z6	5/8	5/8	1-5/8	3-1/2	6	AlTiN	0.015
N00467	S638R-0.625-D1-R030.0-Z6	5/8	5/8	1-5/8	3-1/2	6	AlTiN	0.030
N00468	S638R-0.625-D1-R060.0-Z6	5/8	5/8	1-5/8	3-1/2	6	AlTiN	0.060
N00469	S638R-0.625-D1-R090.0-Z6	5/8	5/8	1-5/8	3-1/2	6	AlTiN	0.090
N00472	S638R-0.625-D1-R120.0-Z6	5/8	5/8	1-5/8	3-1/2	6	AlTiN	0.120
N00474	S638R-0.750-D1-R030.0-Z6	3/4	3/4	1-3/4	4	6	AlTiN	0.030
N00475	S638R-0.750-D1-R060.0-Z6	3/4	3/4	1-3/4	4	6	AlTiN	0.060

DISCOUNT CODE D43

SOLID CARBIDE | HELIX 38° | SQUARE END | RADIUS | BALL END | CENTER CUTTING

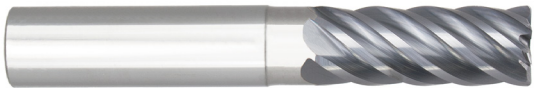
6-FLUTE SERIES S638R (CONT), SB638, SBN638 & SN638

PRODUCT NUMBER	DESCRIPTION	DIMENSIONS IN INCH						NUMBER OF FLUTES	COATING	RADIUS
		FLUTE DIA (DC)	SHANK DIA (DMM)	LOC (APMX)	OVERALL LENGTH (OAL)	NECK DIA (DN)	REACH LENGTH (LN)			
	S638R									
N00476	S638R-0.750-D1-R090.0-Z6	3/4	3/4	1-3/4	4	-	-	6	AlTiN	0.090
N00477	S638R-0.750-D1-R120.0-Z6	3/4	3/4	1-3/4	4	-	-	6	AlTiN	0.120
N00478	S638R-0.750-D1-R190.0-Z6	3/4	3/4	1-3/4	4	-	-	6	AlTiN	0.190
N00482	S638R-1.000-D1-R030.0-Z6	1	1	2	5	-	-	6	AlTiN	0.030
N00483	S638R-1.000-D1-R060.0-Z6	1	1	2	5	-	-	6	AlTiN	0.060
N00484	S638R-1.000-D1-R090.0-Z6	1	1	2	5	-	-	6	AlTiN	0.090
N00485	S638R-1.000-D1-R120.0-Z6	1	1	2	5	-	-	6	AlTiN	0.120
N00486	S638R-1.000-D1-R190.0-Z6	1	1	2	5	-	-	6	AlTiN	0.190
N00487	S638R-1.000-D1-R250.0-Z6	1	1	2	5	-	-	6	AlTiN	0.250
										
	SB638									
N15385	SB638-0.250-D1-B.0-Z6	1/4	1/4	1/4	2	-	-	6	AlTiN	-
N15386	SB638-0.250-D3-B.0-Z6	1/4	1/4	5/8	2	-	-	6	AlTiN	-
N15391	SB638-0.313-D1-B.0-Z6	5/16	5/16	5/16	2	-	-	6	AlTiN	-
N15392	SB638-0.313-D2-B.0-Z6	5/16	5/16	3/4	2	-	-	6	AlTiN	-
N15394	SB638-0.375-D1-B.0-Z6	3/8	3/8	3/8	2	-	-	6	AlTiN	-
N15395	SB638-0.375-D3-B.0-Z6	3/8	3/8	1	2-1/2	-	-	6	AlTiN	-
N15403	SB638-0.500-D1-B.0-Z6	1/2	1/2	1/2	2-1/2	-	-	6	AlTiN	-
N15404	SB638-0.500-D3-B.0-Z6	1/2	1/2	1-1/4	3	-	-	6	AlTiN	-
N15415	SB638-0.625-D1-B.0-Z6	5/8	5/8	5/8	3	-	-	6	AlTiN	-
N15416	SB638-0.625-D3-B.0-Z6	5/8	5/8	1-5/8	4	-	-	6	AlTiN	-
N15427	SB638-0.750-D1-B.0-Z6	3/4	3/4	3/4	3	-	-	6	AlTiN	-
N15428	SB638-0.750-D2-B.0-Z6	3/4	3/4	1-3/4	4	-	-	6	AlTiN	-
N15438	SB638-1.000-D1-B.0-Z6	1	1	1	4	-	-	6	AlTiN	-
N15439	SB638-1.000-D2-B.0-Z6	1	1	2	5	-	-	6	AlTiN	-
										
	SBN638									
N15387	SBN638-0.250-E1-B.0-Z6	1/4	1/4	1/4	2	0.240	0.750	6	AlTiN	-
N15393	SBN638-0.313-E1-B.0-Z6	5/16	5/16	5/16	2-1/2	0.300	1.000	6	AlTiN	-
N15396	SBN638-0.375-E1-B.0-Z6	3/8	3/8	3/8	2-1/2	0.360	1.250	6	AlTiN	-
N15405	SBN638-0.500-E1-B.0-Z6	1/2	1/2	1/2	3	0.480	1.500	6	AlTiN	-
N15417	SBN638-0.625-E1-B.0-Z6	5/8	5/8	5/8	4	0.600	1.875	6	AlTiN	-
N15429	SBN638-0.750-E1-B.0-Z6	3/4	3/4	3/4	5	0.720	2.250	6	AlTiN	-
N15440	SBN638-1.000-E1-B.0-Z6	1	1	1	6	0.960	3.000	6	AlTiN	-
										
	SN638									
N15397	SN638-0.375-E3-S.0-Z6	3/8	3/8	1	3	0.360	1.500	6	AlTiN	-
N15406	SN638-0.500-E2-S.0-Z6	1/2	1/2	1-1/8	4	0.480	2.000	6	AlTiN	-
N15418	SN638-0.625-E2-S.0-Z6	5/8	5/8	1-3/8	5	0.600	2.500	6	AlTiN	-
N15430	SN638-0.750-E2-S.0-Z6	3/4	3/4	1-3/4	6	0.720	3.000	6	AlTiN	-

DISCOUNT CODE D43

SOLID CARBIDE | HELIX 38° | SQUARE END | RADIUS | CENTER CUTTING | CHIPSPLITTER

6-FLUTE SERIES SN638R, SCS638 & SCS638R

PRODUCT NUMBER	DESCRIPTION	DIMENSIONS IN INCH						NUMBER OF FLUTES	COATING	RADIUS
		FLUTE DIA (DC)	SHANK DIA (DMM)	LOC (APMX)	OVERALL LENGTH (OAL)	NECK DIA (DN)	REACH LENGTH (LN)			
										
	SN638R									
N15398	SN638R-0.375-E3-R015.0-Z6	3/8	3/8	1	3	0.360	1.500	6	AlTiN	0.015
N15399	SN638R-0.375-E3-R030.0-Z6	3/8	3/8	1	3	0.360	1.500	6	AlTiN	0.030
N15407	SN638R-0.500-E2-R030.0-Z6	1/2	1/2	1-1/8	4	0.480	2.000	6	AlTiN	0.030
N15408	SN638R-0.500-E2-R060.0-Z6	1/2	1/2	1-1/8	4	0.480	2.000	6	AlTiN	0.060
N15409	SN638R-0.500-E2-R120.0-Z6	1/2	1/2	1-1/8	4	0.480	2.000	6	AlTiN	0.120
N15419	SN638R-0.625-E2-R015.0-Z6	5/8	5/8	1-3/8	5	0.600	2.500	6	AlTiN	0.015
N15420	SN638R-0.625-E2-R030.0-Z6	5/8	5/8	1-3/8	5	0.600	2.500	6	AlTiN	0.030
N15421	SN638R-0.625-E2-R060.0-Z6	5/8	5/8	1-3/8	5	0.600	2.500	6	AlTiN	0.060
N15431	SN638R-0.750-E2-R030.0-Z6	3/4	3/4	1-3/4	6	0.720	3.000	6	AlTiN	0.030
N15432	SN638R-0.750-E2-R060.0-Z6	3/4	3/4	1-3/4	6	0.720	3.000	6	AlTiN	0.060
N15433	SN638R-0.750-E2-R120.0-Z6	3/4	3/4	1-3/4	6	0.720	3.000	6	AlTiN	0.120
N15441	SN638R-1.000-E2-R030.0-Z6	1	1	2-1/4	7	0.960	4.125	6	AlTiN	0.030
N15442	SN638R-1.000-E2-R060.0-Z6	1	1	2-1/4	7	0.960	4.125	6	AlTiN	0.060
N15443	SN638R-1.000-E2-R090.0-Z6	1	1	2-1/4	7	0.960	4.125	6	AlTiN	0.090
N15444	SN638R-1.000-E2-R120.0-Z6	1	1	2-1/4	7	0.960	4.125	6	AlTiN	0.120
N15445	SN638R-1.000-E2-R250.0-Z6	1	1	2-1/4	7	0.960	4.125	6	AlTiN	0.250
										
	SCS638 - Advanced Chip Splitter Design									
N15400	SCS638-0.375-D3-S.0-Z6	3/8	3/8	1-1/4	3	-	-	6	AlTiN	-
N15410	SCS638-0.500-D3-S.0-Z6	1/2	1/2	1-5/8	4	-	-	6	AlTiN	-
N15422	SCS638-0.625-D3-S.0-Z6	5/8	5/8	2	4	-	-	6	AlTiN	-
N15434	SCS638-0.750-D3-S.0-Z6	3/4	3/4	2-1/2	5	-	-	6	AlTiN	-
										
