HARVEY TOOL

## Multi-form Threadmilling Guide

***Series: 169xx, 173xx, 700xx, 701xx, 702xx, 7843xx, 8196xx***

Multi-Form Thread Mills are a fast way to threadmill a part. Since they use the entire length of cut 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 up to and including Hardened 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 #70094 to machine a 9/16-18 internal thread in 17-4 stainless steel

1. From Speeds & Feeds chart (next page), SFM is 200 and Chip Load (IPT) is .00101
2. Calculate Speed (RPM) and Linear Feed (IPM)

   RPM = (SFM x 3.82) / Cutter Diameter
   = (200 x 3.82) / .370
   = 2065

   Linear Feed (IPM) = RPM x IPT x Number of Flutes
   = 2065 x .00101 x 4
   = 8.3

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 - .370) / .562] x 8.3
   = 2.8

   Adj External Feed = [(Major Thread Dia + Cutter Dia) / Major Thread Dia] x Linear Feed
   = [(.562 + .370) / .562] x 8.3
   = 13.8

4. Determine Number of Radial Passes using Table 1

   For Easy Machinability = 1 Radial Pass at full Axial Depth
   For Moderate Machinability = 2 Radial Passes at full Axial Depth
   For Difficult Machinability = 2 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 2065 RPM, 2.8 IPM and make 2 Radial Passes

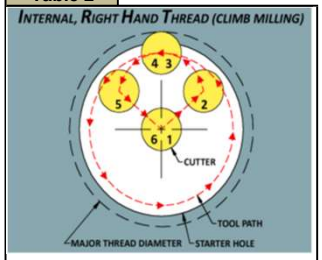
**Setup & Use:**

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. To break in the tool, reduce feed rates by 75% on the on the first one to two 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**

