MICRO 100®

Single Form Thread Milling Guide

Single Form Threadmills are the most versatile threading tool due to their ability to mill multiple pitch sizes. Since they are used in a helical interpolation environment, specific machining parameters are needed to avoid deflection and breakage. These tools can be used successfully in materials ranging from Aluminum to Steels.

Speeds & Feeds calculations:
1. Determine the correct SFM and Chip Load (IPT) for the cutter and material
2. Calculate the Speed (RPM) and Linear Feed (IPM)
3. Adjust Linear Feed to account for helical interpolation of internal or external threads
4. Determine correct number of radial passes at full axial depth

Example: Tool # TM-375 to machine a 9/16-12 internal thread in 17-4 stainless steel

1. From Speeds & Feeds chart (next page), SFM is 150 and Chip Load (IPT) is .00051
2. Calculate Speed (RPM) and Linear Feed (IPM)

   RPM = (SFM x 3.82) / Cutter Diameter
   = (150 x 3.82) / .3750
   = 1528

   Linear Feed (IPM) = RPM x IPT x Number of Flutes
   = 1528 x .00051 x 4
   = 3.12

3. Adjust Linear Feed (use Table 1 to determine Major Thread Diameter)

   Adj Internal Feed = [(Major Thread Dia - Cutter Dia) / Major Thread Dia] x Linear Feed
   = [(.562 - .3750) / .562] x 3.12
   = 1.04

   Adj External Feed = [(Major Thread Dia + Cutter Dia) / Major Thread Dia] x Linear Feed
   = [(.562 + .3750) / .562] x 3.12
   = 5.20

4. Determine Number of Radial Passes using Table 1

   (Note: The number of passes should be based on the thread size of the tool, and not the machined part)

   For Easy Machinability = 2 Radial Pass at full Axial Depth
   For Moderate Machinability = 2 Radial Passes at full Axial Depth
   For Difficult Machinability = 3 Radial Passes at full Axial Depth

   Definitions:
   Easy Machinability materials include Non-Ferrous alloys and Leaded Steels
   Moderate Machinability materials include 200/300/400 Stainless Steels and Steels up to 35 Rc
   Difficult Machinability materials include Inconel, Titanium and Steels 36-45 Rc

5. Conclusion

   In this example, the tool would run at 1528 RPM, 1.04 IPM and make 2 Radial Passes

Setup & Use:
1. Check software and input proper feed values (Linear or Adjusted)
2. Choke up on tool
3. Minimize runout (consider entire system of spindle, collet, holders etc)
4. Minimize all vibration (consider tool holding, work holding, rpm "sweet spot" etc)
5. Break in tool by reducing feed rates by 25% on first 1-2 holes
6. Cutter should engage part using an arcing toolpath to avoid shock loading (see Table 2)
7. Climb mill for best finish and tool life (see Table 2)
8. Flush chips with coolant to avoid recutting

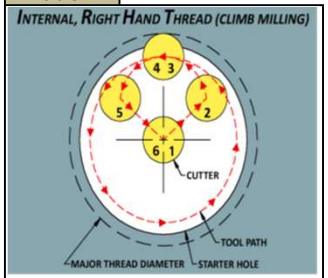
Table 1

Tool Thread Size	Major Thread Diameter	Number of Radial Passes*		
		Easy Machinabilty	Moderate Machinabilty	Difficult Machinabilty
00	0.047	2	3	4
0	0.060	2	3	4
1	0.073	2	3	4
2	0.086	2	3	3
3	0.099	2	3	3
4	0.112	2	3	4
5	0.125	2	3	3
6	0.138	2	3	4
8	0.164	2	2	3
10	0.190	2	3	4
12	0.216	2	2	3
1/4	0.250	2	2	3
5/16	0.312	2	2	3
3/8	0.375	2	2	3
7/16	0.437	2	2	3
1/2	0.500	2	2	3
9/16	0.562	2	2	3
5/8	0.625	2	2	3
3/4	0.750	2	2	3
7/8	0.875	2	2	3
1	1.000	2	3	4

* Number of Radial Passes are based on the coarsest pitch by thread size. For finer pitches, the number of passes may be reduced by 1 pass.

