

# 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. Adjust Chip Load to account for max depth of thread to neck diameter ratio.
- 3. Calculate the Speed (RPM) and Linear Feed (IPM)
- 4. Adjust Linear Feed to account for helical interpolation of internal or external threads
- 5. Determine correct number of radial passes at full axial depth

Example: Tool V952299 to machine a 4-40 internal thread in 17-4 stainless steel

- 1. From Speeds & Feeds chart (next page), SFM is 150 and Chip Load (IPT) is .00022
- 2. Calculate the max depth of thread to neck diameter ratio. Calculate adjusted chip load based on values in Table 3

```
Neck Length Multiple = (Max depth of thread / Neck Diameter)
                     = (0.25" / 0.04")
                     = 6.25 \approx 6
Adjusted Chip Load = Adjustment factor x Base Chip Load
                     = 0.95 \times .00022 IPT
                     = .00021 IPT
```

3. Calculate Speed (RPM) and Linear Feed (IPM)

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RPM = (SFM \times 3.82) / Cutter Diameter
     = (150 \times 3.82) / .080
     = 7162
Linear Feed (IPM) = RPM x IPT x Number of Flutes
                    = 7162 \times .00021 \times 2
                    = 3.01
```

4. 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
                  = [(.112 - .080) / .112] \times 3.01
                  = 0.86
Adj External Feed = [(Major Thread Dia + Cutter Dia) / Major Thread Dia] x Linear Feed
                   = [(.112 + .080) / .112] \times 3.01
                   = 5.16
```

5. 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 = 3 Radial Passes at full Axial Depth
For Difficult Machinability = 4 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 7162 RPM, 0.86 IPM and make 3 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

Tool	Major	Number of Radial Passes*						
Thread	Thread	Easy	Moderate	Difficult Machinabilty				
Size	Diameter	Machinabilty	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				

Table 1

\* 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 3									
Neck Length Multiple	Chip Load Adjustment Factor								
3x	1.15								
4x	1.07								
5x	1.00								
6x	0.95								
7x	0.90								
8x	0.85								
9x	0.70								
10x	0.65								
11x	0.60								
13x	0.50								

# 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)

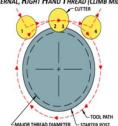
Step 1-2: Cutter moves into position

Step 2-3: Cutter engages part with arcing tool nath while "7" 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

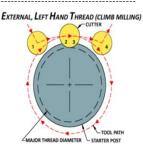
EXTERNAL, RIGHT HAND THREAD (CLIMB MILLING)



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



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



Characteristics: UN, Metric

Hardened Steels:

For 46-54 Rc: 130 SFM, 75% of IPT (from 29-37 Rc section) 3-4 Radial Passes at full Axial Depth

For 55-60 Rc: 80 SFM, 50% of IPT (from 29-37 Rc section) 4-5 Radial Passes at full Axial Depth

