Product handbook

Grooving

_ ENGINEERING KOMPETENZ

Grooving applications with expertise

Your guide for demanding grooving applications

With this practical handbook on grooving, we want to provide you with an aid which can offer you further assistance in a range of issues.

– Which tool should I use and when?
– Which chip formation should I choose?
– Which material can I machine, with which parameters – and, most importantly, using which machining strategy?

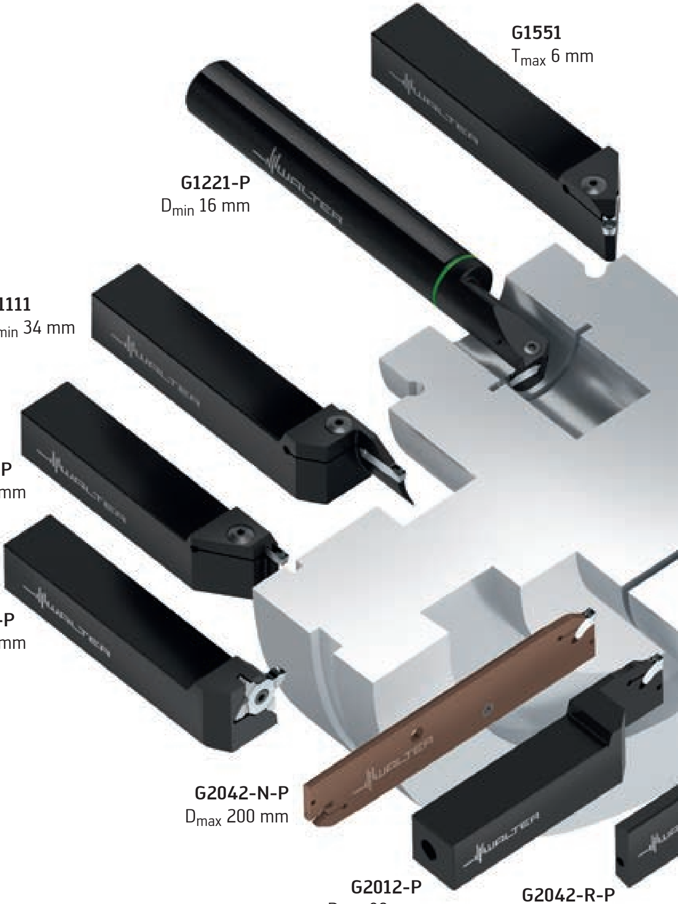
The handbook presents an overview of the various types of chip formation and of grades, systems and strategies. This is accompanied by important information about cutting data, application examples, solutions for difficult applications, as well as tips and tricks.

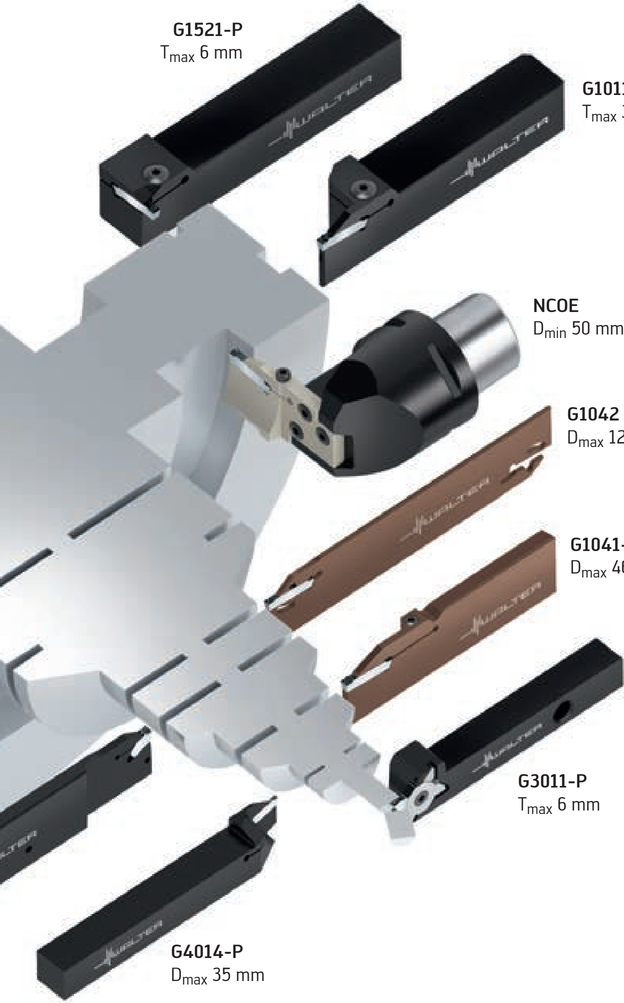
Perfect for planning and practical everyday use.
All this and much more besides makes this handbook the ideal guide and problem-solver for the demanding area of grooving operations.

