Technical Information

CHOOSING THE APPROPRIATE SEPARATOR® CUTOFF INSERT

Separator® Classic

A good general purpose insert for carbon steels, alloy steels and most stainless steels. The Separator Classic chip breaker is designed to perform well at moderate to slow speeds and feeds. The Classic offers standard high lead angles and sharp corners making it the first choice when choosing an insert for nib free cutoff.

Separator® F²

This insert offers superior flatness and finish on a wide variety of materials. Ideal for thick wall parts or cutting off larger diameter parts to center. The Separator F² performs well at slow to moderate speeds and feeds.

Separator® G²

This insert has a corner radius and a slightly more open chip breaker. It's an ideal general purpose insert for CNC machine cutoff applications. Performs well at moderate speeds and feeds on carbon steels, alloy steels and most stainless steels.

Separator® D²

This insert has a high positive dish style chipbreaker. The chip breaker geometry has excellent edge strength for high feed rate applications. The neutral (0 degree lead) version can be used for grooving applications.

Separator® S²

This high positive rake with more open chip breaker allows for increased speeds and feeds for the moderate to high speed applications. The geometry also includes wipers and a corner radius that provides superior flatness and finish. This insert is also available with sharp corners. This geometry works well on a variety of materials although it's greatest strengths can be seen on Stainless Steels and soft gummy steels.

Separator® S²-Ultra

The S²-Ultra is an enhanced version of the S² and is ideal for 300 series stainless, Nickel Based alloys, Tool Steel, Inconel and Titanium at moderate to high speeds and feeds.

Separator® X²

This insert has the same geometry as the MTC-SX™. This chip control geometry offers the widest range of speed and feed capability and provides excellent flatness and finish. This chip breaker cuts with the least amount of tool pressure, extends tool life. The geometry also includes wipers and a corner radius. This geometry works well on a variety of materials.

Separator® X²-Ultra

This insert has the same geometry as the MTC-SX™. The X²-Ultra is an enhanced version of the X² and is ideal for stainless steels, Nickel Based alloys, Tool Steel, Inconel and Titanium.

The inserts listed thus far are single end inserts that go into standard componentized and integral shank holders with up to 3" bar capacity capability. Greater depths of cut and bar capacity can be achieved through customizing and/or special systems. If necessary these Separator inserts can be customized for a particular application.

Separator® PL

This insert is Pressure Locked into a blade style system that allows for varying depths of cut depending on the blade extension from the holder. This insert has a good general purpose chip breaker and is available in sharp corner or corner radius. Ideal for medium to slow speed conditions on a wide variety of materials.

MTC-SX™

This double ended insert is the latest Separator design. The chip control geometry offers the widest range of speed and feed capability and provides excellent flatness and finish. This chip breaker cuts with the least amount of tool pressure, extends tool life. The longer insert and double V offer maximum insert stability. Operator friendly insert indexing. This insert fits into standard and componentized holders capable of up to 25mm depth of cut.

MTC-SX™-Ultra

The SX-Ultra is an enhanced version of the SX and is ideal for 300 series stainless, Nickel Based alloys, Tool Steel, Inconel and Titanium at moderate speeds and feeds.

To improve chip control:

- Use an insert with aggressive chip control geometry. See Table 1, or call Tech. Support.
- Adjust feed rate up or down to accommodate chip formation.
- Use a 0° or smallest lead available.
- Use ample amounts of well-directed coolant. *(See Illustration A.)*
- Maintain sharp cutting edge and corners.

Table 1: Insert Selection For Aggressive Chip Control Requirements

Width	Insert No.	Grade
3/32"	507-207	M45
3mm	507-314	M45
1/8"	507-224	M45
4mm	507-225	M45
3/16"	507-226	M45

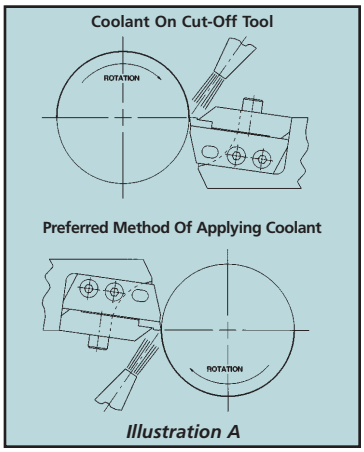


Illustration A

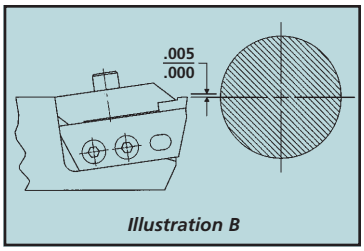


Illustration B

To improve flatness of cutoff surfaces:

- Maintain 90° (perpendicular alignment) position between cutoff tool and work piece.
- For low to moderate speed (sfpm) use Separator F².
- For moderate to high-speed (sfpm) use Separator S² or SX.
- Use strongest tool holder system possible.
- Use 0° lead angle inserts when possible. If lead angle inserts are needed, reduce the feed rate.
- Check for minimum overhang of holder and blade.
- Set up for minimum work piece overhang (distance out of chuck).
- Reduce feed rate.
- Maintain sharp edge and corners on cutoff insert.
- Increase speed (rpm).
- Use ample amounts of well-directed coolant. *(See Illustration A.)*
- Maintain proper tool center height .000" to .005" above center. *(See Illustration B.)*.

To improve surface finish:

- For low to moderate speed (sfpm) use Separator F².
- For moderate to high-speed (sfpm) use Separator S² or SX.
- Avoid overly aggressive chip control.
- Increase speed.
- Reduce lead angle.
- Decrease the feed rate .
- Corner radius too large or small.
- Use a coated grade.
- Use coolant. *(See Illustration A.)*

To minimize edge chipping:

- Check to see if tool is significantly above or below center.
- Reduce feed prior to part drop off.
- Use Separator S², SX or D².
- Choose the proper speed associated with the insert grade used.
- Call Tech. Support to see if a larger hone size is needed.
- Eliminate chatter.
- Avoid chip re-cutting.
- Check for these part and machine problems:
  - Slide is loose.
  - Slide travel is irregular.
  - Bar/tube I.D. and/or O.D. is out of round.
  - Bar/tube is bent.
  - Thin wall collapses (deforms) in the cut.
  - Part is unstable.
  - Cutoff through unturned stock.
  - Excessive tool overhang.
  - Bent or partly attached flash ring.

