WALTER

Product handbook

Drilling &
Threading

_ WALTER TITEX & WALTER PROTOTYP

The perfect thread

WALTER TITEX WALTER PROTOTYP

CONTENTS

Walter has more to offer than just drilling and threading.

A demanding process

The production of female threads is one of the most demanding machining tasks in production engineering. Moreover, the threads are often not made until the end of the production chain, which requires a high level of process reliability. Yet, in mass production, manufacturers demand that threads be produced ever more speedily and economically, which necessitates continuous, ongoing development of processes and of drilling and threading tools. For female threads, there are essentially three production methods available: thread tapping, the proven method; thread forming, a chipless alternative; and thread milling, a method that offers a particularly high degree of reliability. Crucial to selecting the appropriate production method is having as broad a knowledge as possible of the advantages and disadvantages of each method as well as their practical limitations. Ultimately, the decision for or against a particular production method will have to be made under consideration of technical and economic factors.

The perfect core hole

Before the thread can be created, a core hole has to be drilled. The quality of the core hole has a considerable bearing on the cost efficiency and process reliability of the subsequent threading operation.

Our experts not only offer a comprehensive range of drilling and reaming tools, they know exactly what is required to ensure results of consistently high quality and productivity. We offer innovative and dependable drilling solutions, whatever the diameter, from catalogue products to custom-made special tools.

The perfect thread

The better matched the drilling and threading tools are, the better the result will be. Our customers want measurably higher performance. Higher performance not only in terms of threading accuracy, tolerances and chip formation, but also in respect of avoiding bird nesting and oversizing. Walter will show you how tools can be used most efficiently. Only optimally matched, seamless solutions produce the perfect thread. With the combined expertise of Walter Titex and Walter Prototyp, we are able to deliver maximum efficiency in thread manufacturing.

WALTER TITEX

WALTER PROTOTYP

Application example 1:

Longitudinal member machining

Walter Titex X-treme Plus
Through hole drilling

Tool:	A3389DPL
Cutting material:	Solid carbide / DPL
Diameter:	14 mm
Drilling depth:	25 mm
Workpiece material:	QStE380TM (~S355MC)
Tensile strength:	550 N/mm²
Hole type:	Through hole
Machine type:	Machining centre
Adaptor:	Hydraulic expansion chuck

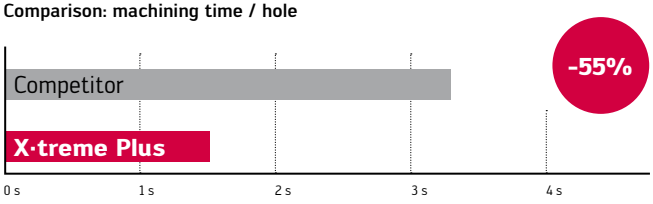
Cutting data:

	Competitor	X-treme Plus
n [1/min]	2,046	3,797
v_c [m/min]	90	167
f [mm]	0.28	0.34
v_f [mm/min]	573	1,291

Benefits for you:

- 85 % higher cutting speed
- Tool life increased from 1,500 to 2,000 holes despite increased cutting performance
- Machining time reduced from 111 hours to 50 hours
- 61 hours of spare machine capacity

Comparison: machining time / hole



Walter Prototyp Prototex ECO-HT
Through hole threading

Tool:	E2026302-M16
Cutting material:	HSS-E-PM / THL
Diameter:	M16
Drilling depth:	25 mm
Workpiece material:	QStE380TM (~S355MC)
Tensile strength:	550 N/mm²
Hole type:	Through hole
Machine type:	Machining centre
Adaptor:	Floating holder

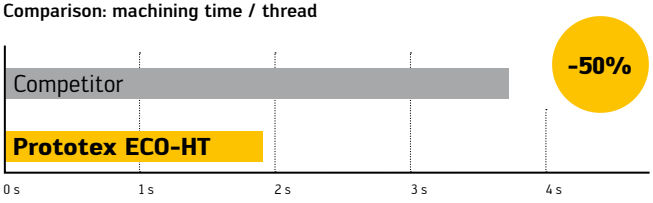
Cutting data:

	Competitor	Prototex ECO-HT
n [1/min]	298	597
v_c [m/min]	15	30
v_f [mm/min]	597	1,194

Benefits for you:

- Double the cutting speed for the same tool life
- Machining time reduced from 120 hours to 60 hours
- 60 hours of spare machine capacity
- Double the productivity

Comparison: machining time / thread



Application example 2:

Gear machining

Walter Titex X-treme Plus
Through hole drilling

Tool:	A3389DPL
Cutting material:	Solid carbide / DPL
Diameter:	6.8 mm
Drilling depth:	25 mm
Workpiece material:	16MnCr5
Tensile strength:	700 - 1,000 N/mm²
Hole type:	Through hole
Machine type:	Machining centre
Adaptor:	Hydraulic expansion chuck

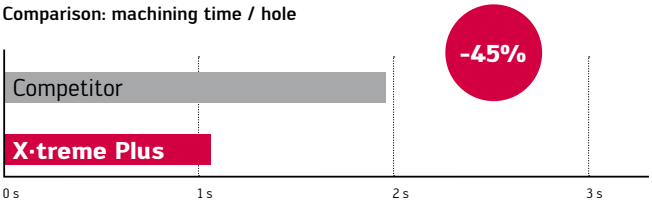
Cutting data:

	Competitor	X-treme Plus
n [1/min]	4,681	8,098
v_c [m/min]	100	173
f [mm]	0.20	0.23
v_f [mm/min]	936	1,863

Benefits for you:

- Cutting speed increased by 73 %
- Tool life increased from 1,900 to 2,800 holes despite increased cutting performance
- Machining time reduced from 110 hours to 60 hours
- 50 hours of spare machine capacity

Comparison: machining time / hole



Walter Prototyp Prototex ECO-HT
Through hole threading

Tool:	E2021342-M8
Cutting material:	HSS-E-PM / THL
Diameter:	M8
Drilling depth:	25 mm
Workpiece material:	16MnCr5
Tensile strength:	700 - 1,000 N/mm²
Hole type:	Through hole
Machine type:	Machining centre
Adaptor:	Floating holder

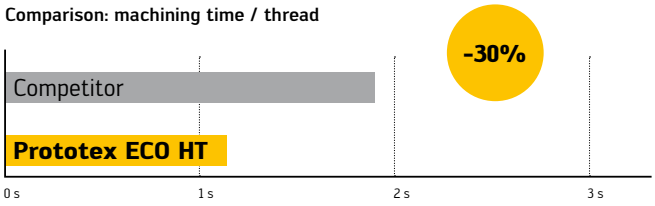
Cutting data:

	Competitor	Prototex ECO HT
n [1/min]	995	1,472
v_c [m/min]	25	37
v_f [mm/min]	1,243	1,840

Benefits for you:

- Cutting speed increased by 48 %
- Tool life increased from 2,400 to 4,000 threads
- Machining time reduced from 100 hours to 70 hours
- 30 hours of spare machine capacity

Comparison: machining time / thread



Walter Titex X·treme Plus

With this tool Walter Titex is setting new standards in drilling with solid carbide tools. The drill incorporates a wealth of innovations – including the new patent pending multifunctional double coating (DPL) that has outstanding properties.
With Walter Titex X·treme Plus you can increase the productivity in the series production of steel and cast iron components to a new level.

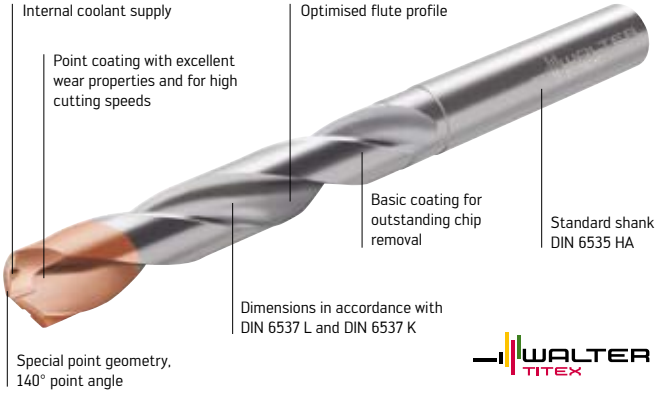
X·TREME
The new Walter Titex X·treme Series with a unique double coating: extremely innovative and extremely productive.

THE TOOL

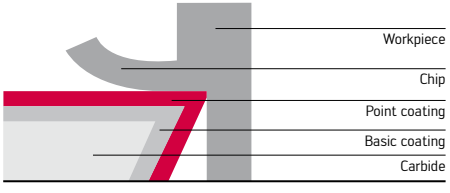
- solid carbide high performance drilling tool with internal coolant supply
- new type of multifunctional double coating DPL "Double Performance Line" (patent pending)
- drilling depth 5 x d (A3389DPL) and 3 x d (A3289DPL)
- diameter range from 3.0 to 20.0 mm

THE APPLICATION

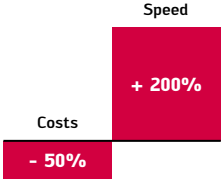
- for all steel and cast iron materials as well as for stainless steels and non-ferrous metals
- HPC machining
- also suitable for dry machining with internal MQL supply



X·treme Plus **Type:** A3289DPL, A3389DPL



X·treme



Cost savings and increases in productivity with the X·treme Plus

YOUR ADVANTAGES

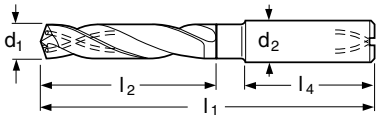
- Maximum productivity; at least double that achievable using conventional tools = more productivity, lower production costs
- Alternative: Double the tool life with conventional cutting data = e.g. fewer tool changes
- Excellent surface finish
- High process reliability
- Varied application possibilities with regard to materials and application (e.g. MQL)
- Ensures spare machine capacity

PRODUCT ADVANTAGES

- New type of multifunctional double coating "DPL – Double Performance Line" (patent pending), consisting of a basic coating for protecting the tool and a special point coating. The combination with the point coating not only makes it possible to use at greater cutting speeds, it also ensures outstanding tool life with conventional cutting data.
- Unique grinding with optimised microgeometry for lower power consumption and optimum surface quality.
- Solid carbide cutting material – micro grain K30F.

X·treme Plus range – A3289DPL

Application:
high performance twist drill for maximum productivity in steel, stainless steel, non-ferrous metals and cast iron materials. Extremely high feed and cutting speeds with superior process reliability and surface quality.



d_1 mm m7	Ø inches/ no.	d_2 mm h6	l_1 mm	l_2 mm max.	l_4 mm	Order code A3289DPL...
3.000		6	62	20	36	-3
3.100		6	62	20	36	-3.1
3.175	1/8 IN	6	62	20	36	-1/8IN
3.200		6	62	20	36	-3.2
3.300		6	62	20	36	-3.3
3.400		6	62	20	36	-3.4
3.500		6	62	20	36	-3.5
3.572	9/64 IN	6	62	20	36	-9/64IN
3.600		6	62	20	36	-3.6
3.700		6	62	20	36	-3.7
3.800		6	66	24	36	-3.8
3.900		6	66	24	36	-3.9
3.969	5/32 IN	6	66	24	36	-5/32IN
4.000		6	66	24	36	-4
4.100		6	66	24	36	-4.1
4.200		6	66	24	36	-4.2
4.300		6	66	24	36	-4.3
4.366	11/64 IN	6	66	24	36	-11/64IN
4.400		6	66	24	36	-4.4
4.500		6	66	24	36	-4.5
4.600		6	66	24	36	-4.6
4.650		6	66	24	36	-4.65
4.700		6	66	24	36	-4.7
4.763	3/16 IN	6	66	24	36	-3/16IN
4.800		6	66	28	36	-4.8
4.900		6	66	28	36	-4.9
5.000		6	66	28	36	-5
5.100		6	66	28	36	-5.1
5.159	13/64 IN	6	66	28	36	-13/64IN
5.200		6	66	28	36	-5.2
5.300		6	66	28	36	-5.3
5.400		6	66	28	36	-5.4
5.500		6	66	28	36	-5.5
5.550		6	66	28	36	-5.55
5.556	7/32 IN	6	66	28	36	-7/32IN
5.600		6	66	28	36	-5.6
5.700		6	66	28	36	-5.7
5.800		6	66	28	36	-5.8
5.900		6	66	28	36	-5.9
5.953	15/64 IN	6	66	28	36	-15/64IN
6.000		6	66	28	36	-6
6.100		8	79	34	36	-6.1
6.200		8	79	34	36	-6.2
6.300		8	79	34	36	-6.3
6.350	1/4 IN	8	79	34	36	-1/4IN
6.400		8	79	34	36	-6.4
6.500		8	79	34	36	-6.5
6.600		8	79	34	36	-6.6
6.700		8	79	34	36	-6.7
6.747	17/64 IN	8	79	34	36	-17/64IN
6.800		8	79	34	36	-6.8
6.900		8	79	34	36	-6.9
7.000		8	79	34	36	-7
7.100		8	79	41	36	-7.1
7.144	9/32 IN	8	79	41	36	-9/32IN
7.200		8	79	41	36	-7.2
7.300		8	79	41	36	-7.3

Product information

X·treme Plus range – A3289DPL

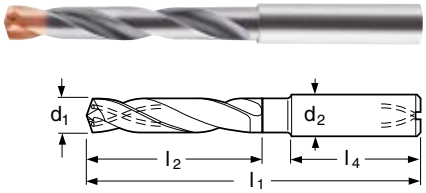
d_1 mm m7	Ø inches/ no.	d_2 mm h6	l_1 mm	l_2 mm max.	l_4 mm	Order code A3289DPL...
7.400		8	79	41	36	7.4
7.500		8	79	41	36	7.5
7.541	19/64 IN	8	79	41	36	19/64IN
7.800		8	79	41	36	7.8
7.900		8	79	41	36	7.9
7.938	5/16 IN	8	79	41	36	5/16IN
8.000		8	79	41	36	8
8.100		10	89	47	40	8.1
8.200		10	89	47	40	8.2
8.300		10	89	47	40	8.3
8.334	21/64 IN	10	89	47	40	21/64IN
8.400		10	89	47	40	8.4
8.500		10	89	47	40	8.5
8.600		10	89	47	40	8.6
8.700		10	89	47	40	8.7
8.731	11/32 IN	10	89	47	40	11/32IN
8.800		10	89	47	40	8.8
9.000		10	89	47	40	9
9.128	23/64 IN	10	89	47	40	23/64IN
9.200		10	89	47	40	9.2
9.300		10	89	47	40	9.3
9.500		10	89	47	40	9.5
9.525	3/8 IN	10	89	47	40	3/8IN
9.600		10	89	47	40	9.6
9.700		10	89	47	40	9.7
9.800		10	89	47	40	9.8
9.922	25/64 IN	10	89	47	40	25/64IN
10.000		10	89	47	40	10
10.100		12	102	55	45	10.1
10.200		12	102	55	45	10.2
10.300		12	102	55	45	10.3
10.319	13/32 IN	12	102	55	45	13/32IN
10.400		12	102	55	45	10.4
10.500		12	102	55	45	10.5
10.716	27/64 IN	12	102	55	45	27/64IN
10.800		12	102	55	45	10.8

d_1 mm m7	Ø inches/ no.	d_2 mm h6	l_1 mm	l_2 mm max.	l_4 mm	Order code A3289DPL...
11.000		12	102	55	45	-11
11.100		12	102	55	45	-11.1
11.113	7/16 IN	12	102	55	45	-7./1 IN
11.200		12	102	55	45	-11.2
11.500		12	102	55	45	-11.5
11.509	29/64 IN	12	102	55	45	-29/64IN
11.700		12	102	55	45	-11.7
11.800		12	102	55	45	-11.8
11.906	15/32 IN	12	102	55	45	-15/32IN
12.000		12	102	55	45	-12
12.100		14	107	60	45	-12.1
12.200		14	107	60	45	-12.2
12.300		14	107	60	45	-12.3
12.303	31/64 IN	14	107	60	45	-31/64IN
12.500		14	107	60	45	-12.5
12.600		14	107	60	45	-12.6
12.700	1/2 IN	14	107	60	45	-1/2IN
13.000		14	107	60	45	-13
13.300		14	107	60	45	-13.3
13.494	17/32 IN	14	107	60	45	-17/32IN
13.500		14	107	60	45	-13.5
14.000		14	107	60	45	-14
14.228	9/16 IN	16	115	65	48	-9/16IN
14.500		16	115	65	48	-14.5
15.000		16	115	65	48	-15
15.500		16	115	65	48	-15.5
15.875	5/8 IN	16	115	65	48	-5/8IN
16.000		16	115	65	48	-16
16.500		18	123	65	48	-16.5
17.000		18	123	65	48	-17
17.500		18	123	65	48	-17.5
18.000		18	123	65	48	-18
19.050	3/4 IN	20	131	79	50	-3/4IN
20.000		20	131	79	50	-20

Product information

X·treme Plus range – A3389DPL

Application:
high performance twist drill for maximum productivity in steel, stainless steel, non-ferrous metals and cast iron materials. Extremely high feed and cutting speeds with superior process reliability and surface quality.



