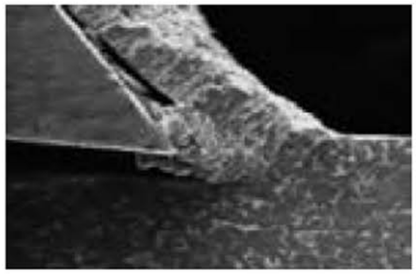
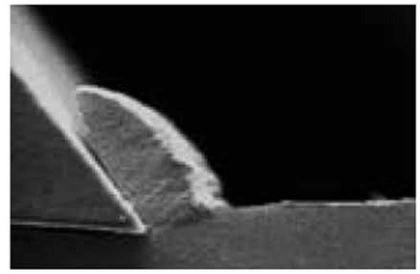
Properties and application range of coatings

UTILIS coating code	Coating	Materials (Category)										Characteristics
		(I) Steel non-alloyed	(II) Steel low alloyed	(III) Steel high alloyed	(V) Stainless steel	(VI) Stainless steel	(IV) Titanium	(VII) Aluminum	(VIII) Brass/ lead-free brass	(IX) Synthetics reinforced/composits	(X) Hard materials	
Standard for general applications												
HX	TiAIN / AlTiN	●	●	●	●	●	●	●	●	○	–	Standard allround coating for finishing and micro-finishing operations on a wide range of materials.
HPX	TiAIN / AlTiN	●	●	●	●	●	●	○	○	○	–	
MZ	TiN / TiAIN	●	●	●	●	●	–	–	–	–	–	Standard allround coating for roughing and finishing operations in steel and stainless steel.
TX+	TiSiN	–	○	●	●	●	●	–	–	–	●	High-performance coating for micro finishing and finishing operations in steel, stainless steel and highly heat resistant materials as well as micro cutting of hardened steels up to 70 HRC.
Special applications (upon customer request)												
HX-F	AlCrN	●	●	●	●	●	○	–	–	–	–	High-performance coating for micro finishing operations in steel and stainless steel. Recommended for sharp edges, which are used in micro machining.
DX-T	Diamond DLC	–	–	–	–	–	–	●	●	○	–	Diamond coating for non-ferrous metals. Recommended for aluminium, plastic, brass and copper.
DX-HC	Diamond Ta-C	–	–	–	–	–	–	●	●	●	–	Diamond coating for non-ferrous metals. Recommended for aluminium alloys, platinum, silver, gold, composites and reinforced synthetics

Properties and application range of coatings

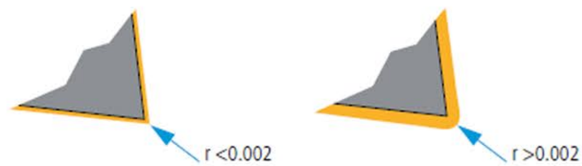
With the refinement of cutting tools with an additional coating the wear will be decisively reduced. Rubbing, warming up, diffusion and oxidation decreases significantly.


Cutting process without coated tool


Cutting process with coated tool

Rounded edges among coated inserts

Every coating of a carbide insert results in arounded cutting edge. The smaller the diameter of the material to be cut, the more significant are the consequences in the cutting performance. Therefore the rounding off of the cutting edge depends on the thickness of the coated layer. As thicker the coating, as greater is the radius created along the cutting edge.



Comparison of default hardness values

Tensile strength (N/mm²)	Vickers HV	Brinell HB	Rockwell HRC	Shore C
700	200	200	–	28
740	210	210	–	29
770	220	220	–	30
810	230	230	19.2	31
840	240	240	21.2	33
880	250	250	23	34
910	260	260	24.7	35
950	270	270	26.1	36
980	280	280	27.6	37
1020	290	290	29	39
1050	300	300	30.3	40
1090	310	310	31.5	41
1120	320	320	32.9	42
1150	330	330	33.8	43
1190	340	340	34.9	44
1230	350	350	36	45
1260	360	359	37	46
1300	370	368	38	47
1330	380	373	38.9	48
1370	390	385	39.8	49
1400	400	393	40.7	50
1440	410	400	41.5	51
1470	420	407	42.3	52
1510	430	416	43.2	53
1540	440	423	44	54
1580	450	429	44.8	55
1610	460	435	45.5	56
1650	470	441	46.3	57
1680	480	450	47	58
1720	490	457	47.7	59
1750	500	465	48.3	60
1790	510	474	49	61
1820	520	482	49.6	62
1860	530	489	50.3	63
1890	540	496	50.9	64
1930	550	503	51.5	65
1960	560	511	52.1	66
2000	570	520	52.7	67

