Thread Turning Technical Section

Contents:	Page:

Carbide Grade Selection

Choose the Carmex 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, Carmex 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

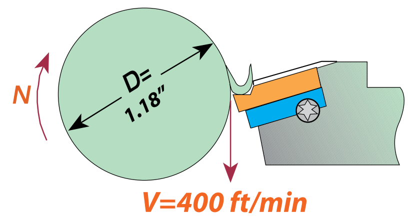
A combination of ground profile, and sintered chip-breaker threading inserts. Unlike most other manufacturers inserts, this combination ensures a consistent high quality thread, with precise shape and dimensions.
Two different unique styles of chip-breaker were designed to suit the different specific requirements of Internal threads and External threads.
All of Carmex Type B inserts are made of BMA Sub-Micrograin grade.

Recommended cutting speed (ft/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		361-689	394-590	328-590	328-590	230-492		164-426
		≥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 Quenched & Tempered		295-459	262-426	230-394	230-394	197-295		164-262
	High Alloy Steel, Cast Steel, and Tool Steel		Annealed Quenched & Tempered		230-295	197-262	164-197	180-230	164-197		131-164
M	Stainless Steel and Cast Steel		Ferritic / Martensitic		328-525	295-426	197-295	197-295	164-262	164-262	
			Martensitic								
			Austenitic								
K	Cast Iron Nodular (GGG)		Ferritic / Pearlitic		459-492	394-426		295-328	213-297		
			Pearlitic								
	Grey Cast Iron (GG)		Ferritic		361-459	328-426		262-328	197-279		
			Pearlitic								
	Malleable Cast Iron		Ferritic		361-459	328-426		262-328	197-279		
			Pearlitic								
N	Aluminum-Wrought Alloy		Not Cureable		2296-3280			1968-2624	1476-1968	1964-2624	1148-1640
			Cured								
	Aluminum-Cast, Alloyed	<=12% Si	Not Cureable		918-2460			565-1804	492-1148	656-1804	361-984
			Cured								
		>12% Si	High Temperature								
	Copper Alloys	>1% Pb	Free Cutting		623-1148			492-820	361-590	492-820	295-492
			Brass								
			Electrolytic Copper								
	Non Metallic		Duroplastics, Fiber Plastics					656-984	492-689	328-656	361-492
			Hard Rubber								
S	High Temp. Alloys, Super Alloys	Fe based	Annealed	16-262	98-213	82-197					
			Cured								
		Ni or Co based	Annealed								
			Cured								
			Cast								
	Titanium Alloys		Alpha +Beta Alloys Cured	95-197	131-164	115-148				115-148	
H	Hardened Steel		Hardened 45-50 HRc	95-197	131-164	115-148					
			Hardened 51-55 HRc								
			Hardened 56-62 HRc								
	Chilled Cast Iron		Cast	66-164	98-131	82-115					
	Cast Iron		Hardened	66-131	66-98	49-82					

Conversion of Cutting Speed to Rotational Speed

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



Example

$$N = \frac{V \times 12}{\pi \times D} = \frac{400 \times 12}{3.14 \times 1.18} = 1294 \text{ RPM}$$