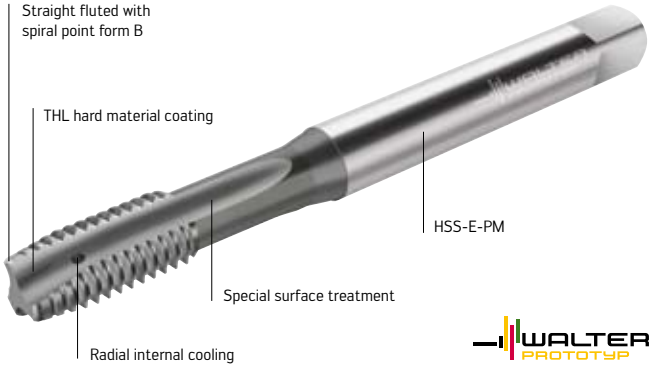
DIN 6537L | 5xd | PLUS | RH | 140° | K30F | DPL | DIN6535 HA | HSC | HRC 45–55

d_1 mm m7	Ø inches/ no.	d_2 mm h6	l_1 mm	l_2 mm max.	l_4 mm	Order code A3389DPL...
3.000		6	66	28	36	-3
3.100		6	66	28	36	-3.1
3.175	1/8 IN	6	66	28	36	-1/8IN
3.200		6	66	28	36	-3.2
3.300		6	66	28	36	-3.3
3.400		6	66	28	36	-3.4
3.500		6	66	28	36	-3.5
3.572	9/64 IN	6	66	28	36	-9/64IN
3.600		6	66	28	36	-3.6
3.700		6	66	28	36	-3.7
3.800		6	74	36	36	-3.8
3.900		6	74	36	36	-3.9
3.969	5/32 IN	6	74	36	36	-5/32IN
4.000		6	74	36	36	-4
4.100		6	74	36	36	-4.1
4.200		6	74	36	36	-4.2
4.300		6	74	36	36	-4.3
4.366	11/64 IN	6	74	36	36	-11/64IN
4.400		6	74	36	36	-4.4
4.500		6	74	36	36	-4.5
4.600		6	74	36	36	-4.6
4.650		6	74	36	36	-4.65
4.700		6	74	36	36	-4.7
4.763	3/16 IN	6	82	44	36	-3/16IN
4.800		6	82	44	36	-4.8
4.900		6	82	44	36	-4.9
5.000		6	82	44	36	-5
5.100		6	82	44	36	-5.1
5.159	13/64 IN	6	82	44	36	-13/64IN
5.200		6	82	44	36	-5.2
5.300		6	82	44	36	-5.3
5.400		6	82	44	36	-5.4
5.500		6	82	44	36	-5.5
5.550		6	82	44	36	-5.55
5.556	7/32 IN	6	82	44	36	-7/32IN
5.600		6	82	44	36	-5.6
5.700		6	82	44	36	-5.7
5.800		6	82	44	36	-5.8
5.900		6	82	44	36	-5.9
5.953	15/64 IN	6	82	44	36	-15/64IN
6.000		6	82	44	36	-6
6.100		8	91	53	36	-6.1
6.200		8	91	53	36	-6.2
6.300		8	91	53	36	-6.3
6.350	1/4 IN	8	91	53	36	-1/4IN
6.400		8	91	53	36	-6.4
6.500		8	91	53	36	-6.5
6.600		8	91	53	36	-6.6
6.700		8	91	53	36	-6.7
6.747	17/64 IN	8	91	53	36	-17/64IN
6.800		8	91	53	36	-6.8
6.900		8	91	53	36	-6.9
7.000		8	91	53	36	-7
7.100		8	91	53	36	-7.1
7.144	9/32 IN	8	91	53	36	-9/32IN
7.200		8	91	53	36	-7.2
7.300		8	91	53	36	-7.3

d_1 mm m7	Ø inches/ no.	d_2 mm h6	l_1 mm	l_2 mm max.	l_4 mm	Order code A3389DPL...
7.400		8	91	53	36	-7.4
7.500		8	91	53	36	-7.5
7.541	19/64 IN	8	91	53	36	-19/64IN
7.800		8	91	53	36	-7.8
7.900		8	91	53	36	-7.9
7.938	5/16 IN	8	91	53	36	-5/16IN
8.000		8	91	53	36	-8
8.100		10	103	61	40	-8.1
8.200		10	103	61	40	-8.2
8.300		10	103	61	40	-8.3
8.334	21/64 IN	10	103	61	40	-21/64IN
8.400		10	103	61	40	-8.4
8.500		10	103	61	40	-8.5
8.600		10	103	61	40	-8.6
8.700		10	103	61	40	-8.7
8.731	11/32 IN	10	103	61	40	-11/32IN
8.800		10	103	61	40	-8.8
9.000		10	103	61	40	-9
9.128	23/64 IN	10	103	61	40	-23/64IN
9.200		10	103	61	40	-9.2
9.300		10	103	61	40	-9.3
9.500		10	103	61	40	-9.5
9.525	3/8 IN	10	103	61	40	-3/8IN
9.600		10	103	61	40	-9.6
9.700		10	103	61	40	-9.7
9.800		10	103	61	40	-9.8
9.922	25/64 IN	10	103	61	40	-25/64IN
10.000		10	103	61	40	-10
10.100		12	118	71	45	-10.1
10.200		12	118	71	45	-10.2
10.300		12	118	71	45	-10.3
10.319	13/32 IN	12	118	71	45	-13/32IN
10.400		12	118	71	45	-10.4
10.500		12	118	71	45	-10.5
10.716	27/64 IN	12	118	71	45	-27/64IN
10.800		12	118	71	45	-10.8

d_1 mm m7	Ø inches/ no.	d_2 mm h6	l_1 mm	l_2 mm max.	l_4 mm	Order code A3389DPL...
11.000		12	118	71	45	-11
11.100		12	118	71	45	-11.1
11.113	7/16 IN	12	118	71	45	-7/16IN
11.200		12	118	71	45	-11.2
11.500		12	118	71	45	-11.5
11.509	29/64 IN	12	118	71	45	-29/64IN
11.700		12	118	71	45	-11.7
11.800		12	118	71	45	-11.8
11.906	15/32 IN	12	118	71	45	-15/32IN
12.000		12	118	71	45	-12
12.100		14	124	77	45	-12.1
12.200		14	124	77	45	-12.2
12.300		14	124	77	45	-12.3
12.303	31/64 IN	14	124	77	45	-31/64IN
12.500		14	124	77	45	-12.5
12.600		14	124	77	45	-12.6
12.700	1/2 IN	14	124	77	45	-1/2IN
13.000		14	124	77	45	-13
13.300		14	124	77	45	-13.3
13.494	17/32 IN	14	124	77	45	-17/32IN
13.500		14	124	77	45	-13.5
14.000		14	124	77	45	-14
14.288	9/16 IN	16	133	83	48	-9/16IN
14.500		16	133	83	48	-14.5
15.000		16	133	83	48	-15
15.500		16	133	83	48	-15.5
15.875	5/8 IN	16	133	83	48	-5/8IN
16.000		16	133	83	48	-16
16.500		18	143	93	48	-16.5
17.000		18	143	93	48	-17
17.500		18	143	93	48	-17.5
18.000		18	143	93	48	-18
19.050	3/4 IN	20	153	101	50	-3/4IN
20.000		20	153	101	50	-20

Walter Prototyp ECO-HT tap



Prototex ECO-HT **Type:** E2021342

Paradur ECO-HT **Type:** E2051312

THE TOOL

- Universal high-performance HSS-E-PM tap for use in long- and short-chipping materials with a tensile strength of up to approximately 1,300 N/mm² on conventional machines or machine tools with synchronous spindle
- THL hard material coating and additional surface treatment for outstanding tool life with no cold welding
- Versions with radial coolant outlet available as standard tool specifically for use with minimum quantity lubrication (MQL)
- **Prototex ECO-HT through-hole thread:**
  - Special form B spiral point guarantees excellent process reliability
- **Paradur ECO-HT blind hole thread:**
  - R45 helix angle, long flutes and special flute geometry for optimum chip formation and good chip removal even in deep threads
  - Thread almost to base of bore due to variant with short chamfer form E
  - Reduced risk of spalling thanks to tapered thread runout
  - Version available with axial internal cooling for optimum chip removal

THE APPLICATION

- Blind-hole or through-hole threads down to 3 x d
- ECO-HT taps are suitable for use with a broad range of materials:
  - Long-chipping materials having moderate to high tensile strength
  - Short-chipping materials
  - Abrasive materials with a tendency to weld
  - Construction steel or high tensile steel (350 – 1,300 N/mm²)
  - Stainless steel
  - Nodular cast and malleable cast iron
  - Long-chipping copper and aluminium alloys

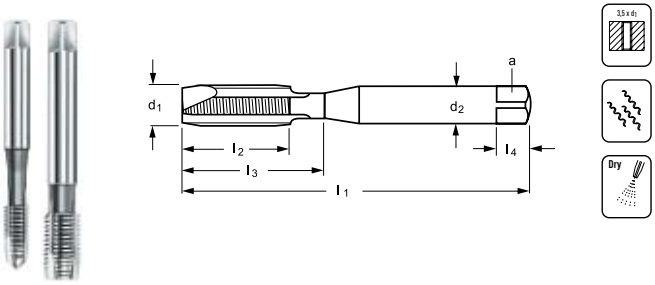
YOUR ADVANTAGES

- Secure chip control ensures excellent process reliability even with relatively deep blind hole or through-hole threads
- Reduction in tool diversity, since it can be used universally in a wide range of materials
- Fewer tool changes and optimum machine output resulting from high cutting speeds and long tool life
- Reduction in cooling lubricant costs thanks to compatibility with dry or MQL machining in steel, cast iron and aluminium alloys

M
DIN13

1.2-6.1 2.1-4 3.1-5 6.1-3 7.2-3.2

HSS-E PM | S M L XL | B= 3,5 - 5 | RH



DIN 371 6HX

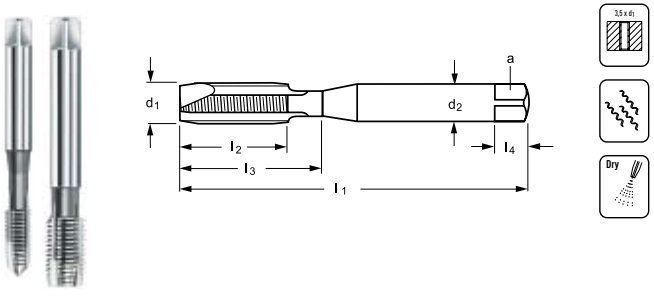
d_1 mm	P mm	l_1 js16 mm	l_2 mm	l_3 ±1 mm	d_2 h9 mm	a h12 mm	l_4 mm	N	Code E2021302 THL
M 2	0.4	45	6	9	2.8	2.1	5	3	-M2
M 2.5	0.45	50	8	12.5	2.8	2.1	5	3	-M2.5
M 3	0.5	56	9	18	3.5	2.7	6	3	-M3
M 4	0.7	63	12	21	4.5	3.4	6	3	-M4
M 5	0.8	70	13	25	6	4.9	8	3	-M5
M 6	1	80	15	30	6	4.9	8	3	-M6
M 8	1.25	90	18	35	8	6.2	9	3	-M8
M 10	1.5	100	20	39	10	8	11	3	-M10

DIN 376 6HX

d_1 mm	P mm	l_1 js16 mm	l_2 mm	l_3 ±1 mm	d_2 h9 mm	a h12 mm	l_4 mm	N	Code E2026302 THL
M 12	1.75	110	23	-	9	7	10	4	-M12
M 14	2	110	25	-	11	9	12	4	-M14
M 16	2	110	25	-	12	9	12	4	-M16
M 18	2.5	125	30	-	14	11	14	4	-M18
M 20	2.5	140	30	-	16	12	15	4	-M20
M 24	3	160	36	-	18	14.5	17	4	-M24
M 27	3	160	36	-	20	16	19	4	-M27
M 30	3.5	180	42	-	22	18	21	4	-M30

1.2-6.1 2.1-4 3.1-5 6.1-3 7.2-3.2

HSS-E PM | S M L XL | B= 3,5 - 5 | RH



DIN 371 6GX

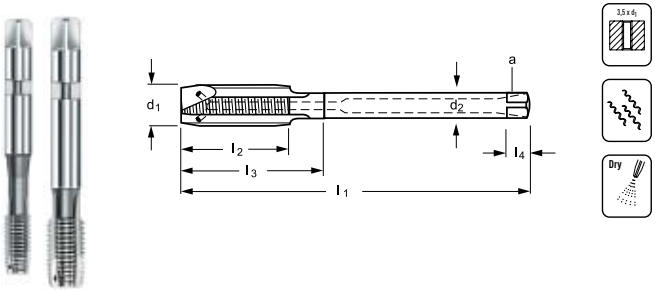
d_1 mm	P mm	l_1 js16 mm	l_2 mm	l_3 ±1 mm	d_2 h9 mm	a h12 mm	l_4 mm	N	Code E2023302 THL
M 2	0.4	45	6	9	2.8	2.1	5	3	-M2
M 2.5	0.45	50	8	12.5	2.8	2.1	5	3	-M2,5
M 3	0.5	56	9	18	3.5	2.7	6	3	-M3
M 4	0.7	63	12	21	4.5	3.4	6	3	-M4
M 5	0.8	70	13	25	6	4.9	8	3	-M5
M 6	1	80	15	30	6	4.9	8	3	-M6
M 8	1.25	90	18	35	8	6.2	9	3	-M8
M 10	1.5	100	20	39	10	8	11	3	-M10

DIN 376 6GX

d_1 mm	P mm	l_1 js16 mm	l_2 mm	l_3 ±1 mm	d_2 h9 mm	a h12 mm	l_4 mm	N	Code E2028302 THL
M 12	1.75	110	23	-	9	7	10	4	-M12
M 14	2	110	25	-	11	9	12	4	-M14
M 16	2	110	25	-	12	9	12	4	-M16

1.2-6.1 2.1-4 3.1-5 6.1-3 7.2-3.2

HSS-E PM | S M L XL | B= 3,5 - 5 | RH



Dry

DIN 371 6HX

d_1 mm	P mm	l_1 js16 mm	l_2 mm	l_3 ±1 mm	d_2 h9 mm	a h12 mm	l_4 mm	N	Code E2021342 THL
M 6	1	80	15	30	6	4.9	8	3	-M6
M 8	1.25	90	18	35	8	6.2	9	3	-M8
M 10	1.5	100	20	39	10	8	11	3	-M10

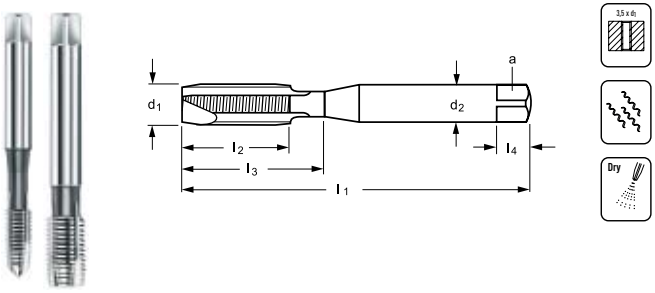
DIN 376 6HX

d_1 mm	P mm	l_1 js16 mm	l_2 mm	l_3 ±1 mm	d_2 h9 mm	a h12 mm	l_4 mm	N	Code E2026342 THL
M 12	1.75	110	23	-	9	7	10	4	-M12
M 16	2	110	25	-	12	9	12	4	-M16