	SCS638R - Advanced Chip Splitter Design									
N15401	SCS638R-0.375-D3-R015.0-Z6	3/8	3/8	1-1/4	3	-	-	6	AlTiN	0.015
N15402	SCS638R-0.375-D3-R030.0-Z6	3/8	3/8	1-1/4	3	-	-	6	AlTiN	0.030
N15411	SCS638R-0.500-D3-R015.0-Z6	1/2	1/2	1-5/8	4	-	-	6	AlTiN	0.015
N15412	SCS638R-0.500-D3-R030.0-Z6	1/2	1/2	1-5/8	4	-	-	6	AlTiN	0.030
N15413	SCS638R-0.500-D3-R060.0-Z6	1/2	1/2	1-5/8	4	-	-	6	AlTiN	0.060
N15414	SCS638R-0.500-D3-R120.0-Z6	1/2	1/2	1-5/8	4	-	-	6	AlTiN	0.120
N15423	SCS638R-0.625-D3-R015.0-Z6	5/8	5/8	2	4	-	-	6	AlTiN	0.015
N15424	SCS638R-0.625-D3-R030.0-Z6	5/8	5/8	2	4	-	-	6	AlTiN	0.030
N15425	SCS638R-0.625-D3-R060.0-Z6	5/8	5/8	2	4	-	-	6	AlTiN	0.060
N15426	SCS638R-0.625-D3-R120.0-Z6	5/8	5/8	2	4	-	-	6	AlTiN	0.120
N15435	SCS638R-0.750-D3-R030.0-Z6	3/4	3/4	2-1/2	5	-	-	6	AlTiN	0.030
N15436	SCS638R-0.750-D3-R060.0-Z6	3/4	3/4	2-1/2	5	-	-	6	AlTiN	0.060
N15437	SCS638R-0.750-D3-R120.0-Z6	3/4	3/4	2-1/2	5	-	-	6	AlTiN	0.120
N15446	SCS638R-1.000-D3-R030.0-Z6	1	1	3-1/8	6	-	-	6	AlTiN	0.030
N15447	SCS638R-1.000-D3-R120.0-Z6	1	1	3-1/8	6	-	-	6	AlTiN	0.120
N15448	SCS638R-1.000-D3-R250.0-Z6	1	1	3-1/8	6	-	-	6	AlTiN	0.250

DISCOUNT CODE D43

MULTI FLUTE
7-FLUTE SERIES

Niagara Cutter
A SECO TOOLS COMPANY

- Designed for Optimized and Peripheral Roughing and Finishing applications in Stainless Steel, Titanium and high temperature alloys
- Variable indexing to reduce harmonics providing smoother cutting and improved surface finish
- Eccentric O.D. relief creating a stronger cutting edge
- Increased feed rates as compared to the S638

SOLID CARBIDE | HELIX 38° | CHAMFER 45° | RADIUS | NON CENTER CUTTING | CHIPSPLITTER

7-FLUTE SERIES S738, S738R & SCS738R

PRODUCT NUMBER	DESCRIPTION	DIMENSIONS IN INCH				NUMBER OF FLUTES	COATING	CHAMFER	RADIUS
		FLUTE DIA (DC)	SHANK DIA (DMM)	LOC (APMX)	OVERALL LENGTH (OAL)				
									
	S738								
N58244	S738-0.250-D2-C003.0-Z7	1/4	1/4	3/8	2	7	AlTiN	0.003	-
N58247	S738-0.250-D3-C003.0-Z7	1/4	1/4	3/4	2-1/2	7	AlTiN	0.003	-
N58250	S738-0.250-D5-C003.0-Z7	1/4	1/4	1-1/4	3	7	AlTiN	0.003	-
N58253	S738-0.375-D1-C005.0-Z7	3/8	3/8	1/2	2-1/2	7	AlTiN	0.005	-
N58256	S738-0.375-D3-C005.0-Z7	3/8	3/8	1	3	7	AlTiN	0.005	-
N58259	S738-0.375-D4-C005.0-Z7	3/8	3/8	1-1/2	3-1/2	7	AlTiN	0.005	-
N58262	S738-0.500-D2-C006.0-Z7	1/2	1/2	3/4	3	7	AlTiN	0.006	-
N58266	S738-0.500-D3-C006.0-Z7	1/2	1/2	1-1/4	3	7	AlTiN	0.006	-
N58270	S738-0.500-D4-C006.0-Z7	1/2	1/2	2	4	7	AlTiN	0.006	-
									
	S738R								
N58245	S738R-0.250-D2-R015.0-Z7	1/4	1/4	3/8	2	7	AlTiN	-	0.015
N58246	S738R-0.250-D2-R030.0-Z7	1/4	1/4	3/8	2	7	AlTiN	-	0.030
N58248	S738R-0.250-D3-R015.0-Z7	1/4	1/4	3/4	2-1/2	7	AlTiN	-	0.015
N58249	S738R-0.250-D3-R030.0-Z7	1/4	1/4	3/4	2-1/2	7	AlTiN	-	0.030
N58251	S738R-0.250-D5-R015.0-Z7	1/4	1/4	1-1/4	3	7	AlTiN	-	0.015
N58252	S738R-0.250-D5-R030.0-Z7	1/4	1/4	1-1/4	3	7	AlTiN	-	0.030
N58254	S738R-0.375-D1-R015.0-Z7	3/8	3/8	1/2	2-1/2	7	AlTiN	-	0.015
N58255	S738R-0.375-D1-R030.0-Z7	3/8	3/8	1/2	2-1/2	7	AlTiN	-	0.030
N58257	S738R-0.375-D3-R015.0-Z7	3/8	3/8	1	3	7	AlTiN	-	0.015
N58258	S738R-0.375-D3-R030.0-Z7	3/8	3/8	1	3	7	AlTiN	-	0.030
N58260	S738R-0.375-D4-R015.0-Z7	3/8	3/8	1-1/2	3-1/2	7	AlTiN	-	0.015
N58261	S738R-0.375-D4-R030.0-Z7	3/8	3/8	1-1/2	3-1/2	7	AlTiN	-	0.030
N58263	S738R-0.500-D2-R015.0-Z7	1/2	1/2	3/4	3	7	AlTiN	-	0.015
N58264	S738R-0.500-D2-R030.0-Z7	1/2	1/2	3/4	3	7	AlTiN	-	0.030
N58265	S738R-0.500-D2-R060.0-Z7	1/2	1/2	3/4	3	7	AlTiN	-	0.060
N58267	S738R-0.500-D3-R015.0-Z7	1/2	1/2	1-1/4	3	7	AlTiN	-	0.015
N58268	S738R-0.500-D3-R030.0-Z7	1/2	1/2	1-1/4	3	7	AlTiN	-	0.030
N58269	S738R-0.500-D3-R060.0-Z7	1/2	1/2	1-1/4	3	7	AlTiN	-	0.060
N58271	S738R-0.500-D4-R015.0-Z7	1/2	1/2	2	4	7	AlTiN	-	0.015
N58272	S738R-0.500-D4-R030.0-Z7	1/2	1/2	2	4	7	AlTiN	-	0.030
N58273	S738R-0.500-D4-R060.0-Z7	1/2	1/2	2	4	7	AlTiN	-	0.060
									
	SCS738R - Advanced Chip Splitter Design								
N15449	SCS738R-0.250-D3-R015.0-Z7	1/4	1/4	3/4	2-1/2	7	AlTiN	-	0.015
N15450	SCS738R-0.250-D5-R015.0-Z7	1/4	1/4	1-1/4	3	7	AlTiN	-	0.015
N15451	SCS738R-0.375-D3-R015.0-Z7	3/8	3/8	1	3	7	AlTiN	-	0.015
N15452	SCS738R-0.375-D4-R015.0-Z7	3/8	3/8	1-1/2	3-1/2	7	AlTiN	-	0.015
N15453	SCS738R-0.500-D3-R030.0-Z7	1/2	1/2	1-1/4	3	7	AlTiN	-	0.030
N15454	SCS738R-0.500-D4-R030.0-Z7	1/2	1/2	2	4	7	AlTiN	-	0.030

MULTI FLUTE
9-FLUTE SERIES

Niagara Cutter
A SECO TOOLS COMPANY

- Designed for Optimized and Peripheral Roughing and Finishing applications in Stainless Steel, Titanium and high temperature alloys
- Eccentric O.D. relief creating a stronger cutting edge
- Variable indexing to reduce harmonics providing smoother cutting and improved surface finish
- Maximum feed rates

SOLID CARBIDE | HELIX 38° | CHAMFER 45° | RADIUS | NON CENTER CUTTING

9-FLUTE SERIES S938 & S938R

PRODUCT NUMBER	DESCRIPTION	DIMENSIONS IN INCH				NUMBER OF FLUTES	COATING	CHAMFER	RADIUS
		FLUTE DIA (DC)	SHANK DIA (DMM)	LOC (APMX)	OVERALL LENGTH (OAL)				
									
