

# Mill-Thread Technical Section



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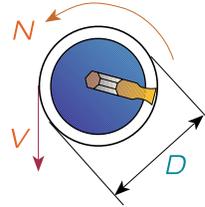
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## Conversion of Cutting Speed to Rotational Speed

Conversion of selected cutting speed to rotational speed is calculated by the following formula:

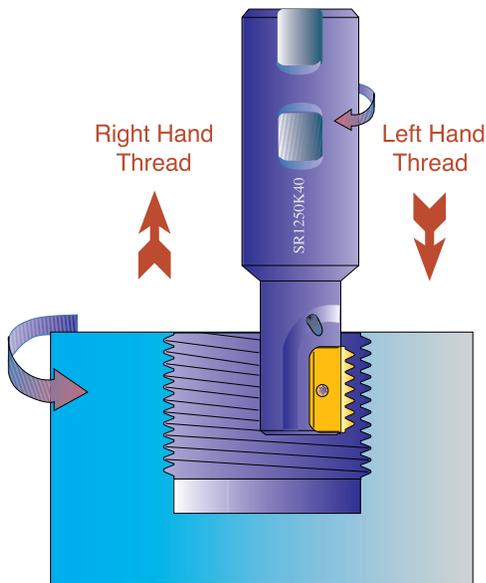
$$N = \frac{V \times 12}{\pi \times D} = \frac{400 \times 12}{3.14 \times 1.25} = 1222 \text{ RPM}$$



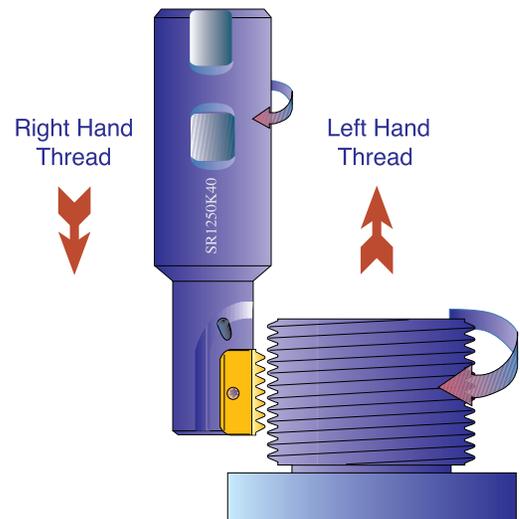
**Example:**  $V=400 \text{ ft/min}$   
 $D=1.25$