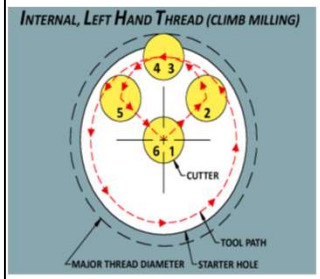
Table 2

INTERNAL, RIGHT HAND THREAD (CLIMB MILLING)



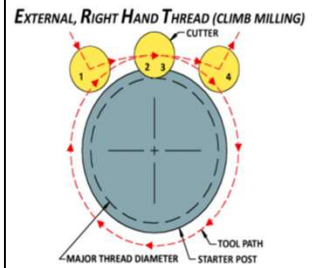
Step 1-2: Cutter moves into position
Step 2-3: Cutter engages part with arcing tool path while "Z" feeds up from bottom
Step 3-4: Cutter moves helically
Step 4-5: Cutter exits part along arcing tool path while maintaining "Z" feed
Step 5-6: Cutter returns to center

INTERNAL, LEFT HAND THREAD (CLIMB MILLING)



Step 1-2: Cutter moves into position
Step 2-3: Cutter engages part with arcing tool path while "Z" feeds down from top
Step 3-4: Cutter moves helically
Step 4-5: Cutter exits part along arcing tool path while maintaining "Z" feed
Step 5-6: Cutter returns to center

EXTERNAL, RIGHT HAND THREAD (CLIMB MILLING)



Step 1-2: Cutter engages part with arcing tool path while "Z" feeds down from top
Step 2-3: Cutter moves helically
Step 3-4: Cutter exits part along arcing tool path while maintaining "Z" feed

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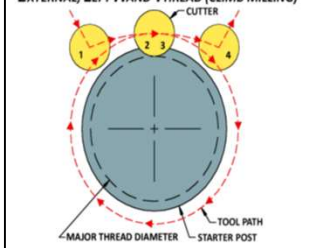
EXTERNAL, LEFT HAND THREAD (CLIMB MILLING)



Step 1-2: Cutter engages part with arcing tool path while "Z" feeds up from bottom
Step 2-3: Cutter moves helically
Step 3-4: Cutter exits part along arcing tool path while maintaining "Z" feed

MATERIAL	SFM	Hardness: ≤ 28 Rc (≤ 271 HBn) Chip Load (IPT) By Cutter Diameter								Depth of Cut
			0.250	0.312	0.375	0.437	0.500	0.625	0.750	1.000	Passes
ALUMINUM ALLOYS Casting (2xx, 5xx, 7xx, 8xx)	750	Deburring	.00198	.00273	.00329	.00383	.00438	.00548	.00657	.00876	1
		Front/Back Chamfer	.00165	.00228	.00274	.00319	.00365	.00456	.00548	.00730	2
Wrought (1xxx, 2xxx, 3xxx, 5xxx, 6xxx, 7xxx, 8xxx)	1000	V-Groove	.00124	.00171	.00205	.00239	.00274	.00342	.00411	.00548	3
Casting - 3%-5% Si (3xx, A3xx, C3xx, 4xx, A4xx, B4xx)	750	Deburring	.00178	.00246	.00296	.00345	.00394	.00493	.00591	.00788	1
Casting - 5%-8% Si (3xx, A3xx, C3xx, 4xx, A4xx, B4xx)	700										
Casting - 8%-12% Si (3xx, A3xx, C3xx, 4xx, A4xx, B4xx)	650	Front/Back Chamfer	.00149	.00205	.00246	.00287	.00329	.00411	.00493	.00657	2
Casting - 12%-16% Si (3xx, A3xx, C3xx, 4xx, A4xx, B4xx)	475										
Wrought - 5%-8% Si (4xxx)	1000	V-Groove	.00111	.00154	.00185	.00215	.00246	.00308	.00370	.00493	3
Wrought - 8%-12% Si (4xxx)	800										
MAGNESIUM ALLOYS	1500	Deburring	.00198	.00273	.00329	.00383	.00438	.00548	.00657	.00876	1
		Front/Back Chamfer	.00165	.00228	.00274	.00319	.00365	.00456	.00548	.00730	2
ZINC ALLOYS	800	V-Groove	.00124	.00171	.00205	.00239	.00274	.00342	.00411	.00548	3
COPPER ALLOYS High Coppers - 90%+ (C1xxxx)	225	Deburring	.00158	.00219	.00263	.00306	.00350	.00438	.00526	.00701	1
Brass (Copper Zinc alloys, C2xxxx, C3xxxx, C4xxxx, C66400-C69800)	500										
Phosphor Bronzes (Copper Tin alloys, C5xxxx)	225										
Aluminum Bronzes (Copper Aluminum alloys, C60600-C64200)	500	Front/Back Chamfer	.00132	.00182	.00219	.00255	.00292	.00365	.00438	.00584	2
Silicon Bronzes (Copper Silicon alloys, C64700-C66100)	500										
Copper Nickels, Nickel Silvers (Copper Nickel alloys, C7xxxx)	225										
Cast Copper Alloys (C83300-C86200, C86400-C87900, C92200-C95800, C97300-C97800, C99400-C99700)	550	V-Groove	.00099	.00137	.00164	.00191	.00219	.00274	.00329	.00438	3