M
DIN13

1.2-6.1 2.1-4 3.1-5 6.1-3 7.2-3.2

HSS-E PM | S M L XL | B= 3,5 - 5 | LH



Dry

DIN 371 6HX

d_1 mm	P mm	l_1 js16 mm	l_2 mm	l_3 ±1 mm	d_2 h9 mm	a h12 mm	l_4 mm	N	Code E2021382 THL
M 3 LH	0.5	56	9	18	3.5	2.7	6	3	-M3
M 4 LH	0.7	63	12	21	4.5	3.4	6	3	-M4
M 5 LH	0.8	70	13	25	6	4.9	8	3	-M5
M 6 LH	1	80	15	30	6	4.9	8	3	-M6
M 8 LH	1.25	90	18	35	8	6.2	9	3	-M8
M 10 LH	1.5	100	20	39	10	8	11	3	-M10

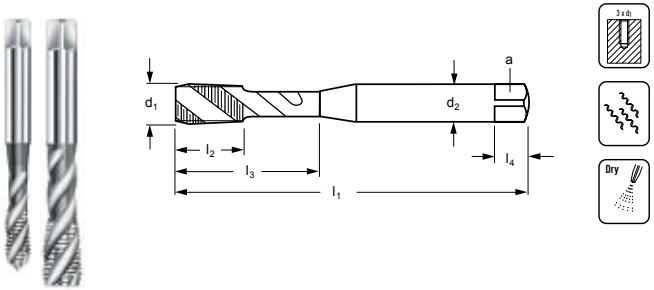
DIN 376 6HX

d_1 mm	P mm	l_1 js16 mm	l_2 mm	l_3 ±1 mm	d_2 h9 mm	a h12 mm	l_4 mm	N	Code E2026382 THL
M 12 LH	1.75	110	23	-	9	7	10	4	-M12
M 16 LH	2	110	25	-	12	9	12	4	-M16
M 20 LH	2.5	140	30	-	16	12	15	4	-M20

M
DIN13

1.2-6.1 | 2.1-4 | 3.1-5 | 5.2 | 6.1-3 | 7.2-3.2

HSS-E PM | M LXL | C = 2-3 | R45 | RH | N/mm² 1250/38 HRC 500 | 3 x d_1 | Dry



~ DIN 371 6HX

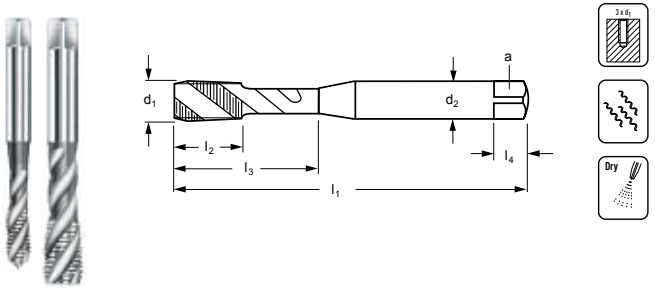
d_1 mm	P mm	l_1 js16 mm	l_2 mm	l_3 ±1 mm	d_2 h9 mm	a h12 mm	l_4 mm	N	Code E2051302 THL
M 2	0.4	45	4	7.6	2.8	2.1	5	3	-M2
M 2.5	0.45	50	4	9.3	2.8	2.1	5	3	-M2,5
M 3	0.5	56	6	11	3.5	2.7	6	3	-M3
M 4	0.7	63	7	14.8	4.5	3.4	6	3	-M4
M 5	0.8	70	8	20.7	6	4.9	8	3	-M5
M 6	1	80	10	25	6	4.9	8	3	-M6
M 8	1.25	90	12	35	8	6.2	9	3	-M8
M 10	1.5	100	15	39	10	8	11	3	-M10

DIN 376 6HX

d_1 mm	P mm	l_1 js16 mm	l_2 mm	l_3 ±1 mm	d_2 h9 mm	a h12 mm	l_4 mm	N	Code E2056302 THL
M 12	1.75	110	16	-	9	7	10	4	-M12
M 14	2	110	20	-	11	9	12	4	-M14
M 16	2	110	20	-	12	9	12	4	-M16
M 18	2.5	125	25	-	14	11	14	4	-M18
M 20	2.5	140	25	-	16	12	15	4	-M20
M 24	3	160	30	-	18	14.5	17	4	-M24
M 27	3	160	30	-	20	16	19	5	-M27
M 30	3.5	180	35	-	22	18	21	5	-M30
M 36	4	200	40	-	28	22	25	5	-M36
M 42	4.5	200	45	-	32	24	27	5	-M42

1.2-6.1 | 2.1-4 | 3.1-5 | 5.2 | 6.1-3 | 7.2-3.2

HSS-E PM | M LXL | C = 2-3 | R45 | RH | N/mm² 1250/38 HRC 500 | 3 x d_1 | Dry



~DIN 371 6GX

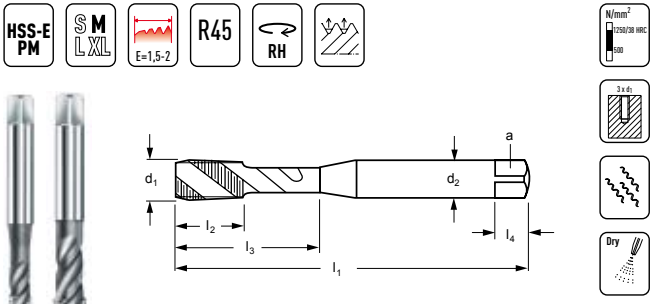
d_1 mm	P mm	l_1 js16 mm	l_2 mm	l_3 ±1 mm	d_2 h9 mm	a h12 mm	l_4 mm	N	Code E2053302 THL
M 2	0.4	45	4	7.6	2.8	2.1	5	3	-M2
M 2.5	0.45	50	4	9.3	2.8	2.1	5	3	-M2,5
M3	0.5	56	6	11	3.5	2.7	6	3	-M3
M 4	0.7	63	7	14.8	4.5	3.4	6	3	-M4
M 5	0.8	70	8	20.7	6	4.9	8	3	-M5
M 6	1	80	10	25	6	4.9	8	3	-M6
M 8	1.25	90	12	35	8	6.2	9	3	-M8
M 10	1.5	100	15	39	10	8	11	3	-M10

DIN 376 6GX

d_1 mm	P mm	l_1 js16 mm	l_2 mm	l_3 ±1 mm	d_2 h9 mm	a h12 mm	l_4 mm	N	Code E2058302 THL
M 12	1.75	110	16	-	9	7	10	4	-M12
M 14	2	110	20	-	11	9	12	4	-M14
M 16	2	110	20	-	12	9	12	4	-M16

M
DIN13

1.2-6.1 | 2.1-4 | 3.1-5 | 6.1-3 | 7.2-3.2



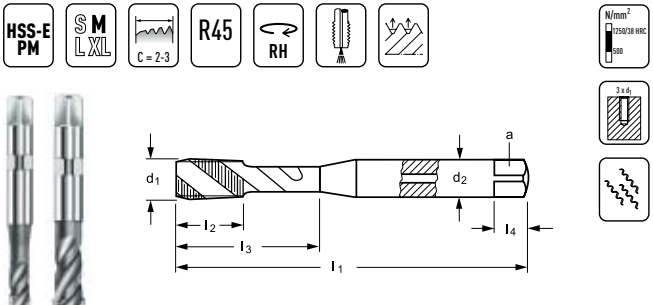
~ DIN 371 6HX

d_1 mm	P mm	l_1 js16 mm	l_2 mm	l_3 ±1 mm	d_2 h9 mm	a h12 mm	l_4 mm	N	Code E2051802 THL
M 4	0.7	63	7	14.8	4.5	3.4	6	3	-M4
M 5	0.8	70	8	20.7	6	4.9	8	3	-M5
M 6	1	80	10	25	6	4.9	8	3	-M6
M 8	1.25	90	12	35	8	6.2	9	4	-M8
M 10	1.5	100	15	39	10	8	11	4	-M10

DIN 376 6HX

d_1 mm	P mm	l_1 js16 mm	l_2 mm	l_3 ±1 mm	d_2 h9 mm	a h12 mm	l_4 mm	N	Code E2056802 THL
M 12	1.75	110	16	-	9	7	10	4	-M12
M 16	2	110	20	-	12	9	12	5	-M16
M 20	2.5	140	25	-	16	12	15	5	-M20
M 24	3	160	30	-	18	14.5	17	5	-M24

1.2-6.1 | 2.1-4 | 3.1-5 | 6.1-3 | 7.2-3.2



~DIN 371 6HX

d_1 mm	P mm	l_1 js16 mm	l_2 mm	l_3 ±1 mm	d_2 h9 mm	a h12 mm	l_4 mm	N	Code E2051312 THL
M 4	0.7	63	7	14.8	4.5	3.4	6	3	-M4
M 5	0.8	70	8	20.7	6	4.9	8	3	-M5
M 6	1	80	10	25	6	4.9	8	3	-M6
M 8	1.25	90	12	35	8	6.2	9	3	-M8
M 10	1.5	100	15	39	10	8	11	3	-M10

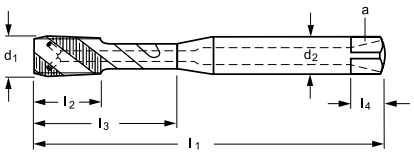
DIN 376 6HX

d_1 mm	P mm	l_1 js16 mm	l_2 mm	l_3 ±1 mm	d_2 h9 mm	a h12 mm	l_4 mm	N	Code E2056312 THL
M 12	1.75	110	16	-	9	7	10	4	-M12
M 16	2	110	20	-	12	9	12	4	-M16
M 20	2.5	140	25	-	16	12	15	4	-M20
M 24	3	160	30	-	18	14.5	17	4	-M24

M
DIN13

1.2-6.1 | 2.1-4 | 3.1-5 | 6.1-3 | 7.2-3.2

HSS-E PM | S M L XL | C = 2-3 | R45 | RH



DIN 371 6HX

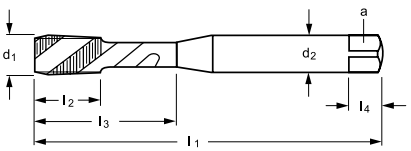
d_1 mm	P mm	l_1 js16 mm	l_2 mm	l_3 ±1 mm	d_2 h9 mm	a h12 mm	l_4 mm	N	Code E2051342 THL
M 8	1.25	90	12	35	8	6.2	9	3	-M8
M 10	1.5	100	15	39	10	8	11	3	-M10

DIN 376 6HX

d_1 mm	P mm	l_1 js16 mm	l_2 mm	l_3 ±1 mm	d_2 h9 mm	a h12 mm	l_4 mm	N	Code E2056342 THL
M 12	1.75	110	16	-	9	7	10	4	-M12
M 16	2	110	20	-	12	9	12	4	-M16

1.2-6.1 | 2.1-4 | 3.1-5 | 6.1-3 | 7.2-3.2

HSS-E PM | S M L XL | C = 2-3 | L45 | LH



~ DIN 371 6HX

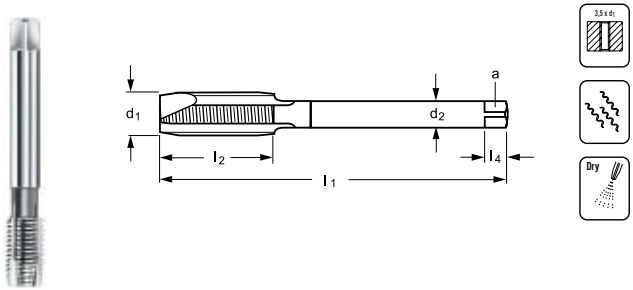
d_1 mm	P mm	l_1 js16 mm	l_2 mm	l_3 ±1 mm	d_2 h9 mm	a h12 mm	l_4 mm	N	Code E2051382 THL
M 3 LH	0.5	56	6	11	3.5	2.7	6	3	-M3
M 4 LH	0.7	63	7	14.8	4.5	3.4	6	3	-M4
M 5 LH	0.8	70	8	20.7	6	4.9	8	3	-M5
M 6 LH	1	80	10	25	6	4.9	8	3	-M6
M 8 LH	1.25	90	12	35	8	6.2	9	3	-M8
M 10 LH	1.5	100	15	39	10	8	11	3	-M10

DIN 376 6HX

d_1 mm	P mm	l_1 js16 mm	l_2 mm	l_3 ±1 mm	d_2 h9 mm	a h12 mm	l_4 mm	N	Code E2056382 THL
M 12 LH	1.75	110	16	-	9	7	10	4	-M12
M 14 LH	2	110	20	-	11	9	12	4	-M14
M 16 LH	2	110	20	-	12	9	12	4	-M16
M 18 LH	2.5	125	25	-	14	11	14	4	-M18
M 20 LH	2.5	140	25	-	16	12	15	4	-M20

1.2-6.1 2.1-4 3.1-5 6.1-3 7.2-3.2

HSS-E PM | S M L XL | B= 3,5 - 5 | RH



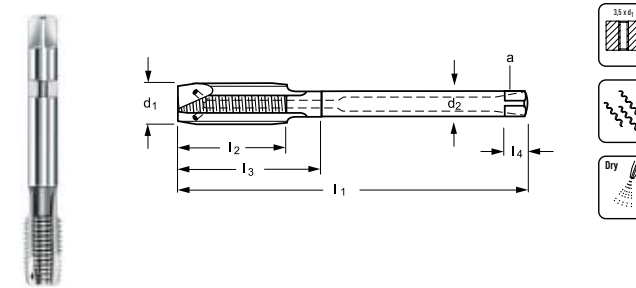
DIN 374 6HX

d_1 mm	P mm	l_1 js16 mm	l_2 mm	d_2 h9 mm	a h12 mm	l_4 mm	N	Code E2126302 THL
M6	0.75	80	15	4.5	3.4	6	3	-M6X0.75
M8	1	90	18	6	4.9	8	3	-M8X1
M10	1	90	20	7	5.5	8	3	-M10X1
M12	1	100	21	9	7	10	4	-M12X1
M10	1.25	100	20	7	5.5	8	3	-M10X1.25
M12	1.25	100	21	9	7	10	4	-M12X1.25
M12	1.5	100	21	9	7	10	4	-M12X1.5
M14	1.5	100	21	11	9	12	4	-M14X1.5
M16	1.5	100	21	12	9	12	4	-M16X1.5
M18	1.5	100	24	14	11	14	4	-M18X1.5
M20	1.5	125	24	16	12	15	4	-M20X1.5
M22	1.5	125	24	18	14.5	17	4	-M22X1.5

MF
DIN13

1.2-6.1 2.1-4 3.1-5 6.1-3 7.2-3.2

HSS-E PM | S M L XL | B= 3,5 - 5 | RH

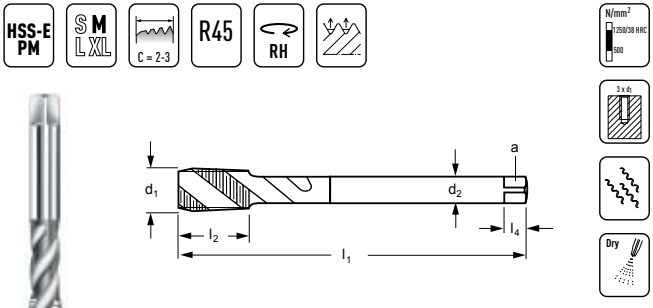


DIN 374 6HX

d_1 mm	P mm	l_1 js16 mm	l_2 mm	d_2 h9 mm	a h12 mm	l_4 mm	N	Code E2126342 THL
M8	1	90	18	6	4.9	8	3	-M8X1
M10	1	90	20	7	5.5	8	3	-M10X1
M12	1	100	21	9	7	10	4	-M12X1
M10	1.25	100	20	7	5.5	8	3	-M10X1.25
M12	1.25	100	21	9	7	10	4	-M12X1.25
M12	1.5	100	21	9	7	10	4	-M12X1.5
M14	1.5	100	21	11	9	12	4	-M14X1.5
M16	1.5	100	21	12	9	12	4	-M16X1.5
M18	1.5	110	24	14	11	14	4	-M18X1.5
M20	1.5	125	24	16	12	15	4	-M20X1.5

