

Mill-Thread Technical Section



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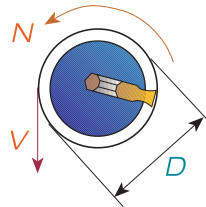
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Conversion of Cutting Speed to Rotational Speed

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

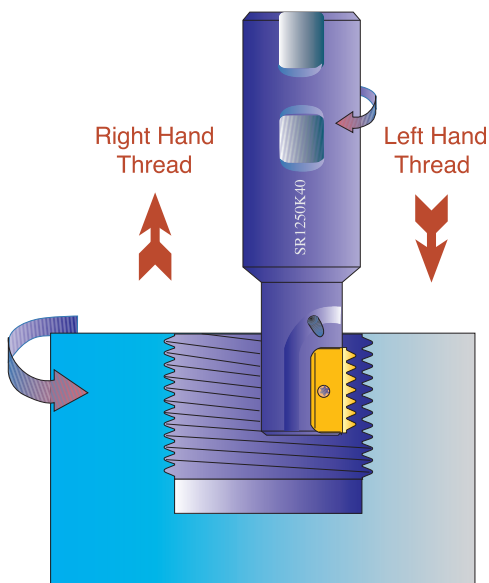
$$N = \frac{V \times 1000}{\pi \times D} = \frac{120 \times 1000}{3.14 \times 30} = 1274 \text{ RPM}$$



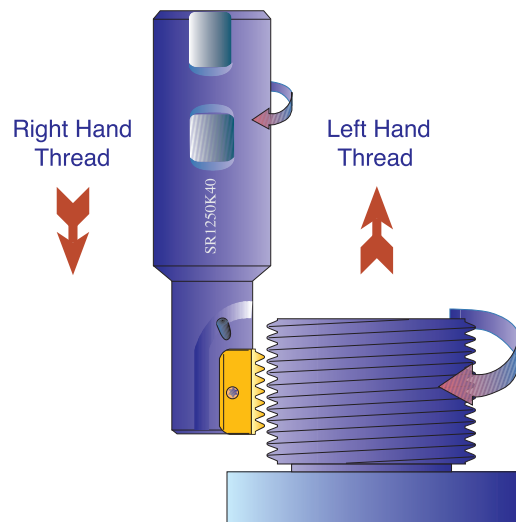
Example: $V=120 \text{ m/min}$
 $D=30 \text{ mm}$