Carbon Steel   100X, 110X, 120X, 121X, ASTM A27   29-37 Rc (279-344 HBm)   600   0.0011   0.0015   0.0019   0.0022   0.0030   0.0067   0.0000   0.0140   0.0169   0.0025   0.028	Material Guide		Hardness		Chip Load (IPT) By Cutter Diameter												
Carbon Seel   ASTM A3B   29-37 Rc (279-944 HBn)   600   .00011   .00015   .00019   .00022   .00030   .00067   .00090   .00140   .00159   .00225   .00030   .00067   .00090   .00140   .00159   .00225   .00030   .00067   .00090   .00140   .00159   .00225   .00030   .00067   .00090   .00140   .00159   .00225   .00030   .00067   .00090   .00140   .00159   .00225   .00030   .00067   .00090   .00110   .00150   .00070				SFM	3/64	1/16	5/64	3/32	1/8	3/16	1/4	5/16	3/8	1/2	5/8	3/4	
Tool Steel  A, L, O, P, W series  29-37 kc (279-344 H8n) 200  00011  00011  00011  00011  00011  00013  00010  00011  00013  00010  00011  00013  00010  00011  00010  00011  00010  000	,	Steel		29-37 Rc (279-344 HBn)	600	.00011	.00015	.00019	.00022	.00030	.00067	.00090	.00140	.00169	.00225	.00281	.00338
A. L. O. F., Wiseries   38.45 Rc (353-421 Her)   100   0.0011   0.0014   0.0018   0.0021   0.0022   0.0030   0.0045   0.00066   0.0010   0.0012   0.0015   0.0019	13XX, 41XX	by Steel 13	3XX, 41XX, 43XX, 51XX, 86XX, 93XX	29-37 Rc (279-344 HBn)	200	.00011	.00015	.00019	.00022	.00030	.00067	.00090	.00125	.00150	.00200	.00250	.00300
38-45 Rc (333-421 HBn)   200   0.0011   .00018   .00021   .00028   .00030   .00045   .00056   .00093   .00112   .00150   .0018   .00028   .00028   .00030   .00045   .00056   .00030   .00045   .00056   .00030   .00045   .00056   .00030   .00045   .00056   .00030   .00045   .00056   .00038   .00051   .00038   .00051   .00038   .00051   .00038   .00051   .00038   .00051   .00038   .00058   .00038   .00051   .00072   .00038   .00051   .00072   .00038   .00051   .00072   .00038   .00051   .00072   .00038   .00051   .00072   .00038   .00051   .00072   .00038   .00051   .00072   .00038   .00051   .00072   .00038   .00051   .00072   .00038   .00051   .00072   .00038   .00051   .00072   .00038   .00051   .00072   .00038   .00051   .00072   .00038   .00051   .00072   .00038   .00051   .00072   .00038   .00051   .00072   .00038   .00051   .00072   .00038   .00051   .00072   .00038   .00051   .00052   .00038   .00051   .00052   .00038   .00051   .00052   .00038   .00051   .00052   .00038   .00051   .00052   .00052   .00052   .00052	ALOPY	А	I O P W series			.00012	.00016	.00021	.00025	.00033	.00049	.00066	.00110	.00132	.00176	.00220	.00264
0, H, M, T, S series 0, H, M, T, S series 343-878 (G 2574-21HeR) 90 00010 00010 00013 00016 00019 00022 00038 0001 00088 0011 00088 00112 0012 00136 00102 00136 0	,, ,, ,,,,,		, -, -, -, - ,													.00187	.00224