To eliminate chatter:

- Minimize tool blade and holder overhang.
- Minimize part overhang.
- Use strongest tool holder system.
- Use a narrower width of insert.
- Chip breaker might be too aggressive, call Tech. Support.
- Adjust speed up or down.
- Adjust feed rate up or down.
- Have work piece held rigidly.
- With a longer part, support with steady rest or live center.
- Avoid machine dwell.
- Use S² or SX to reduce cutting forces.

To reduce the cutoff nib on a solid bar or I.D. burr on tubing:

- Check tool height. Insert cutting edge should be on center to .002" above centerline of work piece.
- To reduce nib on part, use a high lead angle type insert. Lead angle on a cutoff insert reduces the nib, which remains on the work piece. *Caution: The higher the lead the more tool side deflection.*
- Use the narrowest possible cutoff insert. This will minimize the cutoff burr length.
- Reduce feed rate at the end of a cut.
- On most tubing type parts a 4° or 5° lead angle will be sufficient.
- Add support to a long slender type part.
- Maintain proper sub-spindle alignment.
- If nib or burr persist, call Tech. Support about reducing hone size.
- Use small or no corner radius.

To eliminate built-up edge:

- Select proper grade for insert.
- Increase speed (rpm).
- Use ample amounts of well-directed coolant. *(See Illustration A on H3.)*

Chamfer and cutoff operations:

- Use Separator G², S², SX and D².
- Groove or breakdown work piece surface being machined.
- Machine the chamfer.

For jobs requiring a chamfer on both ends of the part, begin by plunging to a depth just beyond the depth of the chamfers. Then, return to the part O.D. and profile each chamfer individually. Finish the cut off after completion of the second chamfer.

- Cutoff the work piece. *(See Illustration C.)*

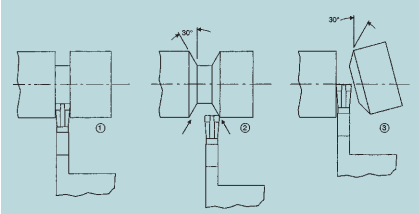
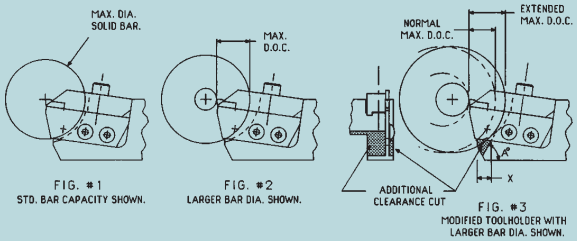


Illustration C

Modifications For Increased Depths Of Cut



CAPACITY CHART FOR 2-1/4" DIA. BAR CAPACITY TOOLING.

BAR DIA.	2.5	3.0	3.5	4.0	4.5	5.0	6.0	NOTE.
MAX. D.O.C.	0.94	0.75	0.62	0.56	0.50	0.47	0.44	WITH NO MODIFICATION ON TOOLHOLDER.
	1.12	1.03	0.97	0.91	0.87	0.84	0.78	WITH MODIFICATION X = .40 ON TOOLHOLDER. A = 60°

CAPACITY CHART FOR 3.0" DIA. BAR CAPACITY TOOLING.

BAR DIA.	3.5	4.0	4.5	5.0	6.0	NOTE.
MAX. D.O.C.	1.12	1.00	0.88	0.78	0.69	WITH NO MODIFICATION ON TOOLHOLDER.
	1.44	1.37	1.31	1.25	1.12	WITH MODIFICATION X = .38 ON TOOLHOLDER. A = 55°

Separator P/L

The Separator P/L insert should be placed in the blade finger tight, then properly seated by lightly tapping with either a rubber or plastic hammer. If none is available, a wood block should be placed over the cutting edge prior to seating with the hammer. *(See Illustration D.)*

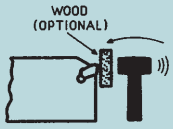


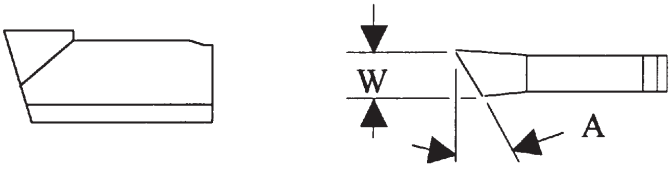
Illustration D

CUTOFF FLAT TOP SEPARATOR® INSERTS

Flat Top Separator® inserts have no chip breaker, no center channel and no corner radii. The flat top Separator® insert mounts into all standrd Manchester Separator® cutoff toolholders.

Advantages a Flat Top Separator® gives you:

- Less cutting tool pressure than a Separator® Classic. This helps when trying to obtain a nib free part.
- 507-189 and 507-122 can be used to produce OD grooves with a flat bottom.
- Flat top inserts provide better finishes on brass, bronze, and most non-ferrous materials than an insert with a chip breaker.