D=Cutting diameter

Internal Thread



External Thread

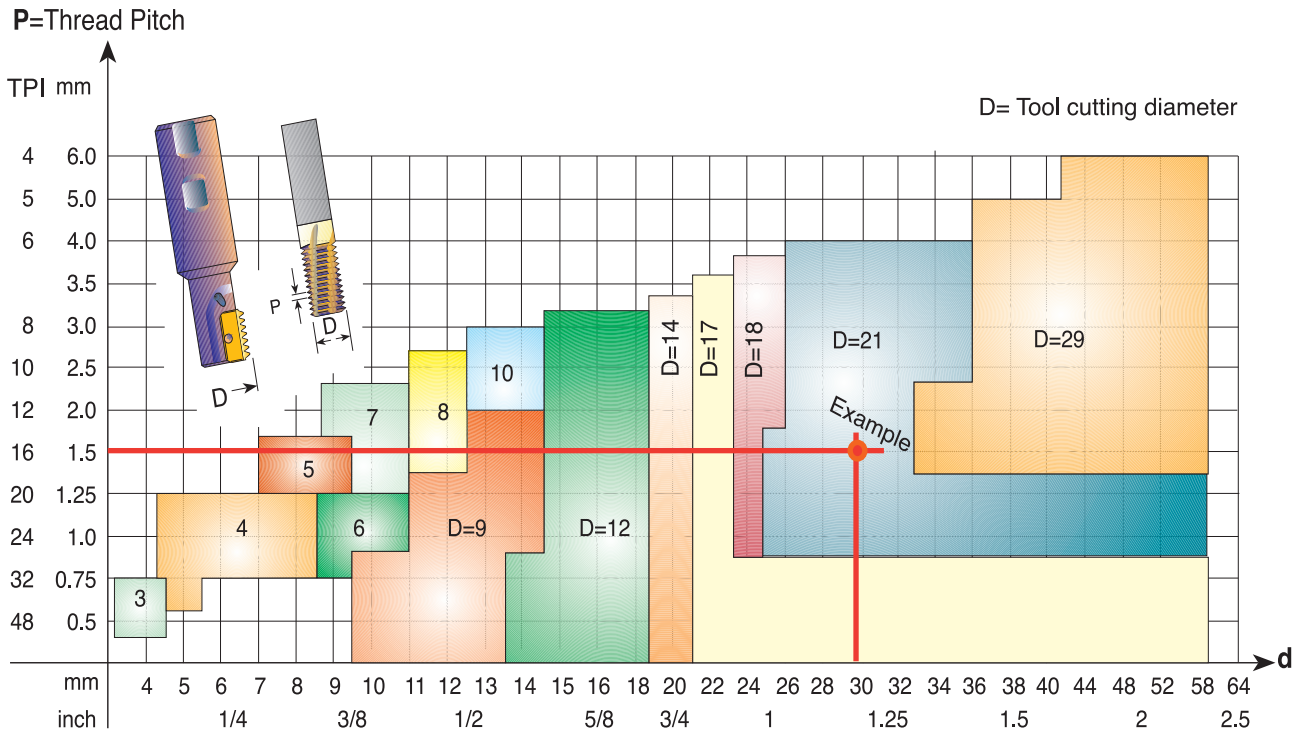


Tool Selection

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 large diameter threads.

Example: Internal thread M30 x 1.5:

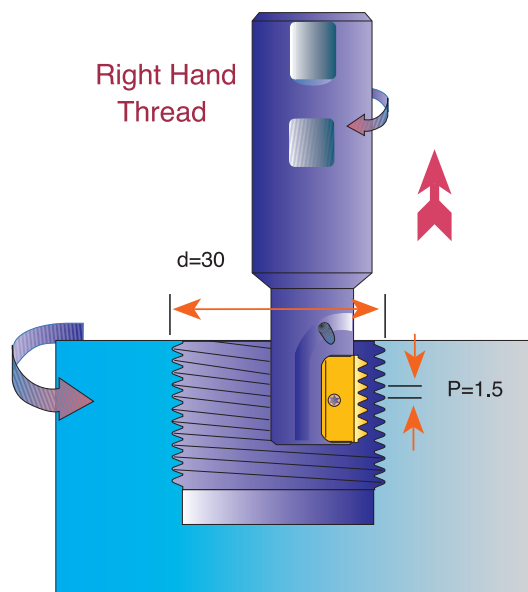
Find a Milling Tool to produce d=30 mm Internal right hand ISO thread with a thread pitch P=1.5 mm.

As can be seen from the chart above, the two red lines intersect at a selected tool with a cutting diameter of D=21 mm.

Chosen toolholder: SR0021H21

Insert: 21 I 1.5 ISO MT7

d=Thread Diameter



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 catalogue and CNC programming Software

This software is provided by Carmex to assist you, the thread milling 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.

$$A = \frac{D_o - D}{2}$$

A = Radius of tool path
 D_o = Major thread dia.
 D = Cutting dia.

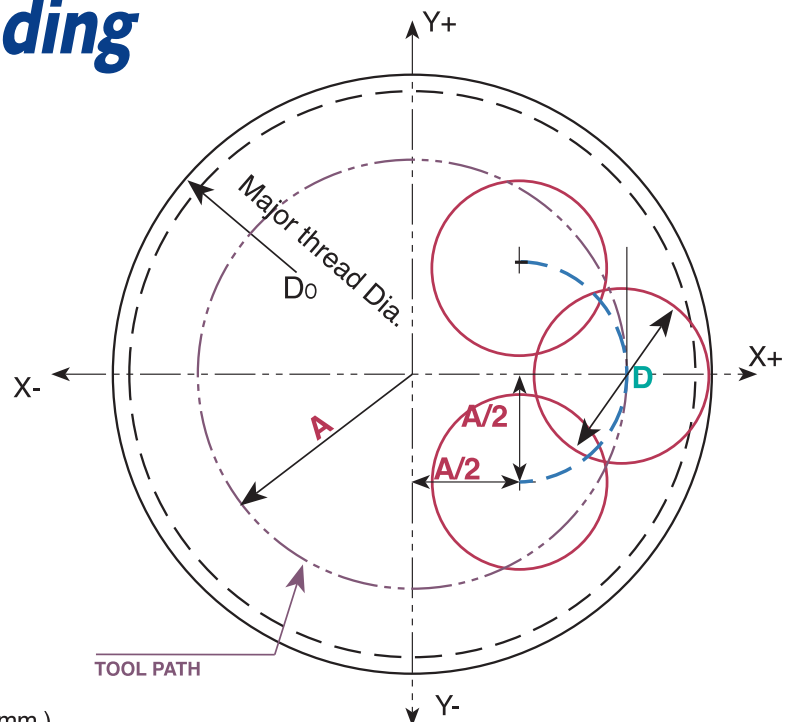
General Program

```
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 : M 32 X 2.0 (Thread depth 18 mm)
 TOOLHOLDER : SR0021 H21 (Cutting dia. 21 mm)
 INSERT: 21 I 2.0 ISO
 A = (32-21)/2 = 5.5