D=Cutting diameter

### Internal Thread



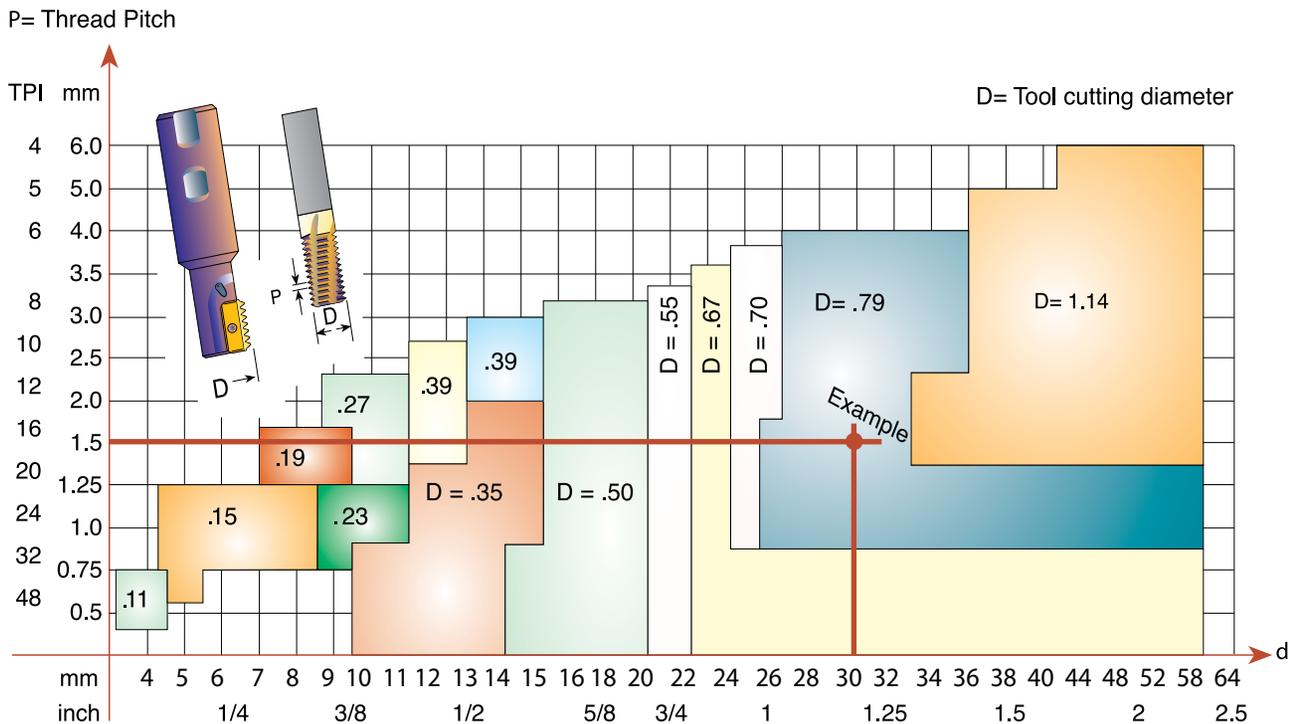
### External Thread



## Tool Selection

For indexable and solid carbide Mill Threads

The following chart provides a fairly accurate visual selection tool for Internal Threading. The chart is suitable for the following thread forms: ISO, UN, WHIT, NPT, NPTF, BSPT and PG.



Any tool with a small cutting diameter can produce larger diameter threads.

**Example:** Internal thread 1 1/4 x 16UN:

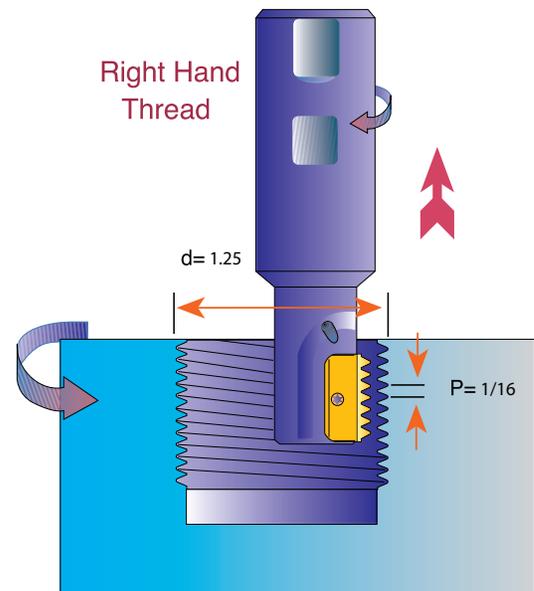
Find a Milling Tool to produce d=1.25 Internal

right hand UN thread with a thread pitch P=1/16 inch

As can be seen from the chart above, the two red lines intersect at a selected tool with a cutting diameter of D=.79 inch

Chosen toolholder: SR0790 H21

Insert: 21 I 16 UN MT7



If you need assistance, please call your local distributor and ask for help in selecting the appropriate tool as well as for a CNC program to suit your CNC milling machine.

## Carmex Mill-Thread catalog and CNC programming Software

This software is provided by Carmex to assist you, the threadmilling user, to select and apply the correct tool to machine threads on CNC machining centers. The program will find tools and inserts which are suitable for your application, calculate cutting data and generate a CNC program for a variety of controls.



The software is available at our web site and on a CD-ROM.

## Example of Thread Milling CNC Program for Internal Threading

Right hand thread (climb milling) from bottom up.

Program is based on tool center.

This method of programming needs no tool radius compensation value other than an offset for wear.

$A = \frac{D_o - D}{2}$	<p>A = Radius of tool path                  D<sub>o</sub> = Major thread dia.                  D = Cutting dia.</p>
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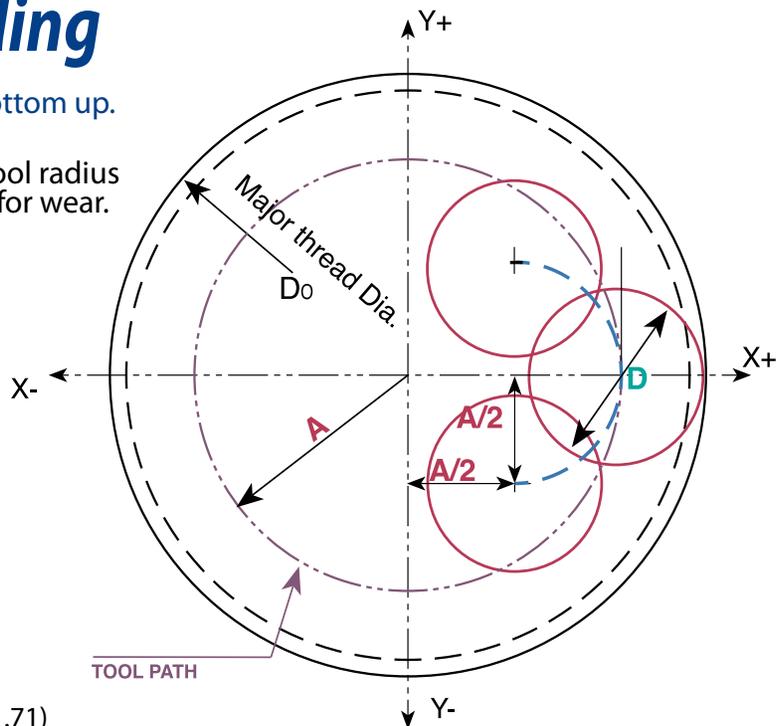
### General Program

```
G90 G00 G54 G43 H1X0 Y0 Z10 S---
G00 Z- (TO THREAD DEPTH)
G01 G91 G41 D1 X(A/2) Y-(A/2) Z0 F---
G03 X(A/2) Y(A/2) R(A/2) Z(1/8 PITCH)
G03 X0 Y0 I-(A) J0 Z(PITCH)
G03 X-(A/2) Y(A/2) R(A/2) Z(1/8 PITCH)
G01 G40 X-(A/2) Y-(A/2) Z0
G90 X0 Y0 Z0
```