MF
DIN13

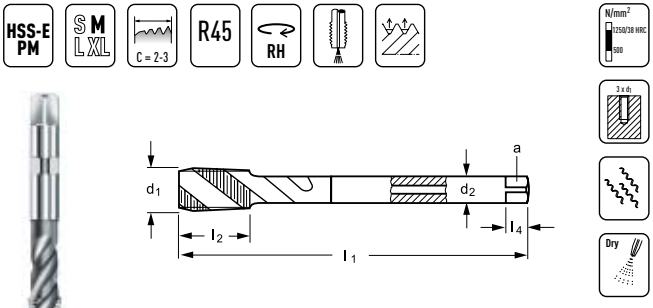
1.2-6.1 | 2.1-4 | 3.1-5 | 5.2 | 6.1-3 | 7.2-3.2



DIN 374 6HX

d_1 mm	P mm	l_1 js16 mm	l_2 mm	d_2 h9 mm	a h12 mm	l_4 mm	N	Code E2156302 THL
M6	0.75	80	10	4.5	3.4	6	3	-M6X0.75
M8	1	90	13	6	4.9	8	3	-M8X1
M10	1	90	12	7	5.5	8	3	-M10X1
M12	1	100	13	9	7	10	4	-M12X1
M10	1.25	100	15	7	5.5	8	3	-M10X1.25
M12	1.25	100	13	9	7	10	4	-M12X1.25
M12	1.5	100	13	9	7	10	4	-M12X1.5
M14	1.5	100	15	11	9	12	4	-M14X1.5
M16	1.5	100	15	12	9	12	4	-M16X1.5
M18	1.5	100	17	14	11	14	4	-M18X1.5
M20	1.5	125	17	16	12	15	4	-M20X1.5
M22	1.5	125	18	18	14.5	17	5	-M22X1.5

1.2-6.1 | 2.1-4 | 3.1-5 | 6.1-3 | 7.2-3.2



DIN 374 6HX

d_1 mm	P mm	l_1 js16 mm	l_2 mm	d_2 h9 mm	a h12 mm	l_4 mm	N	Code E2156312 THL
M8	1	90	13	6	4.9	8	3	-M8X1
M10	1	90	12	7	5.5	8	3	-M10X1
M12	1	100	13	9	7	10	4	-M12X1
M10	1.25	100	15	7	5.5	8	3	-M10X1.25
M12	1.25	100	13	9	7	10	4	-M12X1.25
M12	1.5	100	13	9	7	10	4	-M12X1.5
M14	1.5	100	15	11	9	12	4	-M14X1.5
M16	1.5	100	15	12	9	12	4	-M16X1.5
M18	1.5	110	17	14	11	14	4	-M18X1.5
M20	1.5	125	17	16	12	15	4	-M20X1.5

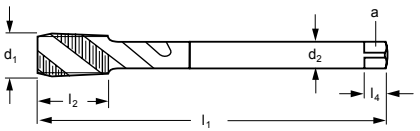
Product information

Paradur ECO-HT range

MF
DIN13

1.2-6.1	2.1-4	3.1-5	6.1-3	7.2-3.2

HSS-E PM | S M L XL | E=1,5-2 | R45 | RH



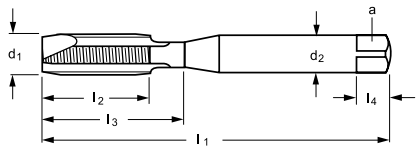
DIN 374 6HX

d_1 mm	P mm	l_1 js16 mm	l_2 mm	d_2 h9 mm	a h12 mm	l_4 mm	N	Code E2156802 THL
M8	1	90	13	6	4.9	8	4	M8X1
M10	1	90	12	7	5.5	8	5	M10X1
M12	1.5	100	13	9	7	10	5	M12X1.5
M14	1.5	100	15	11	9	12	5	M14X1.5

UNC
ASME B1.1

1.2-6.1 2.1-4 3.1-5 6.1-3 7.2-3.2

HSS-E PM | S M L XL | B= 3,5 - 5 | RH | N/mm² 1350/42 HRC 500 | 3,5 x d1 | Dry



DIN 2184-1 2B

d_1-P Nom	d_1 mm	l_1 js16 mm	l_2 mm	l_3 ±1 mm	d_2 h9 mm	a h12 mm	l_4 mm	N	Code E2221302 THL
No. 2-56	2.184	45	7	12	2.8	2.1	5	3	-UNC2
No. 4-40	2.845	56	9	18	3.5	2.7	6	3	-UNC4
No. 6-32	3.505	56	11	20	4	3	6	3	-UNC6
No. 8-32	4.166	63	12	21	4.5	3.4	6	3	-UNC8
No. 10-24	4.826	70	13	25	6	4.9	8	3	-UNC10
1/4-20	6.35	80	15	30	7	5.5	8	3	-UNC1/4

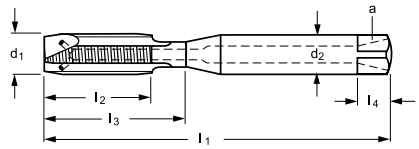
DIN 2184-1 2B

d_1-P Nom	d_1 mm	l_1 js16 mm	l_2 mm	l_3 ±1 mm	d_2 h9 mm	a h12 mm	l_4 mm	N	Code E2226302 THL
5/16-18	7.938	90	18	-	6	4.9	8	3	-UNC5/16
3/8-16	9.525	100	20	-	7	5.5	8	3	-UNC3/8
1/2-13	12.7	110	23	-	9	7	10	4	-UNC1/2
5/8-11	15.875	110	25	-	12	9	12	4	-UNC5/8

UNC
ASME B1.1

1.2-6.1 2.1-4 3.1-5 6.1-3 7.2-3.2

HSS-E PM | S M L XL | B= 3,5 - 5 | RH | N/mm² 1350/42 HRC 500 | 3,5 x d1 | Dry



DIN 2184-1 2B

d_1-P Nom	d_1 mm	l_1 js16 mm	l_2 mm	l_3 ±1 mm	d_2 h9 mm	a h12 mm	l_4 mm	N	Code E2221342 THL
1/4-20	6.35	80	15	30	7	5.5	8	3	-UNC1/4

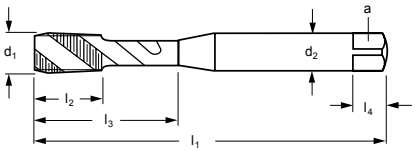
DIN 2184-1 2B

d_1-P Nom	d_1 mm	l_1 js16 mm	l_2 mm	l_3 ±1 mm	d_2 h9 mm	a h12 mm	l_4 mm	N	Code E2226342 THL
5/16-18	7.938	90	18	-	6	4.9	8	3	-UNC5/16
3/8-16	9.525	100	20	-	7	5.5	8	3	-UNC3/8
1/2-13	12.7	110	23	-	9	7	10	4	-UNC1/2
5/8-11	15.875	110	25	-	12	9	12	4	-UNC5/8

UNC
ASME B1.1

1.2-6.1 | 2.1-4 | 3.1-5 | 5.2 | 6.1-3 | 7.2-3.2

HSS-E PM | M | C = 2-3 | R45 | RH | N/mm² 1250/38 HRC 980 | 3 x d_1 | Dry



~DIN 2184-1 2B

d_1-P Nom	d_1 mm	l_1 js16 mm	l_2 mm	l_3 ±1 mm	d_2 h9 mm	a h12 mm	l_4 mm	N	Code E2251302 THL
No. 2-56	2.184	45	4	8.4	2.8	2.1	5	3	-UNC2
No. 4-40	2.845	56	6	11	3.5	2.7	6	3	-UNC4
No. 6-32	3.505	56	6.5	13.7	4	3	6	3	-UNC6
No. 8-32	4.166	63	7	17.8	4.5	3.4	6	3	-UNC8
No. 10-24	4.826	70	8	20.7	6	4.9	8	3	-UNC10
1/4-20	6.35	80	10	27.3	7	5.5	8	3	-UNC1/4

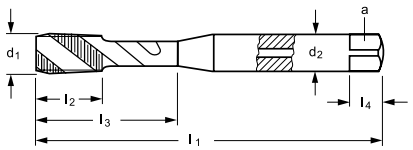
DIN 2184-1 2B

d_1-P Nom	d_1 mm	l_1 js16 mm	l_2 mm	l_3 ±1 mm	d_2 h9 mm	a h12 mm	l_4 mm	N	Code E2256302 THL
5/16-18	7.938	90	13	-	6	4.9	8	3	-UNC5/16
3/8-16	9.525	100	15	-	7	5.5	8	3	-UNC3/8
1/2-13	12.7	110	18	-	9	7	10	4	-UNC1/2
5/8-11	15.875	110	20	-	12	9	12	4	-UNC5/8

UNC
ASME B1.1

1.2-6.1 | 2.1-4 | 3.1-5 | 6.1-3 | 7.2-3.2

HSS-E PM | M | C = 2-3 | R45 | RH | N/mm² 1250/38 HRC 980 | 3 x d_1 | Dry



~DIN 2184-1 2B

d_1-P Nom	d_1 mm	l_1 js16 mm	l_2 mm	l_3 ±1 mm	d_2 h9 mm	a h12 mm	l_4 mm	N	Code E2251312 THL
1/4-20	6.35	80	10	27.3	7	5.5	8	3	-UNC1/4

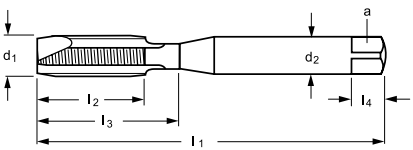
DIN 2184-1 2B

d_1-P Nom	d_1 mm	l_1 js16 mm	l_2 mm	l_3 ±1 mm	d_2 h9 mm	a h12 mm	l_4 mm	N	Code E2256312 THL
5/16-18	7.938	90	13	-	6	4.9	8	3	-UNC5/16
3/8-16	9.525	100	15	-	7	5.5	8	3	-UNC3/8
1/2-13	12.7	110	18	-	9	7	10	4	-UNC1/2
5/8-11	15.875	110	20	-	12	9	12	4	-UNC5/8
3/4-10	19.05	125	25	-	14	11	14	4	-UNC3/4

UNF
ASME B1.1

1.2-6.1 2.1-4 3.1-5 6.1-3 7.2-3.2

HSS-E PM | S M L XL | B= 3,5 - 5 | RH | N/mm² 1350/42 HRC 500 | 3,5 x d1 | Dry



DIN 2184-1 2B

d_1-P Nom	d_1 mm	l_1 js16 mm	l_2 mm	l_3 ±1 mm	d_2 h9 mm	a h12 mm	l_4 mm	N	Code E2321302 THL
No. 4-48	2.845	56	9	18	3.5	2.7	6	3	-UNF4
No. 6-40	3.505	56	11	20	4	3	6	3	-UNF6
No. 8-36	4.166	63	12	21	4.5	3.4	6	3	-UNF8
No. 10-32	4.826	70	13	25	6	4.9	8	3	-UNF10
1/4-28	6.35	80	15	30	7	5.5	8	3	-UNF1/4

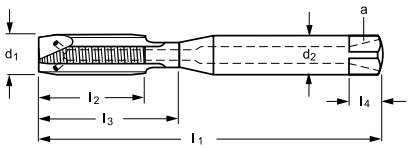
DIN 2184-1 2B

d_1-P Nom	d_1 mm	l_1 js16 mm	l_2 mm	l_3 ±1 mm	d_2 h9 mm	a h12 mm	l_4 mm	N	Code E2326302 THL
5/16-24	7.938	90	18	-	6	4.9	8	3	-UNF5/16
3/8-24	9.525	100	20	-	7	5.5	8	3	-UNF3/8
1/2-20	12.7	100	21	-	9	7	10	4	-UNF1/2
5/8-18	15.875	100	21	-	12	9	12	4	-UNF5/8

UNF
ASME B1.1

1.2-6.1 2.1-4 3.1-5 6.1-3 7.2-3.2

HSS-E PM | S M L XL | B= 3,5 - 5 | RH | N/mm² 1350/42 HRC 500 | 3,5 x d1 | Dry



DIN 2184-1 2B

d_1-P Nom	d_1 mm	l_1 js16 mm	l_2 mm	l_3 ±1 mm	d_2 h9 mm	a h12 mm	l_4 mm	N	Code E2321342 THL
1/4-28	6.35	80	15	30	7	5.5	8	3	-UNF1/4

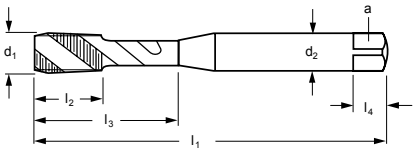
DIN 2184-1 2B

d_1-P Nom	d_1 mm	l_1 js16 mm	l_2 mm	l_3 ±1 mm	d_2 h9 mm	a h12 mm	l_4 mm	N	Code E2326342 THL
5/16-24	7.938	90	18	-	6	4.9	8	3	-UNF5/16
3/8-24	9.525	100	20	-	7	5.5	8	3	-UNF3/8
1/2-20	12.7	100	21	-	9	7	10	4	-UNF1/2

UNF
ASME B1.1

1.2-6.1 | 2.1-4 | 3.1-5 | 5.2 | 6.1-3 | 7.2-3.2

HSS-E PM | M | C = 2-3 | R45 | RH | N/mm² 1250/38 HRC 500 | 3 x d_1 | Dry



~DIN 2184-1 2B

d_1-P Nom	d_1 mm	l_1 js16 mm	l_2 mm	l_3 ±1 mm	d_2 h9 mm	a h12 mm	l_4 mm	N	Code E2351302 THL
No. 4-48	2.845	56	6	11	3.5	2.7	6	3	-UNF4
No. 6-40	3.505	56	6.5	13.1	4	3	6	3	-UNF6
No. 8-36	4.166	63	7	17.4	4.5	3.4	6	3	-UNF8
No. 10-32	4.826	70	8	20.7	6	4.9	8	3	-UNF10
1/4-28	6.35	80	10	25.9	7	5.5	8	3	-UNF1/4

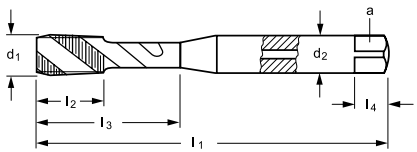
DIN 2184-1 2B

d_1-P Nom	d_1 mm	l_1 js16 mm	l_2 mm	l_3 ±1 mm	d_2 h9 mm	a h12 mm	l_4 mm	N	Code E2356302 THL
5/16-24	7.938	90	13	-	6	4.9	8	3	-UNF5/16
3/8-24	9.525	100	15	-	7	5.5	8	3	-UNF3/8
1/2-20	12.7	100	13	-	9	7	10	4	-UNF1/2
5/8-18	15.875	100	15	-	12	9	12	4	-UNF5/8

UNF
ASME B1.1

1.2-6.1 | 2.1-4 | 3.1-5 | 6.1-3 | 7.2-3.2

HSS-E PM | M | C = 2-3 | R45 | RH | N/mm² 1250/38 HRC 500 | 3 x d_1 | Dry



~DIN 2184-1 2B

d_1-P Nom	d_1 mm	l_1 js16 mm	l_2 mm	l_3 ±1 mm	d_2 h9 mm	a h12 mm	l_4 mm	N	Code E2351312 THL
1/4-28	6.35	80	10	25.9	7	5.5	8	3	-UNF1/4