```
G90 G00 G54 G43 H1X0 Y0 Z10 S2800
G00 Z-18
G01 G91 G41X 2.75 Y-2.75 Z0 F85 D1
G03 X2.75 Y2.75 R2.75 Z0.25
G03 X0 Y0 I-5.5 J0 Z2
G03 X-2.75 Y2.75 R2.75 Z0.25
G01 G40 X-2.75 Y-2.75 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 m/min MT7
P	Low and Medium Carbon Steels	115-280
	High Carbon Steels	130-200
	Alloy Steels, Treated Steels	105-180
M	Stainless Steels	130-190
	Cast Steels	150-190
K	Cast Iron	80-170
N	Non- Ferrous and Aluminum	180-340
	Synthetics, Duroplastics, Thermoplastics	115-460
S	Nickel Alloys, Titanium Alloys	25- 90

Recommended FEED RATE : 0.05 - 0.15 mm

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 m/min MT7
P	Low and Medium Carbon Steels	145-360
	High Carbon Steels	165-255
	Alloy Steels, Treated Steels	135-230
M	Stainless Steels	165-245
	Cast Steels	190-245
K	Cast Iron	100-220
N	Non- Ferrous and Aluminum	230-440
	Synthetics, Duroplastics, Thermoplastics	145-590
S	Nickel Alloys, Titanium Alloys	30-115

Recommended FEED RATE : 0.05 - 0.15 mm

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 m/min
P	Low and Medium Carbon Steels	200-330
	High Carbon Steels	170-235
	Alloy Steels, Treated Steels	100-195
M	Stainless Steels	180-230
	Cast Steels	180-230
K	Cast Iron	200-350
N	Non- Ferrous and Aluminum	500-1100
	Synthetics, Duroplastics, Thermoplastics	400-1500
S	Nickel Alloys, Titanium Alloys	30-55

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 Standard	Material	Cutting Speed m/min
P	Low and Medium Carbon Steels <0.55%C	100-205
	High Carbon Steels ≥0.55%C	100-180
	Alloy Steels, Treated Steels	100-140
M	Stainless Steels - Free Cutting	85-125
	Stainless Steels - Austenitic	80-115
	Cast Steels	115-155
K	Cast Iron	75-145
N	Aluminium ≤12%Si, Copper	150-300
	Aluminium >12% Si	150-300
	Synthetics, Duroplastics, Thermoplastics	100-350
S	Nickel Alloys, Titanium Alloys	45-95