### Internal Thread

EXAMPLE: 1 1/4-12UN (Thread depth .71)  
 TOOLHOLDER: SR0790 H21 (Cutting Dia. .79)  
 INSERT: 21 I 12 UN  
 $A = (1.25 - .79)/2 = .23$

```
G90 G00 G54 G43 H1X0 Y0 Z0.39 S2800
G00 Z-0.71
G01 G91 G41X0.1150Y-0.1150 Z0 F3.35 D1
G03 X0.1150
Y0.1150 R0.1150 Z0.0104
G03 X0 Y0 I-0.23 J0 Z0.0833
G03 X-0.1150 Y0.1150 R0.1150 Z0.0104
G01 G40 X-0.1150 Y-0.1150 Z0
G90 G0 X0 Y0 Z0
```



## Mill-Thread Inserts Speed and Feed Selection

**MT7** Sub-Micron Grade with Titanium Aluminum Nitride multi-layer coating (ISO K10 - K20). This is a general purpose grade, which can be used with all materials; it should be run at medium to high cutting speeds.

ISO	Materials	Cutting Speed ft/min MT7
<b>P</b>	Low and Medium Carbon Steels	380 - 920
	High Carbon Steels	430 - 660
	Alloy Steels, Treated Steels	340 - 590
<b>M</b>	Stainless Steels	430 - 620
	Cast Steels	490 - 620
<b>K</b>	Cast Iron	260 - 560
<b>N</b>	Non-Ferrous & Aluminum	590 - 1120
	Synthetics, Duroplastics, Thermoplastics	380 - 1500
<b>S</b>	Nickel Alloys, Titanium Alloys	80 - 300

**Recommended FEED RATE: .002 - .006**

## Spiral Mill-Thread Inserts Speed and Feed Selection

**MT7** Sub-Micron Grade with Titanium Aluminum Nitride multi-layer coating (ISO K10 - K20). This is a general purpose grade, which can be used with all materials; it should be run at medium to high cutting speeds.

ISO	Materials	Cutting Speed ft/min MT7
<b>P</b>	Low and Medium Carbon Steels	480 - 1200
	High Carbon Steels	540 - 840
	Alloy Steels, Treated Steels	440 - 755
<b>M</b>	Stainless Steels	540 - 800
	Cast Steels	620 - 800
<b>K</b>	Cast Iron	330 - 720
<b>N</b>	Non-Ferrous & Aluminum	755 - 1440
	Synthetics, Duroplastics, Thermoplastics	480 - 1940
<b>S</b>	Nickel Alloys, Titanium Alloys	100 - 380

**Recommended FEED RATE: .002 - .006**

As you may note, cutting speed is shown in range terms. In most standard cases choosing a speed in the middle of the range would be a good choice for a start.

For hard metals reduce cutting speed.

## Spiral Finish Speed and Feed Selection

**MT7** Sub-Micron Grade with Titanium Aluminum Nitride multi-layer coating (ISO K10 - K20). This is a general purpose grade, which can be used with all materials; it should be run at medium to high cutting speeds.

ISO	Materials	Cutting Speed (ft/min)
<b>P</b>	Low and Medium Carbon Steels	660 - 1080
	High Carbon Steels	560 - 770
	Alloy Steels, Treated Steels	330 - 640
<b>M</b>	Stainless Steels	590 - 755
	Cast Steels	590 - 755
<b>K</b>	Cast Iron	660 - 1150
<b>N</b>	Non-Ferrous & Aluminum	1640 - 3610
	Synthetics, Duroplastics, Thermoplastics	1310 - 4920
<b>S</b>	Nickel Alloys, Titanium Alloys	100 - 180

## Cutting Data

### D-Thread type

**MT7** Sub-Micron Grade with Titanium Aluminum Nitride multi-layer coating (ISO K10 - K20). This is a general purpose grade, which can be used with all materials; it should be run at medium to high cutting speeds.