DIN 2184-1 2B

d_1-P Nom	d_1 mm	l_1 js16 mm	l_2 mm	l_3 ±1 mm	d_2 h9 mm	a h12 mm	l_4 mm	N	Code E2356312 THL
5/16-24	7.938	90	13	-	6	4.9	8	3	-UNF5/16
3/8-24	9.525	100	15	-	7	5.5	8	3	-UNF3/8
1/2-20	12.7	100	13	-	9	7	10	4	-UNF1/2
5/8-18	15.875	100	15	-	12	9	12	4	-UNF5/8

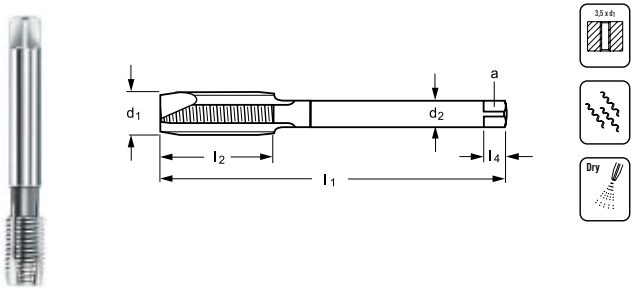
Product information

Prototex ECO-HT range

G
DIN EN ISO 228

1.2-6.1 | 2.1-4 | 3.1-5 | 6.1-3 | 7.2-3.2

HSS-E PM | S M L XL | B= 3,5 - 5 | RH | N/mm² 1350/42 HRC 600 | 3,5 x d_1 | Dry



DIN 5156 G-X

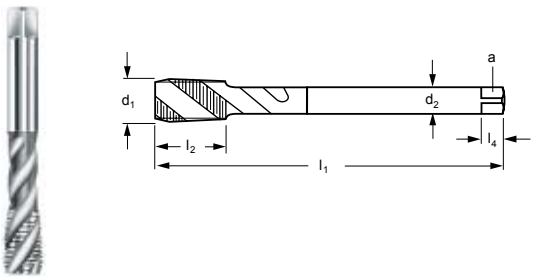
d_1-P Nom	d_1 mm	l_1 js16 mm	l_2 mm	l_3 ±1 mm	d_2 h9 mm	a h12 mm	l_4 mm	N	Code E2426302 THL
G 1/8	9.728	28	90	20	7	5.5	8	3	-G1/8
G 1/4	13.157	19	100	21	11	9	12	4	-G1/4
G 3/8	16.662	19	100	21	12	9	12	4	-G3/8
G 1/2	20.955	14	125	24	16	12	15	4	-G1/2
G 5/8	22.911	14	125	24	18	14.5	17	4	-G5/8
G 3/4	26.441	14	140	26	20	16	19	5	-G3/4
G 1	33.249	11	160	28	25	20	23	5	-G1

Paradur ECO-HT range

G
DIN EN ISO 228

1.2-6.1 | 2.1-4 | 3.1-5 | 6.1-3 | 7.2-3.2

HSS-E PM | S M L XL | C = 2-3 | R45 | RH | N/mm² 1250/38 HRC 500 | 3 x d_1 | Dry



DIN 5156 G-X

d_1 Nom	d_1 mm	l_1 js16 mm	l_2 mm	l_3 ±1 mm	d_2 h9 mm	a h12 mm	l_4 mm	N	Code E2456302 THL
G 1/8	9.728	28	90	12	7	5.5	8	3	-G1/8
G 1/4	13.157	19	100	15	11	9	12	4	-G1/4
G 3/8	16.662	19	100	15	12	9	12	4	-G3/8
G 1/2	20.955	14	125	18	16	12	15	4	-G1/2
G 5/8	22.911	14	125	18	18	14.5	17	4	-G5/8
G 3/4	26.441	14	140	20	20	16	19	5	-G3/4
G 1	33.249	11	160	22	25	20	23	5	-G1

Everything you need to know about threads

Thread types in accordance with DIN 202

The following table provides an overview of the most important thread types.
(Excerpt from DIN 202)

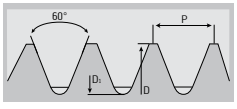
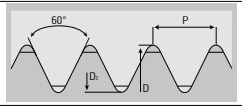
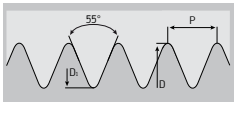
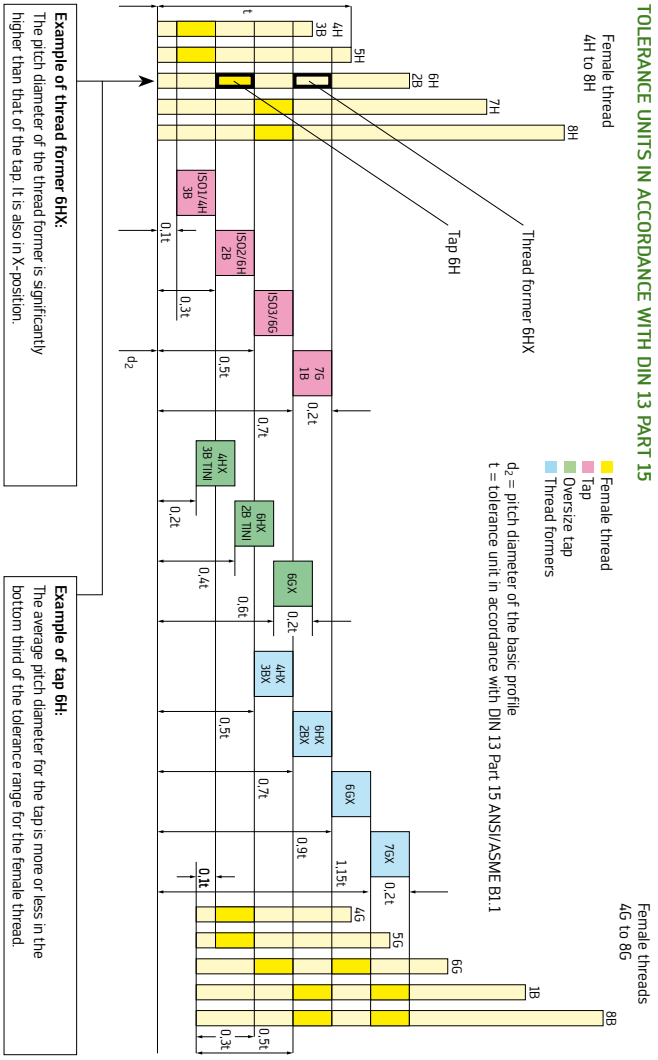
Type of thread	Profile (diagram)	Symbol		Designation (example)	Range of nominal sizes	As specified in	Application
ISO metric screw thread (single-start or multi-start)		M		M 0.8	0.3 mm to 0.9 mm	DIN 14-1 to DIN 14-4	Watches and precision engineering
				M 8	1 mm to 68 mm	DIN 13-1	General purpose screw threads (coarse pitch hreads)
				M 24 x 4 P 2		DIN 13,52	
				M 6 x 0.75 M 8 x 1 – LH	1 mm - 1,000 mm	DIN 13-2 to DIN 13-11	To be used where pitch of coarse thread is too large
				M 24 x 4 P		DIN 13-52	
				M 64 x 4	64 mm and 76 mm	DIN 6630	External barrel threads
				M 30 x 2 – 4H5H	1.4 mm to 355 mm	LN 9163-1 to LN 9163-7 LN 9163-10 and LN 9163-11	Aerospace industry
ISO metric screw thread; helical coil thread for inserts		EG M		EG M 20	2 mm to 52 mm	DIN 8140-2	Helical coil thread (coarse pitch and fine pitch thread) for wire thread inserts
Unified screw thread		UNC UNF		No. 6 (0.138) - 32 UNC-2A		ASME B1.1	USA United Kingdom
				¼ - 20 UNC-2A or 0.250 - 20 UNC-2A		ASME B1.1 BS 1580	USA United Kingdom
Parallel pipe thread where pressure-tight joints are not made on the threads		G		G 1 ½ A G 1 ½ B	$^{1}/_{16}$ to 6	DIN EN ISO 228-1	External screw threads for pipes and pipe joint assemblies
				G 1 ½			Internal screw threads for pipes and pipe joint assemblies
				G ¾	¾, 1, 2	DIN 6630	External barrel threads

Chart of tolerance positions



From the illustration (p. 46), it is clear that a 6H female thread could be produced using, for example, a 6G and, theoretically, even a 7G tap. The 6G tap is almost exactly in the centre of the 6H female thread tolerance range. However, even the slightest axial or radial miscut would soon result in the workpiece having to be rejected.

Taps that are designed for very tough materials are currently produced for the X-position. The illustration shows that, for Walter Prototyp products, this means an increase by half a tolerance position. Examples include the INOX taps or the ECO-HT taps for high tensile steels. Even during thread cutting, high tensile titanium and nickel alloys tend to spring back, which is why the TI and NI taps are also manufactured in the X-position.

Similarly, it is useful to manufacture the tools in X-position where abrasive materials, such as grey cast iron, are being machined and miscutting does not present a problem. An example of a tool such as this is our Paradur ECO-CI tap. The X-position helps to prolong tool life (by increasing the time before which the Go end of the thread gauge becomes impossible to screw in).

Please note:
The X-position is not defined in any particular standard. Dimensional specifications may vary by manufacturer.

Tolerance classes in accordance with DIN/ISO

Tolerance class of the tap		Tolerance range of the female thread to be cut				
Designation (DIN)	Designation (DIN)					
4H	ISO 1	4H	5H	–	–	–
6H	ISO 2	4G	5G	6H	–	–
6G	ISO 3	–	–	6G	7H	8H
7G	–	–	–	–	7G	8G

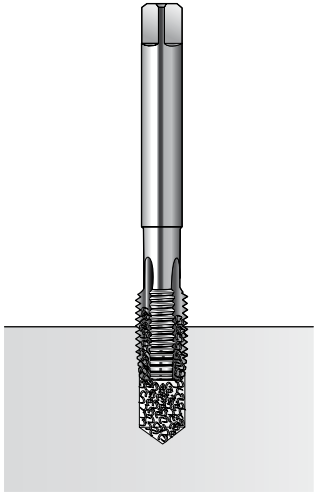
The abbreviation for the tolerance class corresponds to the tolerance range of the female thread for which the tap is predominantly used. It is not always identical, therefore, to the tolerance range of the female thread that was cut.

Tapped hole types: blind hole

BLIND HOLE – SHORT-CHIPPING MATERIALS

Straight-fluted taps do not transport chips out of the hole. For this reason, they are suitable only for short-chipping materials or for cutting short threads.

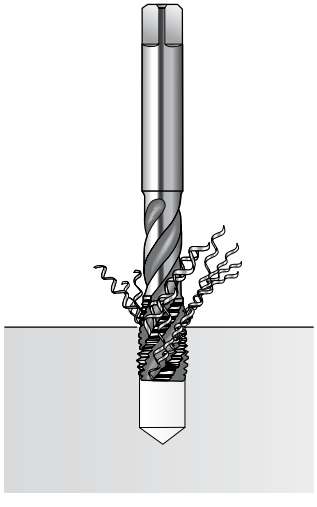
Used for blind hole and through-hole threads.



BLIND HOLE – LONG-CHIPPING MATERIALS

Right-hand spiral taps transport chips back towards the shank. The tougher the workpiece material (producing longer chips) and the deeper the thread, the greater the helix angle required.

Used for tapping blind holes in long-chipping materials.

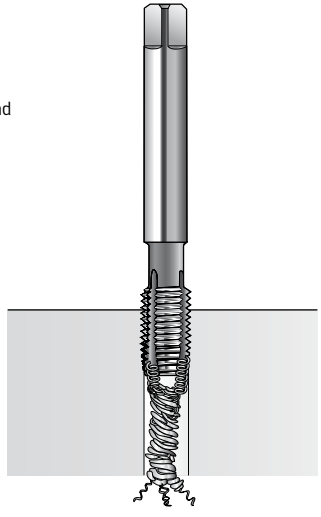


Tapped hole types: through hole

THROUGH HOLE – CHIP REMOVAL IN FEED DIRECTION

Taps with a spiral point (form B) or left-hand spiral expel the chips forwards in the feed direction.

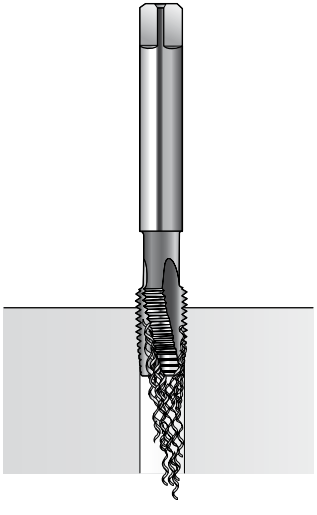
Used for through-hole threads in long-chipping materials.



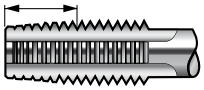
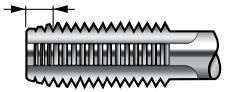
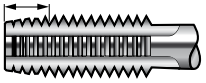
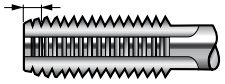
THROUGH HOLE – LONG-CHIPPING MATERIALS

Taps with a spiral point (form B) or left-hand spiral expel the chips forwards in the feed direction.

Used for through-hole threads in long-chipping materials.



Chamfer forms of taps

Form	Threads per chamfer	Type of flute	Used predominantly for
A	6 - 8 threads 	straight-fluted	Through holes in medium- to long-chipping materials
B	3.5 - 5 threads 	straight-fluted with spiral point	Through holes in medium- to long-chipping materials
C	2 - 3 threads 	straight-fluted or spiral-fluted	Blind holes in long- and medium-chipping materials and through holes in short-chipping materials
D	3.5 - 5 threads 	straight-fluted or spiral-fluted	Blind holes with long thread runout and through holes
E	1.5 - 2 threads 	straight-fluted or spiral-fluted	Blind holes with very short thread runout

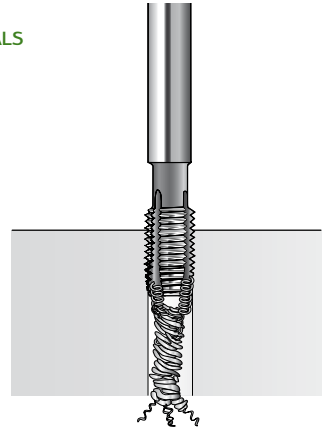
Please note:

- Longer chamfers reduce the strain on the cutting edge, which becomes more significant with increasing material strength
- Longer chamfers increase the torque required
- Longer chamfers require a somewhat longer cycle time due to the increased travel

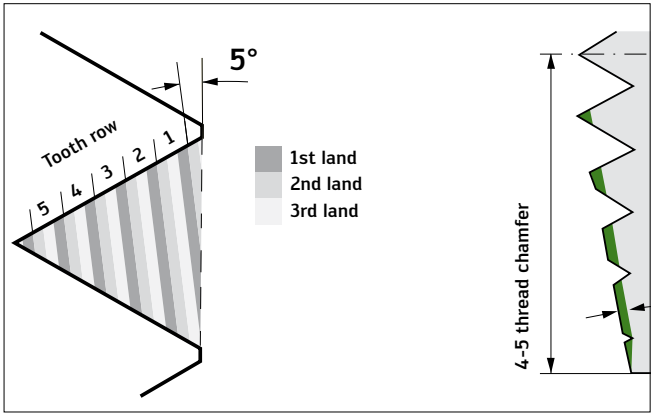
Chip sections of chamfer forms

THROUGH-HOLE THREADS FOR LONG- AND SHORT-CHIPPING MATERIALS

- High torque
- Small chip section
- Reduced strain on the chamfer teeth



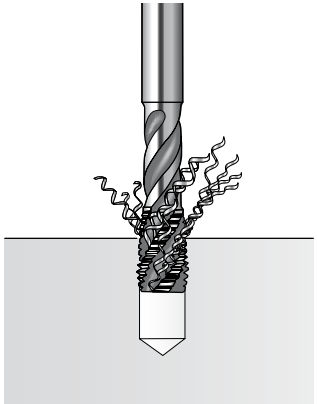
FORM B



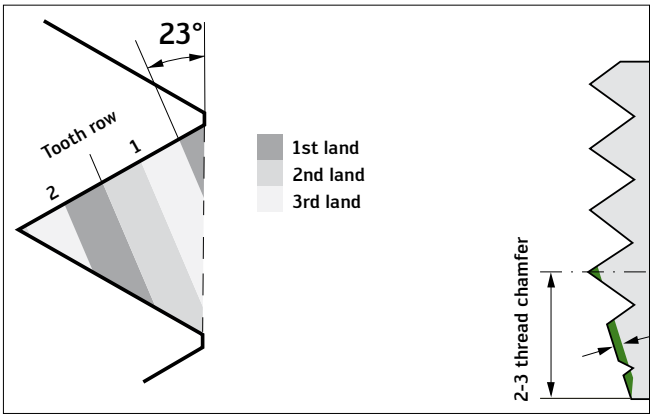
Chip sections of chamfer forms

BLIND HOLE THREADS FOR LONG-CHIPPING MATERIALS

- Low torque
- Large chip section
- Increased strain on the chamfer teeth



FORM E

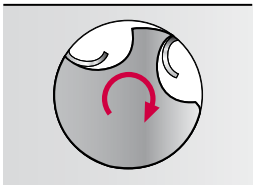


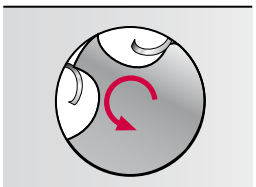
Chamfer clearance angle

Blind hole taps have a small chamfer clearance angle because they need to shear off the chip root when they reverse.