	S938								
N58274	S938-0.625-D1-C008.0-Z9	5/8	5/8	3/4	3	9	AlTiN	0.008	-
N58279	S938-0.625-D3-C008.0-Z9	5/8	5/8	1-5/8	4	9	AlTiN	0.008	-
N58284	S938-0.625-D4-C008.0-Z9	5/8	5/8	2-1/2	5	9	AlTiN	0.008	-
N58289	S938-0.750-D2-C010.0-Z9	3/4	3/4	1-5/8	4	9	AlTiN	0.010	-
N58294	S938-0.750-D3-C010.0-Z9	3/4	3/4	2-1/4	5	9	AlTiN	0.010	-
N58299	S938-0.750-D4-C010.0-Z9	3/4	3/4	3-1/4	6	9	AlTiN	0.010	-
N58304	S938-1.000-D2-C012.0-Z9	1	1	2	5	9	AlTiN	0.012	-
N58309	S938-1.000-D3-C012.0-Z9	1	1	3-1/4	6	9	AlTiN	0.012	-
N58314	S938-1.000-D4-C012.0-Z9	1	1	4-1/8	7	9	AlTiN	0.012	-
									
	S938R								
N58275	S938R-0.625-D1-R030.0-Z9	5/8	5/8	3/4	3	9	AlTiN	-	0.030
N58276	S938R-0.625-D1-R060.0-Z9	5/8	5/8	3/4	3	9	AlTiN	-	0.060
N58277	S938R-0.625-D1-R090.0-Z9	5/8	5/8	3/4	3	9	AlTiN	-	0.090
N58278	S938R-0.625-D1-R120.0-Z9	5/8	5/8	3/4	3	9	AlTiN	-	0.120
N58280	S938R-0.625-D3-R030.0-Z9	5/8	5/8	1-5/8	4	9	AlTiN	-	0.030
N58281	S938R-0.625-D3-R060.0-Z9	5/8	5/8	1-5/8	4	9	AlTiN	-	0.060
N58282	S938R-0.625-D3-R090.0-Z9	5/8	5/8	1-5/8	4	9	AlTiN	-	0.090
N58283	S938R-0.625-D3-R120.0-Z9	5/8	5/8	1-5/8	4	9	AlTiN	-	0.120
N58285	S938R-0.625-D4-R030.0-Z9	5/8	5/8	2-1/2	5	9	AlTiN	-	0.030
N58286	S938R-0.625-D4-R060.0-Z9	5/8	5/8	2-1/2	5	9	AlTiN	-	0.060
N58287	S938R-0.625-D4-R090.0-Z9	5/8	5/8	2-1/2	5	9	AlTiN	-	0.090
N58288	S938R-0.625-D4-R120.0-Z9	5/8	5/8	2-1/2	5	9	AlTiN	-	0.120
N58290	S938R-0.750-D2-R030.0-Z9	3/4	3/4	1-5/8	4	9	AlTiN	-	0.030
N58291	S938R-0.750-D2-R060.0-Z9	3/4	3/4	1-5/8	4	9	AlTiN	-	0.060
N58292	S938R-0.750-D2-R090.0-Z9	3/4	3/4	1-5/8	4	9	AlTiN	-	0.090
N58293	S938R-0.750-D2-R120.0-Z9	3/4	3/4	1-5/8	4	9	AlTiN	-	0.120

DISCOUNT CODE D43

SOLID CARBIDE | HELIX 38° | RADIUS | NON CENTER CUTTING | CHIPSPLITTER

9-FLUTE SERIES S938R (CONT) & SCS938R

PRODUCT NUMBER	DESCRIPTION	DIMENSIONS IN INCH				NUMBER OF FLUTES	COATING	RADIUS
		FLUTE DIA (DC)	SHANK DIA (DMM)	LOC (APMX)	OVERALL LENGTH (OAL)			
	S938R							
N58295	S938R-0.750-D3-R030.0-Z9	3/4	3/4	2-1/4	5	9	AlTiN	0.030
N58296	S938R-0.750-D3-R060.0-Z9	3/4	3/4	2-1/4	5	9	AlTiN	0.060
N58297	S938R-0.750-D3-R090.0-Z9	3/4	3/4	2-1/4	5	9	AlTiN	0.090
N58298	S938R-0.750-D3-R120.0-Z9	3/4	3/4	2-1/4	5	9	AlTiN	0.120
N58300	S938R-0.750-D4-R030.0-Z9	3/4	3/4	3-1/4	6	9	AlTiN	0.030
N58301	S938R-0.750-D4-R060.0-Z9	3/4	3/4	3-1/4	6	9	AlTiN	0.060
N58302	S938R-0.750-D4-R090.0-Z9	3/4	3/4	3-1/4	6	9	AlTiN	0.090
N58303	S938R-0.750-D4-R120.0-Z9	3/4	3/4	3-1/4	6	9	AlTiN	0.120
N58305	S938R-1.000-D2-R030.0-Z9	1	1	2	5	9	AlTiN	0.030
N58306	S938R-1.000-D2-R060.0-Z9	1	1	2	5	9	AlTiN	0.060
N58307	S938R-1.000-D2-R090.0-Z9	1	1	2	5	9	AlTiN	0.090
N58308	S938R-1.000-D2-R120.0-Z9	1	1	2	5	9	AlTiN	0.120
N58310	S938R-1.000-D3-R030.0-Z9	1	1	3-1/4	6	9	AlTiN	0.030
N58311	S938R-1.000-D3-R060.0-Z9	1	1	3-1/4	6	9	AlTiN	0.060
N58312	S938R-1.000-D3-R090.0-Z9	1	1	3-1/4	6	9	AlTiN	0.090
N58313	S938R-1.000-D3-R120.0-Z9	1	1	3-1/4	6	9	AlTiN	0.120
N58315	S938R-1.000-D4-R030.0-Z9	1	1	4-1/8	7	9	AlTiN	0.030
N58316	S938R-1.000-D4-R060.0-Z9	1	1	4-1/8	7	9	AlTiN	0.060
N58317	S938R-1.000-D4-R090.0-Z9	1	1	4-1/8	7	9	AlTiN	0.090
N58318	S938R-1.000-D4-R120.0-Z9	1	1	4-1/8	7	9	AlTiN	0.120
	SCS938R - Advanced Chip Splitter Design							
N15455	SCS938R-0.625-D3-R030.0-Z9	5/8	5/8	1-5/8	4	9	AlTiN	0.030
N15456	SCS938R-0.625-D4-R030.0-Z9	5/8	5/8	2-1/2	5	9	AlTiN	0.030
N15457	SCS938R-0.750-D3-R030.0-Z9	3/4	3/4	2-1/4	5	9	AlTiN	0.030
N15458	SCS938R-0.750-D4-R030.0-Z9	3/4	3/4	3-1/4	6	9	AlTiN	0.030
N15459	SCS938R-1.000-D3-R030.0-Z9	1	1	3-1/4	6	9	AlTiN	0.030
N15460	SCS938R-1.000-D4-R030.0-Z9	1	1	4-1/8	7	9	AlTiN	0.030

DISCOUNT CODE D43

SECO MATERIAL GROUP (SMG)

STEEL, FERRITIC AND MARTENSITIC STAINLESS STEEL

ISO	SMG	REPRESENTATIVE MATERIAL	DESCRIPTION	BHN	kc1.1 x 1000 lbf/in2	m_c
P	1	1010	Very soft carbon steels Purely ferritic steels	< 135	196	0.21
	2	1140	Free-cutting steels	120 < 210	218	0.22
	3	1045	Structural steels. Ordinary carbon steels with low to medium carbon content (<0,5%C)	135 < 165	218	0.25
	4	4140	Carbon steels with high carbon content (>0,5%C) Medium hard steels for toughening. Ordinary low-alloy steels Ferritic and martensitic stainless steels	165 < 210	247	0.24
	5	4340	Normal tool steels Harder steels for toughening Martensitic stainless steels	210 < 270	276	0.24
	6	D2	Difficult tool steels High-alloy steels with high hardness Martensitic stainless steels	270 < 360	290	0.24
H	7	A128 Grade A	Difficult high-strength steels with 42 to 56 HRC hardness Hardened steels from material group 3-6 Martensitic stainless steels	> 360	421	0.22

FREE-CUTTING, AUSTENITIC AND DUPLEX STAINLESS STEEL

M	8	304	Easy-cutting stainless steels Free-cutting stainless steels Calcium-treated stainless steels		254	0.22
	9	316	Moderately difficult stainless steels Austenitic and duplex stainless steels		276	0.2
	10	310	Difficult stainless steels Austenitic and duplex stainless steels		297	0.2
	11	330	Very difficult stainless steels Austenitic and duplex stainless steels		312	0.2

CAST IRON

K	12	60-40-18	Medium hard cast iron Grey cast iron		167	0.22
	13	A536 80-55-06	Low-alloy cast iron Malleable cast iron Nodular cast iron		178	0.25
	14	A536 100-70-03	Moderately difficult alloy cast iron Moderately difficult malleable cast iron Nodular cast iron		196	0.28
	15	A536 120-90-02	Difficult high-alloy cast iron Difficult malleable cast iron Nodular cast iron		213	0.3

OTHER MATERIALS

N	16	A380	Aluminum alloys: Low Si		101	0.25
	17	B390.0	Aluminum alloys: High Si		101	0.27
	18	CA937	Copper alloys			
S	19	Discalloy	Fe-based superalloys			
	20	Stellite 21	Co-based superalloys		377	0.24
	21	Inconel 718 (bar, forge, ring)	Ni-based superalloys		479	0.24
	22	Ti 6Al-4V (annealed)	Titanium alloys		210	0.23

k_c.1-values with 0 degree effective cutting rake angle. For other rake angles, reduce the k_c1.1-value by 1% for every degree increase in the cutting rake angle and vice versa. Keep in mind that the BHN-value is only an aid in the selection of the material group when the material has been worked by rolling, drawing, heat treatment or other methods that increase the strength of the material.