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

	Pitch mm / TPI	Insert Size		No. of Teeth	Ordering Code	No. of Passes	Depth of Cut per pass			
		L (mm)	I.C.				1	2	3	4
ISO External	1.00	16	3/8	3	16 ER 1.0 ISO 3M	2	.015	.010		
	1.50	16	3/8	2	16 ER 1.5 ISO 2M	3	.017	.012	.008	
	1.50	22	1/2	3	22 ER 1.5 ISO 3M	2	.022	.015		
	2.00	22	1/2	2	22 ER 2.0 ISO 2M	3	.022	.016	.011	
	2.00	22	1/2	3	22 ER 2.0 ISO 3M	2	.030	.019		
	3.00	27	5/8	2	27 ER 3.0 ISO 2M	4	.023	.020	.017	.013
ISO Internal	1.00	16	3/8	3	16 IR 1.0 ISO 3M	2	.013	.010		
	1.50	16	3/8	2	16 IR 1.5 ISO 2M	3	.015	.011	.008	
	1.50	22	1/2	3	22 IR 1.5 ISO 3M	2	.020	.015		
	2.00	22	1/2	2	22 IR 2.0 ISO 2M	3	.020	.014	.010	
	2.00	22	1/2	3	22 IR 2.0 ISO 3M	2	.028	.018		
	3.00	27	5/8	2	27 IR 3.0 ISO 2M	4	.023	.018	.015	.012
UN External	16	16	3/8	2	16 ER 16 UN 2M	3	.017	.012	.009	
	16	22	1/2	3	22 ER 16 UN 3M	2	.023	.015		
	12	22	1/2	2	22 ER 12 UN 2M	3	.023	.017	.012	
	12	22	1/2	3	22 ER 12 UN 3M	2	.031	.020		
	8	27	5/8	2	27 ER 8 UN 2M	4	.024	.021	.018	.014
UN Internal	16	16	3/8	2	16 IR 16 UN 2M	3	.017	.011	.009	
	16	22	1/2	3	22 IR 16 UN 3M	2	.022	.015		
	12	22	1/2	2	22 IR 12 UN 2M	3	.021	.015	.012	
	12	22	1/2	3	22 IR 12 UN 3M	2	.029	.019		
	8	27	5/8	2	27 IR 8 UN 2M	4	.025	.020	.016	.012
Whitworth 55° External	14	16	3/8	2	16 ER 14 W 2M	3	.020	.015	.011	
	14	22	1/2	3	22 ER 14 W 3M	2	.028	.030		
	11	22	1/2	2	22 ER 11 W 2M	3	.026	.019	.013	
Whitworth 55° Internal	14	16	3/8	2	16 IR 14 W 2M	3	.020	.015	.011	
	14	22	1/2	3	22 IR 14 W 3M	2	.028	.018		
	11	22	1/2	2	22 IR 11 W 2M	2	.026	.019	.013	
NPT External	14	16	3/8	2	16 ER 14 NPT 2M	3	.021	.018	.017	
	11.5	22	1/2	2	22 ER 11.5 NPT 2M	4	.019	.019	.017	.013
	11.5	27	5/8	3	27 ER 11.5 NPT 3M	4	.020	.019	.017	.012
	8	27	5/8	2	27 ER 8 NPT 2M	4	.029	.026	.024	.021
NPT Internal	14	16	3/8	2	16 IR 14 NPT 2M	3	.021	.018	.017	
	11.5	22	1/2	2	22 IR 11.5 NPT 2M	4	.019	.019	.017	.013
	11.5	27	5/8	3	27 IR 11.5 NPT 3M	4	.020	.019	.017	.012
	8	27	5/8	2	27 IR 8 NPT 2M	4	.029	.026	.024	.021
API Round External	10	22	1/2	2	22 ER 10 APIRD 2M	3	.024	.020	.012	
	10	27	5/8	3	27 ER 10 APIRD 3M	2	.039	.016		
	8	27	5/8	2	27 ER 8 APIRD 2M	3	.031	.024	.016	
API Round Internal	10	22	1/2	2	22 IR 10 APIRD 2M	3	.024	.020	.012	
	10	27	5/8	3	27 IR 10 APIRD 3M	2	.039	.016		
	8	27	5/8	2	27 IR 8 APIRD 2M	3	.031	.024	.016	

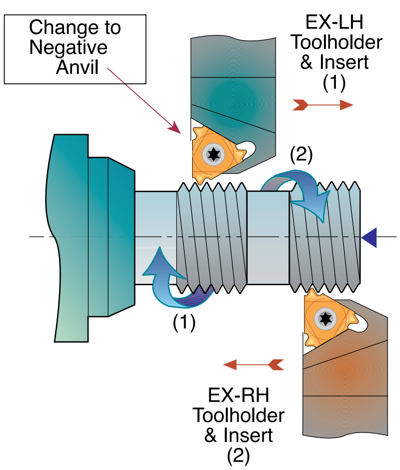
Number of threading passes selection for single point inserts

Pitch:	mm TPI	0.5 48	0.8 32	1.0 24	1.25 20	1.5 16	1.75 14	2.0 12	2.5 10	3.0 8	4.0 6	6.0 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