Standard Flat Top Separator® Inserts							INCH
				Grades			
Part Number	Width W	Lead Angle A	Hand	C2	C5	M20	M40
507-189	1/16	0°	N				•
507-141	3/32	4°	R	•	•		
507-179*	3/32	18°	R				•
507-122	1/8	0°	N	•			
507-180*	1/8	18°	R			•	

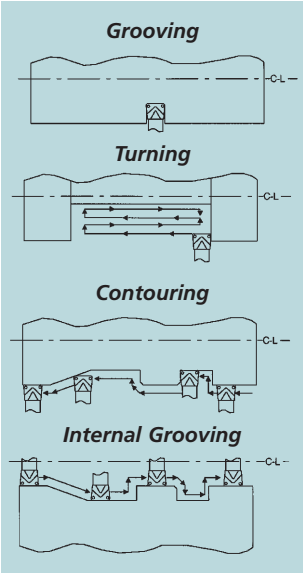
Standard Flat Top Separator® Inserts				METRIC
				Grades
Part Number	Width W mm	Lead Angle A	Hand	M20
507-338	2.4	0°	N	•
507-339	2.4	4°	R	•
507-340	2.4	4°	L	•
507-341	2.4	12°	R	•
507-342	2.4	12°	L	•
507-343	3	0°	N	•
507-344	3	4°	R	•
507-345	3	4°	L	•
507-346	3	12°	R	•
507-347	3	12°	L	•

**Has no back taper clearance on lead side for improved flatness and finish.*

•Indicates grade availability.

Application Information:

- Insure that the machine and the workpiece setups are as rigid as possible.
- The first choice for rigidity in toolholder selection is the use of integral shank holders.
- Use the holder with the shortest possible depth of cut for the application. This is extremely important in applications that involve significant amounts of turning.
- Toolholder overhang out of the block should be as short as possible.
- Inserts should cut as close to center as possible. They should never be more than .010" above center. If measurements are in doubt, a facing cut will corroborate center line position.
- For turning and profiling applications, use 1/2 the insert width as a starting point recommendation for depth of cut. Adjust based on material machinability and feed rate. Select a smaller corner radius to improve chip control.
- The MTC-PT™ offers the widest range of chip control in the Plunge and Turn operation.
- Chipmaker inserts are effective in the plunge mode up to .008 IPR and operate efficiently in the turning mode up to .012 IPR.
- Chipmaker 95 inserts are most effective in the plunge mode at heavier feed rates up to .015 IPR. CM-95 is capable of delivering chip control with corner radii of .060" and larger.



- Use cutoff guidelines, where applicable, for finish, chatter, and edge chipping related problems.
- When changing inserts, make sure the new insert locates securely against the positive stop.
- Plunge grooving with the MTC-PT™ system yields excellent chip control in most materials at productive speeds and feeds.
- The Manchester grooving system is sufficiently rigid to turn in both directions at the same feed rates. This allows continuous cutting when roughing a wide groove as shown.
- Manchester grooving system rigidity allows profiling cuts to be made at productive speeds and feeds along with excellent surface finishes. The MTC-PT™ and Chipmaker® permit chip control in all modes of operation.

Application Information:

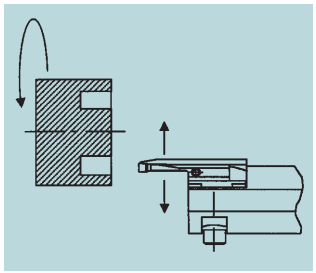
- When changing inserts, be sure the new insert locates against the positive stop located on the clamp.
- Never tighten the insert clamping screw without an insert in the pocket. Permanent damage to the clamp could occur.
- Toolholder projection length out of the tool block should be as short as possible to maintain rigidity.
- Slower speeds and feeds are recommended compared to O.D. grooving

Face Grooving Ranges Per Setting

Given Diameter Setting	Plunge Range At Diameter Setting	
	Smallest O.D.	Largest O.D.
2-1/4	2-1/4	2-3/8
2-1/2	2-3/8	2-5/8
2-3/4	2-9/16	2-15/16
3.0	2-5/8	3-3/8
3-1/2	3-1/16	3-15/16
4.0	3-1/2	4-1/2
5.0	4-1/4	5-3/4
6.0	5.0	7.0
8.0	6-1/2	9-1/2
10.0	8.0	11.0
11.0-16.0	9.0	16.0

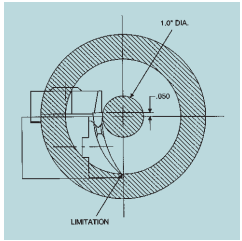
Note: This chart is a general guide for face groove entry at outside diameters both smaller and larger than each given OD setting on the tool. Example: If the tool is adjusted for 4.0 inch OD, plunge cuts from 3-1/2 inch OD to 4-1/2 inch OD can be made without changing the 4.0 inch OD setting.

Widening A Face Groove



Additional clearance is generated on the workpiece after the first groove cut. Without further adjustment, the tool may then be used to widen the groove toward the center, or toward the O.D. of the workpiece.

Small Diameter Face Grooving Clearances



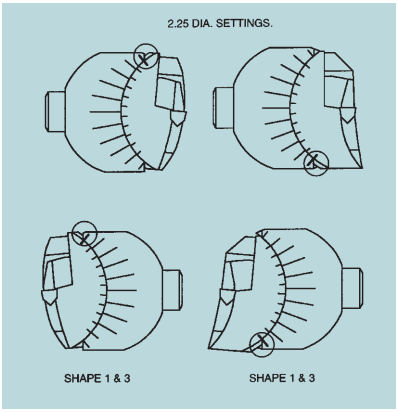
The cutting edge of the small diameter face grooving system is +.050" above center. This is done to improve cutting clearances. This tool should not be repositioned on center. When facing toward center, this system does not have sufficient clearance to cut at diameters of less than 1".

Adjusting Information for Ranger™ Tooling

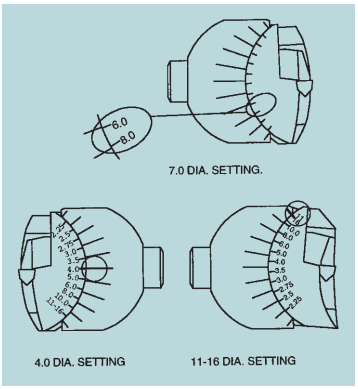
The following instructions are for style 1 Ranger tools. Instructions for style 2 tools are in [brackets].

- Appropriate diameter range setting can be accomplished as follows:

Step 1 Loosen the support blade locking screw and rotate the support blade so that the 2.25 mark is above the top line on the toolholder. [Below the line on toolholder for style 2.]



