# Thread Turning Technical Section

# Carbide Grade Selection

***Choose the C.P.T. grade specifically formulated for your application from the following list:***

## Coated Grades

| | |
|---|---|
| ***HBA*** (H10-H25) (S10-S25) | Extra-fine sub-micron grade with high toughness , for optimized performance on hardened steels and cast iron up to 62HRc, titanium alloys and super alloys (hastelloy, inconel and nickel based alloys). |
| ***BLU*** (M10-M20) (K05-K20) (N10-N20) (S10-S20) | PVD triple layer coated sub-micron grade for stainless steels, cast iron, titanium, non ferrous metals and most of the high temperature alloys. |
| ***BMA*** (P20-P40) (K20-K30) | PVD TiAlN coated sub-micrograin grade for stainless steels and exotic materials at medium to high cutting speeds. |
| ***P25C*** (P15-P35) | PVD TiN coated grade for treated and hard alloy steels (25 HRc & up) at medium to low cutting speeds. |
| ***MXC*** (K10-K20) (P10-P25) | PVD TiN coated micrograin for free cutting untreated alloy steels (below 30 HRc), for stainless steels and cast iron. |
| ***BXC*** (P30-P50) (K25-K40) | PVD TiN coated grade for low cutting speed. Works well with wide range of stainless steels. |

## Uncoated Grades

| | |
|---|---|
| ***P30**** (P20-P30) | Carbide grade for carbon and cast steels, works well at medium to low cutting speeds. |
| ***K20**** (K10-K30) | Carbide grade for non ferrous metals, aluminum and cast iron. |

* Upon request

***Note:*** Due to our unique and specialized production techniques, C.P.T. coated inserts provide superior cutting performance and exceptionally long tool life.

## Grade availability per inserts size

| Grade | HBA | BLU | BMA | P25C | MXC | BXC | P30 | K20 |
|---|---|---|---|---|---|---|---|---|
| Insert sizes | 11, 16, 22, 27 | 11, 16, 22 | 06, 08, 11, 16, 22, 27, 33U, | 11, 16, 22, 27, 33U | 11, 16, 22, 27, 33U | 06, 08 | 11, 16, 22, 27, 33U | 06, 08 11, 16, 22, 27, 33U |
| | | | Type-B 11, 16 | | | | | |

# Type B - Threading Inserts

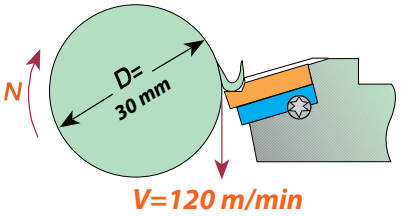
A combination of ground profile, and sintered chip-breaker threading inserts.
Unlike most other manufactures' inserts, this combination ensures a consistent high quality thread, with precise shape and dimensions.
Two different unique styles of chip-breaker were designed to suit the different specific requirements of Internal threads and External threads.
All of C.P.T. Type B inserts are made of BMA Sub-Micrograin grade.