ISO	Materials	Cutting Speed (ft/min)
<b>P</b>	Low and Medium Carbon Steels <0.55%C	330 - 670
	High Carbon Steels ≥0.55%C	330 - 590
	Alloy Steels, Treated Steels	330 - 460
<b>M</b>	Stainless Steels - Free Cutting	280 - 410
	Stainless Steels - Austenitic	260 - 380
	Cast Steels	380 - 510
<b>K</b>	Cast Iron	250 - 480
<b>N</b>	Aluminum ≤12%Si, Copper	490 - 980
	Aluminum >12% Si	490 - 980
	Synthetics, Duroplastics, Thermoplastics	330 - 1150
<b>S</b>	Nickel Alloys, Titanium Alloys	150 - 310

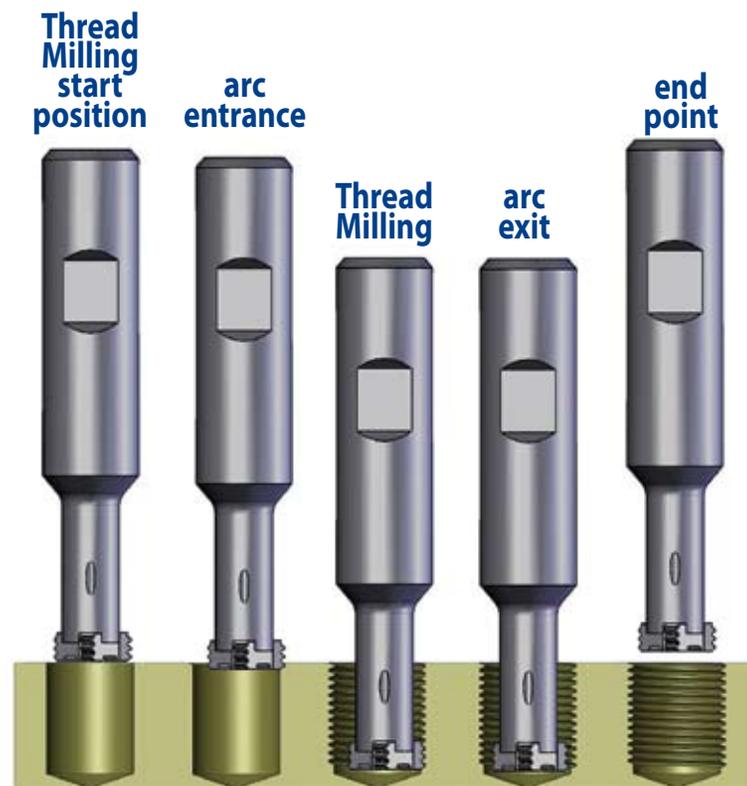
**Recommended FEED RATE: .003 - .006**

## Cutting Data

### CMT type

**MT7** Sub-Micron Grade with Titanium Aluminum Nitride multi-layer coating (ISO K10 - K20). This is a general purpose grade, which can be used with all materials; it should be run at medium to high cutting speeds.

ISO	Materials	Cutting Speed ft/min	Feed inch/tooth Cutting Diameter=D			
			Ø.39	Ø.47	Ø.70	Ø.98
<b>P</b>	Low and Medium Carbon Steels <0.55%C	197 - 394	.0063	.0067	.0079	.0087
	High Carbon Steels ≥0.55%C	197 - 295	.0055	.0063	.0079	.0087
	Alloy Steels, Treated Steels	164 - 262	.0039	.0047	.0063	.0071
<b>M</b>	Stainless Steels - Free Cutting	230 - 328	.0039	.0043	.0059	.0067
	Stainless Steels - Austenitic	197 - 295	.0039	.0043	.0059	.0067
	Cast Steels	230 - 295	.0039	.0047	.0063	.0071
<b>K</b>	Cast Iron	131 - 262	.0063	.0067	.0079	.0087
<b>N</b>	Aluminum ≤12%Si, Copper	328 - 656	.0063	.0067	.0079	.0087
	Aluminum >12% Si	197 - 459	.0039	.0043	.0061	.0071
	Synthetics, Duroplastics, Thermoplastics	164 - 656	.0075	.0075	.0087	.0094
<b>S</b>	Nickel Alloys, Titanium Alloys	66 - 131	.0028	.0028	.0039	.0047
<b>H</b>	Hardened Steel 45 - 50HRc	197 - 230	.0035	.0035	.0051	.0059
	Hardened Steel 50 - 55HRc	164 - 197	.0031	.0031	.0047	.0055



## Mill-Thread Solid Carbide Grades, Speed and Feed Selection

### MT, MTB, MTZ, EMT Types

**MT7** Sub-Micron Grade with Titanium Aluminum Nitride multi-layer coating (ISO K10 - K20). This is a general purpose grade, which can be used with all materials; it should be run at medium to high cutting speeds.