Step 2:
Slowly rotate the support blade down until the 2.25 mark is aligned with the top line of the toolholder. [Rotate the support blade up until the 2.25 mark is aligned with the bottom line on the toolholder for style 2.] At this point, the support blade assembly is properly aligned to cut face grooves at 2.250 inch OD.



For diameters larger than 2.25 OD, continue to rotate the support blade in the same direction until the desired diameter range has been aligned.
Example: The 7.0 inch diameter setting falls between the 6.0 inch and the 8.0 inch diameter settings.

Step 3: Tighten the support blade screw. Inspect the scale to ensure that the desired diameter range is aligned.

Note: It is important that these instructions are followed. Failure to do so may result in damage to the tool and the workpiece.

Adjustable Helix Threading System

1. SELECT PRODUCTION METHOD

The choice of production method is dependent upon the part's shape, the part's stability and the flow of chips.

Normal Threading

The tool is fed in the direction toward the chuck. This method is the most common and provides for the greatest stability.

Reverse Threading

The tool is fed away from the chuck. This method is less common and requires sufficient clamping of workpiece and rigidity of set up. An advantage of this method is that it provides superior chip evacuation in internal threading.

This method requires the use of a N3.0 or N1.5 negative helix.

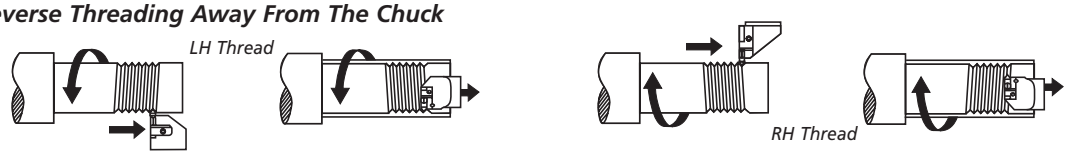
2. SELECT APPROPRIATE CARTRIDGE

To determine the correct threading helix angle, refer to the chart below. The grid triangle on the left side of the chart provides appropriate helix selection for reverse threading. The grid triangle on the right side of the chart provides appropriate helix selection for normal threading.

Use the chart to cross-reference the thread diameter and the Pitch/TPI being machined. Apply the appropriate helix angle to the Adjustable Helix Threading System shown on page E4.

Adjustable Helix Threading System — Helix Angle Chart

Reverse Threading Away From The Chuck



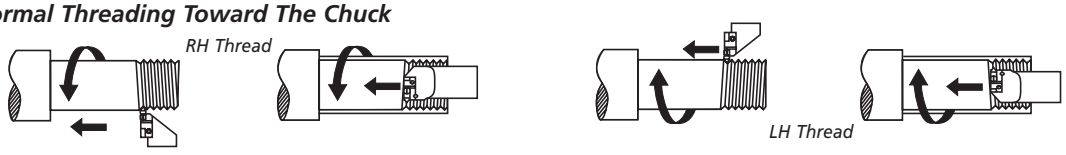
RH Toolholder, RH Neg. Helix — *LH Bar, LH Neg. Helix* — *LH Toolholder, LH Neg. Helix.* — *RH Bar, RH Neg. Helix*

MM	TPI	1/4	1/2	3/4	1	1-1/4	1-1/2	1-3/4	2	2-1/4	2-1/2	2-3/4	3	3-1/4	3-1/2	3-3/4	4	TPI	MM
5.0	5	—	—	—	—	—	N3.0	N3.0	N1.5	N1.5	N1.5	N1.5	N1.5	N1.5	N1.5	N1.5	N1.5		
4.0	6	—	—	—	N3.0	N3.0	N3.0	N1.5	N1.5	N1.5	N1.5	N1.5	N1.5	N1.5	N1.5	N1.5	N1.5		
3.5	7	—	—	—		N3.0	N1.5	N1.5	N1.5	N1.5	N1.5	N1.5	N1.5	N1.5	N1.5	N1.5			
3.0	8	—	—	N3.0	N3.0	N1.5	N1.5	N1.5	N1.5	N1.5	N1.5	N1.5	N1.5	N1.5	N1.5				
	9	—	—	N3.0	N1.5	N1.5	N1.5	N1.5	N1.5	N1.5	N1.5	N1.5	N1.5	N1.5					
2.5	10	—	—	N3.0	N1.5	N1.5	N1.5	N1.5	N1.5	N1.5	N1.5	N1.5	N1.5				P1.5	56	
2.0	11	—	N3.0	N3.0	N1.5	N1.5	N1.5	N1.5	N1.5	N1.5	N1.5	N1.5	N1.5			P1.5	P1.5	48	.5
	12	—	N3.0	N3.0	N1.5	N1.5	N1.5	N1.5	N1.5	N1.5	N1.5	N1.5			P1.5	P1.5	P1.5	44	
1.75	13	—	N3.0	N1.5	N1.5	N1.5	N1.5	N1.5	N1.5	N1.5	N1.5			P1.5	P1.5	P1.5	P1.5	40	
1.5	14	—	N3.0	N1.5	N1.5	N1.5	N1.5	N1.5	N1.5	N1.5	N1.5			P1.5	P1.5	P1.5	P1.5	36	
	16	—	N3.0	N1.5	N1.5	N1.5	N1.5	N1.5	N1.5	N1.5			P1.5	P1.5	P1.5	P1.5	P1.5	32	.75
1.25	18	—	N1.5	N1.5	N1.5	N1.5	N1.5	N1.5	N1.5			P1.5	P1.5	P1.5	P1.5	P1.5	P3.0	28	
1.0	20	—	N1.5	N1.5	N1.5	N1.5	N1.5	N1.5				P1.5	P1.5	P1.5	P1.5	P1.5	P3.0	24	1.0
	24	N3.0	N1.5	N1.5	N1.5	N1.5	N1.5	N1.5			P1.5	P1.5	P1.5	P1.5	P1.5	P1.5	—	20	1.25
.75	28	N3.0	N1.5	N1.5	N1.5	N1.5	N1.5			P1.5	P1.5	P1.5	P1.5	P1.5	P1.5	P1.5	—	18	
	32	N1.5	N1.5	N1.5	N1.5	N1.5			P1.5	P1.5	P1.5	P1.5	P1.5	P1.5	P1.5	P3.0	—	16	1.5
	36	N1.5	N1.5	N1.5	N1.5				P1.5	P1.5	P1.5	P1.5	P1.5	P1.5	P1.5	P3.0	—	14	1.75
	40	N1.5	N1.5	N1.5	N1.5			P1.5	P1.5	P1.5	P1.5	P1.5	P1.5	P1.5	P1.5	P3.0	—	13	
.5	44	N1.5	N1.5	N1.5			P1.5	P1.5	P1.5	P1.5	P1.5	P1.5	P1.5	P1.5	P3.0	P3.0	—	12	2.0
	48	N1.5	N1.5			P1.5	P1.5	P1.5	P1.5	P1.5	P1.5	P1.5	P1.5	P1.5	P3.0	P3.0	—	11	
	56	N1.5				P1.5	P1.5	P1.5	P1.5	P1.5	P1.5	P1.5	P1.5	P1.5	P3.0	—	—	10	2.5
					P1.5	P1.5	P1.5	P1.5	P1.5	P1.5	P1.5	P1.5	P1.5	P1.5	P3.0	—	—	9	
				P1.5	P1.5	P1.5	P1.5	P1.5	P1.5	P1.5	P1.5	P1.5	P1.5	P3.0	P3.0	—	—	8	3.0
			P1.5	P1.5	P1.5	P1.5	P1.5	P1.5	P1.5	P1.5	P1.5	P1.5	P3.0	P3.0	—	—	—	7	3.5
		P1.5	P1.5	P1.5	P1.5	P1.5	P1.5	P1.5	P1.5	P1.5	P1.5	P3.0	P3.0	P3.0	—	—	—	6	4.0
		P1.5	P1.5	P1.5	P1.5	P1.5	P1.5	P1.5	P1.5	P1.5	P3.0	P3.0	—	—	—	—	—	5	5.0
MM	TPI	4	3-3/4	3-1/2	3-1/4	3	2-3/4	2-1/2	2-1/4	2	1-3/4	1-1/2	1-1/4	1	3/4	1/2	1/4	TP1	MM