Tensile strength (N/mm²)	Vickers HV	Brinell HB	Rockwell HRC	Shore C
2030	580	527	53.3	68
2070	590	533	53.8	69
2100	600	533	54.4	70
2140	610	543	54.9	71
2170	620	549	55.4	72
2210	630	555	55.9	73
2240	640	561	56.4	74
2280	650	568	56.9	75
2310	660	574	57.4	75
2350	670	581	57.9	76
2380	680	588	58.7	77
2410	690	595	58.9	78
2450	700	602	59.3	79
2480	710	609	59.8	80
2520	720	616	60.2	81
2550	730	622	60.7	82
2590	740	627	61.1	83
2630	750	633	61.5	83
2660	760	639	61.9	84
2700	770	644	62.3	85
2730	780	650	62.7	86
2770	790	656	63.1	86
2800	800	661	63.5	87
2840	810	666	63.9	87
2870	820	670	64.3	88
2910	830	677	64.6	89
2940	840	682	65	89
2980	850	–	65.3	90
3010	860	–	65.7	90
3050	870	–	66	91
3080	880	–	66.3	91
3120	890	–	66.6	92
3150	900	–	66.9	92
3190	910	–	67.2	–
3220	920	–	67.5	–
3260	930	–	67.7	–
3290	940	–	68	–

A Flank wear

Reasons:
- Cutting speed too high
- Carbide grade with too little wear resistance
- Feed rate not adapted

Remedies:
- Reduce cutting speed
- Select better wear resistant carbide grade
- Adapt feed rate to cutting speed and cutting depth (increase feed rate)

Abrasion on flank, normal wear after a certain machining time.

B Edge chipping

Reasons:
- Grade with too high wear resistance
- Vibrations
- Feed rate too high or excessive cutting depth
- Interrupted cut
- Swarf damage

Remedies:
- Use tougher carbide grade
- Use negative cutting edge geometry with chip groove
- Increase stability (tool and work piece)

Through excessive mechanical stress at the cutting edge fracture and chipping can take place.

C Cratering

Reasons:
- Too high cutting speed and/or feed rate
- Rake angle too shallow
- Carbide grade with little wear resistance
- Insufficient coolant supply

Remedies:
- Reduce cutting speed and/or feed rate
- Increase coolant quantity and/or pressure, optimize coolant supply
- Use carbide grade which is more resistant to cratering

The hot chip which is being evacuated causes cratering at the rake face of the cutting edge.

D Plastic deformation

Reasons:
- Too high machining temperature, resulting in softening of substrate
- Damaged coatings

Remedies:
- Reduce cutting speed
- Choose carbide grade with higher wear resistance
- Provide cooling

High machining temperature and simultaneous mechanical stress can lead to plastic deformation.

E Built-up edges

Reasons:
- Too low cutting speed
- Too small rake angle
- Wrong cutting material
- Lack of cooling/lubrication

Remedies:
- Increase cutting speed
- Enlarge rake angle
- Select more resistant coating
- Use emulsion with higher concentration

Built-up material/edges occur when the chip is not evacuated properly due to a too low cutting temperature.

F Insert breakage

Reasons:
- Excessive stress of cutting material
- Lack of stability
- Corner angle too small
- Excessive notching

Remedies:
- Use tougher carbide grade
- Use protective edge chamfer
- Increase honing of cutting edge
- Use more stable geometry

Excessive stress of the insert causes breakage.