# Recommended cutting speed (m/min) for thread turning inserts

| ISO Standard | Material | | Condition | HBA | BLU | BMA | P25C | MXC | BXC | K20 | P30 |
|---|---|---|---|---|---|---|---|---|---|---|---|
| P | Non-Alloy Steel and Cast Steel, Free Cutting Steel | <0.25%C | Annealed | | 110-210 | 120-180 | 100-180 | 100-180 | 70-150 | | 50-130 |
| | | ≥0.25%C | Annealed | | | | | | | | |
| | | <0.55%C | Quenched & Tempered | | | | | | | | |
| | | ≥0.55%C | Annealed | | | | | | | | |
| | | | Quenched & Tempered | | | | | | | | |
| | Low Alloy Steel and Cast Steel (less than 5% alloying elements) | | Annealed | | 90-140 | 80-130 | 70-120 | 70-120 | 60-90 | | 50-80 |
| | | | Quenched & Tempered | | | | | | | | |
| | High Alloy Steel, Cast Steel, and Tool Steel | | Annealed | | 70-90 | 60-80 | 50-60 | 55-70 | 50-60 | | 40-50 |
| | | | Quenched & Tempered | | | | | | | | |
| M | Stainless Steel and Cast Steel | | Ferritic / Martensitic | | 110-160 | 90-130 | 60-90 | 60-90 | 50-80 | 50-80 | |
| | | | Martensitic | | | | | | | | |
| | | | Austenitic | | | | | | | | |
| K | Cast Iron Nodular (GGG) | | Ferritic / Pearlitic | | 120-150 | 100-130 | | 80-110 | 60-90 | | |
| | | | Pearlitic | | | | | | | | |
| | Grey Cast Iron (GG) | | Ferritic | | 140-150 | 120-130 | | 90-100 | 65-85 | | |
| | | | Pearlitic | | | | | | | | |
| | Malleable Cast Iron | | Ferritic | | 110-140 | 100-130 | | 80-100 | 60-85 | | |
| | | | Pearlitic | | | | | | | | |
| N | Aluminum-Wrought Alloy | | Not Cureable | | 700-1000 | | | 600-800 | 450-600 | 600-800 | 350-500 |
| | | | Cured | | | | | | | | |
| | Aluminum-Cast, Alloyed | <=12% Si | Not Cureable | | 280-750 | | | 200-550 | 150-350 | 200-550 | 110-300 |
| | | | Cured | | | | | | | | |
| | | >12% Si | High Temperature | | | | | | | | |
| | Copper Alloys | >1% Pb | Free Cutting | | 190-350 | | | 150-250 | 110-180 | 150-250 | 90-150 |
| | | | Brass | | | | | | | | |
| | | | Electrolytic Copper | | | | | | | | |
| | Non Metallic | | Duroplastics, Fiber Plastics | | | | | 200-300 | 150-210 | 100-200 | 110-150 |
| | | | Hard Rubber | | | | | | | | |
| S | High Temp. Alloys, Super Alloys | Fe based | Annealed | 20-80 | 30-65 | 25-60 | | | | | |
| | | | Cured | | | | | | | | |
| | | Ni or Co based | Annealed | | | | | | | | |
| | | | Cured | | | | | | | | |
| | | | Cast | | | | | | | | |
| | Titanium Alloys | | Alpha +Beta Alloys Cured | 30-60 | 40-50 | 35-45 | | | | 35-45 | |
| H | Hardened Steel | | Hardened 45-50 HRc | 30-60 | 40-50 | 35-45 | | | | | |
| | | | Hardened 51-55 HRc | | | | | | | | |
| | | | Hardened 56-62 HRc | | | | | | | | |
| | Chilled Cast Iron | | Cast | 20-50 | 30-40 | 25-35 | | | | | |
| | Cast Iron | | Hardened | 20-40 | 20-30 | 15-25 | | | | | |