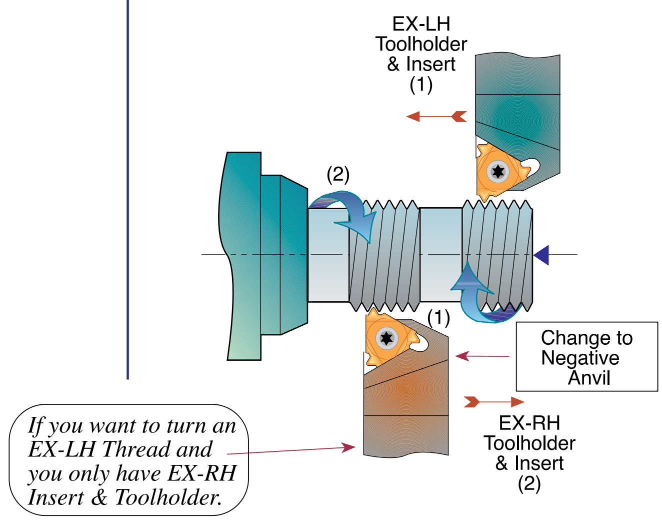
NOTES:
1. For most standard applications the middle of the range is a good starting point.
2. For most materials, the tougher the material, the higher the number of cutting passes you should select.
3. As a general rule of thumb, Fewer passes are better than more speed.

Thread Turning Methods

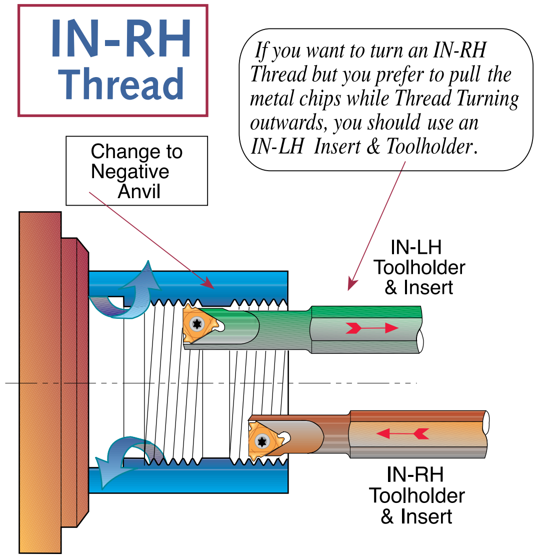
EX-RH Thread



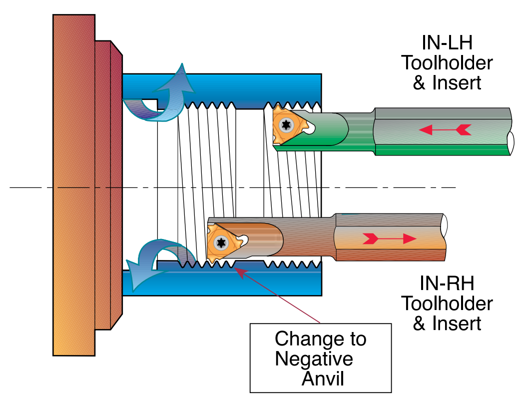
EX-LH Thread



IN-RH Thread

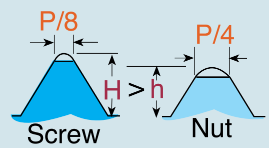


IN-LH Thread

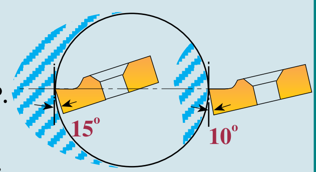


Important Points about Carmex Threading Inserts

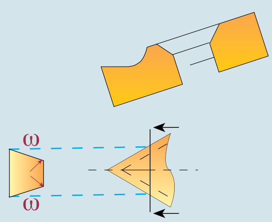
1. In most thread forms internal and external threads have different depth and radii, thus tools are not interchangeable



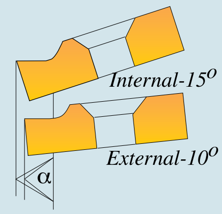
2. The Insert relief angle of a standard Carmex external toolholder is 10º; for an internal toolholder it is 15º. This 5º difference is to provide additional necessary radial clearance.