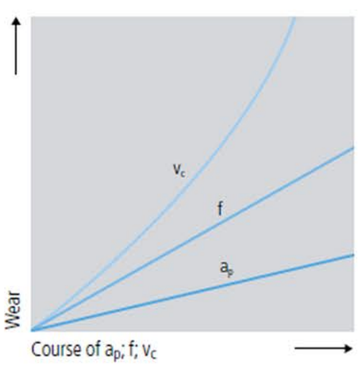
UTILIS multidec® swiss type tools

Problem \ Remedy / Measure		Cutting speed	Feed	Carbide toughness	Carbide hardness	Clearance angle	Rake angle	Stability	Rounded edge condition	Coolant	Face/radial runout
A*	Excessive flank wear	↓	↑		↑						
B*	Chipping of cutting edge	↑	↓	↑			🔍	↑	↑		
C*	Excessive cratering	↓	↓		↑					↑	
D*	Plastic deformation	↓	↓		↑		🔍			🔍	
E*	Built up edge	↑	↑			🔍	↑		🔍	↑	
F*	Insert breakage		↓	↑			🔍	↑			
	Poor surface finish	↑	↓					↑	↓	🔍	↑
	Chip forming, chip pile up					🔍	🔍			🔍	
	Vibration	🔍	🔍			↓	↑	↑			↑
	Hairline cracks	↓	↓	🔍		↓				↑	

* Further information .... 22…

↑ increase ↓ decrease 🔍 inspect, optimise

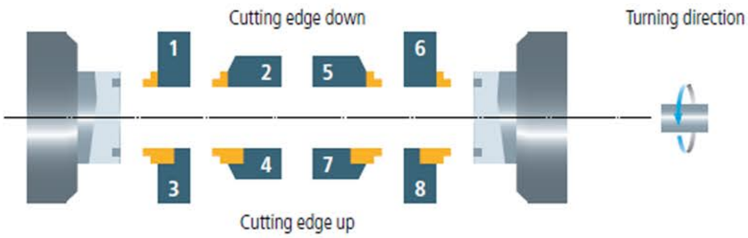
The cutting temperature particularly the wear depends significantly on the cutting conditions (v_c, f and a_p). Thermal causes of wear like oxidation and diffusion increase disproportionately.

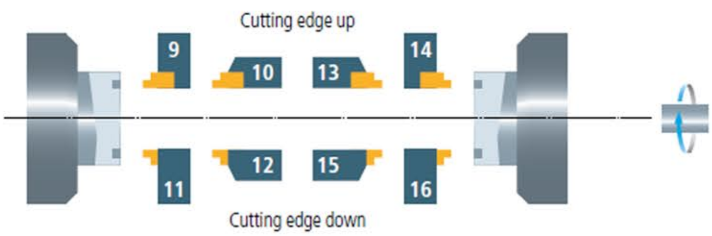


v_c = Cutting speed
f = Feed
a_p = Depth of cut

With the illustration below it is possible to achieve up different tooling situations. Choose yours and we will recommend you the suitable tooling solution.