| Thread Size | Major Thread Diameter | Number of Radial Passes | | |
|---|---|---|---|---|
| | | Easy Machinabilty | Moderate Machinabilty | Difficult Machinability |
| 0-80 | 0.060 | 2 | 3 | 4 |
| 1-64 | 0.073 | 2 | 3 | 4 |
| 2-56 | 0.086 | 2 | 3 | 3 |
| 3-48 | 0.099 | 2 | 3 | 3 |
| 4-40 | 0.112 | 2 | 3 | 3 |
| 5-40 | 0.125 | 2 | 3 | 3 |
| 5-44 | 0.125 | 2 | 3 | 3 |
| 6-32 | 0.138 | 2 | 2 | 3 |
| 8-32 | 0.164 | 2 | 2 | 3 |
| 8-36 | 0.164 | 1 | 2 | 2 |
| 10-24 | 0.190 | 2 | 2 | 3 |
| 10-28 | 0.190 | 1 | 2 | 2 |
| 10-32 | 0.190 | 1 | 2 | 2 |
| 12-24 | 0.216 | 2 | 2 | 3 |
| 12-28 | 0.216 | 1 | 2 | 2 |
| 1/4-20 | 0.250 | 2 | 2 | 3 |
| 1/4-28 | 0.250 | 1 | 1 | 2 |
| 5/16-18 | 0.312 | 2 | 2 | 3 |
| 5/16-24 | 0.312 | 1 | 1 | 2 |
| 3/8-16 | 0.375 | 2 | 2 | 3 |
| 3/8-24 | 0.375 | 1 | 1 | 2 |
| 7/16-14 | 0.437 | 2 | 2 | 3 |
| 7/16-20 | 0.437 | 1 | 1 | 2 |
| 1/2-13 | 0.500 | 2 | 2 | 3 |
| 1/2-20 | 0.500 | 1 | 1 | 2 |
| 9/16-12 | 0.562 | 2 | 2 | 3 |
| 9/16-18 | 0.562 | 1 | 2 | 2 |
| 5/8-11 | 0.625 | 2 | 2 | 3 |
| 5/8-18 | 0.625 | 1 | 2 | 2 |
| 3/4-10 | 0.750 | 2 | 2 | 3 |
| 3/4-12 | 0.750 | 1 | 2 | |
| 3/4-16 | 0.750 | 1 | 2 | 2 |
| 7/8-9 | 0.875 | 2 | 2 | 3 |
| 7/8-14 | 0.875 | 1 | 2 | 2 |
| 1-8 | 1.000 | 2 | 3 | 4 |
| 1-12 | 1.000 | 2 | 2 | 2 |
| 1-14 | 1.000 | 2 | 2 | 2 |
| **NPT/NPTF** | | | | |
| 1/16-27 | 0.312 | 1 | 1 | 2 |
| 1/8-27 | 0.405 | 1 | 1 | 2 |
| 1/4-18 | 0.540 | 1 | 1 | 2 |
| 3/8-18 | 0.675 | 1 | 1 | 2 |
| 1/2-14 | 0.840 | 1 | 2 | 3 |
| 3/4-14 | 1.050 | 1 | 2 | 3 |
| 1-11.5 | 1.315 | 1 | 2 | 3 |
| 2-11.5 | 2.375 | 1 | 2 | 3 |
| **METRIC** | | | | |
| M4.5 x .75 | .177 (4.5mm) | 1 | 2 | 2 |
| M5 X .8 | .197 (5mm) | 1 | 2 | 2 |
| M6 X .75 | .236 (6mm) | 1 | 2 | 2 |
| M6 X 1 | .236 (6mm) | 1 | 2 | 2 |
| M8 X .75 | .315 (8mm) | 1 | 2 | 2 |
| M8 X 1.25 | .315 (8mm) | 2 | 2 | 3 |
| M10 X 1 | .394 (10mm) | 1 | 1 | 2 |
| M10 X 1.5 | .394 (10mm) | 2 | 2 | 3 |
| M12 X 1 | .472 (12mm) | 1 | 1 | 2 |
| M12 X 1.75 | .472 (12mm) | 2 | 2 | 3 |
| M14 X 1.5 | .551 (14mm) | 1 | 2 | 2 |
| M14 X 2.0 | .551 (14mm) | 2 | 2 | 3 |
| M16 X 1 | .630 (16mm) | 1 | 2 | 2 |
| M16 X 2.0 | .630 (16mm) | 2 | 2 | 3 |
| M18 X 1.5 | .709 (18mm) | 1 | 2 | 2 |
| M18 X 2 | .709 (18mm) | 2 | 2 | 3 |
| M20 X 2.5 | .787 (20mm) | 2 | 2 | 3 |

**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 one rotation
Step 4-5: Cutter exits part along arcing tool path while maintaining "Z" feed
Step 5-6: Cutter returns to center

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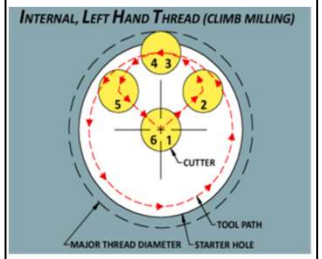


Step 1-2: Cutter moves into position
Step 2-3: Cutter engages part with arcing tool path while "Z" feeds down from top
Step 3-4: Cutter moves helically one rotation
Step 4-5: Cutter exits part along arcing tool path while maintaining "Z" feed
Step 5-6: Cutter returns to center

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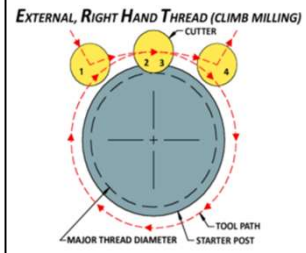


Step 1-2: Cutter engages part with arcing tool path while "Z" feeds down from top
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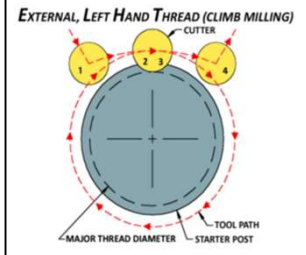


Step 1-2: Cutter engages part with arcing tool path while "Z" feeds up from bottom
Step 2-3: Cutter moves helically one rotation
Step 3-4: Cutter exits part along arcing tool path while maintaining "Z" feed

Speeds & Feeds

**Product Table:** Thread Milling Cutters - Multi-Form
**Characteristics:** UN, Metric, NPT, NPTF
**Series:** 169xx, 173xx, 700xx, 701xx, 702xx, 7843xx, 7904xx, 8196xx

## 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

**Please note:**

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 5%-10% if coated. For ferrous materials with hardness ≤ 28 Rc, chip loads can be increased 3%-5%.

