# VALOR™ HOLEMAKING

## 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 ≈ 6

   Adjusted Chip Load = Adjustment factor x Base Chip Load
   = 0.95 x .00022 IPT
   = .00021 IPT

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

   RPM = (SFM x 3.82) / Cutter Diameter
   = (150 x 3.82) / .080
   = 7162

   Linear Feed (IPM) = RPM x IPT x Number of Flutes
   = 7162 x .00021 x 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] x 3.01
   = 0.86

   Adj External Feed = [(Major Thread Dia + Cutter Dia) / Major Thread Dia] x Linear Feed
   = [(.112 + .080) / .112] x 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

**Table 1**

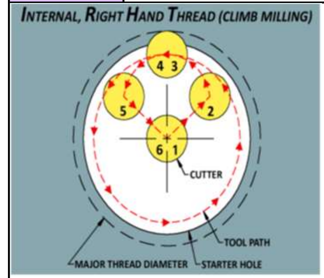
| Tool Thread Size | Major Thread Diameter | Number of Radial Passes* | | |
|---|---|---|---|---|
| | | Easy Machinabilty | Moderate Machinabilty | Difficult Machinabilty |
| 00 | 0.047 | 2 | 3 | 4 |
| 0 | 0.060 | 2 | 3 | 4 |
| 1 | 0.073 | 2 | 3 | 4 |
| 2 | 0.086 | 2 | 3 | 3 |
| 3 | 0.099 | 2 | 3 | 3 |
| 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.

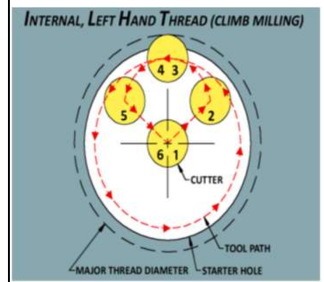
**Table 3**

| 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 |

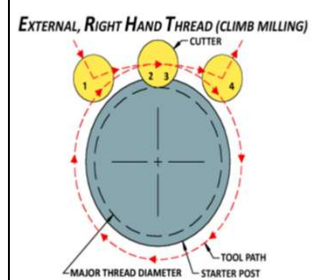
**Table 2**



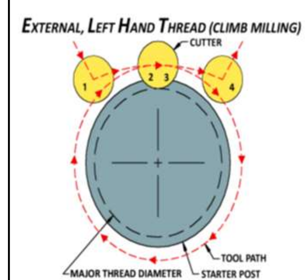

Step 1-2: Cutter moves into position
Step 2-3: Cutter engages part with arcing tool path while "Z" feeds up from bottom
Step 3-4: Cutter moves helically
Step 4-5: Cutter exits part along arcing tool path while maintaining "Z" feed
Step 5-6: Cutter returns to center