MATERIAL	SFM	Hardness: 29-37 Rc (279-344 HBn) Chip Load (IPT) By Cutter Diameter								Depth of Cut
			0.250	0.312	0.375	0.437	0.500	0.625	0.750	1.000	Passes
CARBON STEELS Free-Machining/Low Carbon steels, 10xx - 1029 & all 10Lxx, 11xx - 1139 & all 11Lxx, 12xx - 1215 & all 12Lxx	600	Deburring	.00084	.00118	.00142	.00165	.00189	.00236	.00284	.00378	1
		Front/Back Chamfer	.00070	.00098	.00118	.00138	.00158	.00197	.00236	.00315	3
		V-Groove	.00053	.00074	.00089	.00103	.00118	.00148	.00177	.00236	4
1030 - 1095, 1140 - 1151, 13xx, 15xx, 2xxx, 3xxx, 4xxx & 4xLxx, 5xxx & 5xLxx, 50xxx & 50Lxxx, 51xxx & 51Lxxx, 52xxx & 52Lxxx, 6xxx, 8xxx, 9xxx	200	Deburring	.00077	.00108	.00130	.00151	.00173	.00216	.00259	.00346	1
		Front/Back Chamfer	.00064	.00090	.00108	.00126	.00144	.00180	.00216	.00288	3
		V-Groove	.00048	.00067	.00081	.00094	.00108	.00135	.00162	.00216	4
TOOL STEELS A, L, O, P, W series	200	Deburring	.00077	.00108	.00130	.00151	.00173	.00216	.00259	.00346	1
		Front/Back Chamfer	.00064	.00090	.00108	.00126	.00144	.00180	.00216	.00288	3
		V-Groove	.00048	.00067	.00081	.00094	.00108	.00135	.00162	.00216	4
D, H, M, T, S series	150	Deburring	.00048	.00067	.00081	.00094	.00108	.00135	.00162	.00216	1
		Front/Back Chamfer	.00040	.00056	.00068	.00079	.00090	.00113	.00135	.00180	3
		V-Groove	.00030	.00042	.00051	.00059	.00068	.00084	.00101	.00135	4
STAINLESS STEELS 203 EZ, 303 (all types), 416, 416Se, 416 Plus X, 420F, 420FSe, 430F, 430FSe, 440F, 440FSe	450	Deburring	.00084	.00118	.00142	.00165	.00189	.00236	.00284	.00378	1
		Front/Back Chamfer	.00070	.00098	.00118	.00138	.00158	.00197	.00236	.00315	3
		V-Groove	.00053	.00074	.00089	.00103	.00118	.00148	.00177	.00236	4
201, 202, 203, 205, 301, 302, 304, 304L, 308, 309, 310, 314, 316, 316L, 317, 321, 329, 330, 347, 348, 385, 403, 405, 409, 410, 413, 420, 429, 430, 434, 436, 442, 446, 501, 502	200	Deburring	.00077	.00108	.00130	.00151	.00173	.00216	.00259	.00346	1
		Front/Back Chamfer	.00064	.00090	.00108	.00126	.00144	.00180	.00216	.00288	3
		V-Groove	.00048	.00067	.00081	.00094	.00108	.00135	.00162	.00216	4
414, 431, 440A, 440B, 440C, 13-8, 15-5, 15-7, 17-4, 17-7	150	Deburring	.00048	.00067	.00081	.00094	.00108	.00135	.00162	.00216	1
		Front/Back Chamfer	.00040	.00056	.00068	.00079	.00090	.00113	.00135	.00180	3
		V-Groove	.00030	.00042	.00051	.00059	.00068	.00084	.00101	.00135	4
TITANIUM ALLOYS	150	Deburring	.00048	.00067	.00081	.00094	.00108	.00135	.00162	.00216	1
		Front/Back Chamfer	.00040	.00056	.00068	.00079	.00090	.00113	.00135	.00180	3
		V-Groove	.00030	.00042	.00051	.00059	.00068	.00084	.00101	.00135	4
HIGH TEMP ALLOYS Inconel, Hastelloy, Waspalloy, Monel, Nimonic, Haynes, Discoloy, Incoloy	70	Deburring	.00048	.00067	.00081	.00094	.00108	.00135	.00162	.00216	1
		Front/Back Chamfer	.00040	.00056	.00068	.00079	.00090	.00113	.00135	.00180	3
		V-Groove	.00030	.00042	.00051	.00059	.00068	.00084	.00101	.00135	4