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



4. Profiles of Carmex 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.



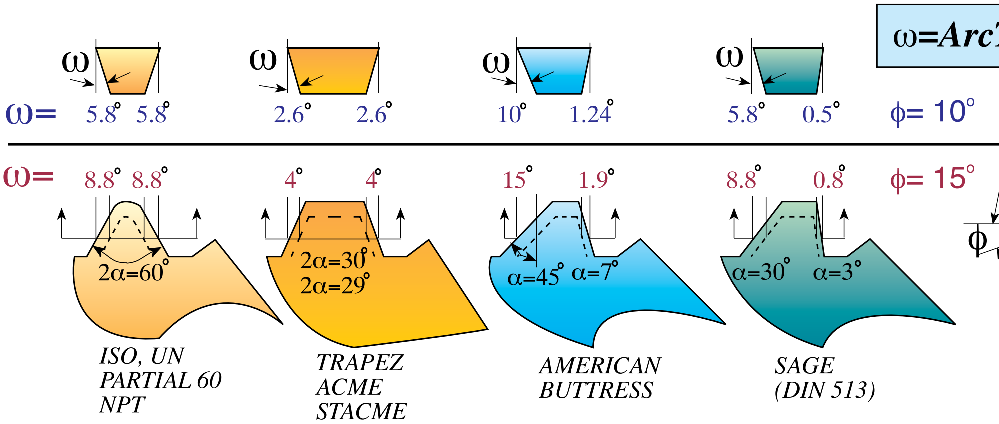
5. Insert and toolholder should always match. An IN-RH insert must be used with an IN-RH toolholder. No mismatch is allowed.