# Conversion of Cutting Speed to Rotational Speed

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




*Example*

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

## Number of passes and depth of cut per pass for multitooth insert

| | Pitch mm | Insert Size | | No. of Teeth | Ordering Code | No. of Passes | Depth of Cut per pass | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | L | I.C. (in) | | | | 1 | 2 | 3 | 4 |
| ISO External | 1.00 | 16 | 3/8 | 3 | 16 ER 1.0 ISO 3M | 2 | 0.38 | 0.25 | | |
| | 1.50 | 16 | 3/8 | 2 | 16 ER 1.5 ISO 2M | 3 | 0.42 | 0.30 | 0.20 | |
| | 1.50 | 22 | 1/2 | 3 | 22 ER 1.5 ISO 3M | 2 | 0.55 | 0.37 | | |
| | 2.00 | 22 | 1/2 | 2 | 22 ER 2.0 ISO 2M | 3 | 0.57 | 0.40 | 0.28 | |
| | 2.00 | 22 | 1/2 | 3 | 22 ER 2.0 ISO 3M | 2 | 0.76 | 0.49 | | |
| | 3.00 | 27 | 5/8 | 2 | 27 ER 3.0 ISO 2M | 4 | 0.59 | 0.51 | 0.42 | 0.32 |
| ISO Internal | 1.00 | 16 | 3/8 | 3 | 16 IR 1.0 ISO 3M | 2 | 0.33 | 0.25 | | |
| | 1.50 | 16 | 3/8 | 2 | 16 IR 1.5 ISO 2M | 3 | 0.38 | 0.29 | 0.20 | |
| | 1.50 | 22 | 1/2 | 3 | 22 IR 1.5 ISO 3M | 2 | 0.50 | 0.37 | | |
| | 2.00 | 22 | 1/2 | 2 | 22 IR 2.0 ISO 2M | 3 | 0.52 | 0.37 | 0.26 | |
| | 2.00 | 22 | 1/2 | 3 | 22 IR 2.0 ISO 3M | 2 | 0.70 | 0.45 | | |
| | 3.00 | 27 | 5/8 | 2 | 27 IR 3.0 ISO 2M | 4 | 0.58 | 0.46 | 0.39 | 0.30 |
| UN External | 16 | 16 | 3/8 | 2 | 16 ER 16 UN 2M | 3 | 0.44 | 0.31 | 0.22 | |
| | 16 | 22 | 1/2 | 3 | 22 ER 16 UN 3M | 2 | 0.58 | 0.39 | | |
| | 12 | 22 | 1/2 | 2 | 22 ER 12 UN 2M | 3 | 0.59 | 0.42 | 0.30 | |
| | 12 | 22 | 1/2 | 3 | 22 ER 12 UN 3M | 2 | 0.78 | 0.52 | | |
| | 8 | 27 | 5/8 | 2 | 27 ER 8 UN 2M | 4 | 0.62 | 0.54 | 0.45 | 0.35 |
| UN Internal | 16 | 16 | 3/8 | 2 | 16 IR 16 UN 2M | 3 | 0.42 | 0.28 | 0.22 | |
| | 16 | 22 | 1/2 | 3 | 22 IR 16 UN 3M | 2 | 0.55 | 0.37 | | |
| | 12 | 22 | 1/2 | 2 | 22 IR 12 UN 2M | 3 | 0.53 | 0.38 | 0.31 | |
| | 12 | 22 | 1/2 | 3 | 22 IR 12 UN 3M | 2 | 0.74 | 0.48 | | |
| | 8 | 27 | 5/8 | 2 | 27 IR 8 UN 2M | 4 | 0.63 | 0.50 | 0.40 | 0.30 |
| Whitworth 55° External | 14 | 16 | 3/8 | 2 | 16 ER 14 W 2M | 3 | 0.52 | 0.37 | 0.27 | |
| | 14 | 22 | 1/2 | 3 | 22 ER 14 W 3M | 2 | 0.70 | 0.46 | | |
| | 11 | 22 | 1/2 | 2 | 22 ER 11 W 2M | 3 | 0.67 | 0.47 | 0.34 | |
| Whitworth 55° Internal | 14 | 16 | 3/8 | 2 | 16 IR 14 W 2M | 3 | 0.52 | 0.37 | 0.27 | |
| | 14 | 22 | 1/2 | 3 | 22 IR 14 W 3M | 2 | 0.70 | 0.46 | | |
| | 11 | 22 | 1/2 | 2 | 22 IR 11 W 2M | 2 | 0.67 | 0.47 | 0.34 | |
| NPT External | 14 | 16 | 3/8 | 2 | 16 ER 14 NPT 2M | 3 | | | | |
| | 11.5 | 22 | 1/2 | 2 | 22 ER 11.5 NPT 2M | 4 | 0.54 | 0.47 | 0.37 | 0.30 |
| | 11.5 | 27 | 5/8 | 3 | 27 ER 11.5 NPT 3M | 4 | 0.76 | 0.54 | 0.38 | |
| | 8 | 27 | 5/8 | 2 | 27 ER 8 NPT 2M | 4 | 0.81 | 0.60 | 0.55 | 0.45 |
| NPT Internal | 14 | 16 | 3/8 | 2 | 16 IR 14 NPT 2M | 3 | | | | |
| | 11.5 | 22 | 1/2 | 2 | 22 IR 11.5 NPT 2M | 4 | 0.54 | 0.47 | 0.37 | 0.30 |
| | 11.5 | 27 | 5/8 | 3 | 27 IR 11.5 NPT 3M | 4 | 0.76 | 0.54 | 0.38 | |
| | 8 | 27 | 5/8 | 2 | 27 IR 8 NPT 2M | 4 | 0.81 | 0.60 | 0.55 | 0.45 |
| API Round External | 10 | 22 | 1/2 | 2 | 22 ER 10 APIRD 2M | 3 | 0.60 | 0.50 | 0.31 | |
| | 10 | 27 | 5/8 | 3 | 27 ER 10 APIRD 3M | 2 | 1.00 | 0.41 | | |
| | 8 | 27 | 5/8 | 2 | 27 ER 8 APIRD 2M | 3 | 0.80 | 0.60 | 0.41 | |
| API Round Internal | 10 | 22 | 1/2 | 2 | 22 IR 10 APIRD 2M | 3 | 0.60 | 0.50 | 0.31 | |
| | 10 | 27 | 5/8 | 3 | 27 IR 10 APIRD 3M | 2 | 1.00 | 0.41 | | |
| | 8 | 27 | 5/8 | 2 | 27 IR 8 APIRD 2M | 3 | 0.80 | 0.60 | 0.41 | |