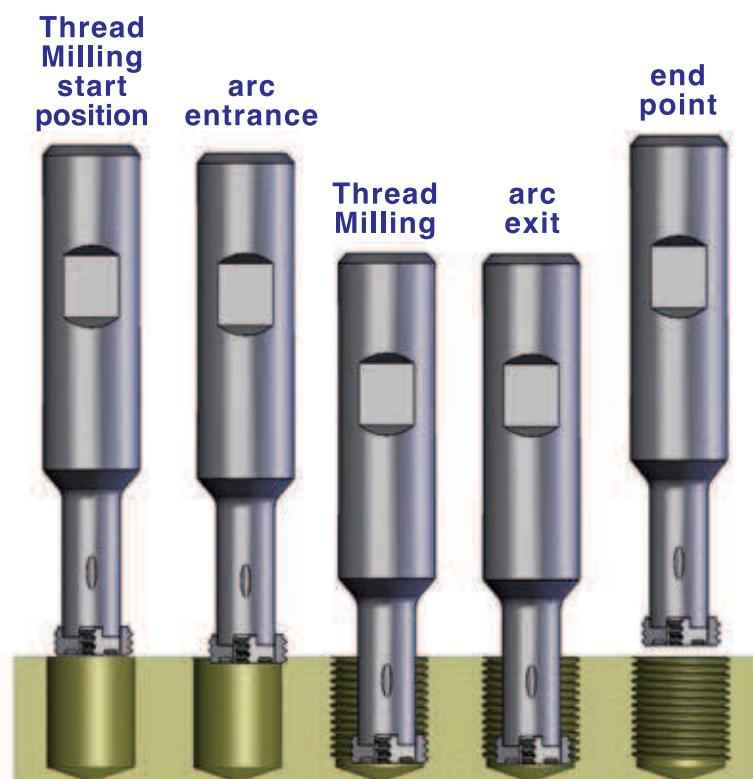
Recommended FEED RATE : 0.07 - 0.15 mm

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 Standard	Material	Cutting Speed m/min	Feed mm/tooth			
			Ø10	Ø12	Ø18	Ø25
P	Low and Medium Carbon Steels <0.55%C	60-120	0.16	0.17	0.20	0.22
	High Carbon Steels ≥0.55%C	60-90	0.14	0.16	0.20	0.22
	Alloy Steels, Treated Steels	50-80	0.10	0.12	0.16	0.18
M	Stainless Steels - Free Cutting	70-100	0.10	0.11	0.15	0.17
	Stainless Steels - Austenitic	60-90	0.10	0.11	0.15	0.17
	Cast Steels	70-90	0.10	0.12	0.16	0.18
K	Cast Iron	40-80	0.16	0.17	0.20	0.22
N	Aluminium ≤12%Si, Copper	100-200	0.16	0.17	0.20	0.22
	Aluminium >12% Si	60-140	0.10	0.11	0.16	0.18
	Synthetics, Duroplastics, Thermoplastics	50-200	0.19	0.19	0.22	0.24
S	Nickel Alloys, Titanium Alloys	20-40	0.07	0.07	0.10	0.12
H	Hardened Steel 45 - 50HRc	60-70	0.09	0.09	0.13	0.15
	Hardened Steel 50 - 55HRc	50-60	0.08	0.08	0.12	0.14



Mill-Thread Solid Carbide Grades, Speed and Feed Selection

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	Material	Cutting Speed m/min	Feed mm/tooth							
			Ø3	Ø4	Ø5	Ø6	Ø8	Ø9	Ø10	Ø12
P	Low and Medium Carbon Steels <0.55%C	60-120	0.02	0.03	0.03	0.04	0.05	0.05	0.05	0.05
	High Carbon Steels ≥0.55%C	60-90	0.015	0.02	0.03	0.03	0.04	0.04	0.04	0.05
	Alloy Steels, Treated Steels	50- 80	0.015	0.02	0.02	0.02	0.02	0.03	0.03	0.04
M	Stainless Steels - Free Cutting	70-100	0.015	0.02	0.02	0.02	0.02	0.03	0.03	0.03
	Stainless Steels - Austenitic	60-90	0.015	0.02	0.02	0.02	0.02	0.03	0.03	0.03
	Cast Steels	70-90	0.015	0.02	0.02	0.02	0.02	0.03	0.03	0.04
K	Cast Iron	40-80	0.02	0.03	0.03	0.04	0.05	0.05	0.05	0.05
N	Aluminium ≤12%Si, Copper	100-200	0.02	0.03	0.03	0.04	0.05	0.05	0.05	0.05
	Aluminium >12% Si	60-140	0.015	0.02	0.02	0.02	0.02	0.03	0.03	0.03
	Synthetics, Duroplastics, Thermoplastics	50-200	0.03	0.04	0.05	0.05	0.06	0.06	0.06	0.06

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.