If you require additional information, Harvey Tool has a team of technical experts available to assist you through even the most challenging applications. Please contact us at **800-645-5609** or **tech@harveytool.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.

### Hardness: ≤ 28 Rc (≤ 271 HBn)

| MATERIAL | SFM | Chip Load (IPT) By Cutter Diameter | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | 0.047 | 0.062 | 0.078 | 0.093 | 0.125 | 0.187 | 0.250 | 0.312 | 0.375 | 0.500 | 0.625 | 0.750 |
| **ALUMINUM ALLOYS** | | | | | | | | | | | | | |
| Casting (2xx, 5xx, 7xx, 8xx) | 750 | .00015 | .00020 | .00025 | .00030 | .00040 | .00084 | .00113 | .00172 | .00206 | .00275 | .00344 | .00413 |
| Wrought (1xxx, 2xxx, 3xxx, 5xxx, 6xxx, 7xxx, 8xxx) | 1200 | | | | | | | | | | | | |
| Casting - 3%-5% Si (3xx, A3xx, C3xx, 4xx, A4xx, B4xx) | 750 | .00014 | .00018 | .00022 | .00027 | .00036 | .00076 | .00101 | .00154 | .00186 | .00248 | .00309 | .00371 |
| Casting - 5%-8% Si (3xx, A3xx, C3xx, 4xx, A4xx, B4xx) | 700 | | | | | | | | | | | | |
| Casting - 8%-12% Si (3xx, A3xx, C3xx, 4xx, A4xx, B4xx) | 650 | | | | | | | | | | | | |
| Casting - 12%-16% Si (3xx, A3xx, C3xx, 4xx, A4xx, B4xx) | 475 | | | | | | | | | | | | |
| Wrought - 5%-8% Si (4xxx) | 1000 | | | | | | | | | | | | |
| Wrought - 8%-12% Si (4xxx) | 800 | | | | | | | | | | | | |
| **MAGNESIUM ALLOYS** | 1500 | .00015 | .00020 | .00025 | .00030 | .00040 | .00084 | .00113 | .00172 | .00206 | .00275 | .00344 | .00413 |
| **ZINC ALLOYS** | 800 | | | | | | | | | | | | |
| **COPPER ALLOYS** | | | | | | | | | | | | | |
| High Coppers - 90%+ (C1xxxx) | 450 | .00014 | .00019 | .00024 | .00029 | .00038 | .00068 | .00091 | .00144 | .00173 | .00231 | .00288 | .00346 |
| Brass (Copper Zinc alloys, C2xxxx, C3xxxx, C4xxxx, C66400-C69800) | 1000 | | | | | | | | | | | | |
| Phosphor Bronzes (Copper Tin alloys, C5xxxx) | 450 | | | | | | | | | | | | |
| Aluminum Bronzes (Copper Aluminum alloys, C60600-C64200) | 600 | | | | | | | | | | | | |
| Silicon Bronzes (Copper Silicon alloys, C64700-C66100) | 1000 | | | | | | | | | | | | |
| Copper Nickels, Nickel Silvers (Copper Nickel alloys, C7xxxx) | 450 | | | | | | | | | | | | |
| Cast Copper Alloys (C83300-C86200, C86400-C87900, C9200-C95800, C97300-C97800, C99400-C99700) | 1000 | | | | | | | | | | | | |