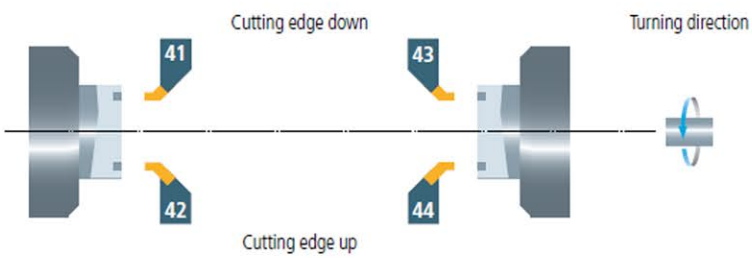
Turning axial

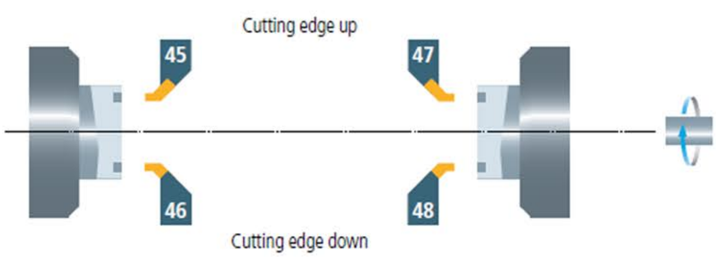




Situation	Execution	
	Holder	Insert
1	R	L
2	L	L
3	R	L
4	L	L
5	R	R
6	L	R
7	R	R
8	L	R
9	L	R
10	R	R
11	L	R
12	R	R
13	L	L
14	R	L
15	L	L
16	R	L

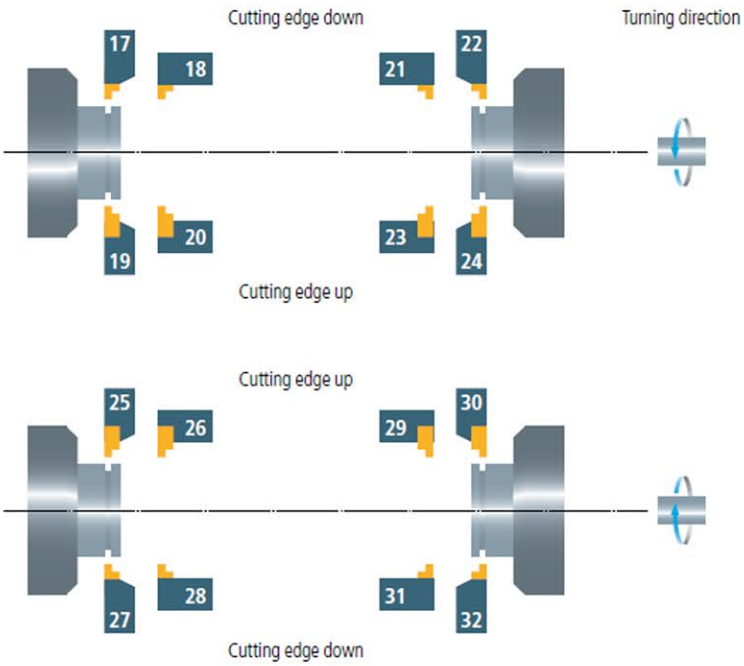
Turning axial (with holder 45°)





Situation	Execution	
	Holder	Insert
41	R	R
42	R	R
43	L	L
44	L	L
45	L	L
46	L	L
47	R	R
48	R	R

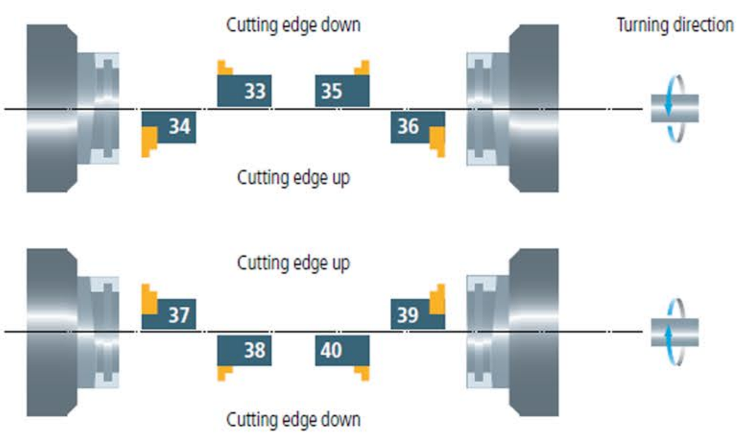
Turning radial outside



Situation	Execution	
	Holder	Insert
17	R	R
18	L	R
19	R	R
20	L	R
21	R	L
22	L	L
23	R	L
24	L	L
25	L	L
26	R	L
27	L	L
28	R	L
29	L	R
30	R	R
31	L	R
32	R	R

R = right   L = left

Turning radial inside



Situation	Execution	
	Holder	Insert
33	R	L
34	R	L
35	L	R
36	L	R
37	L	R
38	L	R
39	R	L
40	R	L

R = right   L = left

Execution of holder/insert

The side on which the insert is located determines whether it is a "left-" or "right-hand" holder. For this purpose, the holder is viewed with the insert pointing towards the observer.