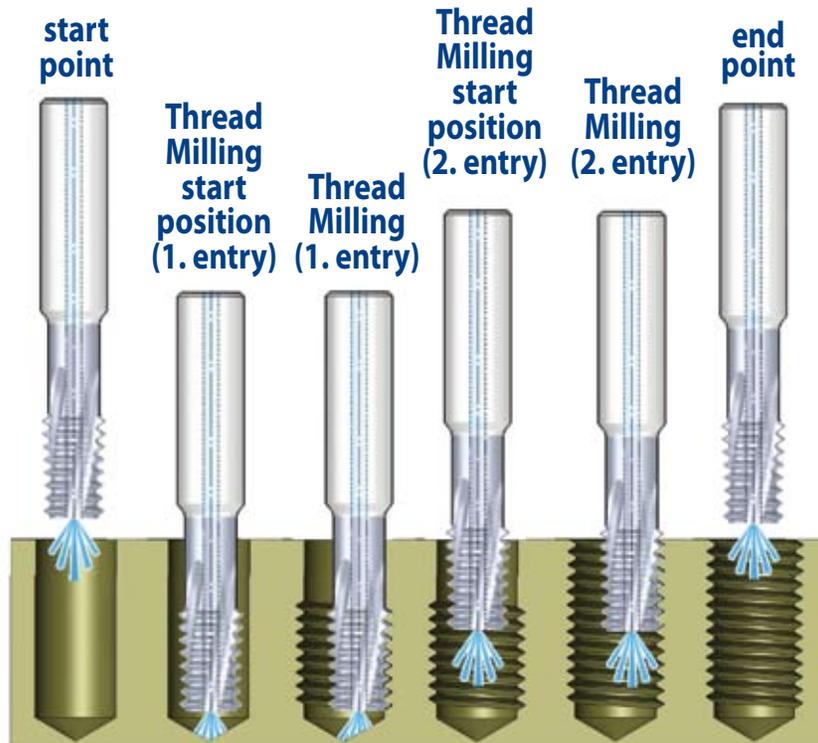
ISO	Materials	Cutting Speed ft/min	Feed inch/tooth Cutting Diameter=D										
			Ø.08	Ø.12	Ø.16	Ø.24	Ø.31	Ø.39	Ø.47	Ø.55	Ø.63	Ø.79	Ø.98
<b>P</b>	Low and Medium Carbon Steels <0.55%C	330- 820	.0012	.0016	.0016	.0024	.0028	.0032	.0037	.0042	.0047	.0057	.0070
	High Carbon Steels ≥0.55%C	360- 590	.0009	.0011	.0013	.0018	.0022	.0026	.0031	.0035	.0039	.0048	.0059
	Alloy Steels, Treated Steels	300- 520	.0008	.0009	.0010	.0013	.0016	.0018	.0021	.0023	.0026	.0031	.0038
<b>M</b>	Stainless Steels - Free Cutting	200- 520	.0008	.0012	.0010	.0016	.0020	.0024	.0024	.0028	.0031	.0035	.0043
	Stainless Steels - Austenitic	200- 390	.0008	.0008	.0010	.0012	.0016	.0020	.0020	.0024	.0028	.0031	.0039
	Cast Steels	430- 560	.0008	.0009	.0010	.0013	.0016	.0018	.0021	.0023	.0026	.0031	.0038
<b>K</b>	Cast Iron	230- 490	.0011	.0014	.002	.0022	.0027	.0032	.0037	.0042	.0047	.0057	.0070
<b>N</b>	Aluminum ≤12%Si, Copper	490-1150	.0011	.0014	.002	.0022	.0027	.0032	.0037	.0042	.0047	.0057	.0070
	Aluminum >12% Si	330- 820	.0008	.0009	.0010	.0013	.0016	.0018	.0021	.0023	.0026	.0031	.0038
	Synthetics, Duroplastics, Thermoplastics	330-1310	.0021	.0024	.003	.0032	.0038	.0043	.0049	.0054	.0060	.0071	.0085
<b>S</b>	Nickel Alloys, Titanium Alloys	70- 260	.0009	.0009	.0010	.0010	.0011	.0012	.0013	.0014	.0015	.0017	.0019

For cutters with long cutting length reduce feed rate by 40%

## MTQ type

**MT7** Sub-Micron Grade with Titanium Aluminum Nitride multi-layer coating (ISO K10 - K20). This is a general purpose grade, which can be used with all materials; it should be run at medium to high cutting speeds.