### Hardness: 29-37 Rc (279-344 HBn)

| MATERIAL | SFM | Chip Load (IPT) By Cutter Diameter | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | 0.047 | 0.062 | 0.078 | 0.093 | 0.125 | 0.187 | 0.250 | 0.312 | 0.375 | 0.500 | 0.625 | 0.750 |
| **CARBON STEELS** | | | | | | | | | | | | | |
| Free-Machining/Low Carbon steels, 10xx - 1029 & all 10Lxx, 11xx - 1139 & all 11Lxx, 12xx - 1215 & all 12Lxx | 550 | .00011 | .00015 | .00019 | .00022 | .00030 | .00067 | .00090 | .00140 | .00169 | .00225 | .00281 | .00338 |
| 1030 - 1095, 1140 - 1151, 13xx, 15xx, 2xxx, 3xxx, 4xxx & 4xLxx, 5xxx & 5xLxx, 51xxx & 50Lxxx, 51xxx & 51Lxxx, 52xxx & 52Lxxx, 6xxx, 8xxx, 9xxx | 450 | .00011 | .00015 | .00019 | .00022 | .00030 | .00067 | .00090 | .00125 | .00150 | .00200 | .00250 | .00300 |
| **STAINLESS STEELS** | | | | | | | | | | | | | |
| 203 EZ, 303 (all types), 416, 416Se, 416 Plus X, 420F, 420FSe, 430F, 430FSe, 440F, 440FSe | 400 | .00011 | .00015 | .00019 | .00022 | .00030 | .00067 | .00090 | .00140 | .00169 | .00225 | .00281 | .00338 |
| 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 | 350 | .00011 | .00015 | .00019 | .00022 | .00030 | .00045 | .00060 | .00094 | .00113 | .00150 | .00188 | .00225 |
| 414, 431, 440A, 440B, 440C, 13-8, 15-5, 15-7, 17-4, 17-7 | 200 | .00011 | .00015 | .00019 | .00022 | .00030 | .00045 | .00060 | .00084 | .00101 | .00135 | .00169 | .00203 |
| **TOOL STEELS** | | | | | | | | | | | | | |
| A, L, O, P, W series | 325 | .00012 | .00016 | .00021 | .00025 | .00033 | .00049 | .00066 | .00110 | .00132 | .00176 | .00220 | .00264 |
| D, H, M, T, S series | 225 | .00011 | .00015 | .00019 | .00022 | .00030 | .00045 | .00060 | .00100 | .00120 | .00160 | .00200 | .00240 |
| **TITANIUM ALLOYS** | 275 | .00012 | .00016 | .00021 | .00025 | .00033 | .00049 | .00066 | .00096 | .00116 | .00154 | .00193 | .00231 |
| **HIGH TEMP ALLOYS** | | | | | | | | | | | | | |
| Inconel, Hastelloy, Waspalloy, Monel, Nimonic, Haynes, Discoloy, Incoloy | 90 | .00010 | .00014 | .00017 | .00020 | .00028 | .00041 | .00055 | .00081 | .00098 | .00130 | .00163 | .00195 |

### Hardness: 38-45 Rc (353-421 HBn)

| SFM | Chip Load (IPT) By Cutter Diameter | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 0.047 | 0.062 | 0.078 | 0.093 | 0.125 | 0.187 | 0.250 | 0.312 | 0.375 | 0.500 | 0.625 | 0.750 |
| - | - | - | - | - | - | - | - | - | - | - | - | - |
| - | - | - | - | - | - | - | - | - | - | - | - | - |
| - | - | - | - | - | - | - | - | - | - | - | - | - |
| 200 | .00010 | .00013 | .00016 | .00019 | .00026 | .00038 | .00051 | .00080 | .00096 | .00128 | .00159 | .00191 |
| 160 | .00010 | .00013 | .00016 | .00019 | .00026 | .00038 | .00051 | .00072 | .00086 | .00115 | .00143 | .00172 |
| 200 | .00011 | .00014 | .00018 | .00021 | .00028 | .00042 | .00056 | .00093 | .00112 | .00150 | .00187 | .00224 |
| 180 | .00010 | .00013 | .00016 | .00019 | .00026 | .00038 | .00051 | .00085 | .00102 | .00136 | .00170 | .00204 |
| 150 | .00011 | .00014 | .00018 | .00021 | .00028 | .00042 | .00056 | .00082 | .00098 | .00131 | .00164 | .00196 |
| 70 | .00009 | .00012 | .00015 | .00017 | .00023 | .00035 | .00047 | .00069 | .00083 | .00111 | .00138 | .00166 |