Austenitic Stainless Steel Nitronic 50, Nitronic 60, 301, 303, 304, 304, Incolory 27-7Mo, 316, 3121, 347  Mattensitic & Ferritic Stainless Steel (Stainless Steel)  PH Stainless Steel Stainless Steel (Stainless Steel)  15-5, 17-4, Carpenter 450, Carpenter 450, Carpenter 450, Carpenter 465  Nickel Alloy  15-8, 17-4, Carpenter 450, 38-45 Rc (353-421 HBn) 70	D. H. M. T.		. H. M. T. S series													.00200	.00240
Austenitic Stainless Steel 303, 3041, inclore) 27-7MO, 316, 3161, 321, 347  Martensitic & Ferritic Stainless Steel 403, 410, 416, 420, 440, 430, 446 403, 410, 410, 440, 430, 446 403, 410, 416, 420, 440, 430, 446 403, 410, 416, 420, 440, 430, 446 403, 410, 416, 420, 440, 430, 446 403, 410, 416, 420, 440, 430, 446 403, 410, 416, 420, 440, 430, 446 403, 410, 416, 420, 440, 430, 446 403, 410, 416, 420, 440, 430, 446 403, 410, 416, 420, 440, 430, 440, 430, 446 404, 410, 410, 410, 410, 410, 410, 410,				38-45 Rc (353-421 HBn)	90	.00010	.00013	.00016	.00019	.00026	.00038	.00051	.00085	.00102	.00136	.00170	.00204
Stainless Steel   403, 410, 416, 420, 440, 430, 446   38-45 Rc (353-421 HBn)   100   .00010   .00013   .00016   .00019   .00026   .00038   .00051   .00080   .00096   .00128   .0015	304, 304L,	ainless Steel 30	04, 304L, Incoloy 27-7MO, 316,	29-37 Rc (279-344 HBn)	450	.00011	.00015	.00019	.00022	.00030	.00067	.00090	.00140	.00169	.00225	.00281	.00338
Stainless Steel   38.45 Rc (353-421 Hbn)   100   .00010   .00013   .00016   .00019   .00026   .00038   .00051   .00080   .00096   .00128   .0015	402 410 /	& Ferritic	03 410 416 430 440 430 446	29-37 Rc (279-344 HBn)	200	.00011	.00015	.00019	.00022	.00030	.00045	.00060	.00094	.00113	.00150	.00188	.00225
Nickel Alloy   Hastelloy C-22, Incone (625, Waspaloy, René 41, Incone) 78, Incoloy 20   138-45 Rc (353-421 HBn)   90   .00010   .00013   .00016   .00019   .00026   .00038   .00051   .00072   .00086   .00115   .0014	403, 410, 2	s Steel	403, 410, 416, 420, 440, 430, 446	38-45 Rc (353-421 HBn)	100	.00010	.00013	.00016	.00019	.00026	.00038	.00051	.00080	.00096	.00128	.00159	.00191
Carpenter 465   38-45 Rc (353-421 HBn)   90   .00010   .00013   .00016   .00019   .00026   .00038   .00051   .00072   .00086   .00115   .0014	15-5, 17-4,	15	1 1 1 1	29-37 Rc (279-344 HBn)	150	.00011	.00015	.00019	.00022	.00030	.00045	.00060	.00084	.00101	.00135	.00169	.00203
Nickel Alloy   Waspaloy, René 41, Inconel 718, Incoloy 20   29-37 Rc (279-344 HBh)   70   .00014   .00014   .00015   .00017   .00023   .00033   .00049   .00066   .00096   .00083   .00111   .00154   .0019    Titanium Alloy   Titanium Alloy   Titanium Alloy   Titanium Alloy   Titanium Alloy   Titanium Alloy   2014, 5062, 6061, 7050, 7075, 7475   \$28 Rc (353-421 HBh)   75   .00011   .00014   .00018   .00021   .00025   .00033   .00049   .00066   .00096   .00083   .00111   .00154   .00166   .00096   .00084   .00166   .00096   .00084   .00166   .00096   .00084   .00166   .00096   .00084   .00166   .00096   .00084   .00166   .00096   .00084   .00166   .00096   .00084   .00166   .00096   .00084   .00166   .00096   .00084   .00166   .00096   .00084   .00166   .00096   .00084   .00166   .00096   .00084   .00166   .00096   .00086	Carpenter	ca Ca		38-45 Rc (353-421 HBn)	90	.00010	.00013	.00016	.00019	.00026	.00038	.00051	.00072	.00086	.00115	.00143	.00172