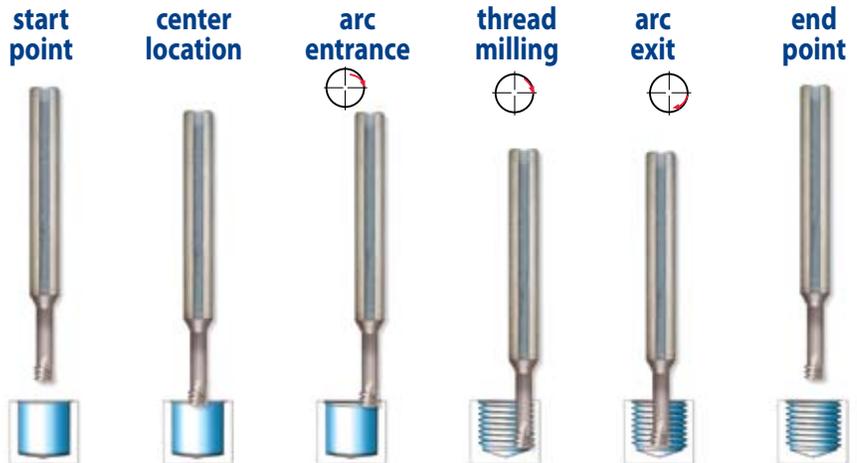
ISO	Materials	Cutting Speed ft/min	Feed inch/tooth Cutting Diameter=D					
			Ø.39	Ø.47	Ø.55	Ø.63	Ø.79	Ø.98
<b>P</b>	Low and Medium Carbon Steels <0.55%C	330 - 820	.0022	.0026	.0029	.0033	.0040	.0049
	High Carbon Steels ≥0.55%C	360 - 590	.0018	.0021	.0025	.0028	.0034	.0041
	Alloy Steels, Treated Steels	300 - 520	.0013	.0014	.0016	.0018	.0022	.0026
<b>M</b>	Stainless Steels - Free Cutting	200 - 520	.0017	.0017	.0019	.0022	.0025	.0030
	Stainless Steels - Austenitic	200 - 390	.0014	.0014	.0017	.0019	.0022	.0028
	Cast Steels	430 - 560	.0013	.0014	.0016	.0018	.0022	.0026
<b>K</b>	Cast Iron	230 - 490	.0022	.0026	.0029	.0033	.0040	.0049
<b>N</b>	Aluminum ≤12%Si, Copper	490 - 1150	.0022	.0026	.0029	.0033	.0040	.0049
	Aluminum >12% Si	330 - 820	.0013	.0014	.0016	.0018	.0022	.0026
	Synthetics, Duoplastics, Thermoplastics	330 - 1310	.0030	.0034	.0038	.0042	.0050	.0059
<b>S</b>	Nickel Alloys, Titanium Alloys	70 - 260	.0009	.0009	.0010	.0010	.0012	.0013



## Mini Mill-Thread MTS and MTI types

- MT7** Sub-Micron Grade with Titanium Aluminum Nitride multi-layer coating (ISO K10 - K20). This is a general purpose grade, which can be used with all materials; it should be run at medium to high cutting speeds.
- MT8** Sub-Micron Grade with Aluminum Titanium Nitride (AlTiN) multi-layer coating (ISO K10-K20). Extremely high heat resistant and smooth cutting operation, for high performance, and normal machining conditions. General purpose for all materials.
- MT11** Ultra-fine sub-micron grade with advanced PVD triple coating.

ISO Standard	Materials	Cutting Speed ft/min	Feed inch/tooth													
			Cutting Diameter = D													
			Ø.04	Ø.06	Ø.08	Ø.12	Ø.16	Ø.20	Ø.24	Ø.28	Ø.31	Ø.35	Ø.39	Ø.47	Ø.55	Ø.63
<b>P</b>	Low and Medium Carbon Steels <0.55%C	200-390	.0016	.0020	.0020	.0028	.0035	.0043	.0051	.0055	.0059	.0063	.0063	.0067	.0071	.0071
	High Carbon Steels ≥0.55%C	200-300	.0012	.0016	.0020	.0024	.0031	.0035	.0039	.0047	.0051	.0055	.0055	.0063	.0067	.0071
	Alloy Steels, Treated Steels	160-260	.0012	.0016	.0016	.0020	.0020	.0024	.0028	.0028	.0031	.0035	.0039	.0047	.0051	.0055
<b>M</b>	Stainless Steels - Free Cutting	230-330	.0008	.0012	.0012	.0016	.0020	.0024	.0024	.0028	.0031	.0035	.0039	.0043	.0047	.0051
	Stainless Steels - Austenitic	200-300	.0008	.0012	.0012	.0016	.0020	.0024	.0024	.0028	.0031	.0035	.0039	.0043	.0047	.0051
	Cast Steels	230-300	.0012	.0016	.0016	.0020	.0020	.0024	.0028	.0028	.0031	.0035	.0039	.0047	.0051	.0055
<b>K</b>	Cast Iron	130-260	.0016	.0020	.0020	.0028	.0035	.0043	.0051	.0055	.0059	.0063	.0063	.0067	.0071	.0071
<b>N</b>	Aluminum ≤12%Si, Copper	330-660	.0016	.0020	.0020	.0028	.0035	.0043	.0051	.0055	.0059	.0063	.0063	.0067	.0071	.0071
	Aluminum >12% Si	200-460	.0012	.0012	.0012	.0016	.0020	.0024	.0024	.0028	.0031	.0035	.0039	.0043	.0051	.0054
	Synthetics, Duroplastics, Thermoplastics	160-660	.0035	.0039	.0043	.0047	.0055	.0063	.0071	.0075	.0075	.0075	.0075	.0075	.0079	.0079
<b>S</b>	Nickel Alloys and Titanium Alloys	70-130	.0012	.0012	.0012	.0016	.0016	.0020	.0024	.0024	.0024	.0028	.0028	.0028	.0031	.0031