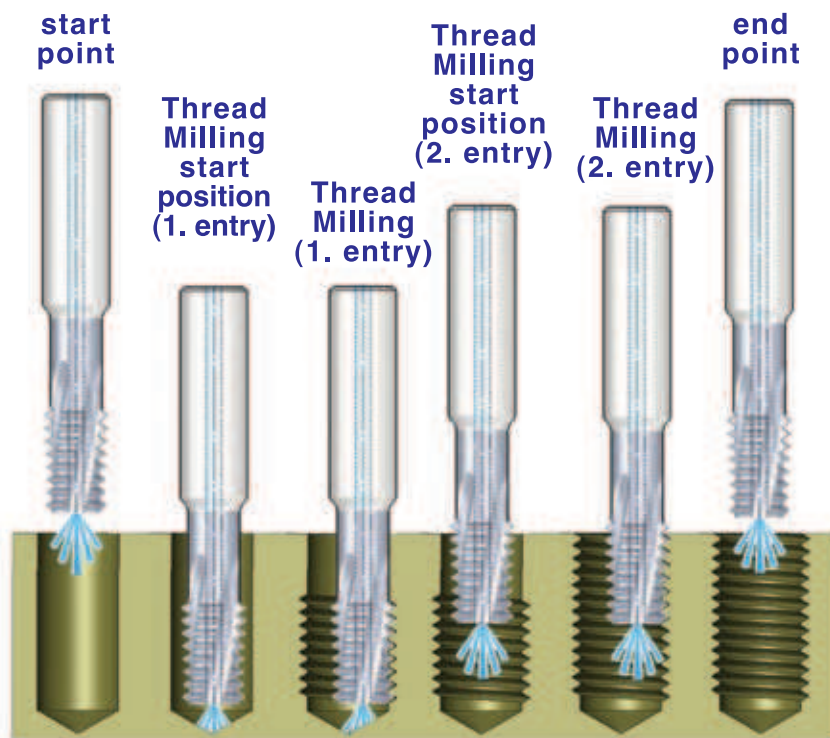
ISO	Material	Cutting Speed m/min	Feed mm/tooth										
			Ø2	Ø3	Ø4	Ø6	Ø8	Ø10	Ø12	Ø14	Ø16	Ø20	Ø25
P	Low and Medium Carbon Steels <0.55%C	100-250	0.03	0.04	0.04	0.06	0.07	0.08	0.09	0.11	0.12	0.15	0.18
	High Carbon Steels ≥0.55%C	110-180	0.02	0.03	0.03	0.05	0.06	0.07	0.08	0.09	0.10	0.12	0.15
	Alloy Steels, Treated Steels	90-160	0.02	0.02	0.03	0.03	0.04	0.05	0.05	0.06	0.07	0.08	0.10
M	Stainless Steels - Free Cutting	60-160	0.02	0.03	0.03	0.04	0.05	0.06	0.06	0.07	0.08	0.09	0.11
	Stainless Steels - Austenitic	60-120	0.02	0.02	0.03	0.03	0.04	0.05	0.05	0.06	0.07	0.08	0.10
	Cast Steels	130-170	0.02	0.02	0.03	0.03	0.04	0.05	0.05	0.06	0.07	0.08	0.10
K	Cast Iron	70-150	0.03	0.04	0.04	0.06	0.07	0.08	0.09	0.11	0.12	0.15	0.18
N	Aluminium ≤12%Si, Copper	150-350	0.03	0.04	0.04	0.06	0.07	0.08	0.09	0.11	0.12	0.15	0.18
	Aluminium >12% Si	100-250	0.02	0.02	0.03	0.03	0.04	0.05	0.05	0.06	0.07	0.08	0.10
	Synthetics, Duroplastics,	100-400	0.05	0.06	0.07	0.08	0.10	0.11	0.12	0.13	0.15	0.18	0.22
S	Thermoplastics and Nickel Alloys, Titanium Alloys	20- 80	0.02	0.02	0.02	0.03	0.03	0.03	0.03	0.04	0.04	0.04	0.05

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	Material	Cutting Speed m/min	Feed mm/tooth					
			Ø10	Ø12	Ø14	Ø16	Ø20	Ø25
P	Low and Medium Carbon Steels <0.55%C	100-250	0.06	0.07	0.07	0.08	0.10	0.12
	High Carbon Steels ≥0.55%C	110-180	0.05	0.05	0.06	0.07	0.09	0.10
	Alloy Steels, Treated Steels	90-160	0.03	0.04	0.04	0.05	0.06	0.07
M	Stainless Steels - Free Cutting	60-160	0.04	0.04	0.05	0.06	0.06	0.08
	Stainless Steels - Austenitic	60- 120	0.04	0.04	0.04	0.05	0.06	0.07
	Cast Steels	130-170	0.03	0.04	0.04	0.05	0.06	0.07
K	Cast Iron	70-150	0.06	0.07	0.07	0.08	0.10	0.12
N	Aluminium ≤12%Si, Copper	150-350	0.06	0.07	0.07	0.08	0.10	0.12
	Aluminium >12% Si	100-250	0.03	0.04	0.04	0.05	0.06	0.07
	Synthetics, Duoplastics, Thermoplastics	100-400	0.08	0.09	0.10	0.11	0.13	0.15
S	Nickel Alloys, Titanium Alloys	20- 80	0.02	0.02	0.02	0.03	0.03	0.03