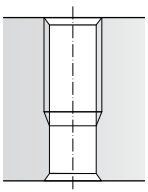
Through-hole taps (spiral point) have a larger chamfer clearance angle than blind hole taps.

Due to its greater chamfer clearance angle, a spiral point tap should be able to cut straight through the through hole.



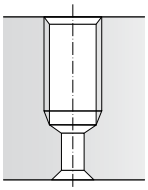


Examples:



Through-hole taps possible, but only with reduced chamfer clearance angle because of need to shear off chip root.

Secondary operations required.



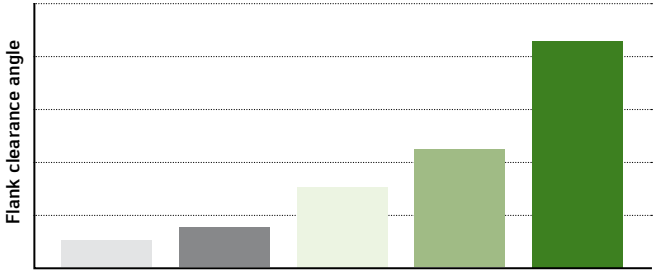
Blind hole tap required because chip has to be transported in opposite direction to feed direction.

No secondary operations required.

Thread clearance angle

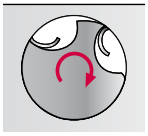
It should be possible for a tap to turn easily into the cut thread without it causing further abrasion.

If this is not possible, a tool with a greater clearance angle should be selected.

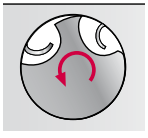


- Paradur WSH, Paradur WTH
- Prototex H, Paradur N
- Prototex INOX, Paradur INOX
- Prototex ECO-HT, Paradur ECO-HT
- Prototex Synchrospeed, Paradur Synchrospeed

Blind hole tapping process



The tap has been cutting and now comes to a stop. At this very moment, all cutting edges on the chamfer are still in the process of forming a chip.



The tool begins to reverse. The chips remain where they are for the time being. The reverse torque at this point is virtually zero.

The chips come into contact with the back of the trailing land of the tap. The reverse torque now increases sharply. The chip has to be shorn off. As the chamfer of the tap has a clearance angle and withdraws from the thread axially when it backs out of the hole, it is inevitable that the purchase point will no longer be directly at the root of the chip. For this reason, the chip would require a certain amount of stability (thickness) to be cut. As a result, taps having a long chamfer are not suitable for use in blind hole cutting because of their greater chamfer angle. If a tap such as this were used, there would be a risk of the too thin chip not being shorn off, but simply flattened and becoming trapped between the chamfer and the thread. This could lead to spalling on the chamfer and, in extreme cases, tap breakage.

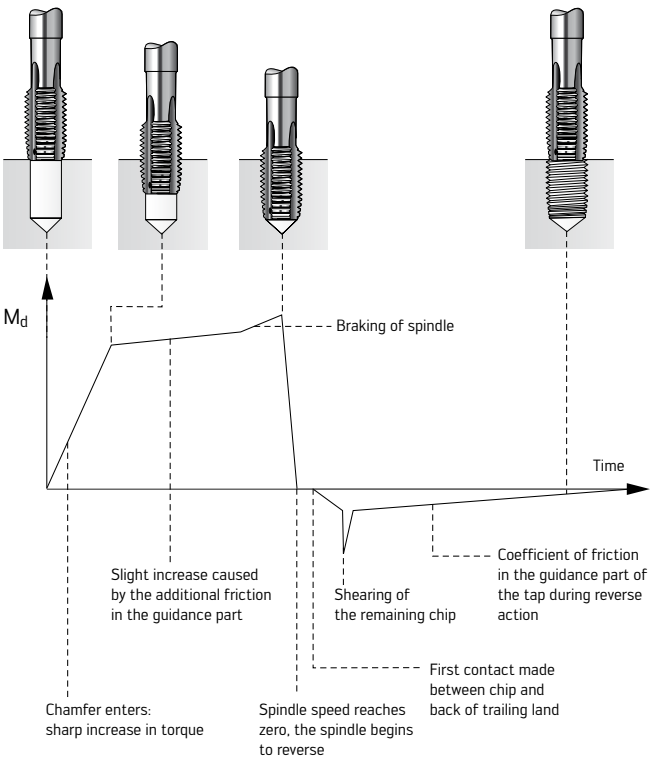
The chip has been shorn off and reverse torque decreases to the friction between the guidance part and the cut thread.

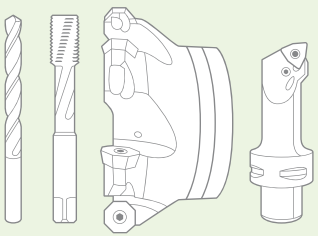
Blind hole tapping process

Please note:

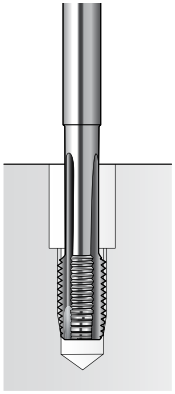
The shearing of the chip in the blind hole thread presents a particular problem. If the chip becomes too thin, it simply flattens and can no longer be cut through. Instead, it becomes trapped between the component and chamfer flank face. Long chamfers (form A, form D or form B) and high chamfer clearance angles are therefore unsuitable for tapping blind hole threads.

TORQUE CURVE DURING THE BLIND HOLE TAPPING PROCESS



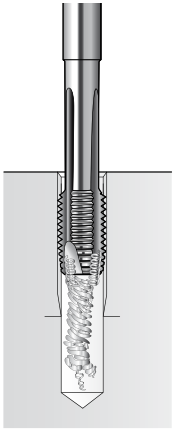


RECESSED AND DEEP BLIND HOLE THREADS



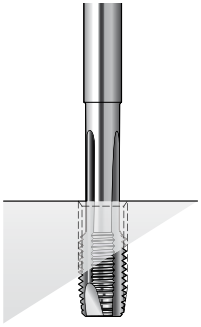
- Where possible, use a straight-fluted tap with axial internal coolant supply or a coated tap with bright finished rake:
  · Paradur HT
- For construction and carbon steels from 500 to 850 N/mm², use a tap with special cutting edge geometry:
  · Paradur Short Chip Soft
- For stainless steels, we recommend the thread forming method (preferably with oil) or the use of a spiral-fluted tap:
  · Thread forming: Protodyn S ECO-INOX
  · Thread tapping: Paradur ECO-HT

THREAD WITH SIGNIFICANTLY DEEPER CORE HOLE THAN THREAD DEPTH



- Use a tap with modified spiral point:
  · Reduce chamfer clearance to that of a blind hole tap
  · Shorten chamfer length to 3 threads
  Advantage: longer tool edge life than blind hole taps
  Disadvantage: chips remain inside the hole

INCLINED THREAD LEAD-OUT

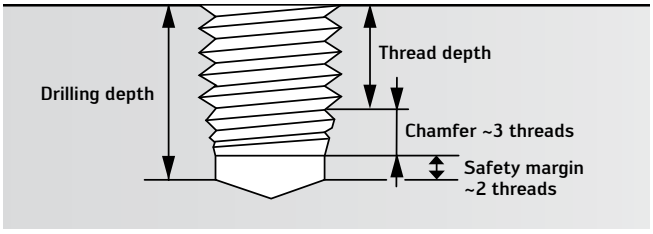


- Use a tap with as long a guidance part as possible and maximum stability
  · Inclinations of up to 30° relatively unproblematic
- Alternative: thread milling

General notes on core holes

DEPTH OF THE CORE HOLE FOR THREAD CUTTING / THREAD FORMING

Drilling depth ≥ effective thread depth + chamfer length + safety margin



Please note:

For flat-bottomed core holes, take into consideration the type of point that the threading tool might have (external centre or external centre with reduced point).

DIAMETER OF THE CORE HOLE FOR THREAD CUTTING

Rule of thumb: hole diameter = nominal diameter - lead

Example: M10 thread cutting

Hole diameter = 10.0 mm - 1.5 mm
= **8.5 mm**

SPECIAL NOTES ON THREAD FORMING

- The core diameter of the thread is produced by the thread former and depends on the flow properties of the formed material.
- After the forming process, the core diameter must be within the limits specified on page 80.
- In the case of Walter Prototyp products, the guide value for the pilot hole is specified on each thread former. The following tolerances, relative to this guide value, should be fulfilled:

Lead	Tolerance
≤ 0.3 mm	± 0.01 mm
> 0.3 mm to < 0.5 mm	± 0.02 mm
≥ 0.5 mm to < 1 mm	± 0.03 mm
≥ 1 mm	± 0.05 mm

After the forming process, it is essential to gauge the thread core diameter. For notes on gauging threads, please refer to pages 64 and 65.

Rule of thumb: hole diameter = nominal diameter - 0.45 x lead

Example: M10 thread forming

Hole diameter = 10.0 mm - 0.45 x 1.5 mm
= 10.0 mm - 0.675 mm
= 9.325 mm
= **9.3 mm**

Cooling and lubrication

Material group	Material	Suitable coolant Thread cutting	Suitable coolant Thread forming
P	Steel	Emulsion 5 %	Emulsion 5 - 10 %
	Steel 850 - 1,200 N/mm²	Emulsion 5-10 %	Emulsion 10 %
			Oil (Protofluid)
	Steel 1,200 - 1,400 N/mm²	Emulsion 10 %	Oil (Protofluid or Hardcut 525)
		Oil (Protofluid)	Emulsion 10 %
	Steel 1,400 - 1,600 N/mm² equivalent to 44 - 49 HRC	Oil (Protofluid or Hardcut 525)	Forming generally not possible
M	Stainless steel	Emulsion 5-10 %	Oil (Protofluid)
		Oil (Protofluid)	Emulsion 5 - 10 %, possible only with small leads up to 1.5 mm
K	Grey cast iron	Emulsion 5 %	Forming not possible
	Nodular cast iron	Emulsion 5 %	Emulsion 10 %
N	Aluminium up to max. 12 % Si	Emulsion 5-10 %	Emulsion 5 - 15 %
	Aluminium over 12 % Si	Emulsion 5-10 %	Emulsion 5 - 10 %, but forming useful only in exceptional cases
	Magnesium	Oil (Protofluid)	Forming not possible at room temperature
	Copper	Emulsion 5-10 %	Emulsion 5 - 10 %
	Synthetics	Emulsion 5 %	Forming does not produce dimensionally accurate threads
S	Titanium alloys	Oil (Protofluid or Hardcut 525)	Oil (Hardcut 525)
		Emulsion 10 %	
	Nickel alloys	Oil (Protofluid or Hardcut 525)	Oil (Protofluid or Hardcut 525)
		Emulsion 10 %	
H	Steel >49 HRC	Oil (Hardcut 525) possible only with carbide tools	Forming not possible

Minimum quantity lubrication (MQL)

- Most steel, aluminium and copper materials are machinable with MQL (cutting and forming)
- Use internal MQL for thread depths >1.5 x d
- Flow rate: 5 to 20 ml/h
- MQL is not recommended for steel > 1,200 N/mm², stainless steels or titanium/nickel alloys.

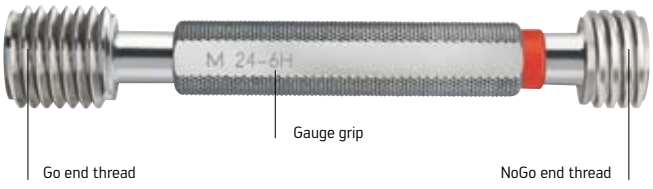
Dry machining

- Thread forming: not recommended
- Thread cutting: through hole machining in steels of low or medium tensile strength and in cast iron

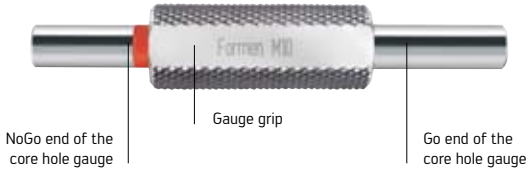
Gauging female threads

Thread gauges are used to check thread dimensions after the cutting or forming process.

Pitch diameter



Core diameter



GO END OF THE THREAD GAUGE

- Checks compliance with the minimum dimension for the pitch diameter including form errors, roundness errors and straightness errors in respect of the thread axis.
- Checks the minimum dimension for the outside diameter and whether the length of the flank portion is sufficient.
- The Go gauge thread must be able to be turned easily into the cut or formed thread.

NOGO END OF THE THREAD GAUGE

- Checks whether the pitch diameter of the female thread in the workpiece exceeds the specified maximum value.
- It must not be possible to screw the NoGo end of the gauge into the workpiece thread from either side by more than two turns by hand without any significant amount of force.
- If the workpiece thread has fewer than three turns, it must not be possible to screw the NoGo end all the way through.

BARREL GAUGE FOR CHECKING THE CORE DIAMETER

- Core hole gauging is particularly important in thread forming because the core diameter is produced by the thread former.
- In thread cutting, the core diameter may become too narrow due to burring during the tapping process.
- It must not be possible to insert the NoGo end of the barrel gauge more than one full thread turn from either side.

THE FEMALE THREAD IS DEEMED TO BE TRUE TO GAUGE IF THE FOLLOWING CONDITIONS ARE FULFILLED:

- The Go end of the thread gauge must be able to be screwed easily down to the bottom.
- It must not be possible to screw in the NoGo end of the thread gauge by more than 2 turns.
- It must be possible to insert the Go end of the core hole gauge easily.
- It must not be possible to screw in the NoGo end of the core hole gauge by more than one full thread turn.

Synchronous machining

To reduce process times in threading operations, manufacturers are increasingly favouring higher rotation speeds and cutting speeds (HSC). For high cutting speeds especially, the synchronous machining approach is recommended.

The **Synchrospeed** tool range from Walter Prototyp has been optimised specifically for this particular process. The key characteristics of these tools are their extremely high clearance, their extra short thread and their sharp cutting edges.

While Synchrospeed threading tools have been developed exclusively for synchronous applications, ECO threading tools can be used for both rigid and conventional tapping.

Synchronous tapping requires a machine that can synchronise the rotary motion of the main spindle with the feed motion. Today's machining centres are usually equipped with this capability as standard.

Synchronous taps are compatible with conventional Weldon chucks as well as collet chucks (where possible with square drive).
Both fixtures have the disadvantage of being unable to compensate for the axial forces that are generated.

Protoflex C synchronous tapping chuck

A better alternative is the Protoflex C tapping chuck with minimum compensation. Protoflex C is a tapping chuck for machining centres with synchronous control logic. It guarantees a precisely defined minimum compensation and is matched to the geometry of Synchrospeed tools.

What's so special about Protoflex C?