S638 / S638R / SB638 / SBN638 - START VALUES

SIDE MILLING - ROUGHING																
ISO GROUP	SMG	a_p x Dc (max)	a_e x Dc (max)	v_c (sf / min)				$Z_n = 6$								
								1/8	3/16	1/4	5/16	3/8	1/2	5/8	3/4	1
P	E 1 - 2	2.00 x Dc	0.12 x Dc	700			n (min-1)	21392	14261	10696	8557	7131	5348	4278	3565	2674
							fz (in)	0.0010	0.0015	0.0020	0.0025	0.0030	0.0040	0.0050	0.0060	0.0080
				525	-	875	vf (in/min)	128	128	128	128	128	128	128	128	128
	E 3 - 4	2.00 x Dc	0.12 x Dc	645			n (min-1)	19711	13141	9856	7884	6570	4928	3942	3285	2464
							fz (in)	0.0010	0.0015	0.0020	0.0025	0.0030	0.0040	0.0050	0.0060	0.0080
				484	-	806	vf (in/min)	118	118	118	118	118	118	118	118	118
	E 5 - 6	2.00 x Dc	0.10 x Dc	525			n (min-1)	16044	10696	8022	6418	5348	4011	3209	2674	2006
							fz (in)	0.0008	0.0012	0.0016	0.0020	0.0024	0.0033	0.0041	0.0049	0.0065
				394	-	656	vf (in/min)	78	78	78	78	78	78	78	78	78
M	E 8 - 9	2.00 x Dc	0.12 x Dc	600			n (min-1)	18336	12224	9168	7334	6112	4584	3667	3056	2292
							fz (in)	0.0009	0.0014	0.0019	0.0023	0.0028	0.0038	0.0047	0.0056	0.0075
				450	-	750	vf (in/min)	103	103	103	103	103	103	103	103	103
	E 10 - 11	2.00 x Dc	0.10 x Dc	565			n (min-1)	17266	11511	8633	6907	5755	4317	3453	2878	2158
							fz (in)	0.0008	0.0012	0.0016	0.0020	0.0024	0.0033	0.0041	0.0049	0.0065
				424	-	706	vf (in/min)	84	84	84	84	84	84	84	84	84
K	E 12 - 13	2.00 x Dc	0.10 x Dc	495			n (min-1)	15127	10085	7564	6051	5042	3782	3025	2521	1891
							fz (in)	0.0009	0.0013	0.0018	0.0022	0.0026	0.0035	0.0044	0.0053	0.0070
				371	-	619	vf (in/min)	79	79	79	79	79	79	79	79	79
	E 14 - 15	2.00 x Dc	0.10 x Dc	430			n (min-1)	13141	8761	6570	5256	4380	3285	2628	2190	1643
							fz (in)	0.0006	0.0009	0.0013	0.0016	0.0019	0.0025	0.0031	0.0038	0.0050
				323	-	538	vf (in/min)	49	49	49	49	49	49	49	49	49
S	E 19	2.00 x Dc	0.07 x Dc	150			n (min-1)	4584	3056	2292	1834	1528	1146	917	764	573
							fz (in)	0.0006	0.0009	0.0013	0.0016	0.0019	0.0025	0.0031	0.0038	0.0050
				113	-	188	vf (in/min)	17	17	17	17	17	17	17	17	17
	E 20	2.00 x Dc	0.06 x Dc	120			n (min-1)	3667	2445	1834	1467	1222	917	733	611	458
							fz (in)	0.0006	0.0008	0.0011	0.0014	0.0017	0.0023	0.0028	0.0034	0.0045
				90	-	150	vf (in/min)	12	12	12	12	12	12	12	12	12
	E 21	2.00 x Dc	0.06 x Dc	100			n (min-1)	3056	2037	1528	1222	1019	764	611	509	382
							fz (in)	0.0006	0.0008	0.0011	0.0014	0.0017	0.0023	0.0028	0.0034	0.0045
				75	-	125	vf (in/min)	10	10	10	10	10	10	10	10	10
	E 22	2.00 x Dc	0.10 x Dc	270			n (min-1)	8251	5501	4126	3300	2750	2063	1650	1375	1031
							fz (in)	0.0008	0.0012	0.0016	0.0020	0.0024	0.0033	0.0041	0.0049	0.0065
				203	-	338	vf (in/min)	40	40	40	40	40	40	40	40	40

SMG = Seco Material Group
n (min-1) = RPM
fz (in) = Feed/tooth
vf (in/min) = Feed rate
v_C (sf/min) = Surface feet/min
a_p x D_c = % of diameter
a_e x D_c = % of diameter
All cutting data are start values
All cutting data is in inch values

NOTE: Optimized Roughing is an excellent strategy for achieving quality parts and extending tool life, but requires use of the right equipment and cutting parameters. If you are having problems implementing the approach or want to learn more about how to use the strategy to process a part, contact the Technical Support Team at 1-800-TEC-TEAM.

SN638 / SN638R - START VALUES

SIDE MILLING - ROUGHING											
ISO GROUP	SMG	a_p x Dc (max)	a_e x Dc (max)	v_c (sf / min)				$Z_n = 6$			
								3/8	1/2	5/8	3/4	1
P	E 1 - 2	2.00 x Dc	0.08 x Dc		700		n (min-1)	7131	5348	4278	3565	2674
							fz (in)	0.0030	0.0040	0.0050	0.0060	0.0080
				525	-	875	vf (in/min)	128	128	128	128	128
	E 3 - 4	2.00 x Dc	0.08 x Dc		645		n (min-1)	6570	4928	3942	3285	2464
							fz (in)	0.0030	0.0040	0.0050	0.0060	0.0080
				484	-	806	vf (in/min)	118	118	118	118	118
	E 5 - 6	2.00 x Dc	0.07 x Dc		525		n (min-1)	5348	4011	3209	2674	2006
							fz (in)	0.0024	0.0033	0.0041	0.0049	0.0065
				394	-	656	vf (in/min)	78	78	78	78	78
M	E 8 - 9	2.00 x Dc	0.08 x Dc		600		n (min-1)	6112	4584	3667	3056	2292
							fz (in)	0.0028	0.0038	0.0047	0.0056	0.0075
				450	-	750	vf (in/min)	103	103	103	103	103
	E 10 - 11	2.00 x Dc	0.07 x Dc		565		n (min-1)	5755	4317	3453	2878	2158
							fz (in)	0.0024	0.0033	0.0041	0.0049	0.0065
				424	-	706	vf (in/min)	84	84	84	84	84
K	E 12 - 13	2.00 x Dc	0.07 x Dc		495		n (min-1)	5042	3782	3025	2521	1891
							fz (in)	0.0026	0.0035	0.0044	0.0053	0.0070
				371	-	619	vf (in/min)	79	79	79	79	79
	E 14 - 15	2.00 x Dc	0.07 x Dc		430		n (min-1)	4380	3285	2628	2190	1643
							fz (in)	0.0019	0.0025	0.0031	0.0038	0.0050
				323	-	538	vf (in/min)	49	49	49	49	49
S	E 19	2.00 x Dc	0.05 x Dc		150		n (min-1)	1528	1146	917	764	573
							fz (in)	0.0019	0.0025	0.0031	0.0038	0.0050
				113	-	188	vf (in/min)	17	17	17	17	17
	E 20	2.00 x Dc	0.04 x Dc		120		n (min-1)	1222	917	733	611	458
							fz (in)	0.0017	0.0023	0.0029	0.0035	0.0046
				90	-	150	vf (in/min)	13	13	13	13	13
	E 21	2.00 x Dc	0.04 x Dc		100		n (min-1)	1019	764	611	509	382
							fz (in)	0.0017	0.0023	0.0029	0.0035	0.0046
				75	-	125	vf (in/min)	11	11	11	11	11
	E 22	2.00 x Dc	0.07 x Dc		270		n (min-1)	2750	2063	1650	1375	1031
							fz (in)	0.0024	0.0033	0.0041	0.0049	0.0065
				203	-	338	vf (in/min)	40	40	40	40	40

SMG = Seco Material Group
n (min-1) = RPM
fz (in) = Feed/tooth
vf (in/min) = Feed rate
v_C (sf/min) = Surface feet/min
a_p x D_c = % of diameter
a_e x D_c = % of diameter
All cutting data are start values
All cutting data is in inch values