Left hand holder

Neutral holder

Right hand holder

Indexable inserts

Form of insert

Index	α
V	35°
D	55°
C	80°

Clearance angle

Index	α
C	7°
N	0°
P	11°

Tolerance

Index	s ±	d ±
E	0.025	0.025
G	0.13	0.025
M	0.13	0.05–0.15*
X	0.1	0.04

* Dependent on dimension of insert

Distinctive mark

Index	
W	
T	
U	
X/Z	Special shape

DCGT 0702015 FN -A3 UHM 30 HX

Chip breaker 220

Carbide 18

Coating 21

Edge condition

Index	
F	Sharp
E	Rounded

Cutting direction

Index	
L	Left
N	Neutral
R	Right

Edge length

Index	l	d
06	6.4	6.35
09	9.7	9.53
12	12.9	12.7
07	7.75	6.35
11	11.6	9.53
11	11.1	6.35
16	16.6	9.53
10	10	6.35

Insert thickness

Index	s
02	2.38
03	3.18
T3	3.97
04	4.76

Corner radius

Index	R
00/ZZ	0
003	0.03
006	0.06
008	0.08
01	0.1
015	0.15
02	0.2
035	0.35
04	0.4
075	0.75
08	0.8

Holder OD turning

Shaft height
h_1 / h_2

Shaft width
b

Holder lenght	
Index	l_1
D	60
E	70
F	80
H	100
K	125
M	150
X	Special shape

Edge length		
Index	l	d
06	6.4	6.35
09	9.7	9.53
12	12.9	12.7
07	7.75	6.35
11	11.6	9.53
11	11.1	6.35
16	16.6	9.59
10	10	6.35

Special shape	
Index	
U	For Swiss type automatic lathes

SDJCR 1212 H07 U

Clamping	
Index	
S	Screwed

Form of insert	
Index	α
V	35°
D	55°
C	80°

Clearance angle	
Index	α
C	7°
N	0°
P	11°

Cutting direction	
Index	
L	Left
N	Neutral
R	Right

Holder form							
Index	α	Index	α	Index	α	Index	α
A	90°	J	93°	P	117.5°	V	72.5°
D	45°	L	95°	Q*	93°	X	Special shape
H	107.5°	N	62.5°	U	93°		

* UTILIS standard

Holder ID turning

Shaft execution

Index	
A	Steel shaft with internal cooling

Shaft diameter

d_1

Holder lenght

Index	l_1
F	80
H	100
K	125
M	150
Q	180
R	200
S	250
T	300
X...	Special

Edge length

Index	l	d
06	6.4	6.35
09	9.7	9.53
12	12.9	12.7
07	7.75	6.35
11	11.6	9.53
11	11.1	6.35
16	16.6	9.59
10	10	6.35

A12K SDUCR 07

Clamping

Index	
S	Screwed

Form of insert

Index	α
V	35°
D	55°
C	80°

Clearance angle

Index	α
C	7°
N	0°
P	11°

Cutting direction

Index	
L	Left
N	Neutral
R	Right

Holder form

Index	α	Index	α	Index	α
F	90°	**L**	95°	**Q**	107.5°
D	45°	**O**	95°	**U**	93°
J	93°	**Q***	92°	**X**	Special shape

* UTILIS standard

UTILIS multidec® swiss type tools

Cutting speed (v_c)	Revolutions per minute (n)	Feedrate (v_f)
$v_c = \frac{d_1 \cdot \pi \cdot n}{1000}$ [m/min]	$n = \frac{v_c \cdot 1000}{d_1 \cdot \pi}$ [min^{-1}]	$v_f = f \cdot n$ [mm/min]