▲ REVERSE THREADING (NEGATIVE HELIX) ▲

▼ NORMAL THREADING (POSITIVE HELIX) ▼

Normal Threading Toward The Chuck



RH Toolholder, RH Pos. Helix — *LH Bar, LH Pos. Helix* — *LH Toolholder, LH Pos. Helix* — *RH Bar, RH Pos. Helix*

Adjustable Helix Threading System

3. SELECT APPROPRIATE THREADING INSERT

Full Profile Inserts
The advantage of full profile threading inserts is that they provide a perfect thread with a complete profile without burrs.

Partial Profile Inserts
The advantage of partial profile inserts is that single insert may be utilized to cover a variety of thread pitches and can be utilized for external and internal applications.

4. SELECT INSERT GRADE/CUTTING SPEED

To determine recommended cutting speed (SFM) and grade, refer to chart below.

AISI Material Designation	*Recommended Cutting Speed Ft/Min*			
	M40	**M45**	**M50**	**M93**
Low Carbon Steels 1010, 1015, 1018, 1022, 1025, 1140 12L13, 12L14, 1035, 1040, 1042	100-350	125-400	350-600	450-750
High Carbon Steels 1095, 4130, 4140, 6150, 8620	100-300	125-350	250-400	350-500
High Alloy Steels O1, S1, W1, 4340, H13 A2, D2, M2, M7, M35	100-225	100-250	250-350	300-450
Free Machining Stainless Steels 303, 410, 410S, 416, 430	100-300	125-350	300-400	300-400
Difficult Machining Stainless Steels 304, 348, 420, 440C, 15-5PH, 17-4PH 310, 316, 316L, 317, 318, 321, 660	100-200	125-250	—	200-400
Cast Iron, Grey Iron, Alloy Cast Iron A48-20B, A47-32510, A48-25B, 60/40/18 A48-50B, , A48-60B	250-400	250-400	400-600	400-700
Nickel, Cobalt and Iron Based Superalloys under 38 Rc	100-200	100-250	125-250	150-300
Brass	200-500	250-500	400-700	400-700
Bronze	200-500	250-500	300-400	350-500
Copper	200-500	250-500	—	225-300
Aluminum	200-500	500-900	350-500	500-900
Titanium	75-175	100-200	200-300	150-250

Preferred selection shown in shaded box. If two selections are shown, check for stock status.

6. SELECT NUMBER OF PASSES/INFEED PER PASS

The following tables provide basic recommendations for threading in free machining steels with a hardness of below 320 HB (32Rc). The total number of passes may be adjusted slightly higher or lower for optimum performance as refined by trial.

If insert breakage should occur, the number of passes should be increased. If flank wear is excessive, the number of passes should be reduced.