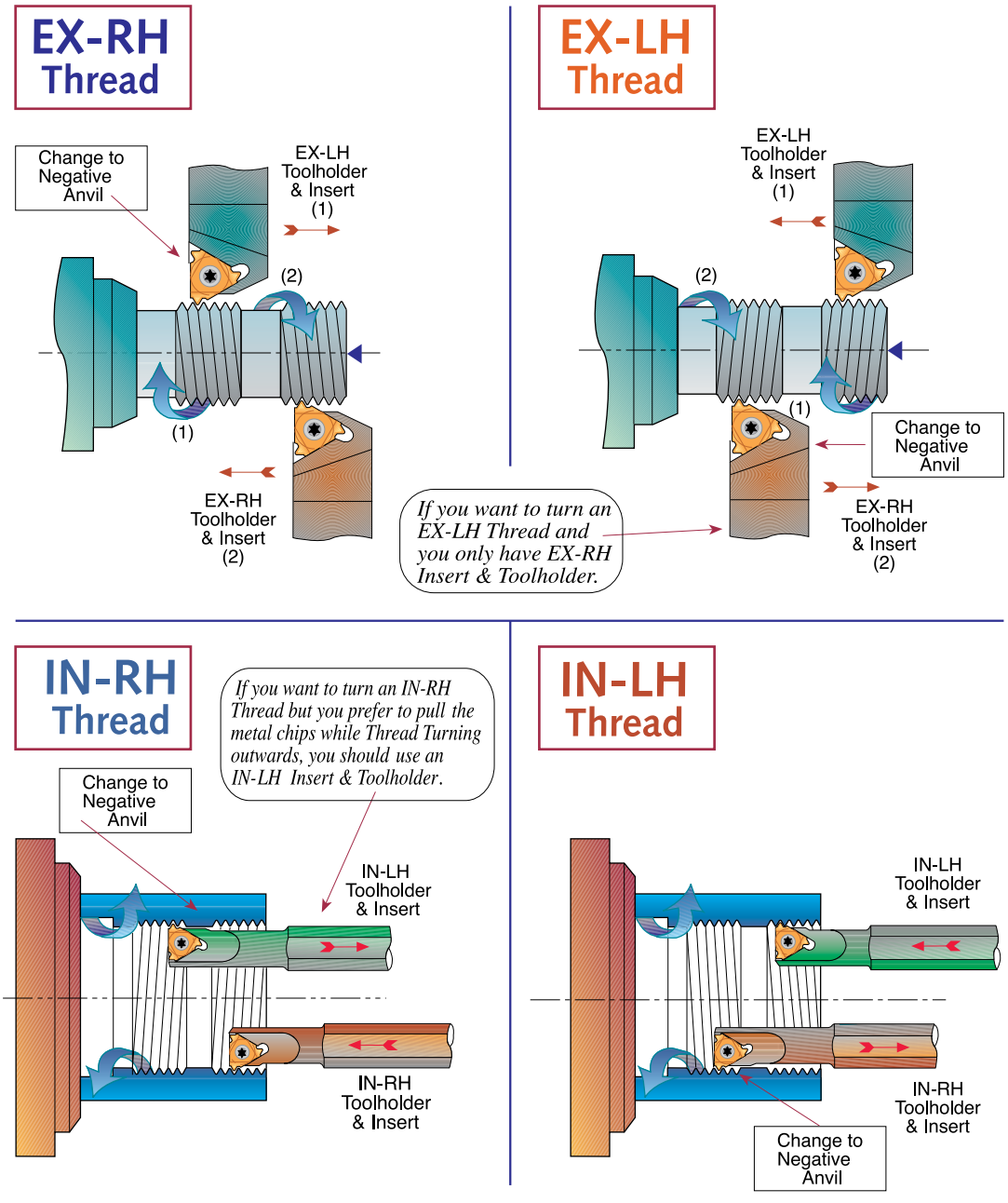
## Number of threading passes selection for single point inserts

| Pitch: | mm<br>TPI | 0.5<br>48 | 0.8<br>32 | 1.0<br>24 | 1.25<br>20 | 1.5<br>16 | 1.75<br>14 | 2.0<br>12 | 2.5<br>10 | 3.0<br>8 | 4.0<br>6 | 6.0<br>4 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Number of Passes | | 3-6 | 4-7 | 4-9 | 6-10 | 5-11 | 9-12 | 6-13 | 7-15 | 8-17 | 10-20 | 11-22 |

***NOTES:***

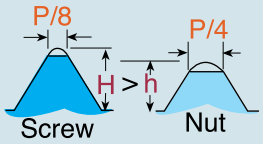
1. For most standard applications the middle of the range is a good starting point.
2. For most materials, the tougher the material, the higher the number of cutting passes you should select.
3. As a general rule of thumb, fewer passes are better than more speed.