SFM	Hardness: 38-45 Rc (353-421 HBn) Chip Load (IPT) By Cutter Diameter									Depth of Cut
		0.250	0.312	0.375	0.437	0.500	0.625	0.750	1.000	Passes
-	-	-	-	-	-	-	-	-	-	-
	-	-	-	-	-	-	-	-	-	-
	-	-	-	-	-	-	-	-	-	-
-	-	-	-	-	-	-	-	-	-	-
	-	-	-	-	-	-	-	-	-	-
	-	-	-	-	-	-	-	-	-	-
100	Deburring	.00077	.00108	.00130	.00151	.00173	.00216	.00259	.00346	1
	Front/Back Chamfer	.00064	.00090	.00108	.00126	.00144	.00180	.00216	.00288	4
	V-Groove	.00048	.00067	.00081	.00094	.00108	.00135	.00162	.00216	5
90	Deburring	.00048	.00067	.00081	.00094	.00108	.00135	.00162	.00216	1
	Front/Back Chamfer	.00040	.00056	.00068	.00079	.00090	.00113	.00135	.00180	4
	V-Groove	.00030	.00042	.00051	.00059	.00068	.00084	.00101	.00135	5
-	-	-	-	-	-	-	-	-	-	-
	-	-	-	-	-	-	-	-	-	-
	-	-	-	-	-	-	-	-	-	-
100	Deburring	.00077	.00108	.00130	.00151	.00173	.00216	.00259	.00346	1
	Front/Back Chamfer	.00064	.00090	.00108	.00126	.00144	.00180	.00216	.00288	4
	V-Groove	.00048	.00067	.00081	.00094	.00108	.00135	.00162	.00216	5
90	Deburring	.00048	.00067	.00081	.00094	.00108	.00135	.00162	.00216	1
	Front/Back Chamfer	.00040	.00056	.00068	.00079	.00090	.00113	.00135	.00180	4
	V-Groove	.00030	.00042	.00051	.00059	.00068	.00084	.00101	.00135	5
75	Deburring	.00048	.00067	.00081	.00094	.00108	.00135	.00162	.00216	1
	Front/Back Chamfer	.00040	.00056	.00068	.00079	.00090	.00113	.00135	.00180	4
	V-Groove	.00030	.00042	.00051	.00059	.00068	.00084	.00101	.00135	5
50	Deburring	.00048	.00067	.00081	.00094	.00108	.00135	.00162	.00216	1
	Front/Back Chamfer	.00040	.00056	.00068	.00079	.00090	.00113	.00135	.00180	4
	V-Groove	.00030	.00042	.00051	.00059	.00068	.00084	.00101	.00135	5

MICRO 100®

Speeds & Feeds

Product Table: Thread Milling Cutters - Single Form - UN Threads - Reduced Shank
Characteristics: 60°-90° Included Angle
Series: TM-XXX

Product notes:

Chip Loads are given 3 ways:
Deburring: Generating an Edge Break of .005"-.008"
Front/Back Chamfer: Full chamfer generation using front or back of the cutter head
V-Groove: Assumes engagement on the point, front and back of the cutter head

Depth of Cut is shown as number of Passes with each pass resulting in a reduced percentage stepover as shown in Table 3.

TABLE 3

Radial Passes	Percentage of CUTTER'S Maximum Radial Depth of Cut				
2	70%	30%			
3	50%	30%	20%		
4	46%	25%	18%	11%	
5	46%	25%	16%	8%	5%

General notes:

All posted speed and feed parameters are suggested starting values that may be increased given optimal setup conditions. Chip loads reflect uncoated cutters and may be increased 10%-20% if coated. For ferrous materials with hardness ≤ 28 Rc, chip loads can be increased 10%-20%.

If you require additional information, Micro100 has a team of technical experts available to assist you through even the most challenging applications. Please contact us at **800-421-8065** or **micro100tech@harveyperformance.com**.

WARNING: Cutting tools may shatter under improper use. Government regulations require use of safety glasses and other appropriate safety equipment in the vicinity of use.