UN Threads, External

Pitch TPI	5	6	7	8	9	10	11	12	13	14	16	18	20	24	28	32
Tot. depth in.	0.130	0.107	0.092	0.082	0.072	0.065	0.060	0.055	0.051	0.047	0.041	0.037	0.033	0.028	0.024	0.021
Pass 1 inch	0.017	0.014	0.014	0.012	0.011	0.011	0.011	0.011	0.010	0.009	0.009	0.009	0.008	0.007	0.007	0.007
2	0.016	0.013	0.013	0.011	0.010	0.010	0.010	0.010	0.009	0.009	0.008	0.008	0.007	0.007	0.006	0.006
3	0.014	0.011	0.010	0.010	0.008	0.008	0.008	0.008	0.007	0.007	0.006	0.006	0.006	0.006	0.004	0.005
4	0.012	0.009	0.009	0.008	0.007	0.007	0.007	0.007	0.007	0.006	0.006	0.006	0.005	0.005	0.004	0.003
5	0.010	0.009	0.008	0.007	0.007	0.006	0.006	0.006	0.006	0.005	0.005	0.005	0.004	0.003	0.003	
6	0.009	0.008	0.007	0.006	0.006	0.006	0.006	0.005	0.005	0.004	0.004	0.003	0.003			
7	0.008	0.007	0.007	0.006	0.006	0.005	0.005	0.005	0.004	0.004	0.003					
8	0.008	0.006	0.006	0.005	0.005	0.005	0.004	0.003	0.003	0.003						
9	0.007	0.006	0.006	0.005	0.005	0.004	0.003									
10	0.007	0.006	0.005	0.005	0.004	0.003										
11	0.007	0.005	0.004	0.004	0.003											
12	0.006	0.005	0.003	0.003												
13	0.005	0.004														
14	0.004	0.004														

UN Threads, Internal

Pitch TPI	5	6	7	8	9	10	11	12	13	14	16	18	20	24	28	32
Tot. depth in.	0.118	0.097	0.084	0.074	0.065	0.059	0.054	0.049	0.045	0.042	0.037	0.033	0.030	0.025	0.022	0.019
Pass 1 inch	0.017	0.014	0.013	0.012	0.011	0.011	0.011	0.011	0.010	0.009	0.009	0.009	0.008	0.007	0.007	0.007
2	0.015	0.013	0.013	0.011	0.010	0.010	0.009	0.009	0.008	0.007	0.007	0.007	0.006	0.006	0.005	0.005
3	0.013	0.010	0.009	0.009	0.007	0.007	0.007	0.007	0.006	0.006	0.006	0.006	0.005	0.005	0.004	0.004
4	0.011	0.008	0.008	0.007	0.006	0.006	0.006	0.006	0.005	0.005	0.005	0.005	0.004	0.004	0.003	0.003
5	0.009	0.007	0.007	0.006	0.006	0.005	0.005	0.005	0.005	0.004	0.004	0.003	0.004	0.003	0.003	
6	0.008	0.006	0.006	0.005	0.005	0.005	0.005	0.004	0.004	0.004	0.003	0.003	0.003			
7	0.007	0.006	0.006	0.005	0.005	0.004	0.004	0.004	0.004	0.004	0.003					
8	0.007	0.006	0.005	0.004	0.004	0.004	0.004	0.003	0.003	0.003						
9	0.006	0.005	0.005	0.004	0.004	0.004	0.003									
10	0.006	0.005	0.005	0.004	0.004	0.003										
11	0.005	0.005	0.004	0.004	0.003											
12	0.005	0.004	0.003	0.003												
13	0.005	0.004														
14	0.004	0.004														

ISO Metric Threads, External

Pitch TPI	5.0	4.5	4.0	3.5	3.0	2.5	2.0	1.75	1.5	1.25	1.0	.75	.50
Tot. depth in.	0.126	0.113	0.100	0.088	0.076	0.063	0.049	0.044	0.037	0.032	0.026	0.019	0.014
Pass 1 inch	0.016	0.015	0.013	0.013	0.011	0.011	0.009	0.008	0.008	0.008	0.008	0.006	0.005
2	0.015	0.013	0.013	0.012	0.010	0.009	0.009	0.008	0.008	0.007	0.006	0.006	0.004
3	0.013	0.011	0.010	0.010	0.008	0.008	0.007	0.007	0.007	0.006	0.005	0.004	0.003
4	0.011	0.009	0.009	0.008	0.007	0.007	0.006	0.006	0.006	0.004	0.004	0.003	0.002
5	0.010	0.009	0.008	0.008	0.007	0.006	0.006	0.005	0.005	0.004	0.003		
6	0.009	0.008	0.007	0.007	0.006	0.006	0.005	0.004	0.003	0.003			
7	0.009	0.008	0.007	0.006	0.006	0.005	0.004	0.003					
8	0.008	0.007	0.006	0.006	0.005	0.004	0.003	0.003					
9	0.007	0.007	0.006	0.006	0.005	0.004							
10	0.007	0.006	0.005	0.005	0.004	0.003							
11	0.006	0.006	0.005	0.004	0.004								
12	0.006	0.005	0.004	0.003	0.003								
13	0.005	0.005	0.004										
14	0.004	0.004	0.003										

ISO Metric Threads, Internal

Pitch TPI	5.0	4.5	4.0	3.5	3.0	2.5	2.0	1.75	1.5	1.25	1.0	.75	.50
Tot. depth in.	0.117	0.104	0.092	0.081	0.070	0.058	0.045	0.041	0.033	0.030	0.024	0.018	0.012
Pass 1 inch	0.017	0.015	0.013	0.013	0.011	0.010	0.009	0.009	0.008	0.007	0.007	0.006	0.004
2	0.016	0.013	0.012	0.012	0.010	0.010	0.008	0.007	0.007	0.007	0.006	0.005	0.003
3	0.013	0.011	0.009	0.009	0.008	0.007	0.007	0.006	0.006	0.006	0.004	0.004	0.003
4	0.010	0.009	0.008	0.007	0.006	0.006	0.006	0.005	0.005	0.004	0.004	0.003	0.002
5	0.009	0.008	0.007	0.007	0.006	0.005	0.005	0.004	0.004	0.003	0.003		
6	0.008	0.007	0.007	0.006	0.005	0.005	0.004	0.004	0.003	0.003			
7	0.007	0.006	0.006	0.006	0.005	0.004	0.003	0.003					
8	0.006	0.006	0.005	0.005	0.004	0.004	0.003	0.003					
9	0.006	0.006	0.005	0.005	0.004	0.004							
10	0.006	0.005	0.005	0.004	0.004	0.003							
11	0.005	0.005	0.004	0.004	0.004								
12	0.005	0.005	0.004	0.003	0.003								
13	0.005	0.004	0.004										
14	0.004	0.004	0.003										

Selection Guidelines

7. SELECT INFEED METHOD

In practice, always consider the workpiece material, the machine tool and the thread pitch in determining the preferred method of infeed.