# Thread Turning Methods

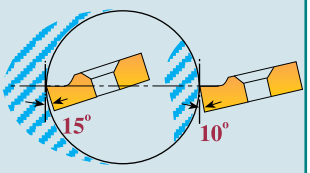


# Important Points about C.P.T. Threading Inserts

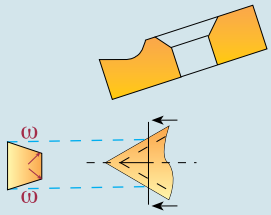
1. In most thread forms internal and external threads have different depth and radii, thus tools are not interchangeable



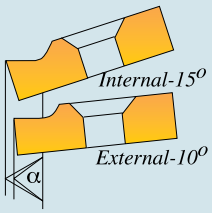

2. The Insert relief angle of a standard C.P.T. external toolholder is 10°; for an internal toolholder it is 15°. This 5° difference is to provide additional necessary radial clearance.




3. Our built-in relief angles ensure automatic insert flank angle clearance.



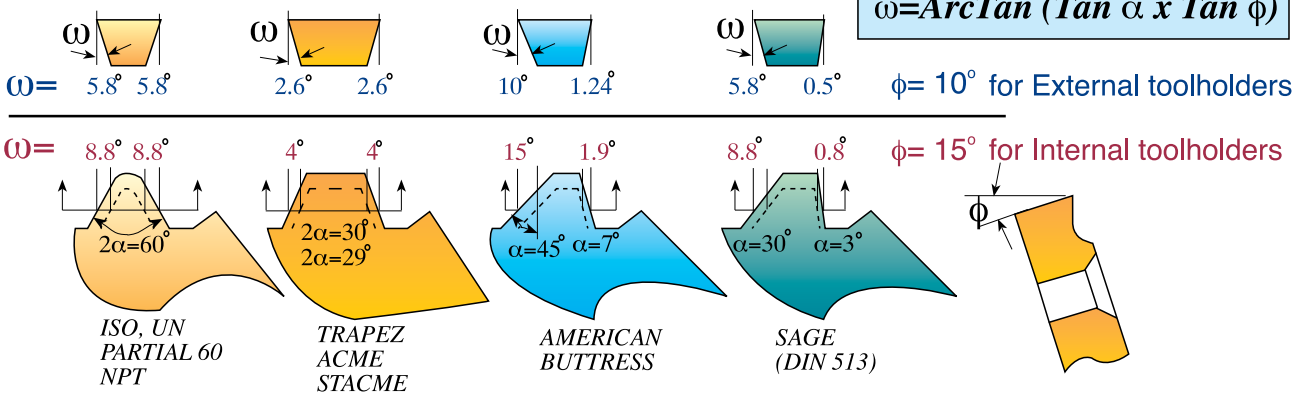

4. Profiles of C.P.T. internal & external threading inserts are precision ground to ensure accurate thread geometry when used in their corresponding toolholders. Using internal inserts with an external holder will result in distortion of angle and insert geometry.




5. Insert and toolholder should always match. An IN-RH insert must be used with an IN-RH toolholder. No mismatch is allowed.