SCS638 / SCS638R - CHIP SPLITTERS - START VALUES

SIDE MILLING - SEMI ROUGHING												
ISO GROUP	SMG	a_p x Dc (max)	a_e x Dc (max)	v_c (sf / min)				Z_n = 6				
								3/8	1/2	5/8	3/4	1
P	E 1 - 2	3.00 x Dc	0.08 x Dc		700		n (min-1)	7131	5348	4278	3565	2674
							fz (in)	0.0030	0.0040	0.0050	0.0060	0.0080
				525	-	875	vf (in/min)	128	128	128	128	128
	E 3 - 4	3.00 x Dc	0.08 x Dc		645		n (min-1)	6570	4928	3942	3285	2464
							fz (in)	0.0030	0.0040	0.0050	0.0060	0.0080
				484	-	806	vf (in/min)	118	118	118	118	118
	E 5 - 6	3.00 x Dc	0.07 x Dc		525		n (min-1)	5348	4011	3209	2674	2006
							fz (in)	0.0024	0.0033	0.0041	0.0049	0.0065
				394	-	656	vf (in/min)	78	78	78	78	78
M	E 8 - 9	3.00 x Dc	0.08 x Dc		600		n (min-1)	6112	4584	3667	3056	2292
							fz (in)	0.0028	0.0038	0.0047	0.0056	0.0075
				450	-	750	vf (in/min)	103	103	103	103	103
	E 10 - 11	3.00 x Dc	0.07 x Dc		565		n (min-1)	5755	4317	3453	2878	2158
							fz (in)	0.0024	0.0033	0.0041	0.0049	0.0065
				424	-	706	vf (in/min)	84	84	84	84	84
K	E 12 - 13	3.00 x Dc	0.07 x Dc		495		n (min-1)	5042	3782	3025	2521	1891
							fz (in)	0.0026	0.0035	0.0044	0.0053	0.0070
				371	-	619	vf (in/min)	79	79	79	79	79
	E 14 - 15	3.00 x Dc	0.07 x Dc		430		n (min-1)	4380	3285	2628	2190	1643
							fz (in)	0.0019	0.0025	0.0031	0.0038	0.0050
				323	-	538	vf (in/min)	49	49	49	49	49
S	E 19	3.00 x Dc	0.05 x Dc		150		n (min-1)	1528	1146	917	764	573
							fz (in)	0.0019	0.0025	0.0031	0.0038	0.0050
				113	-	188	vf (in/min)	17	17	17	17	17
	E 20	3.00 x Dc	0.04 x Dc		120		n (min-1)	1222	917	733	611	458
							fz (in)	0.0017	0.0023	0.0029	0.0035	0.0046
				90	-	150	vf (in/min)	13	13	13	13	13
	E 21	3.00 x Dc	0.04 x Dc		100		n (min-1)	1019	764	611	509	382
							fz (in)	0.0017	0.0023	0.0029	0.0035	0.0046
				75	-	125	vf (in/min)	11	11	11	11	11
	E 22	3.00 x Dc	0.07 x Dc		270		n (min-1)	2750	2063	1650	1375	1031
							fz (in)	0.0024	0.0033	0.0041	0.0049	0.0065
				203	-	338	vf (in/min)	40	40	40	40	40

SMG = Seco Material Group
n (min-1) = RPM
fz (in) = Feed/tooth
vf (in/min) = Feed rate
v_C (sf/min) = Surface feet/min
a_p x D_c = % of diameter
a_e x D_c = % of diameter
All cutting data are start values
All cutting data is in inch values

NOTE: Optimized Roughing is an excellent strategy for achieving quality parts and extending tool life, but requires use of the right equipment and cutting parameters. If you are having problems implementing the approach or want to learn more about how to use the strategy to process a part, contact the Technical Support Team at 1-800-TEC-TEAM.

S638 / S638R / SN638 / SN638R / SB638 / SBN638 - START VALUES

SIDE MILLING - FINISHING

ISO GROUP	SMG	a_p x Dc (max)	a_e x Dc (max)	v_c (sf / min)				$Z_n = 6$								
								1/8	3/16	1/4	5/16	3/8	1/2	5/8	3/4	1
P	E 1 - 2	2.00 x Dc	0.02 x Dc	805			n (min-1)	24601	16401	12300	9840	8200	6150	4920	4100	3075
							fz (in)	0.0006	0.0009	0.0013	0.0016	0.0019	0.0025	0.0031	0.0038	0.0050
				604	-	1006	vf (in/min)	92	92	92	92	92	92	92	92	92
	E 3 - 4	2.00 x Dc	0.02 x Dc	742			n (min-1)	22676	15117	11338	9070	7559	5669	4535	3779	2834
							fz (in)	0.0006	0.0009	0.0013	0.0016	0.0019	0.0025	0.0031	0.0038	0.0050
				557	-	928	vf (in/min)	85	85	85	85	85	85	85	85	85
	E 5 - 6	2.00 x Dc	0.02 x Dc	604			n (min-1)	18458	12305	9229	7383	6153	4615	3692	3076	2307
							fz (in)	0.0006	0.0009	0.0013	0.0016	0.0019	0.0025	0.0031	0.0038	0.0050
				453	-	755	vf (in/min)	69	69	69	69	69	69	69	69	69
M	E 8 - 9	2.00 x Dc	0.02 x Dc	690			n (min-1)	21086	14058	10543	8435	7029	5272	4217	3514	2636
							fz (in)	0.0006	0.0009	0.0013	0.0016	0.0019	0.0025	0.0031	0.0038	0.0050
				518	-	863	vf (in/min)	79	79	79	79	79	79	79	79	79
	E 10 - 11	2.00 x Dc	0.02 x Dc	650			n (min-1)	19864	13243	9932	7946	6621	4966	3973	3311	2483
							fz (in)	0.0006	0.0009	0.0013	0.0016	0.0019	0.0025	0.0031	0.0038	0.0050
				488	-	813	vf (in/min)	74	74	74	74	74	74	74	74	74
K	E 12 - 13	2.00 x Dc	0.02 x Dc	569			n (min-1)	17389	11592	8694	6955	5796	4347	3478	2898	2174
							fz (in)	0.0006	0.0009	0.0013	0.0016	0.0019	0.0025	0.0031	0.0038	0.0050
				427	-	711	vf (in/min)	65	65	65	65	65	65	65	65	65
	E 14 - 15	2.00 x Dc	0.02 x Dc	495			n (min-1)	15127	10085	7564	6051	5042	3782	3025	2521	1891
							fz (in)	0.0005	0.0008	0.0010	0.0013	0.0015	0.0020	0.0025	0.0030	0.0040
				371	-	619	vf (in/min)	45	45	45	45	45	45	45	45	45
S	E 19	2.00 x Dc	0.02 x Dc	173			n (min-1)	5287	3525	2643	2115	1762	1322	1057	881	661
							fz (in)	0.0005	0.0008	0.0010	0.0013	0.0015	0.0020	0.0025	0.0030	0.0040
				130	-	216	vf (in/min)	16	16	16	16	16	16	16	16	16
	E 20	2.00 x Dc	0.02 x Dc	138			n (min-1)	4217	2812	2109	1687	1406	1054	843	703	527
							fz (in)	0.0005	0.0008	0.0010	0.0013	0.0015	0.0020	0.0025	0.0030	0.0040
				104	-	173	vf (in/min)	13	13	13	13	13	13	13	13	13
	E 21	2.00 x Dc	0.02 x Dc	115			n (min-1)	3514	2343	1757	1406	1171	879	703	586	439
							fz (in)	0.0005	0.0008	0.0010	0.0013	0.0015	0.0020	0.0025	0.0030	0.0040
				86	-	144	vf (in/min)	11	11	11	11	11	11	11	11	11
	E 22	2.00 x Dc	0.02 x Dc	311			n (min-1)	9504	6336	4752	3802	3168	2376	1901	1584	1188
							fz (in)	0.0006	0.0009	0.0013	0.0016	0.0019	0.0025	0.0031	0.0038	0.0050
				233	-	389	vf (in/min)	36	36	36	36	36	36	36	36	36

SMG = Seco Material Group
n (min-1) = RPM
fz (in) = Feed/tooth
vf (in/min) = Feed rate
v_C (sf/min) = Surface feet/min
a_p x D_c = % of diameter
a_e x D_c = % of diameter
All cutting data are start values
All cutting data is in inch values