For short chipping materials and when threading fine pitches, the infeed method selected is less critical.

When threading long chipping materials and coarse pitches, the infeed method selected becomes more critical.

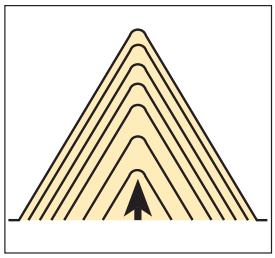
Following are shown three basic selections of infeed method.

Radial Infeed is the only method available on manual machines. It is the preferred method in work hardening materials.

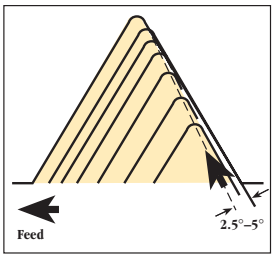
Modified Flank Infeed is the preferred method on all CNC Turning Centers. If this method cannot be applied use Standard Flank Infeed.

Incremental Infeed is less common and requires a special CNC program. This method is most suitable for long part run applications.

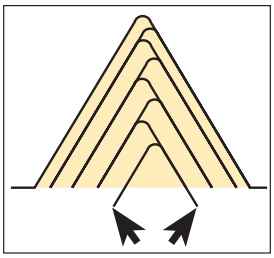
Radial Infeed



Modified Flank Infeed



Incremental Infeed



HELIX SELECTION FOR COMMON EXTERNAL THREADS

The following charts may be used for Quick Reference in selecting the Correct External Threading Helix for Common External Threads when threading toward the chuck, using the "normal threading" method.

Helix Angle Chart For Standard External UN Threads

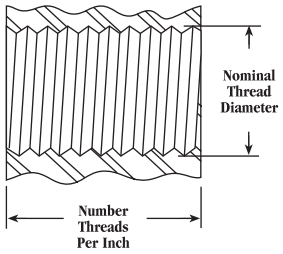
PART DIAMETER (inches)	PITCH (TPI)												
	32	28	24	20	18	16	14	13	12	11	10	9	8	7
1/4	P3.0	P3.0												
5/16	P1.5		P3.0											
3/8	P1.5		P3.0			P3.0								
7/16		P1.5		P3.0			P3.0							
1/2		P1.5		P1.5				P3.0						
9/16			P1.5		P1.5				P3.0					
5/8			P1.5		P1.5					P3.0				
3/4				P1.5		P1.5					P3.0			
7/8				P1.5			P1.5					P3.0		
1				P1.5					P1.5				P3.0	
1-1/8					P1.5				P1.5					P3.0
1-1/4					P1.5				P1.5					P3.0

Helix Angle Chart For Standard External ISO Metric Threads

PART DIAMETER (mm)	PITCH (mm)							
	1.0	1.25	1.5	1.75	2.0	2.5	3.0	3.5
6	P3.0							
7	P3.0							
8	P3.0	P3.0						
10		P3.0	P3.0					
12		P1.5		P3.0				
14			P1.5		P3.0			
16			P1.5		P3.0			
18			P1.5			P3.0		
20			P1.5			P3.0		
22			P1.5			P3.0		
24					P1.5		P3.0	
27					P1.5		P3.0	

Limits With Standard Inserts

INTERNAL THREADING
Pitch Range vs. Internal Diameter



Unified "J" Series Thread

The controlled root radius thread form (MIL-S-8879A) is defined for the external thread only.

To machine the corresponding internal thread, choose any internal full profile UN threading insert (per desired pitch).

Refer to Tables II-VII in MIL-S-8879A for the correct "J" thread minor diameter values on internal thread.

**** Requires insert and internal bar modification. A more coarse pitch per nominal thread size may be attained dependent on thread form and type of material.***

Nominal Thread Size	Insert Style 3/Range of TPI
1"	32-24
1-1/16"	32-18
1-1/8"	32-14
1-1/4"	32-12
1-5/16"	32-10
1-3/8"	32-10
1-7/16"	32-10
1-1/2"	32-8
1-9/16"	32-8
1-5/8"	32-8
1-3/4"	32-8
1-7/8"	32-8
2"	32-8
2-1/4"	32-8
2-1/2"	32-8
2-3/4"	32-8
3"	32-8