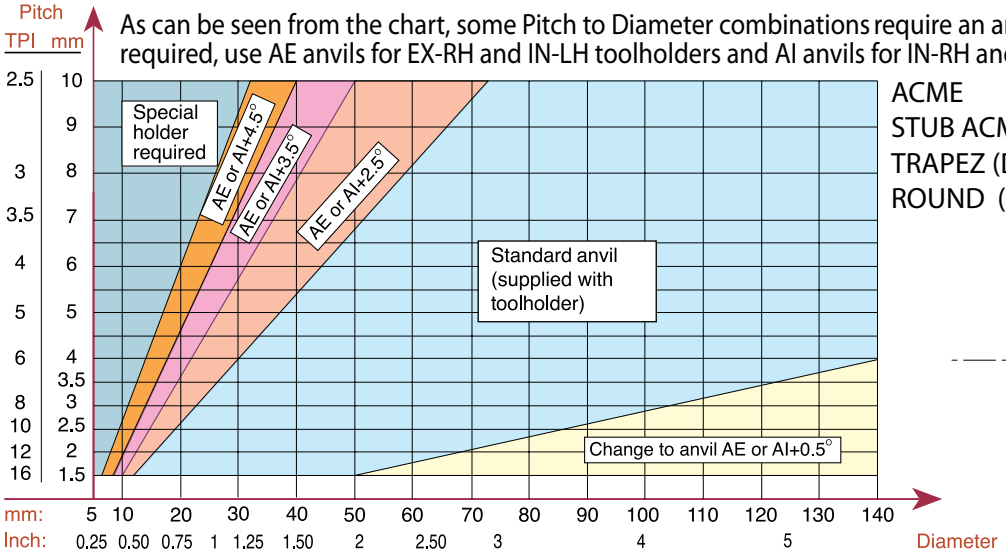

# Flank Clearance Angle ω

$$\omega = ArcTan\ (Tan\ \alpha \times Tan\ \phi)$$

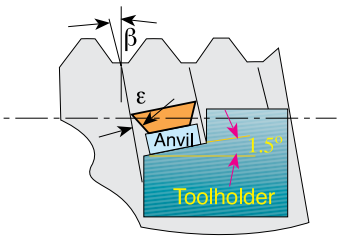


# Anvil Change Recommendation

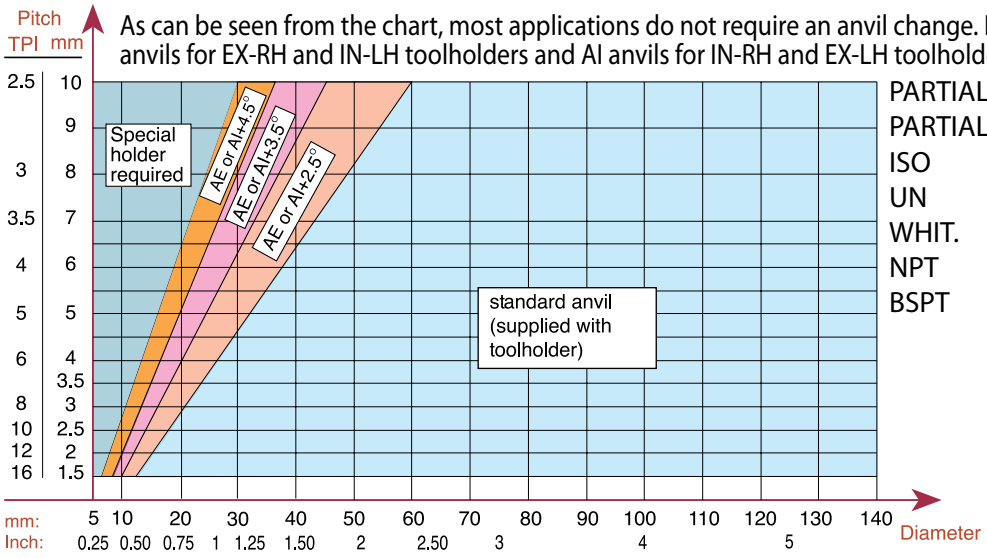
As can be seen from the chart, some Pitch to Diameter combinations require an anvil change. If change is required, use AE anvils for EX-RH and IN-LH toolholders and AI anvils for IN-RH and EX-LH toolholders.




ACME
STUB ACME
TRAPEZ (DIN 103)
ROUND (DIN 405)

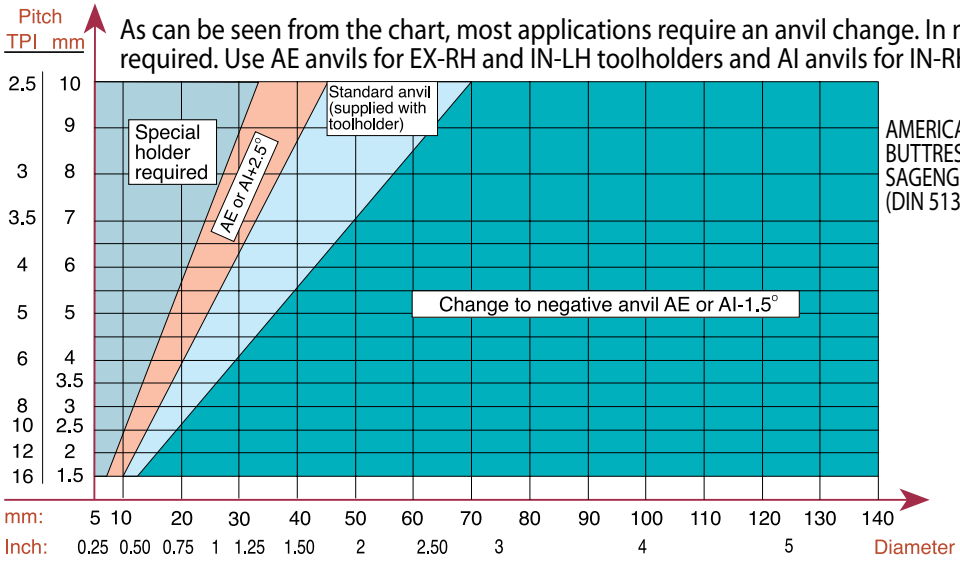



As can be seen from the chart, most applications do not require an anvil change. If change is required, use AE anvils for EX-RH and IN-LH toolholders and AI anvils for IN-RH and EX-LH toolholders.