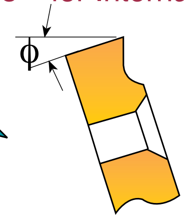
Flank Clearance Angle ω

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

ϕ= 10° for External toolholders

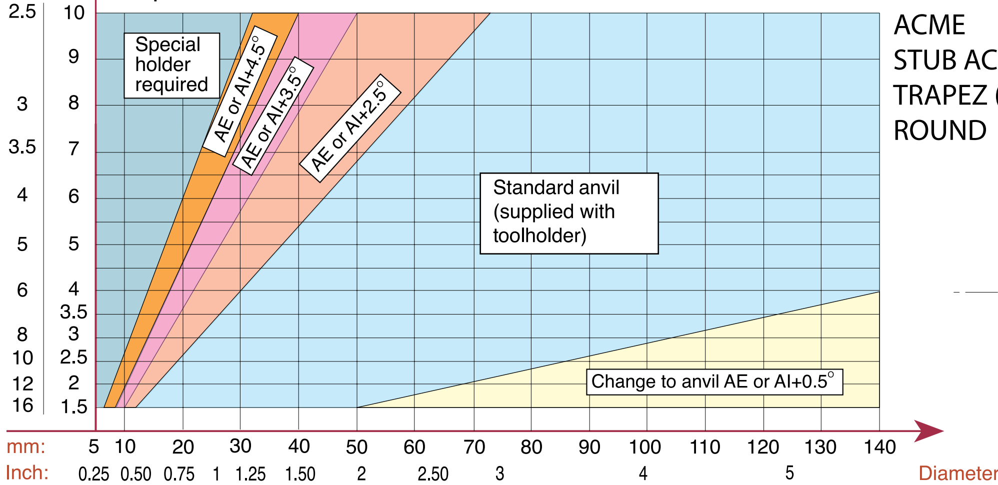
ϕ= 15° for Internal toolholders



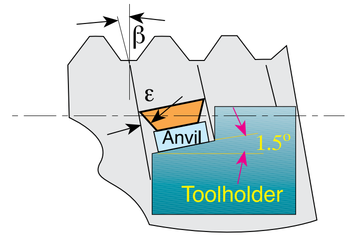


Anvil Change Recommendation

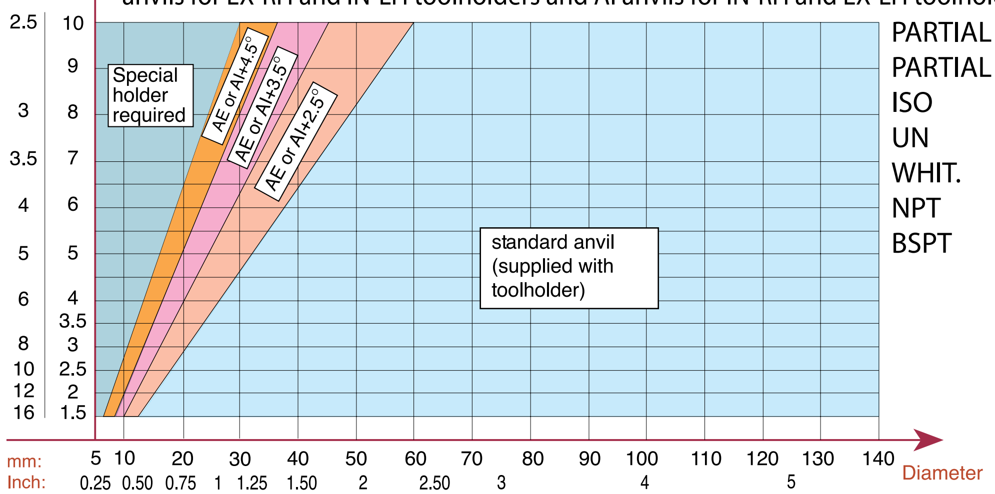
As can be seen from the chart, some Pitch to Diameter combinations require an anvil change. If change is required, use AE anvils for EX-RH and IN-LH toolholders and AI anvils for IN-RH and EX-LH toolholders.



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

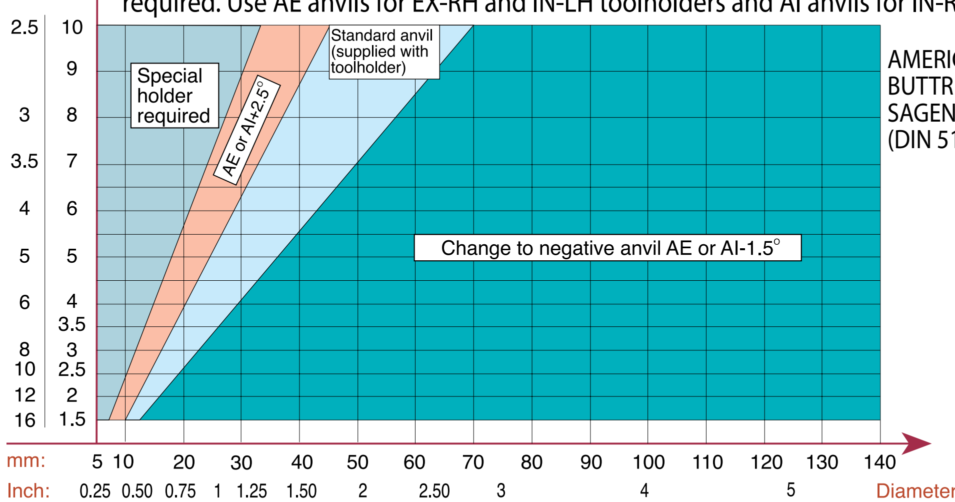


As can be seen from the chart, most applications do not require an anvil change. If change is required, use AE anvils for EX-RH and IN-LH toolholders and AI anvils for IN-RH and EX-LH toolholders.

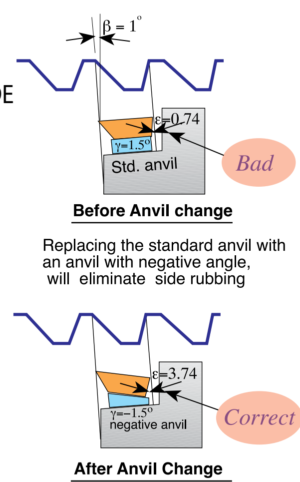


PARTIAL PROFILE 60°
PARTIAL PROFILE 55°
ISO
UN
WHIT.
NPT
BSPT

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)



Thread Turning - Step by Step

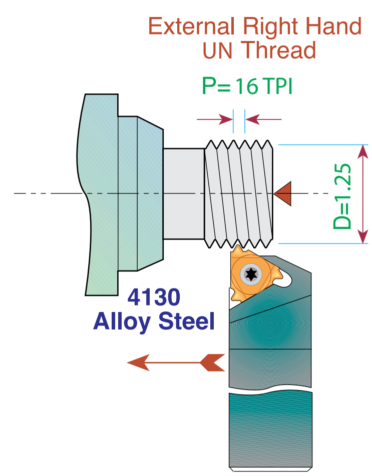
Step 1 : Choose Thread Turning Method
Step 2 : Choose Insert
Step 3 : Choose Toolholder
Step 4 : Choose Insert Grade
Step 5 : Choose Thread Turning Speed
Step 6 : Choose Number of Threading Passes