Incoloy 20   38-45 Rc (353-421 HBn)   50   .00009   .00012   .00015   .00017   .00023   .00035   .00047   .00069   .00083   .00111   .00134			Waspaloy, René 41, Inconel 718,	29-37 Rc (279-344 HBn)	70	.00010	.00014	.00017	.00020	.00028	.00041	.00055	.00081	.00098	.00130	.00163	.00195
Titanium Alloy  Ti 3Al-2.5V, Ti 6Al-4V, Ti 10V-2Fe-3Al  29-37 Rc (279-344 HBn)  75  .00011  .00012  .00016  .00012  .00016  .00011  .00018  .00021  .00025  .00033  .00049  .00066  .00066  .00066  .00066  .00066  .00066  .00082  .00082  .00082  .00082  .00084  .00113  .0016  .00114  .0018  .0018  .00172  .00206  .00275  .0034  .0036  .00376  .00101  .00154  .00186  .0036  .00376  .0038  .0038  .00398  .00113  .00172  .00206  .00275  .0038  .00398  .0		*		38-45 Rc (353-421 HBn)	50	.00009	.00012	.00015	.00017	.00023	.00035	.00047	.00069	.00083	.00111	.00138	.00166
38-45 Rc (353-421 HBn) 75				29-37 Rc (279-344 HBn)	150	.00012	.00016	.00021	.00025	.00033	.00049	.00066	.00096	.00116	.00154	.00193	.00231
Wrought Aluminum Alloy       5% - 8% Si (4XXX)       ≤ 28 Rc (≤ 271 HBn)       1000       .00014       .00018       .00022       .00027       .00036       .00076       .00101       .00154       .00186       .00248       .0030         Cast Aluminum Alloy       5% - 8% Si (4XXX)       5% - 8% Si (3XX, A3XX, C3XX, 4XX, A4XX, B4XX)       750       .00015       .00020       .00025       .00030       .00040       .00084       .00113       .00172       .00206       .00275       .0034         Cast Aluminum Alloy       5% - 8% Si (3XX, A3XX, C3XX, 4XX, A4XX, B4XX)       5% - 8% Si (3XX, A3XX, C3XX, 4XX, A4XX, B4XX)       5% - 8% Si (3XX, A3XX, C3XX, 4XX, A4XX, A4XX, B4XX)       50014       .00018       .0002       .00027       .00036       .00076       .00101       .00154       .00166       .00248       .0030         8% - 12% Si (3XX, A3XX, C3XX, AXX, A4XX, B4XX)       5% - 12% Si (3XX, A3XX, C3XX, 4XX, A4XX, B4XX)       650       .00014       .00018       .00022       .00027       .00036       .00076       .00101       .00154       .00186       .00248       .0030         12% - 16% Si (3XX, A3XX, C3XX, 4XX, A	Ti 3Al-2.5V	n Alloy II		38-45 Rc (353-421 HBn)	75	.00011	.00014	.00018	.00021	.00028	.00042	.00056	.00082	.00098	.00131	.00164	.00196
Second	2014, 5062	20	014, 5062, 6061, 7050, 7075, 7475	≤ 28 Rc (≤ 271 HBn)	1000	.00015	.00020	.00025	.00030	.00040	.00084	.00113	.00172	.00206	.00275	.00344	.00413