CONTENTS

Grooving tools at a glance

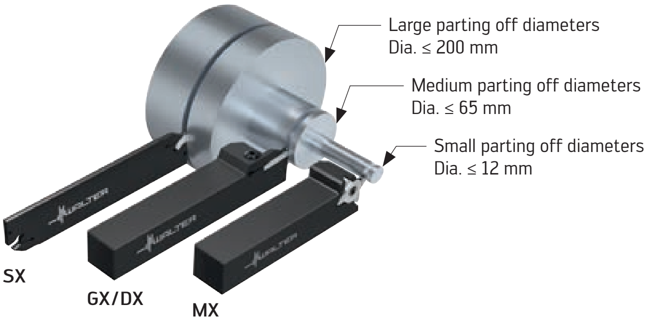
Grooving, parting off, internal recessing – axially and radially, for highly diverse workpiece materials and for a wide range of component profiles: There are recessing tools for an almost infinite array of operations.
Here are the most important systems together with their specific cutting inserts, shank shapes and cutting edge orientation at a glance.




G1521-P
T_{max} 6 mm
G1011-P
T_{max} 33 mm
NCOE
D_{min} 50 mm
G1042
D_{max} 120 mm
G1041-GX24-P
D_{max} 46 mm
G3011-P
T_{max} 6 mm
G4014-P
D_{max} 35 mm

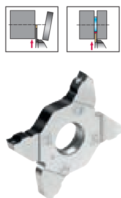
Walter Cut grooving systems by diameter range

Three systems – up to 200 mm



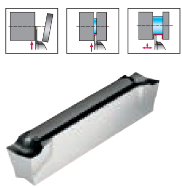
Small parting off diameters of up to 12 mm

– Four-edged MX indexable inserts
– For economic grooving and parting off in mass production, as well as grooving special profiles



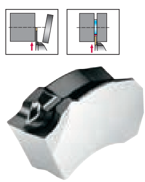
Medium parting off diameters of up to 65 mm

– Double-edged GX/DX indexable inserts
– Method for grooving, parting off and recessing universally and efficiently



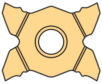
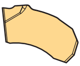
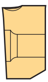
Large parting off diameters of up to 200 mm

– Single-edged SX indexable inserts
– Inserts with self-clamping system, ideal for deep grooving and slot milling



Cutting inserts

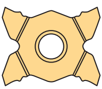
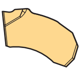
Grooving and parting off

	**MX**	MX grooving inserts, four cutting edges
	**DX**	DX grooving inserts, two cutting edges
 	**GX . . E** **GX . . F**	GX grooving inserts, two cutting edges (E), one cutting edge (F)
	**SX**	SX grooving inserts, one cutting edge
	**UX**	UX grooving inserts, one cutting edge

Recessing

	**GX**	GX grooving inserts, two cutting edges

Semi-finished products/blanks

	**MX**	MX grooving inserts, four cutting edges
	**GX**	GX grooving inserts, two cutting edges
	**SX**	SX grooving inserts, one cutting edge

Cutting tool materials

Heat-resistant and tough, the Tiger·tec® Silver grades with PVD Al_2O_3 coating offer a very long tool edge life and process reliability.