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" β on the "RESULTANT FLANK CLEARANCE" ε. If ε 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 58, we chose **EX - RH Insert & Toolholder**

Step 2: Choose Insert from page 13: **16 ER 16 UN**

Step 3: Choose Toolholder from page 39: **SER 0750 K16**

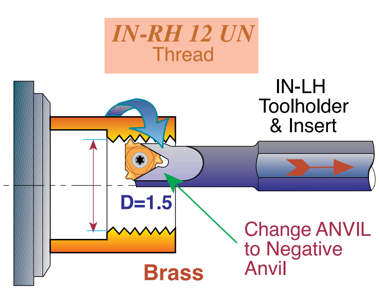
Step 4: Choose Insert Grade from selection on page 56
Our choice for Alloy Steel is Grade **P25C**

Step 5: Choose Thread Turning Speed from chart on page 56,
we chose **330 ft/min**

Rotational Speed calculation: $N = \frac{330 \times 12}{\pi \times 1.25} = 1008$ rpm

Step 6: Choose Number of Threading passes
from table on page 57, we chose **8 passes**

Example No. 2:



Step 1: Choose Thread Turning Method from page 58
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 1000 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 56
Our choice for Brass is Grade **K20**

Step 5: Choose Thread Turning Speed from chart on page 56,
we chose **450 ft/min**

Rotational Speed calculation: $N = \frac{450 \times 12}{\pi \times 1.5} = 1146$ RPM

Step 6: Choose Number of Threading passes from table
on page 57, we chose **9 passes**

Example No. 3:

Step 1: Choose Thread Turning Method from page 58
We chose EX-RH Insert & Toolholder.

Step 2: Choose Insert from page 31: **16 ER 12 ABUT**

Step 3: Choose Toolholder from page 39: **SER 1000 M16**

Step 4: Choose Insert Grade from selection on page 56
Our choice for Stainless Steel is Grade **BMA**

Step 5: Choose Thread Turning Speed from chart on page 57
We chose 360 ft/min.
Rotational Speed calculation: $N = \frac{360 \times 12}{\pi \times 1.5} = 917$ RPM

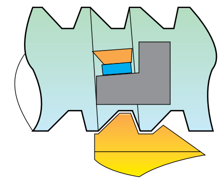
Step 6: Choose Number of Threading passes
from table on page 56. We chose **13 passes**

Step 7: Find Thread Helix Angle: on page 47
for Pitch of 12 TPI and 40 Diameter
Helix Angle as shown in the chart is 1º

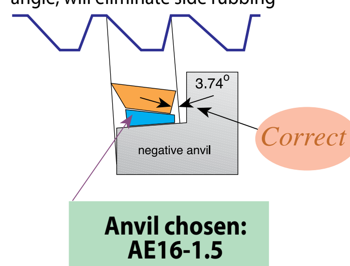
Step 8: Choose correct Anvil: As can be seen
from the chart on page 71, for AMERICAN
BUTTRESS Thread, for 12 TPI and 40 Diameter
a negative anvil **AE16-1.5** should replace the
standard anvil supplied with the toolholder

EX-RH. AMERICAN BUTTRESS
12 TPI on 1.5" diameter.

Stainless Steel 304

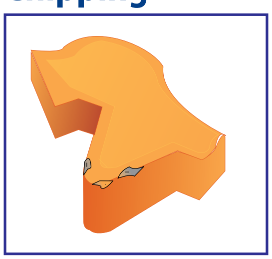


Replacing the standard anvil
with an anvil with negative
angle, will eliminate side rubbing



Troubleshooting

Chipping



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

Crater Wear

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

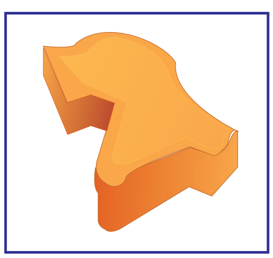
Build-up Edge

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 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**
P.A.C: **Pacific Asia Connection**
P.A.C: **API Spec 7**
HUGHES: **API Spec 7**