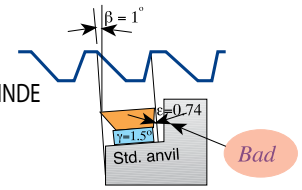



PARTIAL PROFILE 60°
PARTIAL PROFILE 55°
ISO
UN
WHIT.
NPT
BSPT

As can be seen from the chart, most applications require an anvil change. In most cases a negative anvil is required. Use AE anvils for EX-RH and IN-LH toolholders and AI anvils for IN-RH and EX-LH toolholders.

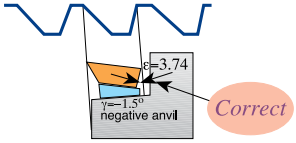



AMERICAN BUTTRESS SAGENGEWINDE (DIN 513)




**Before Anvil change**

Replacing the standard anvil with an anvil with negative angle, will eliminate side rubbing




**After Anvil Change**

# Thread Turning - Step by Step

**Step 1 : Choose Thread Turning Method from page 63**
**Step 2 : Choose Insert**
**Step 3 : Choose Toolholder**
**Step 4 : Choose Insert Grade**
**Step 5 : Choose Thread Turning Speed**
**Step 6 : Choose Number of Threading Passes**

In most cases the above mentioned 6 steps would be the steps needed to ensure a good thread. When cutting more complicated threads such as TRAPEZ, ACME, BUTTRESS or SAGE, it is advisable to check the effect of the thread "HELIX ANGLE" $\beta$ on the "RESULTANT FLANK CLEARANCE" $\varepsilon$. If $\varepsilon$ is smaller than 2°, an anvil change is required.

**Step 7 : Find Thread Helix Angle**
**Step 8 : Choose Correct Anvil**

## EXAMPLES:

### Example No. 1:

Step 1: Choose Thread Turning Method from page 63, we chose **EX - RH Insert & Toolholder**

Step 2: Choose Insert from page 9: **16 ER 1.5 ISO**

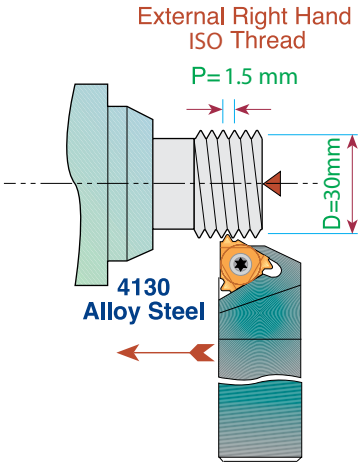
Step 3: Choose Toolholder from page 39: **SER 2020 K16**

Step 4: Choose Insert Grade from selection on page 60
Our choice for Alloy Steel is Grade **P25C**

Step 5: Choose Thread Turning Speed from chart on page 61, we chose **100 m/min**

Rotational Speed calculation: $N = \frac{100 \times 1000}{\pi \times 30} = 1065$ rpm

Step 6: Choose Number of Threading passes from table on page 63, we chose **8 passes**




### Example No. 2:

Step 1: Choose Thread Turning Method from page 63
Usually, an IN-RH Toolholder and Insert will be chosen, however, in this particular case we prefer to pull the metal chips while thread turning outward, thus we chose to work with **IN-LH Insert & Toolholder**

Step 2: Choose Insert from page 13: **16 IL 12 UN**

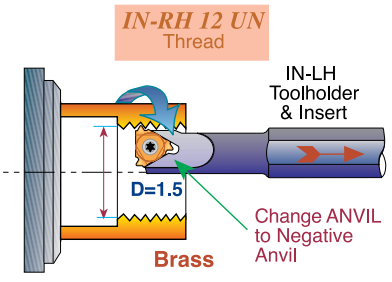
Step 3: Choose Toolholder from page 41: **SIL 0025 R16**
Note: since we thread cut IN-RH thread outward with an IN-LH tool, do not forget to replace the standard anvil (supplied with the holder) with a negative anvil **AE16-1.5**

Step 4: Choose Insert Grade from selection on page 60
Our choice for Brass is Grade **K20**

Step 5: Choose Thread Turning Speed from chart on page 61, we chose **150 m/min**

Rotational Speed calculation: $N = \frac{150 \times 1000}{\pi \times 38.1} = 1254$ RPM

Step 6: Choose Number of Threading passes from table on page 63, we chose **9 passes**



## *Example No. 3:*

Step 1: Choose Thread Turning Method from page 63
We chose EX-RH Insert & Toolholder.