SB638 / SBN638 - START VALUES

COPY MILLING - ROUGHING														
ISO GROUP	SMG	a_p x Dc (max)	a_e x Dc (max)	v_c (sf / min)				$Z_n = 6$						
								1/4	5/16	3/8	1/2	5/8	3/4	1
P	E 1 - 2	0.050 x Dc	0.050 x Dc		950		n (min-1)	14516	11613	9677	7258	5806	4839	3629
							fz (in)	0.0033	0.0041	0.0049	0.0065	0.0081	0.0098	0.0130
				713	-	1188	vf (in/min)	283	283	283	283	283	283	283
	E 3 - 4	0.050 x Dc	0.050 x Dc		820		n (min-1)	12530	10024	8353	6265	5012	4177	3132
							fz (in)	0.0030	0.0038	0.0045	0.0060	0.0075	0.0090	0.0120
				615	-	1025	vf (in/min)	226	226	226	226	226	226	226
	E 5 - 6	0.040 x Dc	0.040 x Dc		705		n (min-1)	10772	8618	7182	5386	4309	3591	2693
							fz (in)	0.0030	0.0038	0.0045	0.0060	0.0075	0.0090	0.0120
				529	-	881	vf (in/min)	194	194	194	194	194	194	194
M	E 8 - 9	0.050 x Dc	0.050 x Dc		360		n (min-1)	5501	4401	3667	2750	2200	1834	1375
							fz (in)	0.0030	0.0038	0.0045	0.0060	0.0075	0.0090	0.0120
				270	-	450	vf (in/min)	99	99	99	99	99	99	99
	E 10 - 11	0.040 x Dc	0.040 x Dc		230		n (min-1)	3514	2812	2343	1757	1406	1171	879
							fz (in)	0.0030	0.0038	0.0045	0.0060	0.0075	0.0090	0.0120
				173	-	288	vf (in/min)	63	63	63	63	63	63	63
K	E 12 - 13	0.050 x Dc	0.050 x Dc		900		n (min-1)	13752	11002	9168	6876	5501	4584	3438
							fz (in)	0.0028	0.0034	0.0041	0.0055	0.0069	0.0083	0.0110
				675	-	1125	vf (in/min)	227	227	227	227	227	227	227
	E 14 - 15	0.050 x Dc	0.050 x Dc		740		n (min-1)	11307	9046	7538	5654	4523	3769	2827
							fz (in)	0.0025	0.0031	0.0038	0.0050	0.0063	0.0075	0.0100
				555	-	925	vf (in/min)	170	170	170	170	170	170	170
S	E 19	0.045 x Dc	0.045 x Dc		295		n (min-1)	4508	3606	3005	2254	1803	1503	1127
							fz (in)	0.0025	0.0031	0.0038	0.0050	0.0063	0.0075	0.0100
				221	-	369	vf (in/min)	68	68	68	68	68	68	68
	E 20	0.040 x Dc	0.040 x Dc		295		n (min-1)	4508	3606	3005	2254	1803	1503	1127
							fz (in)	0.0025	0.0031	0.0038	0.0050	0.0063	0.0075	0.0100
				221	-	369	vf (in/min)	68	68	68	68	68	68	68
	E 21	0.035 x Dc	0.035 x Dc		145		n (min-1)	2216	1772	1477	1108	886	739	554
							fz (in)	0.0020	0.0025	0.0030	0.0040	0.0050	0.0060	0.0080
				109	-	181	vf (in/min)	27	27	27	27	27	27	27
	E 22	0.050 x Dc	0.050 x Dc		295		n (min-1)	4508	3606	3005	2254	1803	1503	1127
							fz (in)	0.0025	0.0031	0.0038	0.0050	0.0063	0.0075	0.0100
				221	-	369	vf (in/min)	68	68	68	68	68	68	68

SMG = Seco Material Group
n (min-1) = RPM
fz (in) = Feed/tooth
vf (in/min) = Feed rate
v_C (sf/min) = Surface feet/min
a_p x D_c = % of diameter
a_e x D_c = % of diameter
All cutting data are start values
All cutting data is in inch values

SB638 / SBN638 - START VALUES

COPY MILLING - FINISHING														
ISO GROUP	SMG	a_p x Dc (max)	a_e x Dc (max)	v_c (sf / min)				$Z_n = 6$						
								1/8	3/16	1/4	5/16	3/8	3/4	1
P	E 1 - 2	0.02 x Dc	0.02 x Dc		1045		n (min-1)	15968	12774	10645	7984	6387	5323	3992
							fz (in)	0.0026	0.0033	0.0039	0.0052	0.0065	0.0078	0.0104
				784	-	1306	vf (in/min)	249	249	249	249	249	249	249
	E 3 - 4	0.02 x Dc	0.02 x Dc		900		n (min-1)	13752	11002	9168	6876	5501	4584	3438
							fz (in)	0.0024	0.0030	0.0036	0.0048	0.0060	0.0072	0.0096
				675	-	1125	vf (in/min)	198	198	198	198	198	198	198
	E 5 - 6	0.02 x Dc	0.02 x Dc		775		n (min-1)	11842	9474	7895	5921	4737	3947	2961
							fz (in)	0.0024	0.0030	0.0036	0.0048	0.0060	0.0072	0.0096
				581	-	969	vf (in/min)	171	171	171	171	171	171	171
M	E 8 - 9	0.02 x Dc	0.02 x Dc		395		n (min-1)	6036	4828	4024	3018	2414	2012	1509
							fz (in)	0.0024	0.0030	0.0036	0.0048	0.0060	0.0072	0.0096
				296	-	494	vf (in/min)	87	87	87	87	87	87	87
	E 10 - 11	0.02 x Dc	0.02 x Dc		250		n (min-1)	3820	3056	2547	1910	1528	1273	955
							fz (in)	0.0024	0.0030	0.0036	0.0048	0.0060	0.0072	0.0096
				188	-	313	vf (in/min)	55	55	55	55	55	55	55
K	E 12 - 13	0.02 x Dc	0.02 x Dc		990		n (min-1)	15127	12102	10085	7564	6051	5042	3782
							fz (in)	0.0022	0.0028	0.0033	0.0044	0.0055	0.0066	0.0088
				743	-	1238	vf (in/min)	200	200	200	200	200	200	200
	E 14 - 15	0.02 x Dc	0.02 x Dc		815		n (min-1)	12453	9963	8302	6227	4981	4151	3113
							fz (in)	0.0020	0.0025	0.0030	0.0040	0.0050	0.0060	0.0080
				611	-	1019	vf (in/min)	149	149	149	149	149	149	149
S	E 19	0.02 x Dc	0.02 x Dc		325		n (min-1)	4966	3973	3311	2483	1986	1655	1242
							fz (in)	0.0020	0.0025	0.0030	0.0040	0.0050	0.0060	0.0080
				244	-	406	vf (in/min)	60	60	60	60	60	60	60
	E 20	0.02 x Dc	0.02 x Dc		325		n (min-1)	4966	3973	3311	2483	1986	1655	1242
							fz (in)	0.0020	0.0025	0.0030	0.0040	0.0050	0.0060	0.0080
				244	-	406	vf (in/min)	60	60	60	60	60	60	60
	E 21	0.02 x Dc	0.02 x Dc		160		n (min-1)	2445	1956	1630	1222	978	815	611
							fz (in)	0.0016	0.0020	0.0024	0.0032	0.0040	0.0048	0.0064
				120	-	200	vf (in/min)	23	23	23	23	23	23	23
	E 22	0.02 x Dc	0.02 x Dc		325		n (min-1)	4966	3973	3311	2483	1986	1655	1242
							fz (in)	0.0020	0.0025	0.0030	0.0040	0.0050	0.0060	0.0080
				244	-	406	vf (in/min)	60	60	60	60	60	60	60

SMG = Seco Material Group
n (min-1) = RPM
fz (in) = Feed/tooth
vf (in/min) = Feed rate
v_C (sf/min) = Surface feet/min
a_p x D_c = % of diameter
a_e x D_c = % of diameter
All cutting data are start values
All cutting data is in inch values

S738 / S938 - START VALUES

SIDE MILLING - ROUGHING													
ISO GROUP	SMG	a_p x Dc (max)	a_e x Dc (max)	v_c (sf / min)				Zn=7			Zn=9		
								1/4	3/8	1/2	5/8	3/4	1
P	E 1 - 2	2.00 x Dc	0.07 x Dc		800		n (rev/min)	12224	8149	6112	4890	4075	3056
							fz (in)	0.0025	0.0038	0.0050	0.0063	0.0075	0.0100
				600	-	1000	vf (in/min)	214	214	214	275	275	275
	E 3 - 4	2.00 x Dc	0.07 x Dc		740		n (rev/min)	11307	7538	5654	4523	3769	2827
							fz (in)	0.0025	0.0038	0.0050	0.0063	0.0075	0.0100
				555	-	925	vf (in/min)	198	198	198	254	254	254
	E 5 - 6	2.00 x Dc	0.06 x Dc		605		n (rev/min)	9244	6163	4622	3698	3081	2311
							fz (in)	0.0020	0.0030	0.0040	0.0050	0.0060	0.0080
				454	-	756	vf (in/min)	129	129	129	166	166	166
M	E 8 - 9	2.00 x Dc	0.07 x Dc		680		n (rev/min)	10390	6927	5195	4156	3463	2598
							fz (in)	0.0020	0.0030	0.0040	0.0056	0.0068	0.0090
				510	-	850	vf (in/min)	145	145	145	210	210	210
	E 10 - 11	2.00 x Dc	0.06 x Dc		630		n (rev/min)	9626	6418	4813	3851	3209	2407
							fz (in)	0.0018	0.0026	0.0035	0.0050	0.0060	0.0080
				473	-	788	vf (in/min)	118	118	118	173	173	173
K	E 12 - 13	2.00 x Dc	0.07 x Dc		550		n (rev/min)	8404	5603	4202	3362	2801	2101
							fz (in)	0.0020	0.0030	0.0040	0.0050	0.0060	0.0080
				413	-	688	vf (in/min)	118	118	118	151	151	151
	E 14 - 15	2.00 x Dc	0.06 x Dc		490		n (rev/min)	7487	4991	3744	2995	2496	1872
							fz (in)	0.0018	0.0026	0.0035	0.0044	0.0053	0.0070
				368	-	613	vf (in/min)	92	92	92	118	118	118
S	E 19	2.00 x Dc	0.04 x Dc		170		n (rev/min)	2598	1732	1299	1039	866	649
							fz (in)	0.0015	0.0023	0.0030	0.0038	0.0045	0.0060
				128	-	213	vf (in/min)	27	27	27	35	35	35
	E 20	2.00 x Dc	0.04 x Dc		135		n (rev/min)	2063	1375	1031	825	688	516
							fz (in)	0.0014	0.0021	0.0028	0.0034	0.0041	0.0055
				101	-	169	vf (in/min)	20	20	20	26	26	26
	E 21	2.00 x Dc	0.04 x Dc		115		n (rev/min)	1757	1171	879	703	586	439
							fz (in)	0.0014	0.0021	0.0028	0.0034	0.0041	0.0055
				86	-	144	vf (in/min)	17	17	17	22	22	22
	E 22	2.00 x Dc	0.06 x Dc		310		n (rev/min)	4737	3158	2368	1895	1579	1184
							fz (in)	0.0015	0.0023	0.0030	0.0041	0.0049	0.0065
				233	-	388	vf (in/min)	50	50	50	69	69	69