APPLICATIONS*

Material	Grade	Cutoff (Separator)		Grooving		Face Grooving	
		SFM	IPR	SFM	IPR	SFM	IPR
Carbon Steels	M40	100-350	.001-.004	100-350	.002-.004**	100-350	.001-.004
Low Carbon (less than .30% C)	M43	250-700	.001-.004	250-700	.002-.007		
AISI 1000, 1100 and 1200 Series	M45	125-400	.001-.004	125-400	.002-.004		
	M50	250-700	.001-.004	250-700	.002-.004	250-400	.001-.004
	M53			250-700	.004-.010**		
	M74			700-900	.001-.004		
	M93	300-800	.001-.004	300-900	.002-.007		
	C5	250-500	.001-.004	250-500	.002-.004	250-400	.001-.004
	GC	350-700	.001-.004	350-700	.002-.004	350-400	.001-.004
Carbon Steels	M40	100-350	.002-.005	100-350	.002-.005**	100-350	.002-.005
High Carbon (Greater than .30%C)	M43	250-700	.003-.007	250-700	.002-.005		
AISI 1000, 1100 and 1200 Series	M45	125-400	.002-.005	125-400	.002-.005		
	M50	250-700	.003-.007	250-500	.003-.006	250-400	.003-.006
	M53			250-600	.004-.012**		
	M74			700-900	.001-.004		
	M93	300-800	.003-.007	300-800	.003-.008		
	C5	250-450	.003-.006	250-450	.003-.006	250-400	.003-.006
	GC	350-700	.003-.005	250-550	.003-.006	350-400	.003-.005
Alloy Steels	M40	100-350	.001-.005	100-350	.002-.005**	100-350	.001-.005
Low Carbon (Less than .30%C)	M43	250-700	.002-.007	250-700	.003-.007		
AISI 1300, 4000, 5000, 6000,	M45	125-400	.001-.005	125-400	.002-.005		
8000 and 9000 Series	M50	250-600	.002-.007	250-600	.002-.007	250-400	.002-.006
	M53			250-600	.004-.012**		
	M74			700-900	.001-.004		
	M93	300-800	.002-.007	300-900	.003-.007		
	C5	250-500	.002-.006	250-500	.002-.006	250-400	.002-.006
	GC	350-600	.002-.005	300-600	.002-.005	300-400	.002-.005
Alloy Steels	M40	100-300	.002-.005	100-300	.002-.005**	100-300	.002-.005
High Carbon (Greater than .30%C)	M43	250-600	.003-.006	250-600	.003-.008		
AISI 1300, 4000, 5000, 6000,	M45	125-400	.002-.005	125-400	.002-.005		
8000 and 9000 Series	M50	250-600	.003-.006	250-500	.003-.005	250-400	.003-.006
	M53			250-600	.004-.012**		
	M74			700-900	.001-.004		
	M93	300-800	.003-.006	300-800	.003-.008		
	C5	250-450	.003-.005	250-450	.003-.006	250-400	.003-.005
	GC	350-600	.003-.005	250-550	.003-.005	350-400	.003-.005
Tool Steels	M40	100-200	.002-.005	100-200	.002-.005**	100-200	.002-.005
Example A-2, D-2, M-2, H-13	M43	150-300	.003-.006	150-350	.003-.007		
	M45	125-250	.002-.005	125-250	.002-.005		
	M50	150-300	.003-.006	150-300	.003-.005	150-300	.003-.006
	M53			250-350	.004-.008**		
	M74			400-600	.002-.004		
	M93	200-370	.003-.006	250-450	.003-.007		
	C5	180-250	.003-.006	180-250	.003-.005	180-250	.003-.006
	GC	220-300	.003-.005	220-300	.003-.005	220-300	.003-.005

APPLICATIONS

Material	Grade	Cutoff (Separator)		Grooving		Face Grooving	
		SFM	IPR	SFM	IPR	SFM	IPR
Martensitic Stainless Steels	M40	100-300	.001-.004	100-300	.002-.004**	100-300	.001-.004
400 Series	M43	250-450	.002-.007	250-450	.003-.007		
	M45	125-350	.002-.004	125-350	.002-.004		
	M50	250-500	.002-.007	250-500	.002-.007	250-400	.002-.006
	M53			350-500	.004-.012**		
	M74			400-600	.002-.004		
	M93	300-500	.002-.007				
	C5	250-400	.002-.006	250-400	.002-.006	250-400	.002-.006
	GC	350-500	.002-.006	350-500	.002-.005	350-400	.002-.006
Austenitic Stainless Steels	M40	100-200	.001-.005	100-200	.002-.005**	100-200	.001-.005
300 Series	M43	150-300	.002-.005	150-300	.003-.006		
	M45	125-250	.001-.005	125-250	.002-.005		
	M53			200-350	.004-.007		
	M74			300-500	.001-.003		
	M93			200-350	.002-.005		
	C2	200-250	.0025-.004	200-250	.0025-.004	200-250	.0025-.004
Low Machinability Alloys	M40	50-125	.002-.005	50-125	.002-.005	50-125	.002-.005
Iron, Nickel and Cobalt based	M43	70-200	.002-.005				
Example: Inconel™, Hastelloy™	M45	70-150	.002-.005	70-125	.002-.005		
	M93	90-240	.002-.004				
	C2	70-175	.003-.004	70-175	.003-.004	70-175	.003-.004
Non Ferrous Free Machining	M40	400+	.002-.010	400+	.002-.010	400+	.002-.010
Materials—Aluminum., Copper	M43	450+	.002-.010	450+	.002-.010		
And Zinc Based	M45	400+	.002-.010	400+	.002-.010		
	M93	500+	.002-.010				
	C2	500+	.002-.010	500+	.002-.010	500+	.002-.010
Titanium	M40	100-150	.002-.005	100-150	.002-.005	100-150	.002-.005
	M43	150-225	.002-.005				
	M45	125-175	.002-.005	125-175	.002-.005		
	M93	170-250	.002-.004				
	C2	150-250	.002-.004	150-250	.002-.004	150-250	.002-.004
Cast Irons	M40	400-500	.002-.010	400-600	.002-.010	400-500	.002-.010
Grey, Soft (20-30 Rc)	M43	400-600	.002-.010	500-800	.002-.010		
	M45	400-500	.002-.010	450-700	.002-.010		
	M93	800-1000	.002-.008				
	C2	500-600	.002-.008	500-800	.002-.008	500-600	.002-.008
	AlOx			800-1200	.002-.010	800-1200	.002-.008

For MTC applications, see page A21

***Feed rates higher for Chipmaker® 95*

Inconel is a trademark of Huntington Alloys.
Hastelloy is a trademark of Cabot Corporation.

CBN GROOVING APPLICATIONS

Material	Grade	SFM	IPR
Gray Cast Iron (180-270 Bhn)	CBN-CI	1500-3000	.002-.010
Hard Cast Iron (>400 Bhn)	CBN-CI	250-500	.002-.010
Hardened Steel (>450 Bhn)	CBN-HT	300-450	.002-.006
Superalloys (>350 Bhn)	CBN-CI	550-800	.002-.010
Sintered Iron	CBN-CI	300-600	.002-.010

CERAMIC GROOVING APPLICATIONS

Material	Grade	SFM	IPR
Gray Cast Iron (180-270 Bhn)	M70	500-2000	.002-.008
Hard Cast Iron (>400 Bhn)	M70	100-800	.002-.008
Hardened Steel	M70	100-400	.002-.005
Superalloys	M70	400-800	.002-.007

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