Step 2: Choose Insert from page 33: **16 ER 12 ABUT**

Step 3: Choose Toolholder from page 39: **SER 2525 M16**

Step 4: Choose Insert Grade from selection on page 60
Our choice for Stainless Steel is Grade **BMA**

Step 5: Choose Thread Turning Speed from chart on page 61
We chose 120 m/min.
Rotational Speed calculation: $N = \frac{120 \times 1000}{\pi \times 40} = 954$ RPM

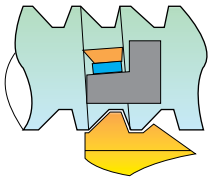
Step 6: Choose Number of Threading passes
from table on page 63. We chose **13 passes**

Step 7: Find Thread Helix Angle: on page 48
for Pitch of 12 TPI and 40 Diameter
Helix Angle as shown in the chart is 1°

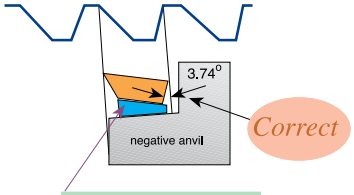
Step 8: Choose correct Anvil: As can be seen
from the chart on page 65, for AMERICAN
BUTTRESS Thread, for 12 TPI and 40 Diameter
a negative anvil **AE16-1.5** should replace the
standard anvil supplied with the toolholder

EX-RH. AMERICAN BUTTRESS
12 TPI on 40 mm diameter.

Stainless Steel 304



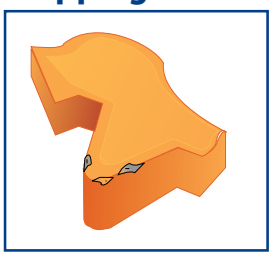
Replacing the standard anvil with an anvil with negative angle will eliminate side rubbing




**Anvil chosen: AE16-1.5**

# *Troubleshooting*

### Chipping



1. Use a tougher carbide grade
2. Eliminate tool overhang
3. Check if insert is correctly clamped
4. Eliminate vibration

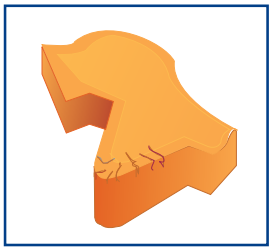
### Crater Wear

1. Reduce cutting speed
2. Apply coolant fluid
3. Use a harder carbide grade

### Build-up Edge

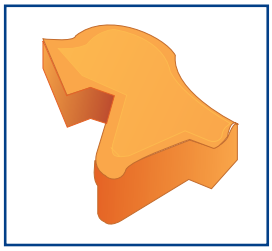
1. Increase cutting speed
2. Use a tougher carbide grade

### Thermal Cracking



1. Reduce cutting speed
2. Apply coolant fluid
3. Use a tougher carbide grade

### Deformation



1. Use a harder carbide grade
2. Reduce cutting speed
3. Reduce depth of cut
4. Apply coolant fluid

### Fracture

1. Use a tougher carbide grade
2. Reduce depth of cut
3. Index insert sooner
4. Check machine and tool stability

# Threading Inserts Standards

| Thread Profile | Standard | Thread Class |
|---|---|---|
| ISO | DIN 13 | 6g / 6H |
| UN | ANSI B1.1-1989 | 2A / 2B |
| WHITWORTH | B.S. 84: 1956 | Medium Class |
| NPT | ANSI B1.20.1-1983 | - |
| NPTF | ANSI B1.20.3-1976 | - |
| BSPT | B.S. 21: 1957 | - |
| DIN 477 | DIN 477 | - |
| ACME | ANSI B1.5-1988 | 3G |
| STUB ACME | ANSI B1.5-1988 | 2G |
| TRAPEZ | DIN 103 | 7e / 7H |
| ROUND | DIN 405 | Class 7 |
| UNJ | MIL-S-8879C | 3A / 3B |
| MJ | ISO 5855 | 4h/6h<br>4H/5H |
| AMERICAN BUTTRESS | ANSI B1.9-1973 | Class 2 |
| SAGENGEWINDE | DIN 513 | - |
| PG | DIN 40430 | - |
| V-0.040 | API Spec7 | - |
| V-0.038R | API Spec7 | - |
| V-0.050 | API Spec7 | - |
| V-0.055 | API Spec7 | - |
| API ROUND | API Spec Standard 5B | - |
| EXTREME – LINE CASING | API Spec Standard 5B | - |
| BUTTRESS CASING | API Spec Standard 5B | - |
| VAM | VAM | - |

DIN: **Deutsches Institut für Normung**
ANSI: **American National Standards Institute**
API: **American Petroleum Institute**
B.S.: **British Standards**
ISO: **International Organisation for Standardisation**
MIL-S: **Military Specification**