SMG = Seco Material Group
n (min-1) = RPM
fz (in) = Feed/tooth
vf (in/min) = Feed rate
v_C (sf/min) = Surface feet/min
a_p x D_c = % of diameter
a_e x D_c = % of diameter
All cutting data are start values
All cutting data is in inch values

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S738 / S938 - START VALUES

SIDE MILLING - FINISHING													
ISO GROUP	SMG	a_p x Dc (max)	a_e x Dc (max)	v_c (sf / min)				Zn=7			Zn=9		
								1/4	3/8	1/2	5/8	3/4	1
P	E 1 - 2	2.00 x Dc	0.02 x Dc		920		n (min-1)	14058	9372	7029	5623	4686	3514
							fz (in)	0.0013	0.0019	0.0025	0.0031	0.0038	0.0050
				690	-	1150	vf (in/min)	123	123	123	158	158	158
	E 3 - 4	2.00 x Dc	0.02 x Dc		851		n (min-1)	13003	8669	6502	5201	4334	3251
							fz (in)	0.0013	0.0019	0.0025	0.0031	0.0038	0.0050
				638	-	1064	vf (in/min)	114	114	114	146	146	146
	E 5 - 6	2.00 x Dc	0.02 x Dc		696		n (min-1)	10635	7090	5317	4254	3545	2659
							fz (in)	0.0013	0.0019	0.0025	0.0031	0.0038	0.0050
				522	-	870	vf (in/min)	93	93	93	120	120	120
M	E 8 - 9	2.00 x Dc	0.02 x Dc		782		n (min-1)	11949	7966	5974	4780	3983	2987
							fz (in)	0.0013	0.0019	0.0025	0.0031	0.0038	0.0050
				587	-	978	vf (in/min)	105	105	105	134	134	134
	E 10 - 11	2.00 x Dc	0.02 x Dc		725		n (min-1)	11078	7385	5539	4431	3693	2770
							fz (in)	0.0013	0.0019	0.0025	0.0031	0.0038	0.0050
				544	-	906	vf (in/min)	97	97	97	125	125	125
K	E 12 - 13	2.00 x Dc	0.02 x Dc		633		n (min-1)	9672	6448	4836	3869	3224	2418
							fz (in)	0.0013	0.0019	0.0025	0.0031	0.0038	0.0050
				475	-	791	vf (in/min)	85	85	85	109	109	109
	E 14 - 15	2.00 x Dc	0.02 x Dc		564		n (min-1)	8618	5745	4309	3447	2873	2154
							fz (in)	0.0010	0.0015	0.0020	0.0025	0.0030	0.0040
				423	-	705	vf (in/min)	60	60	60	78	78	78
S	E 19	2.00 x Dc	0.02 x Dc		196		n (min-1)	2995	1997	1497	1198	998	749
							fz (in)	0.0010	0.0015	0.0020	0.0025	0.0030	0.0040
				147	-	245	vf (in/min)	21	21	21	27	27	27
	E 20	2.00 x Dc	0.02 x Dc		155		n (min-1)	2368	1579	1184	947	789	592
							fz (in)	0.0010	0.0015	0.0020	0.0025	0.0030	0.0040
				116	-	194	vf (in/min)	17	17	17	21	21	21
	E 21	2.00 x Dc	0.02 x Dc		132		n (min-1)	2017	1345	1008	807	672	504
							fz (in)	0.0010	0.0015	0.0020	0.0025	0.0030	0.0040
				99	-	165	vf (in/min)	14	14	14	18	18	18
	E 22	2.00 x Dc	0.02 x Dc		357		n (min-1)	5455	3637	2727	2182	1818	1364
							fz (in)	0.0013	0.0019	0.0025	0.0031	0.0038	0.0050
				268	-	446	vf (in/min)	48	48	48	61	61	61

SMG = Seco Material Group
n (min-1) = RPM
fz (in) = Feed/tooth
vf (in/min) = Feed rate
v_C (sf/min) = Surface feet/min
a_p x D_c = % of diameter
a_e x D_c = % of diameter
All cutting data are start values
All cutting data is in inch values

SCS738R / SCS938R - CHIP SPLITTERS - START VALUES

SIDE MILLING - SEMI ROUGHING													
ISO GROUP	SMG	a_p x Dc (max)	a_e x Dc (max)	v_c (sf / min)				Zn=7			Zn=9		
								1/4	3/8	1/2	5/8	3/4	1
P	E 1 - 2	3.00 x Dc	0.05 x Dc		800		n (min-1)	12224	8149	6112	4890	4075	3056
							fz (in)	0.0025	0.0038	0.0050	0.0063	0.0075	0.0100
				600	-	1000	vf (in/min)	214	214	214	275	275	275
	E 3 - 4	3.00 x Dc	0.05 x Dc		740		n (min-1)	11307	7538	5654	4523	3769	2827
							fz (in)	0.0025	0.0038	0.0050	0.0063	0.0075	0.0100
				555	-	925	vf (in/min)	198	198	198	254	254	254
	E 5 - 6	3.00 x Dc	0.04 x Dc		605		n (min-1)	9244	6163	4622	3698	3081	2311
							fz (in)	0.0020	0.0030	0.0040	0.0050	0.0060	0.0080
				454	-	756	vf (in/min)	129	129	129	166	166	166
M	E 8 - 9	3.00 x Dc	0.05 x Dc		680		n (min-1)	10390	6927	5195	4156	3463	2598
							fz (in)	0.0020	0.0030	0.0040	0.0056	0.0068	0.0090
				510	-	850	vf (in/min)	145	145	145	210	210	210
	E 10 - 11	3.00 x Dc	0.04 x Dc		630		n (min-1)	9626	6418	4813	3851	3209	2407
							fz (in)	0.0018	0.0026	0.0035	0.0050	0.0060	0.0080
				473	-	788	vf (in/min)	118	118	118	173	173	173
K	E 12 - 13	3.00 x Dc	0.05 x Dc		550		n (min-1)	8404	5603	4202	3362	2801	2101
							fz (in)	0.0020	0.0030	0.0040	0.0050	0.0060	0.0080
				413	-	688	vf (in/min)	118	118	118	151	151	151
	E 14 - 15	3.00 x Dc	0.04 x Dc		490		n (min-1)	7487	4991	3744	2995	2496	1872
							fz (in)	0.0018	0.0026	0.0035	0.0044	0.0053	0.0070
				368	-	613	vf (in/min)	92	92	92	118	118	118
S	E 19	3.00 x Dc	0.03 x Dc		170		n (min-1)	2598	1732	1299	1039	866	649
							fz (in)	0.0015	0.0023	0.0030	0.0038	0.0045	0.0060
				128	-	213	vf (in/min)	27	27	27	35	35	35
	E 20	3.00 x Dc	0.03 x Dc		135		n (min-1)	2063	1375	1031	825	688	516
							fz (in)	0.0014	0.0021	0.0028	0.0034	0.0041	0.0055
				101	-	169	vf (in/min)	20	20	20	26	26	26
	E 21	3.00 x Dc	0.03 x Dc		115		n (min-1)	1757	1171	879	703	586	439
							fz (in)	0.0014	0.0021	0.0028	0.0034	0.0041	0.0055
				86	-	144	vf (in/min)	17	17	17	22	22	22
	E 22	3.00 x Dc	0.04 x Dc		310		n (min-1)	4737	3158	2368	1895	1579	1184
							fz (in)	0.0015	0.0023	0.0030	0.0041	0.0049	0.0065
				233	-	388	vf (in/min)	50	50	50	69	69	69

SMG = Seco Material Group
n (min-1) = RPM
fz (in) = Feed/tooth
vf (in/min) = Feed rate
v_C (sf/min) = Surface feet/min
a_p x D_c = % of diameter
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All cutting data are start values
All cutting data is in inch values