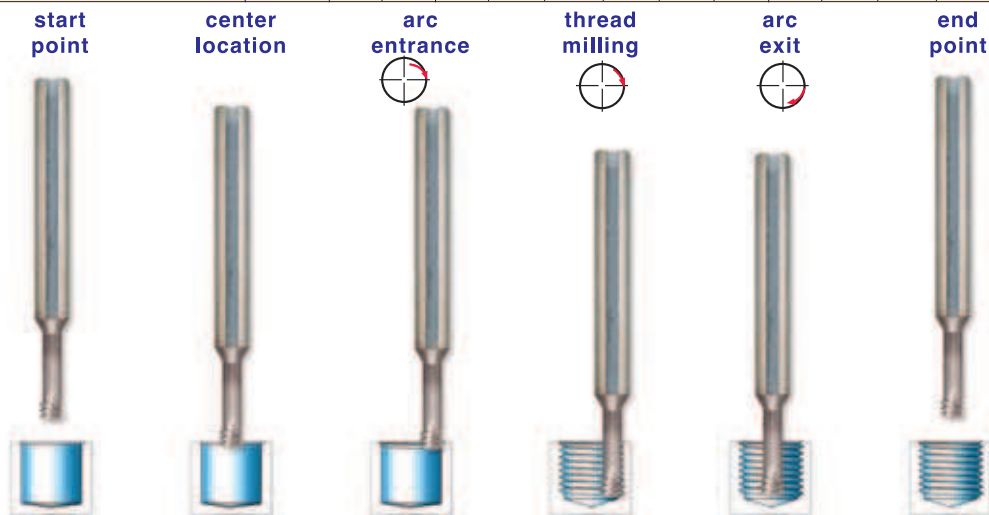
Mini Mill-Thread MTS and MTI types

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 Aluminium 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	Material	Cutting Speed m/min	Feed mm/tooth													
			Cutting Diameter = D													
			ø1	ø1.5	ø2	ø3	ø4	ø5	ø6	ø7	ø8	ø9	ø10	ø12	ø14	ø16
P	Low & Medium Carbon Steels < 0.55%C	60-120	0.04	0.05	0.05	0.07	0.09	0.11	0.13	0.14	0.15	0.16	0.16	0.17	0.18	0.18
	High Carbon Steels ≥ 0.55%C	60-90	0.03	0.04	0.05	0.06	0.08	0.09	0.10	0.12	0.13	0.14	0.14	0.16	0.17	0.18
	Alloy Steels, Treated Steels	50-80	0.03	0.04	0.04	0.05	0.05	0.06	0.07	0.07	0.08	0.09	0.10	0.12	0.13	0.14
M	Stainless Steels - Free Cutting	70-100	0.02	0.03	0.03	0.04	0.05	0.06	0.06	0.07	0.08	0.09	0.10	0.11	0.12	0.13
	Stainless Steel-Austenitic	60-90	0.02	0.03	0.03	0.04	0.05	0.06	0.06	0.07	0.08	0.09	0.10	0.11	0.12	0.13
	Cast Steels	70-90	0.03	0.04	0.04	0.05	0.05	0.06	0.07	0.07	0.08	0.09	0.10	0.12	0.13	0.14
K	Cast Iron	40-80	0.04	0.05	0.05	0.07	0.09	0.11	0.13	0.14	0.15	0.16	0.16	0.17	0.18	0.18
N	Aluminium ≤12%Si, Copper	100-200	0.04	0.05	0.05	0.07	0.09	0.11	0.13	0.14	0.15	0.16	0.16	0.17	0.18	0.18
	Aluminium >12%Si	60-140	0.03	0.03	0.03	0.04	0.05	0.06	0.06	0.07	0.08	0.09	0.10	0.11	0.13	0.14
	Synthetics, Duroplastics, Thermoplastics	50-200	0.09	0.10	0.11	0.12	0.14	0.16	0.18	0.19	0.19	0.19	0.19	0.19	0.20	0.20
S	Nickel Alloys and Titanium Alloys	20-40	0.03	0.03	0.03	0.04	0.04	0.05	0.06	0.06	0.06	0.07	0.07	0.07	0.08	0.08