## Mini Mill-Thread vs. Taps

Features	Mini Mill-Thread	Taps
Thread surface quality	High	Medium
Thread geometry	Very accurate	Medium
Thread tolerances	4H, 5H, 6H with std cutter	6H with standard tap, 4H with specific tap
Machining time	Same as tap or shorter	Short
Tool breakage	Almost not possible	Could happen often
Machining load	Very low	High
Range of thread diameters	Wide range of diameters	Specific tap for each diameter
Right/Left hand threading	Same cutter	Specific tap for each
Geometric shape	Full profile	Partial profile

## DMT type

**MT7** Sub-Micron Grade with Titanium Aluminum Nitride multi-layer coating (ISO K10 - K20). This is a general purpose grade, which can be used with all materials; it should be run at medium to high cutting speeds.

ISO	Materials	Cutting Speed ft/min	Feed inch/tooth Cutting Diameter=D						
			Ø.16	Ø.20	Ø.24	Ø.31	Ø.35	Ø.39	Ø.47
<b>P</b>	Low and Medium Carbon Steels <0.55%C	200-395	.0012	.0012	.0016	.0020	.0020	.0020	.0020
	High Carbon Steels ≥0.55%C	200-295	.0008	.0012	.0012	.0016	.0016	.0016	.0020
	Alloy Steels, Treated Steels	165-260	.0008	.0008	.0008	.0008	.0012	.0012	.0016
<b>M</b>	Stainless Steels - Free Cutting	230-330	.0008	.0008	.0008	.0008	.0012	.0012	.0012
	Stainless Steels - Austenitic	200-295	.0008	.0008	.0008	.0008	.0012	.0012	.0012
	Cast Steels	230-295	.0008	.0008	.0008	.0008	.0012	.0012	.0016
<b>K</b>	Cast Iron	130-260	.0012	.0012	.0016	.0020	.0020	.0020	.0020
<b>N</b>	Aluminum ≤12%Si, Copper	330-655	.0012	.0012	.0016	.0020	.0020	.0020	.0020
	Aluminum >12% Si	200-460	.0008	.0008	.0008	.0008	.0012	.0012	.0012
	Synthetics, Duroplastics, Thermoplastics	165-655	.0016	.0020	.0020	.0024	.0024	.0024	.0024