Unlike all other known tapping chucks, the Protoflex C design is based on a precision-machined flexor with high spring rate, which compensates both radially and axially for microscopic deflections. The patented microcompensator is made from a special alloy originally developed for NASA. The conventional synchro chucks on the market use plastic parts for this purpose, but these lose their flexibility over time, at which point they are no longer able to provide microcompensation.

The Protoflex C helps to reduce considerably the pressure forces that act on the flanks of the tap. This results in:

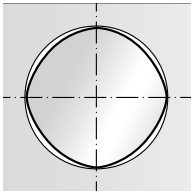
- improved surface quality on the flanks of the cut thread
- greater process reliability thanks to the reduced risk of breakage, particularly where dimensions are small
- a longer tool life due to less friction
- maximum utilisation of machine power

Flexor with minimum compensation

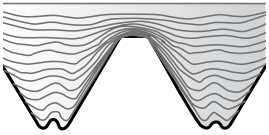
The thread forming method

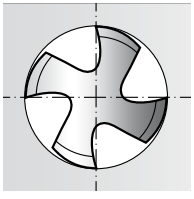
ADVANTAGES

- No chips
  · cold forming process
- Deep thread down to 4 x d possible as standard
  · no problems associated with chip removal
- Improved thread surface
  · significantly less roughness in the flanks than with thread cutting
- Around 20 % higher break-out resistance under static load
  · due to strain hardening of the thread flanks and root
- More than double the fatigue strength under dynamic load
  · due to strain hardening and uninterrupted fibre pattern
- Maximum possible machining safety thanks to tools of high stability
  · large core cross section without flutes
- Significantly longer tool life than taps
  · rounded thread profile with no cutting edges
- Universal use in a broad material spectrum
  · around 65 % of all machined materials in industry are formable

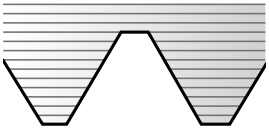


Thread forming



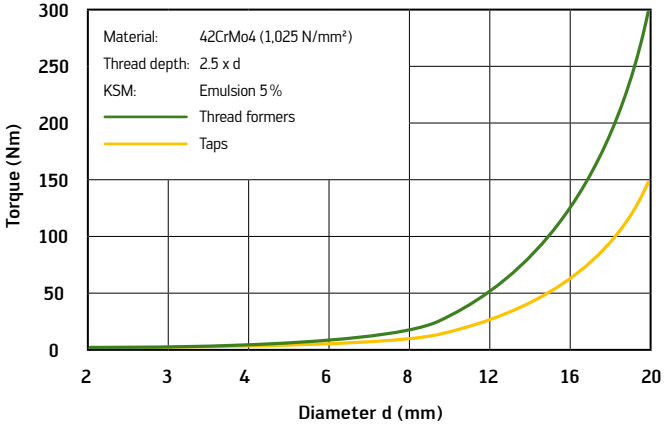


Thread cutting



Please note:

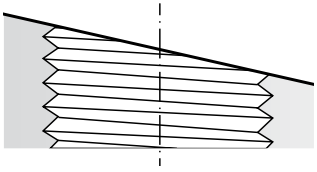
- Discontinuity / incomplete thread
  An incompletely formed thread root or lead-in can cause problems during automatic screwing and in the cleaning of threads
- Greater torque
  Around 30 % higher by comparison with thread tapping



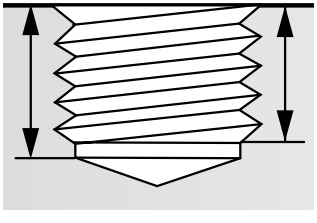
The thread milling method

ADVANTAGES

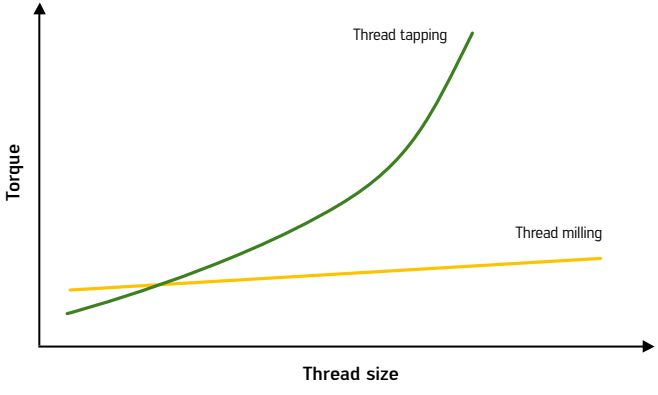
- Universal application
  - in almost all long- or short-chipping materials: steels, stainless steels, grey cast iron, nodular cast iron, aluminium and AlSi alloys, nickel alloys and titanium alloys
- Different thread dimensions
  - with just one tool, it is possible to produce different thread sizes with the same thread pitch because the thread is not made until the milling process
- Any thread tolerances
  - can be produced using a single thread milling cutter because the thread tolerance is not produced by the tool but by the milling process alone
- With just one tool
  - blind hole and through-hole threads
  - single-start and multi-start threads
  - right- and left-hand threads
- Best process reliability
  - thanks to short chips (milling process) even with tough and difficult materials
  - tool breakage does not necessarily result in workpiece rejection because the tool diameter is always less than the core diameter of the thread
- Threads with inclined entry and exit surfaces possible



- Uniform motion
  - no change in the direction of rotation (no reversing action required)
  - lower spindle strain and thus less machine wear
- Dimensionally accurate threads almost all the way down to the root
  - because thread milling cutters have no chamfer unlike conventional taps or thread formers
  - no possibility of miscutting



- Low torques
  - large thread dimensions are straightforward to produce even on machines with low driving power



Please note:

- Modern machine tool with 3D CNC control system required
- Take tool diameter into consideration (radius correction)
- Higher tool costs than with taps
- Generally slower than thread tapping or forming

Additional information

X·treme Plus cutting data

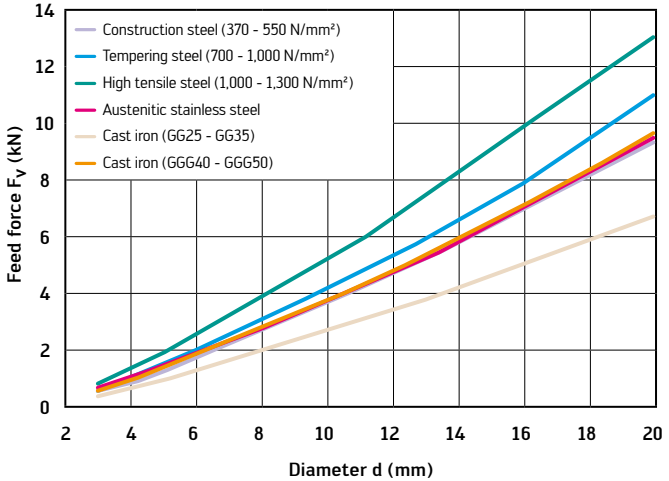
Material to be machined		Cutting speed v_c (m/min)		Feed f (mm) for Ø (mm)				
Material group	Designation	Operating range	Standard value	3-4	4-6	6-9	9-14	14-20
1.1.1	Free cutting steel	160-230	190	0.10-0.15	0.14-0.22	0.2-0.32	0.29-0.42	0.38-0.51
1.1.2	Soft construction steels up to 550 N/mm²	160-230	190	0.10-0.14	0.13-0.21	0.19-0.3	0.27-0.39	0.35-0.48
1.1.3	Low-alloy steel and cast steel 550 - 700 N/mm²	140-210	171	0.09-0.13	0.12-0.19	0.18-0.28	0.25-0.36	0.33-0.44
1.2	Low-alloy steel and cast steel 700 - 1,000 N/mm²	120-170	143	0.08-0.12	0.11-0.18	0.16-0.26	0.23-0.33	0.3-0.41
1.3	Steel 1,000 - 1,300 N/mm²	100-140	114	0.07-0.10	0.09-0.15	0.14-0.21	0.19-0.28	0.25-0.34
1.4	Steel 1,300 - 1,600 N/mm²	60-90	72	0.04-0.06	0.05-0.09	0.08-0.13	0.12-0.17	0.15-0.21
1.5.1	Steel, hardened 45 - 55 HRC	50-80	65	0.03-0.05	0.04-0.07	0.07-0.1	0.09-0.13	0.12-0.16
1.6.1	Tool steel, non-alloyed	100-140	114	0.07-0.11	0.1-0.16	0.15-0.24	0.21-0.3	0.28-0.38
1.6.2	Tool steel, low-alloyed	100-140	114	0.07-0.1	0.1-0.16	0.14-0.22	0.2-0.29	0.26-0.36
1.6.3	Tool steel, high-alloyed	70-100	82	0.06-0.09	0.08-0.13	0.12-0.19	0.17-0.25	0.23-0.31
1.7.1	Stainless steel, ferritic, martensitic	40-60	47	0.06-0.09	0.08-0.13	0.12-0.19	0.17-0.25	0.23-0.31
1.7.2	Stainless steel, austenitic, sulphurised	60-90	74	0.08-0.11	0.1-0.17	0.15-0.24	0.22-0.32	0.29-0.39
1.7.3	Stainless steel, austenitic	40-60	47	0.04-0.06	0.06-0.09	0.09-0.14	0.12-0.18	0.16-0.22
1.7.4	Stainless steel, hardened	40-60	47	0.04-0.06	0.06-0.09	0.09-0.14	0.12-0.18	0.16-0.22
2.1	Ni and Co alloys up to 900 N/mm²	30-50	39	0.04-0.05	0.05-0.08	0.07-0.11	0.1-0.15	0.13-0.18
2.2	Ni and Co alloys 900 - 1,200 N/mm²	20-30	29	0.03-0.04	0.04-0.06	0.05-0.09	0.08-0.11	0.1-0.14
2.3	Ni and Co alloys over 1,200 N/mm²	20-20	18	0.03-0.04	0.04-0.06	0.05-0.09	0.08-0.11	0.1-0.14
3.1	Cast iron GG10-GG20	120-180	148	0.13-0.19	0.17-0.28	0.26-0.41	0.37-0.53	0.48-0.65
3.2	Cast iron GG25 - GG40	100-150	124	0.13-0.19	0.17-0.28	0.26-0.41	0.37-0.53	0.48-0.65
3.3.1	Cast iron GGG40 - GGG50	130-180	152	0.13-0.19	0.17-0.28	0.26-0.41	0.37-0.53	0.48-0.65
3.3.2	Cast iron GGG60-GGG80	100-140	114	0.11-0.17	0.15-0.25	0.23-0.36	0.33-0.47	0.42-0.57
6.1	Titanium and titanium alloys up to 700 N/mm²	60-90	76	0.05-0.08	0.07-0.11	0.1-0.16	0.15-0.21	0.19-0.26
6.2	Titanium alloys over 700 N/mm²	50-80	66	0.04-0.06	0.06-0.09	0.09-0.14	0.12-0.18	0.16-0.22

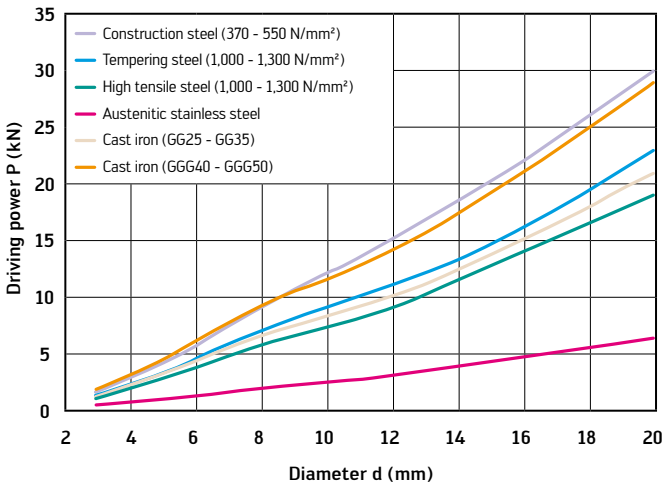
The values listed apply to a drilling depth of max. 3 x d.
The data should be reduced by approx. 5 % for values over 5 x d.

Only the most important materials are listed here.
For additional materials and precise values, please refer to TEC+CCS.

Additional information

X·treme Plus driving power





All values refer to recommended cutting data for the respective materials.

ECO-HT tap cutting data

Material to be machined			TH v_c (m/min)	BH v_c (m/min)
Material group	Designation		THL	THL
1. steel	1.2 construction / case-hardened steel	E,M	40-50	25-35
	1.3 carbon steel	E,M	35-45	20-30
	1.4 alloyed / tempered	E,O,M	25-35	15-25
	1.5 alloyed / tempered	O,E	15-20	10-15
	1.6.1 alloyed / tempered	O,E	10-12	7-10
2. stainless and acidproof steel	2.1 sulphurised	E,O,M	10-15	7-12
	2.2 austenitic	E,O,M	10-12	7-10
	2.3 ferritic, austenitic, martensitic	E,O,M	7-10	5-7
	2.4 highly heat-resistant	E,O,M	6-8	3-5
3. cast iron	3.1 grey cast iron	E,D	20-30	15-20
	3.2 grey cast iron	E,D	15-20	10-15
	3.3 tempered nodular cast iron	O,E,M	25-35	15-25
	3.4 tempered nodular cast iron	O,E,M	10-20	7-15
	3.5 cast iron, vermicular	E,D	10-15	7-12
6. copper	6.1 pure copper	E	15-20	10-15
	6.2 brass, bronze, red brass, short-chipping	E	40-60	30-40
	6.3 brass, long chipping, wrought alloy	E	30-40	20-30
7. aluminium, magnesium	7.2 Al, alloyed, Si<0.5 %, wrought and cast alloys	E	50-60	35-45
	7.3.1 Al, alloyed, Si>=0.5 %<4 %, wrought and cast alloys	E	35-40	20-25
	7.3.2 Al, alloyed, Si>=4 %<10 %, wrought and cast alloys	E	30-35	20-25

E = Emulsion
O = Oil
M = Minimum quantity lubrication
D = Dry / compressed air
TH = Through hole
BH = Blind hole

Our expert system, TEC+CCS, will recommend the cutting data to suit your machining needs.