Mini Mill-Thread vs. Taps

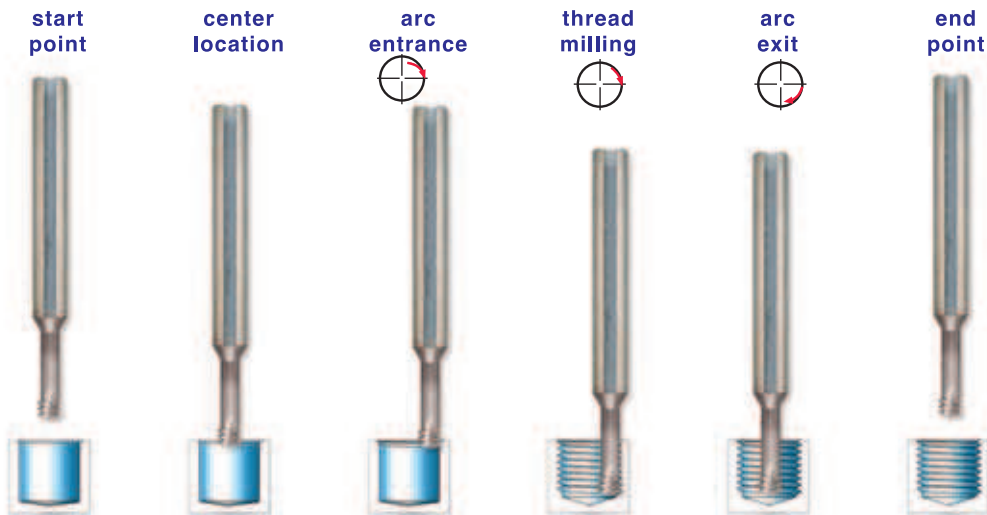
Features	Mini Mill-Thread	Taps
Thread surface quality	High	Medium
Thread geometry	Very accurate	Medium
Thread tolerances	4H, 5H, 6H with std cutter	6H with standard tap, 4H with specific tap
Machining time	Same as tap or shorter	Short
Tool breakage	Almost not possible	Could happen often
Machining load	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

Mini Mill-Thread MTSH type

MT9 Sub-Micron Grade with advanced PVD triple coating.

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

ISO	Material	Hardness HRc	Cutting Speed m/min	Feed mm/tooth													
				Cutting Diameter = D													
				ø1	ø1.5	ø2	ø3	ø4	ø5	ø6	ø7	ø8	ø9	ø10	ø12	ø14	ø16
S	Nickel Alloys, Titanium Alloys and High Temp. Alloys		20-40	0.03	0.03	0.03	0.04	0.04	0.05	0.06	0.06	0.06	0.07	0.07	0.07	0.08	0.08
H	Hardened Steels	45-50	60-70	0.03	0.04	0.04	0.05	0.05	0.06	0.06	0.07	0.07	0.08	0.08	0.09	0.10	0.11
		51-55	50-60	0.02	0.03	0.03	0.04	0.04	0.05	0.05	0.06	0.06	0.07	0.07	0.08	0.09	0.10
		56-62	40-50	0.01	0.02	0.02	0.03	0.03	0.04	0.04	0.05	0.05	0.06	0.06	0.07	0.08	0.09



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: 44 m / min Feed: 0.03 mm / 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 blue coating.

ISO Standard	Material	Hardness HRc	Cutting Speed m/min	Feed mm/tooth Cutting Diameter = D								
				Ø2.5	Ø3	Ø4	Ø5	Ø6	Ø7	Ø8	Ø9	Ø10
S	Nickel Alloys, Titanium Alloys, High Temperature Alloys		20 - 50	0.02	0.02	0.02	0.02	0.03	0.03	0.03	0.03	0.04
		45 - 50	70 - 80	0.02	0.03	0.03	0.04	0.04	0.05	0.05	0.06	0.07
		51 - 55	60 - 70	0.01	0.02	0.02	0.03	0.03	0.04	0.04	0.05	0.06
H	Hardened Steels, Cast Iron	56 - 62	40 - 50	0.005	0.01	0.01	0.02	0.02	0.03	0.03	0.04	0.05

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