8% - 12% Si (4XXX)  319.0, 328.0, 355.0, 360.0, 380.0, 380.0, 380.0, 383.0, 390.0, 520.0, 535.0  38 - 5% Si (3XX, A3XX, C3XX, 4XX, A4XX, B4XX)  5% - 8% Si (3XX, A3XX, C3XX, 4XX, A4XX, B4XX)  8% - 12% Si (3XX, A3XX, C3XX, 4XX, A4XX, B4XX)  12% - 16% Si (3XX, A3XX, C3XX, 4XX, A4XX, A4XX, B4XX)  12% - 16% Si (3XX, A3XX, C3XX, 4XX, A4XX, A4XX, B4XX)  12% - 16% Si (3XX, A3XX, C3XX, 4XX, A4XX, B4XX)  12% - 16% Si (3XX, A3XX, C3XX, 4XX, A4XX, A4XX, B4XX)  12% - 16% Si (3XX, A3XX, C3XX, 4XX, A4XX, A4XX, B4XX)  12% - 16% Si (3XX, A3XX, C3XX, 4XX, A4XX, A4XX, A4XX, B4XX)  12% - 16% Si (3XX, A3XX, C3XX, 4XX, A4XX, A4XX, A4XX, A4XX, B4XX)  12% - 16% Si (3XX, A3XX, C3XX, 4XX, A4XX, A4XX, A4XX, A4XX, B4XX)  12% - 16% Si (3XX, A3XX, C3XX, 4XX, A4XX, A4XX	y 5% - 8% Si	minum Alloy 59	% - 8% Si (4XXX)		1000	00014	00019	00022	00027	00036	00076	00101	00154	00196	00349	.00309	.00371
383.0, 390.0, 520.0, 535.0 3% - 5% Si (3XX, A3XX, C3XX, 4XX, A4XX, B4XX) 5% - 8% Si (3XX, A3XX, C3XX, 4XX, A4XX, B4XX) 3% - 12% Si (3XX, A3XX, C3XX, 4XX, A4XX, B4XX) 12% - 16% Si (3XX, A3XX, C3XX, 4XX, A4XX, B4XX) 12% - 16% Si (3XX, A3XX, C3XX, 4XX, A4XX, B4XX) 12% - 16% Si (3XX, A3XX, C3XX, 4XX, A475	8% - 12% Si (4XXX)	89		800	.00014	.00010	.00022	.00027	.00056	.00076	.00101	.00134	.00100	.00248	.00309	.003/1	
A4XX, B4XX)  5% - 8% Si (3XX, A3XX, C3XX, 4XX, A4XX, B4XX)  8% - 12% Si (3XX, A3XX, C3XX, 4XX, A4XX, B4XX)  12% - 16% Si (3XX, A3XX, C3XX, 4XX, A4XX, B4XX)  12% - 16% Si (3XX, A3XX, C3XX, 4XX, A4XX, B4XX)  12% - 16% Si (3XX, A3XX, C3XX, 4XX, A4XX, B4XX)  12% - 16% Si (3XX, A3XX, C3XX, 4XX, A4XX, B4XX)				≤ 28 Rc (≤ 271 HBn)	750	.00015	.00020	.00025	.00030	.00040	.00084	.00113	.00172	.00206	.00275	.00344	.00413
A4XX, B4XX)  8% - 12% Si (3XX, A3XX, C3XX, 4XX, A4XX)  12% - 16% Si (3XX, A3XX, C3XX, 4XX, A4XX)  475			, , , , ,		750	00014	.00018	.00022	.00027	.00036	.00076	.00101	.00154		.00248	.00309	.00371
8% - 12% Si (3XX, A3XX, C3XX, 4XX, A4XX, B4XX) 12% - 16% Si (3XX, A3XX, C3XX, 4XX,		num Allov	, , , , ,		700									.00186			
4/5			, , , , ,		650												
A4XX, B4XX)					475												
Copper Alloy  Cu-ETP, CuBe2, CuZn30, CuZn36Pb3, CuZn10, CuSn5  ≤ 28 Rc (≤ 271 HBn)  225-550  .00014  .00019  .00024  .00029  .00038  .00068  .00091  .0014  .00173  .00231  .0028		r Allov		≤ 28 Rc (≤ 271 HBn)	225-550	.00014	.00019	.00024	.00029	.00038	.00068	.00091	.00144	.00173	.00231	.00288	.00346
Magnesium Alloys ≤28 Rc (≤271 HBn) 1500 .00015 .00020 .00025 .00030 .00040 .00084 .00113 .00172 .00206 .00275 .0034		ım Alloys		∠ 20 Dc /∠ 271 ⊔Dc\	1500	00015	00030	00025	00030	00040	00084	00112	00172	00206	00275	.00344	.00413
≤ 28 Rc (≤ 271 HBn)		lloys		≥ 20 KC (≥ 2/1 HBN)	800	.00013	.00020	.00025	.00050	.00040	.00064	.00113	.001/2	.00200	.002/3	.00544	.00413

### **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, Valor Holemaking has a team of technical experts available to assist you through even the most challenging applications. Please contact us at 866-840-1505 or Valortech@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.