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




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

**Product Table:** Thread Mills - Single-Form
**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

| Material Guide | | Hardness | SFM | Chip Load (IPT) By Cutter Diameter | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | 3/64 | 1/16 | 5/64 | 3/32 | 1/8 | 3/16 | 1/4 | 5/16 | 3/8 | 1/2 | 5/8 | 3/4 |
| Carbon Steel | 10XX, 11XX, 12XX, 12LXX, ASTM A27, ASTM A36 | 29-37 Rc (279-344 HBn) | 600 | .00011 | .00015 | .00019 | .00022 | .00030 | .00067 | .00090 | .00140 | .00169 | .00225 | .00281 | .00338 |
| Low Alloy Steel | 13XX, 41XX, 43XX, 51XX, 86XX, 93XX | 29-37 Rc (279-344 HBn) | 200 | .00011 | .00015 | .00019 | .00022 | .00030 | .00067 | .00090 | .00125 | .00150 | .00200 | .00250 | .00300 |
| Tool Steel | A, L, O, P, W series | 29-37 Rc (279-344 HBn) | 200 | .00012 | .00016 | .00021 | .00025 | .00033 | .00049 | .00066 | .00110 | .00132 | .00176 | .00220 | .00264 |
| | | 38-45 Rc (353-421 HBn) | 100 | .00011 | .00014 | .00018 | .00021 | .00028 | .00042 | .00056 | .00093 | .00112 | .00150 | .00187 | .00224 |
| | D, H, M, T, S series | 29-37 Rc (279-344 HBn) | 200 | .00011 | .00015 | .00019 | .00022 | .00030 | .00045 | .00060 | .00100 | .00120 | .00160 | .00200 | .00240 |
| | | 38-45 Rc (353-421 HBn) | 90 | .00010 | .00013 | .00016 | .00019 | .00026 | .00038 | .00051 | .00085 | .00102 | .00136 | .00170 | .00204 |
| Austenitic Stainless Steel | Nitronic 50, Nitronic 60, 301, 303, 304, 304L, Incoloy 27-7MO, 316, 316L, 321, 347 | 29-37 Rc (279-344 HBn) | 450 | .00011 | .00015 | .00019 | .00022 | .00030 | .00067 | .00090 | .00140 | .00169 | .00225 | .00281 | .00338 |
| Martensitic & Ferritic Stainless Steel | 403, 410, 416, 420, 440, 430, 446 | 29-37 Rc (279-344 HBn) | 200 | .00011 | .00015 | .00019 | .00022 | .00030 | .00045 | .00060 | .00094 | .00113 | .00150 | .00188 | .00225 |
| | | 38-45 Rc (353-421 HBn) | 100 | .00010 | .00013 | .00016 | .00019 | .00026 | .00038 | .00051 | .00080 | .00096 | .00128 | .00159 | .00191 |
| PH Stainless Steel | 15-5, 17-4, Carpenter 450, Carpenter 465 | 29-37 Rc (279-344 HBn) | 150 | .00011 | .00015 | .00019 | .00022 | .00030 | .00045 | .00060 | .00084 | .00101 | .00135 | .00169 | .00203 |
| | | 38-45 Rc (353-421 HBn) | 90 | .00010 | .00013 | .00016 | .00019 | .00026 | .00038 | .00051 | .00072 | .00086 | .00115 | .00143 | .00172 |
| Nickel Alloy | Hastelloy C-22, Inconel 625, Waspaloy, René 41, Inconel 718, Incoloy 20 | 29-37 Rc (279-344 HBn) | 70 | .00010 | .00014 | .00017 | .00020 | .00028 | .00041 | .00055 | .00081 | .00098 | .00130 | .00163 | .00195 |
| | | 38-45 Rc (353-421 HBn) | 50 | .00009 | .00012 | .00015 | .00017 | .00023 | .00035 | .00047 | .00069 | .00083 | .00111 | .00138 | .00166 |
| Titanium Alloy | Ti 3Al-2.5V, Ti 6Al-4V, Ti 10V-2Fe-3Al | 29-37 Rc (279-344 HBn) | 150 | .00012 | .00016 | .00021 | .00025 | .00033 | .00049 | .00066 | .00096 | .00116 | .00154 | .00193 | .00231 |
| | | 38-45 Rc (353-421 HBn) | 75 | .00011 | .00014 | .00018 | .00021 | .00028 | .00042 | .00056 | .00082 | .00098 | .00131 | .00164 | .00196 |
| Wrought Aluminum Alloy | 2014, 5062, 6061, 7050, 7075, 7475 | ≤ 28 Rc (≤ 271 HBn) | 1000 | .00015 | .00020 | .00025 | .00030 | .00040 | .00084 | .00113 | .00172 | .00206 | .00275 | .00344 | .00413 |
| | 5% - 8% Si (4XXX) | | 1000 | .00014 | .00018 | .00022 | .00027 | .00036 | .00076 | .00101 | .00154 | .00186 | .00248 | .00309 | .00371 |
| | 8% - 12% Si (4XXX) | | 800 | | | | | | | | | | | | |
| Cast Aluminum Alloy | 319.0, 328.0, 355.0, 360.0, 380.0, 383.0, 390.0, 520.0, 535.0 | ≤ 28 Rc (≤ 271 HBn) | 750 | .00015 | .00020 | .00025 | .00030 | .00040 | .00084 | .00113 | .00172 | .00206 | .00275 | .00344 | .00413 |
| | 3% - 5% Si (3XX, A3XX, C3XX, 4XX, A4XX, B4XX) | | 750 | .00014 | .00018 | .00022 | .00027 | .00036 | .00076 | .00101 | .00154 | .00186 | .00248 | .00309 | .00371 |
| | 5% - 8% Si (3XX, A3XX, C3XX, 4XX, A4XX, B4XX) | | 700 | | | | | | | | | | | | |
| | 8% - 12% Si (3XX, A3XX, C3XX, 4XX, A4XX, B4XX) | | 650 | | | | | | | | | | | | |
| | 12% - 16% Si (3XX, A3XX, C3XX, 4XX, 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 | .00144 | .00173 | .00231 | .00288 | .00346 |
| Magnesium Alloys | | ≤ 28 Rc (≤ 271 HBn) | 1500 | .00015 | .00020 | .00025 | .00030 | .00040 | .00084 | .00113 | .00172 | .00206 | .00275 | .00344 | .00413 |
| Zinc Alloys | | | 800 | | | | | | | | | | | | |

**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**.