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END MILL TOLERANCES

SOLID CARBIDE END MILLS

END MILL STYLE	NUMBER OF FLUTES	NIAGARA CUT DIAMETER TOLERANCE	CORRESPONDING LIST NUMBERS
SINGLE-END DOUBLE-END FINISHERS	ALL	+ 0.000 / - 0.002	STS430.2, STR430.2, STB430.2, STRN430.2, STBN430.2, STS430M.2, STR430M.2, STB430M.2, STR440.2, STB440.2, STRN440.2, STBN440.2, STR440M.2, STB440M.2, STS540, STR540, STS540M,STR540M, A245, A245R, AB245, AN245, ANB245, AN340, A345, A345R, AN345, AN345R, A345M, S335, SB335, SN335, S545, S545R, S638, S638R, SB638, SBN638, SN638, SN638R, SCS638, SCS638R, S738, S738R, SCS738R, S938, S938R, SCS938R, S545M, S645M, SN200R, SN400R, SN500R C230, C230R, C330, C360, C430, C430R, CB230, CB330, CB430, C230M, C430M, CB230M, CB430M, C330M, CD230, CD430, CSD230, CSD430, CSDB230, CSDB430
SINGLE-END & DOUBLE-END FINISHERS (FLUTE DIA <=7/64")	ALL	+ / - 0.0005	C230, CB230, CSD230, CSDB230, C330, CB330, C430, CB430, CSD430, CSDB430, C230M, CB230M, C330M, C430M, CB430M
high feed (flute dia<1/8")	2	+ / - 0.0005	SN200R
SINGLE-END, FINISHERS, NC TOLERANCE	2 & 4	+ 0.001 / - 0.000	CNC230, CNCB230, CNC430, CNCB430
SINGLE-END ROUGHERS	3, 4 & 5	+ 0.000 / - 0.003	AR330, SR420, SR545, SR420M
SINGLE-END MICRO DECIMAL	2 & 4	+ / - 0.0005	ME230, MES230, MEB230, MESB230, ME430, MES430, MEB430
THREAD MILLS	ALL	+ 0.000 / - 0.002	NTM100UN, NTM120UN, NTM160UN, NTM200NPT, NTM300NPTF, NTM400MI
COMPOSITE CUTTING TOOLS	ALL	+ 0.000 / - 0.002	DIARTREM, DIARTRBE, DIACC, DIAEPB, DIAPPB, DIABEB
DIAMOND COATED END MILLS	2 & 4	+ / - 0.001	DIA230, DIA430, DIAB230, DIAB430, DIACR430, DIAL230, DIAL430, DIALB430, DIAXRB430, DIAXRR430, DIAXSB430, DIA230M, DIAB230M, DIA430M
MOLD & DIE	6	+ 0.000 / - 0.002	MZ645, MZ645R
MOLD AND DIE (FLUTE DIA < SHANK DIA)	2	+ / - 0.0005	MB215, MB215M, MBZ215, MBZ215M
MOLD AND DIE (FLUTE DIA = SHANK DIA)	2	+ 0.000 / - 0.001	MB215, MB215M, MBZ215, MBZ215M
BALL-END	ALL	BALL RADIUS TOLERANCE: FLUTE DIA TOLERANCE / 2	ALL
CORNER RADIUS	ALL	+ / - 0.001	ALL SERIES

SHANK DIAMETER TOLERANCES	END MILL STYLE	NIAGARA TOLERANCE
	ALL INCH SHANK	- 0.0001 / - 0.0004
	ALL METRIC SHANK	h6

LENGTH OF CUT TOLERANCES	END MILL STYLE	NIAGARA TOLERANCE
	ALL EXCLUDING MICRO DECIMAL	+ 0.030 / - 0.000
	MICRO DECIMAL	+ 0.010 / - 0.000

OVERALL LENGTH TOLERANCES	END MILL STYLE	NIAGARA TOLERANCE
	ALL	+ / - 0.060

TIR CONDITION	END MILL STYLE	CUTTING DIAMETER	NIAGARA TOLERANCE
	ALL EXCEPT ROUGHERS	0.005 - 0.030	0.0001 MAX
		0.031 - 0.060	0.0002 MAX
		0.061 - 0.111	0.0003 MAX
		0.112 AND ABOVE	0.0005 MAX
	ROUGHERS	ALL	0.0010 MAX

BACK TAPER	END MILL STYLE	NIAGARA TOLERANCE
	ALL	0.0005 MAX back taper per inch permissible. Not to exceed the cutting diameter tolerance.

NOTE: ALL DIMENSIONS IN INCH

Surface speed, surface footage and surface area are directly related. Cutting speed is the peripheral speed (velocity) at the outside edge of an endmill (surface speed). The faster the spindle speed the higher the SFM. SFM is the distance in feet that the cutting edge travels in one minute. IPM and IPT is the rate at which the cutting tool is advanced into the workpiece. Feed per tooth is the thickness of chip that each cutting edge removes in one pass.

RPM

$$n = \frac{v_c \cdot 12}{\pi \cdot D_c} \text{ or } \frac{v_c \cdot 3.82}{D_c} \quad \text{(rev/min)}$$

CUTTING SPEED

$$v_c = \frac{n \cdot \pi \cdot D_c}{12} \text{ or } \frac{n \cdot D_c}{3.82} \quad \text{(sf/min)}$$

FEED SPEED

$$v_f = n \cdot z_n \cdot f_z$$
$$v_f = n \cdot z_c \cdot f_z \quad \text{(inch/min)}$$

FEED PER REVOLUTION

$$f = z_n \cdot f_z$$
$$f = z_c \cdot f_z \quad \text{(inch/rev)}$$

METAL REMOVAL RATE (MRR)

$$Q = a_e \cdot a_p \cdot v_f \quad \text{(inch}^3\text{/min)}$$

CUTTING SPEED AND RPM FOR COPYING

$$v_c = \frac{n \cdot \pi \cdot D_w}{12} \text{ or } \frac{n \cdot D_w}{3.82} \quad \text{(sf/min)}$$

$$n = \frac{v_c \cdot 12}{\pi \cdot D_w} \text{ or } \frac{v_c \cdot 3.82}{D_w} \quad \text{(RPM)}$$

$$D_w = 2 \cdot \sqrt{a_p (D_c - a_p)} \quad \text{(inch)}$$

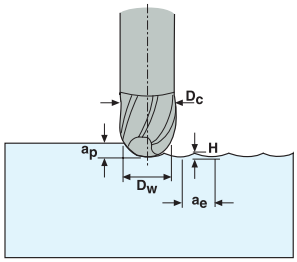
CALCULATION OF a_p VS. OVERHANG LENGTH:
If the overhang length (XS) is longer than 4 x D_c and cylindrical shanks are used, it is important to adopt another depth of cut (a_p) value than that indicated in the table.Use the following formula to calculate the new a_p value

$$a_p = a_p \cdot (4 \cdot Dc/xs)\,2$$

PROFILE HEIGHT

$$H = \frac{D_c}{2} - \frac{\sqrt{D_c^2 - a_e^2}}{2}$$

$$D_W = 2 \cdot \sqrt{a_p (D_c - a_p)}$$



PROFILE HEIGHT H (UM)

D_c	Pitch a_e (mm)						
	0.06	0.08	0.11	0.15	0.20	0.30	0.45
1	0.90	1.60	3.00	5.70	10.00	23.00	53.00
2	0.45	0.80	1.50	2.80	5.00	11.00	26.00
4	0.23	0.40	0.76	1.40	2.50	5.60	13.00
6	0.15	0.27	0.50	0.94	1.70	3.80	8.40
8	0.11	0.20	0.38	0.70	1.30	2.80	6.30
10	0.09	0.16	0.30	0.56	1.00	2.30	5.10
12	0.08	0.13	0.25	0.47	0.83	1.90	4.20

a_p = Depth of cut (mm) / axial depth of cut (in)

a_e = Width of cut (mm) / radial depth of cut (in)

D_c = Cutter diameter

f = Feed per revolution (in/rev)

f_z = Feed per tooth (in/tooth)

z_n = No. of teeth

n = RPM (rev/min)

Q = Material removal rate (in^3/min)

v_c = Cutting speed (sf/min)

v_f = Feed speed (in/min)

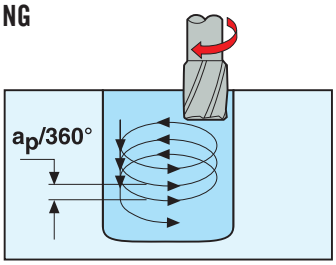
D_w = Working diameter

HELICAL INTERPOLATION

The table below shows the minimum hole diameter that should be made per the diameter of the end mill being used.

RECOMMENDED DIAMETER OF HOLE FOR HELICAL INTERPOLATION RAMPING

DIAMETER OF END MILL D_c	DIAMETER OF HOLE
1/32 - 3/32	1.4 x D_c
1/8 - 1/4	1.3 x D_c
3/8 - 1/2	1.2 x D_c
5/8 - 1 1/4	1.15 x D_c

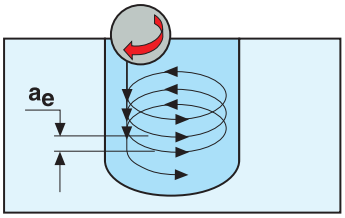


TROCHOIDAL METHOD

The figure below shows a method often called the trochoidal method for milling slots.

RECOMMENDED WIDTH OF SLOT

DIAMETER OF END MILL D_c	SLOT WIDTH
1/32 - 3/32	1.8 x D_c
1/8 - 1/4	1.6 x D_c
3/8 - 1/2	1.4 x D_c
5/8 - 1 1/4	1.2 x D_c



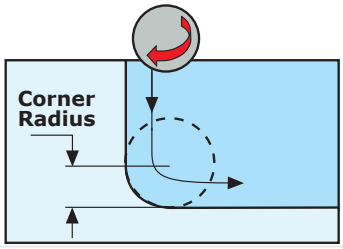
CORNER CONTACT

GENERATE COMPONENT CORNERS TO OPTIMIZE TOOL LIFE:

- Use maximum diameter of cutting tool, but have maximum difference between the radius of the tool and the radius in the corner of the component.
- In a corner, the contact arc of the tool increases rapidly according to the difference in radius between the tool and the component. This causes more force on the tool, resulting in deflection and increased temperature in the corner, reducing tool life.

RECOMMENDATIONS

END MILL DIAMETER	MINIMUM CORNER RADIUS
1/64 - 3/32	D_c / 2 x 1.4
1/8 - 1/4	D_c / 2 x 1.3
3/8 - 1/2	D_c / 2 x 1.2
5/8 - 1 1/4	D_c / 2 x 1.15



Example: ¼ tool, minimum corner radius to be generated is 0.1625”.

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