## DMTH type

**MT11** Ultra-fine Sub-Micron grade with advanced PVD triple Blue coating

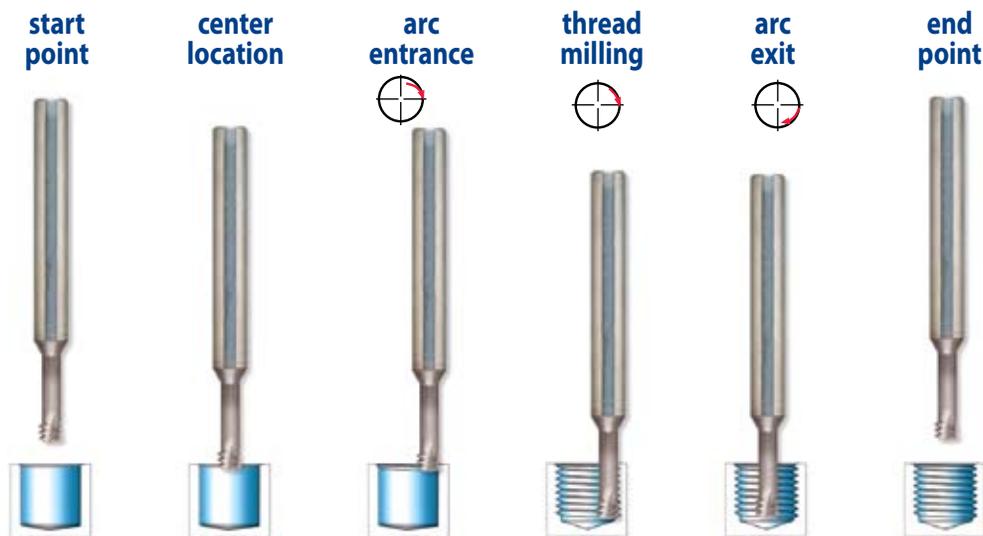
ISO	Materials	Cutting Speed ft/min	Feed inch/tooth Cutting Diameter=D								
			Ø.08	Ø.12	Ø.16	Ø.20	Ø.24	Ø.31	Ø.35	Ø.39	Ø.47
<b>P</b>	Low and Medium Carbon Steels <0.55%C	190 - 390	.0008	.0008	.0012	.0012	.0016	.0020	.0020	.0020	.0020
	High Carbon Steels ≥0.55%C	190 - 290	.0008	.0008	.0008	.0012	.0012	.0016	.0016	.0016	.0020
	Alloy Steels, Treated Steels	160 - 260	.0008	.0008	.0008	.0008	.0008	.0008	.0012	.0012	.0016
<b>M</b>	Stainless Steels - Free Cutting	230 - 330	.0008	.0008	.0008	.0008	.0008	.0008	.0012	.0012	.0012
	Stainless Steels - Austenitic	190 - 290	.0008	.0008	.0008	.0008	.0008	.0008	.0012	.0012	.0012
	Cast Steels	230 - 290	.0008	.0008	.0008	.0008	.0008	.0008	.0012	.0012	.0016
<b>K</b>	Cast Iron	130 - 260	.0012	.0012	.0012	.0012	.0016	.0020	.0020	.0020	.0020
<b>N</b>	Aluminum ≤10%Si, Copper	330 - 650	.0012	.0012	.0012	.0012	.0016	.0020	.0020	.0020	.0020
	Aluminum >10% Si	190 - 460	.0008	.0008	.0008	.0008	.0008	.0008	.0012	.0012	.0012
	Synthetics, Duroplastics, Thermoplastics	160 - 650	.0016	.0020	.0016	.0020	.0020	.0024	.0024	.0024	.0024
<b>S</b>	Nickel Alloys, Titanium Alloys and High Temp. Alloys	65 - 130	.0008	.0012	.0012	.0016	.0020	.0020	.0024	.0024	.0024
<b>H</b>	Hardened Steels 45-50 HRc	190 - 230	.0008	.0008	.0008	.0012	.0016	.0016	.0020	.0020	.0020
	Hardened Steels 50-55 HRc	160 - 190	.0004	.0004	.0004	.0008	.0012	.0012	.0016	.0016	.0016

## Mini Mill-Thread MTSH type

**MT9** Sub-Micron Grade with advanced PVD triple coating.

**Left hand cutting for CNC code use M04**

ISO	Materials	Hardness HRc	Cutting Speed ft/min	Feed inch/tooth													
				Cutting Diameter = D													
				ø.04	ø.06	ø.08	ø.12	ø.16	ø.20	ø.24	ø.28	ø.31	ø.35	ø.39	ø.47	ø.55	ø.63
<b>S</b>	Nickel Alloys, Titanium Alloys and High Temp. Alloys		70-130	.0012	.0012	.0012	.0016	.0016	.0020	.0024	.0024	.0024	.0028	.0028	.0028	.0031	.0031
<b>H</b>	Hardened Steels	45-50	200-230	.0012	.0016	.0016	.0020	.0020	.0024	.0024	.0028	.0028	.0031	.0031	.0035	.0039	.0043
		51-55	160-200	.0008	.0012	.0012	.0016	.0016	.0020	.0020	.0024	.0024	.0028	.0028	.0031	.0035	.0039
		56-62	130-160	.0004	.0008	.0008	.0012	.0012	.0016	.0016	.0020	.0020	.0024	.0024	.0028	.0031	.0035



### Case Study

Application	Internal Thread M4 X 0.7
Thread Depth	8.0 mm
Workpiece Material	Tool Steel: D2
Hardness	60-62 (HRc)
Cutter Description	MTSH0250C35 0.7 ISO
Machining Conditions	Cutting Speed: 144 ft / min Feed: .0012 Inch / tooth
Machine	Mori Seiki VN5000
Control	Fanuc
Cooling Lubricant	Emulsion
Tool Life (No. of Threads)	84

## MTH type

**MT11** Sub-Micron Grade with advanced PVD triple coating.

ISO	Materials	Hardness HRc	Cutting Speed ft/min	Feed inch/tooth								
				Cutting Diameter = D								
				Ø.10	Ø.12	Ø.16	Ø.20	Ø.24	Ø.28	Ø.31	Ø.35	Ø.39
<b>S</b>	Nickel Alloys, Titanium Alloys and High Temp. Alloys		66-164	.0008	.0008	.0008	.0008	.0012	.0012	.0012	.0012	.0016
<b>H</b>	Hardened Steels Cast Iron	45-50	230-262	.0008	.0012	.0012	.0016	.0016	.0020	.0020	.0024	.0028
		51-55	197-230	.0004	.0008	.0008	.0012	.0012	.0016	.0016	.0020	.0024
		56-62	131-164	.0002	.0004	.0004	.0008	.0008	.0012	.0012	.0016	.0020

For cutters with long cutting length reduce feed rate by 40%

Positioning

Thread Milling

Chamfering