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- Electronic catalogue of cutting data
- Customisable database of special tools and determination of associated cutting and performance data (CCS)
- Selection of appropriate core-hole drills via direct link between CCS and TEC
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Additional information

Thread tapping core diameters

M ISO metric coarse pitch thread

Designation (DIN 13)	Female thread core diameter (mm)		Drill size (mm)
	min	6H max	
M 2	1.567	1.679	1.60
M 2.5	2.013	2.138	2.05
M 3	2.459	2.599	2.50
M 4	3.242	3.422	3.30
M 5	4.134	4.334	4.20
M 6	4.917	5.153	5.00
M 8	6.647	6.912	6.80
M 10	8.376	8.676	8.50
M 12	10.106	10.441	10.20
M 14	11.835	12.210	12.00
M 16	13.835	14.210	14.00
M 18	15.294	15.744	15.50
M 20	17.294	17.744	17.50
M 24	20.752	21.252	21.00
M 27	23.752	24.252	24.00
M 30	26.211	26.771	26.50
M 36	31.670	32.270	32.00
M 42	37.129	37.799	37.50

MF ISO metric fine pitch thread

Designation (DIN 13)	Female thread core diameter (mm)		Drill size (mm)
	min	6H max	
M 6 x 0.75	5.188	5.378	5.25
M 8 x 1	6.917	7.153	7.00
M 10 x 1	8.917	9.153	9.00
M 10 x 1.25	8.647	8.912	8.75
M 12 x 1	10.917	11.153	11.00
M 12 x 1.25	10.647	10.912	10.75
M 12 x 1.5	10.376	10.676	10.50
M 14 x 1.5	12.376	12.676	12.50
M 16 x 1.5	14.376	14.676	14.50
M 18 x 1.5	16.376	16.676	16.50
M 20 x 1.5	18.376	18.676	18.50
M 22 x 1.5	20.376	20.676	20.50

UNC (Unified Coarse Thread)

Designation (ASME B 1.1)	Female thread core diameter (mm)		Drill size (mm)
	min	2B max	
No. 2-56	1.694	1.872	1.85
No. 4-40	2.156	2.385	2.35
No. 6-32	2.642	2.896	2.85
No. 8-32	3.302	3.531	3.50
No. 10-24	3.683	3.962	3.90
1/4 -20	4.976	5.268	5.10
5/16 -18	6.411	6.734	6.60
3/8 -16	7.805	8.164	8.00
1/2 -13	10.584	11.013	10.80
5/8 -11	13.376	13.868	13.50
3/4 -10	16.299	16.833	16.50

UNF Unified Fine Thread

Designation (ASME B 1.1)	Female thread core diameter (mm)		Drill size (mm)
	min	2B max	
No. 4-48	2.271	2.459	2.40
No. 6-40	2.819	3.023	2.95
No. 8-36	3.404	3.607	3.50
No. 10-32	3.962	4.166	4.10
1/4 -28	5.367	5.580	5.50
5/16 -24	6.792	7.038	6.90
3/8 -24	8.379	8.626	8.50
1/2 -20	11.326	11.618	11.50
5/8 -18	14.348	14.671	14.50

G Pipe thread

Designation (DIN EN ISO 228)	Female thread core diameter (mm)		Drill size (mm)
	min	max	
G 1/8	8.566	8.848	8.80
G 1/4	11.445	11.890	11.80
G 3/8	14.950	15.395	15.25
G 1/2	18.632	19.173	19.00
G 5/8	20.588	21.129	21.00
G 3/4	24.118	24.659	24.50
G 1	30.292	30.932	30.75

Additional information

Thread forming core diameters

M ISO metric coarse pitch thread

Designation (DIN 13)	Female thread core diameter (DIN 13-50) (mm)		Pilot drill size (mm)
	min	7H max	
M 1.6	1.221	-	1.45
M 2	1.567	1.707	1.82
M 2.5	2.013	2.173	2.30
M 3	2.459	2.639	2.80
M 3.5	2.850	3.050	3.25
M 4	3.242	3.466	3.70
M 5	4.134	4.384	4.65
M 6	4.917	5.217	5.55
M 8	6.647	6.982	7.40
M 10	8.376	8.751	9.30
M 12	10.106	10.106	11.20
M 14	11.835	12.310	13.10
M 16	13.835	14.310	15.10

MF ISO metric fine pitch thread

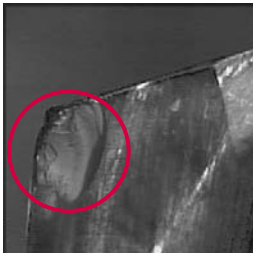
Designation (DIN 13)	Female thread core diameter (DIN 13-50) (mm)		Pilot drill size (mm)
	min	7H max	
M 6 x 0.75	5.188	5.424	5.65
M 8 x 1	6.917	7.217	7.55
M 10 x 1	8.917	9.217	9.55
M 12 x 1	10.917	11.217	11.55
M 12 x 1.5	10.376	10.751	11.30
M 14 x 1.5	12.376	12.751	13.30
M 16 x 1.5	14.376	14.751	15.30

Protodyn ECO plus thread former – the ideal addition to the ECO-HT tap range.

Additional information

Troubleshooting: drilling

BROKEN CUTTING EDGE CORNERS



– Excessive corner wear causing corners to break off
  · Recondition promptly

– Workpiece springs up during through hole drilling, tool therefore latches
  · Reduce feed rate for through hole drilling (-50 %)

– Inclined exit during through hole drilling results in interrupted cut
  · Reduce feed rate for through drilling (-50 %)

– Through hole drilling of a cross hole results in interrupted cut
  · Reduce feed rate for through drilling of the cross hole (-50 % to -70 %)

– Centring with too small a point angle, tool therefore drilling corner first
  · Precentre with point angle > point angle of drill

– Mechanical overload of corner cutting edges
  · Reduce feed rate

– Material has hard surface
  · Reduce feed rate and cutting speed for drilling on entry (and, if applicable, on exit if hard on both sides) (-50 % in both cases)

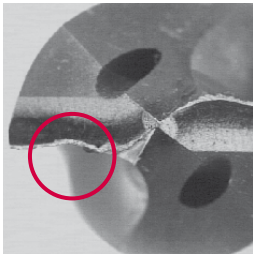
– Material too hard
  · Use special tool for hard/hardened materials

CUTTING EDGE CORNERS DESTROYED

– Excessive corner wear
  · Recondition promptly

– Cutting edge corners overheating
  · Reduce cutting speed

CENTRE REGION DESTROYED



– Excessive wear in the centre causing it to spall
  · Recondition promptly

– Mechanical overload of point
  · Reduce feed rate

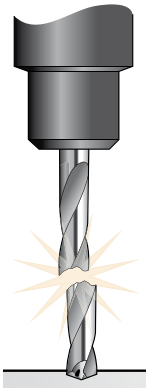
– Material has hard surface
  · Reduce feed rate and cutting speed for drilling on entry (-50 %)

– Material too hard
  · Use special tool for hard/hardened materials

Additional information

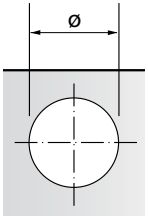
Troubleshooting: drilling

DRILL BIT BREAKAGE



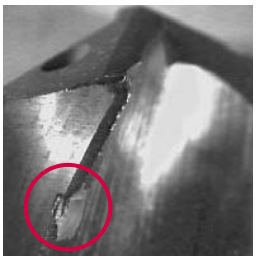
- Excessive wear causing breakage due to overloading
  · Recondition promptly
- Crowding
  · Check that the flute length is at least equal to drilling depth +1.5 x d
  · Use a drill bit with better chip transport properties
- Drill bit wanders on entry (e.g. because bit too long, entry surface not flat, entry surface inclined)
  · Centre-mark
- On lathes: alignment error between rotary axis and drill axis
  · Instead of a solid carbide tool, use an HSS(-E) drill bit or a drill bit with steel shank
- Workpiece not clamped with adequate stability
  · Improve workpiece security

HOLE TOO LARGE



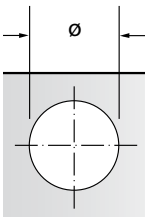
- Excessive centre wear or irregular wear
  · Recondition promptly
- Drill bit wanders on entry (e.g. because bit too long, entry surface not flat, entry surface inclined)
  · Centre-mark
- Radial runout of the chuck or machine spindle
  · Use a hydraulic expansion chuck or shrink-fit chuck
  · Check and repair the machine spindle
- Workpiece not clamped with adequate stability
  · Improve workpiece security

SPALLING ON CYLINDRICAL LANDS



- Handling error
  · Keep tools in original packaging
  · Keep tools apart/prevent contact

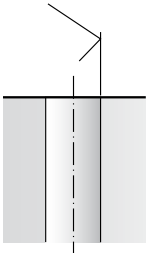
HOLE TOO SMALL



- Excessive wear of cylindrical lands or corners
  · Recondition promptly
- Hole not round
  · Reduce cutting speed

Troubleshooting: drilling

POOR SURFACE FINISH



- Excessive wear of the corner cutting edge or cylindrical lands
  · Recondition promptly
- Crowding
  · Check that the flute length is at least equal to drilling depth +1.5 x d
  · Use a drill bit with better chip transport properties

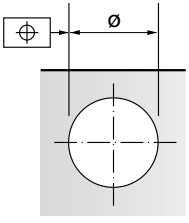
BURR ON THE BORE EXIT

- Excessive wear of the corner cutting edge
  · Recondition promptly

POOR CHIP FORMATION

- Excessive wear of the main cutting edge affecting chip formation
  · Recondition promptly
- Chips too thin because feed rate too low
  · Increase feed rate
- Inadequate cooling causing the chips to overheat
  · Use internal cooling instead of external
  · Increase the pressure of the internal coolant supply
  · Incorporate dwell periods into the program if necessary

ENTRY POSITION OUTSIDE TOLERANCE

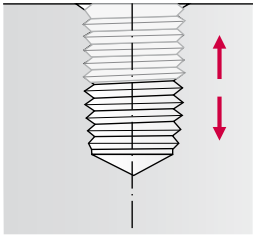


- Excessive centre wear
  · Recondition promptly
- Drill bit wanders on entry (e.g. because bit too long, entry surface not flat, entry surface inclined)
  · Centre-mark

Additional information

Troubleshooting: threading

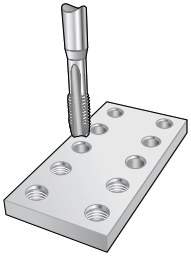
AXIAL MISCUTTING OF THREADS



– Tap not cutting to pitch specification
  · Reduce feed rate by approximately 5 - 10 % (for chucks with length compensation)

– Contact pressure too low/high
  · Adjust contact pressure

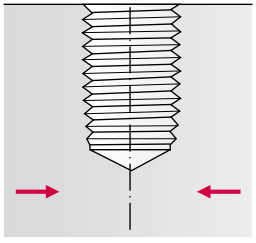
TOOL LIFE TOO SHORT



– Unsuitable cutting edge geometry
  · Select an appropriate tool recommended by the catalogue or TEC+CCS

– Core hole strain-hardened due to blunt preparatory tool
  · Change drill bit/regrind promptly

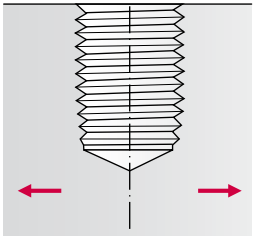
THREAD TOO SHORT



– Incorrect tool type
  · Select an appropriate tool recommended by the catalogue or TEC+CCS

– Tolerance not identical to the tolerance specified on the drawing or thread gauge
  · Use a tap with appropriate tolerance

RADIAL MISCUTTING OF THREADS



– Tool also cutting in the core
  · Select a large core diameter
  · Improve chip removal
  · Use a greater helix angle

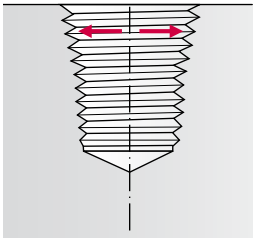
– Cutting edge geometry unsuitable for the work
  · Select an appropriate tool recommended by the catalogue or TEC+CCS

– Core hole position or angle error
  · Check workpiece security – reduce feed rate on entry if necessary

– Tap exhibits cold welding
  · Use a new tap,
  · Improve lubrication (cooling)
  · Select a suitable surface treatment or coating

– Inadequate internal coolant supply
  · Improve lubricating agent or supply

BELL MOUTH



– Core hole position or angle error
  · Check workpiece security – reduce feed rate on entry if necessary

– Incorrect contact pressure
  · With length compensating chuck, switch to expansion

Drilling calculation formulas

Speed		
n [rpm]	$n = \frac{v_c \cdot 1{,}000}{d_1 \cdot \pi}$	[rpm]
Cutting speed		
v_c [m/min]	$v_c = \frac{d_1 \cdot \pi \cdot n}{1{,}000}$	[m/min]
Feed per revolution		
f [mm]	$f = f_z \cdot Z$	[mm]
Feed rate		
v_f [mm/min]	$v_f = f \cdot n$	[mm/min]
Metal removal rate		
Q [cm³/min]	$Q = \frac{v_f \cdot \pi \cdot d_1^2}{1{,}000}$	[cm³/min]

Thread tapping/forming calculation formulae

Speed		
n [rpm]	$n = \frac{v_c \cdot 1{,}000}{d_1 \cdot \pi}$	[rpm]
Cutting speed		
v_c [m/min]	$v_c = \frac{d_1 \cdot \pi \cdot n}{1{,}000}$	[m/min]
Feed rate		
v_f [mm/min]	$v_f = p \cdot n$	[mm/min]

Walter Titex CATexpress

WHAT IS CAT EXPRESS?

CATexpress is Walter's express ordering and delivery service for Walter Titex special tools. CATexpress covers a defined range of special tools. For these tools, we guarantee a short lead time of a maximum of two weeks from the time of order intake.

WHAT'S POSSIBLE?

- Carbide drilling and reaming tools, e.g. Alpha® 2, Alpha® 4,
- X·treme Plus (+1 week), XD technology, XD-Pilot, etc.
- Spiral and straight-fluted tools
- Batch sizes of 3 to 50 pce.
- Diameters from 3 mm to 20 mm
- Drilling depths down to 35 x d
- Stepped tools with up to two 2 steps
- Coatings, e.g. TFL, TFT, TFP, etc.

HOW DOES IT WORK?

- Complete our special forms for defining your special tools
- These forms are available from your contact in the inhouse/field service
- You will find further information and our forms at www.walter-tools.de

Alpha® Jet step drill with 180° "form E" point

EXAMPLES OF CATEXPRESS SPECIAL SOLUTIONS

Twisted step drill

X·treme Plus

X·treme DH, XD technology

X·treme Pilot 180, pilot drill with XD technology

YOUR ADVANTAGES

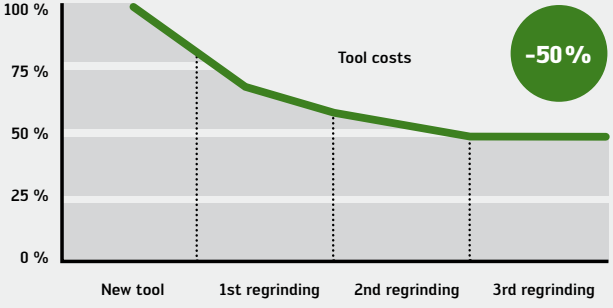
- Cost savings thanks to reduced storage
- More flexibility thanks to 2 weeks lead time
- Fast feedback thanks to quote returned within 24 hours
- Easy to use thanks to cutting data recommendations
- Reduction in errors in tool design as there is no need to place the order until the desired component has been defined
- All CATexpress tools are manufactured in Germany to meet proven Walter Titex quality standards

WALTER TITEX AND WALTER PROTOTYP MILLING, DRILLING AND REAMING TOOLS OF ORIGINAL QUALITY.

Our Reconditioning Service for Walter Titex and Walter Prototyp tools make an important contribution to reducing your production costs. On the one hand, you obtain tools that are as good as new but cost almost a third of the price of a brand new product. On the other hand, you save around 50 % of tool costs with the third regrinding – especially in the case of high-quality, high-tech tools.

This means:
100 % original quality, 50 % lower costs.

REGRINDING AND RECOATING PAYS OFF:

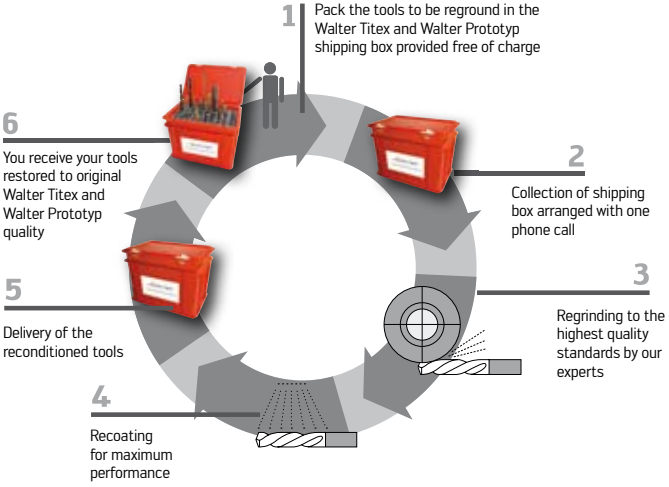


TOP QUALITY, EASY HANDLING AND PROMPT DELIVERY.

With our Reconditioning Service, not only do you save costs and time, you also spare resources. This is how it works: You decide which tools need to be reground and place them in our "Redbox". We arrange for its collection and then return your tools free of charge and restored to their original quality a few days later.

OUR DELIVERY SERVICE

- Easy handling with standardised delivery note and barcode stickers
- Regrinding/recoating of catalogue tools to restore original geometry and coating
- Regrinding of special tools in accordance with drawing (price on request)



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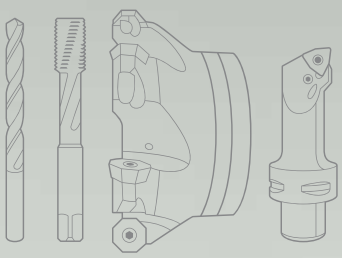

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