The Tiger·tec® Silver PVD grades for parting off, grooving and longitudinal turning

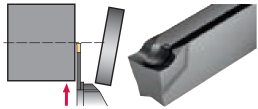
WSM13S
– For finishing and medium machining with uninterrupted cuts

WSM23S
– For stable conditions, high cutting speeds and when oil is used as the cooling lubricant

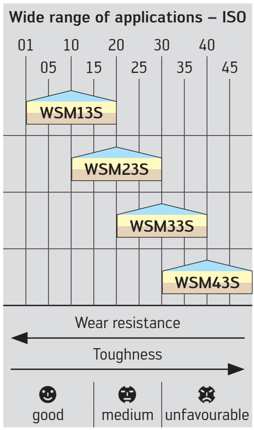
WSM33S
– First choice for steels, stainless steels and heat-resistant super alloys
– Outstanding wear resistance and high toughness

WSM43S
– Tough and reliable for steels, stainless steels and heat-resistant super alloys
– For interrupted cuts, low cutting speeds and unstable clamping or poor machine conditions

PVD – first choice for parting off



P M S

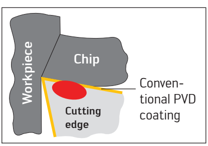


PVD – Al_2O_3 heat shield for maximum wear resistance

COMPARISON

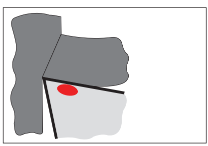
Heat ingress into carbide

Competitors



High level of heat ingress into carbide

Tiger·tec® Silver PVD



Thermal protection by Al_2O_3

Tiger·tec® Silver CVD grades improve tool life quantity and productivity thanks to high hot hardness.

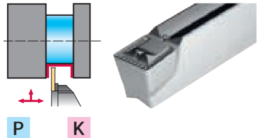
The Tiger·tec® Silver CVD grades for grooving and longitudinal turning

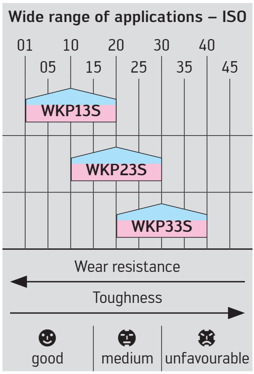
WKP13S
- Excellent wear resistance and high cutting speeds
- Continuous cutting

WKP23S
- First choice for continuous cutting to slightly interrupted cuts
- High wear resistance and cutting speed

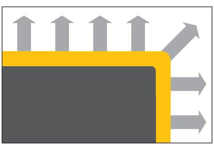
WKP33S
- For excellent wear resistance and toughness
- For unfavourable conditions or interrupted cuts

CVD – first choice for recessing

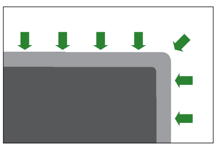




CVD – coating and post-treatment for maximum toughness



Tensile stresses/risk of fractures in the CVD coating

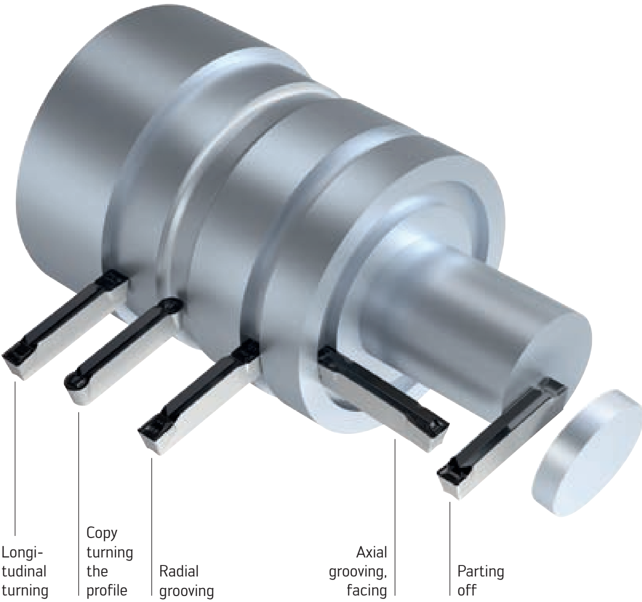


Compressive stresses in the CVD coating caused by mechanical post-treatment

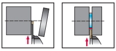
Indexable insert geometries

The end of the designation key describes the cutting edge geometry:

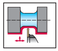
GX	24	–	2	E	300	N	03	–	U	F	4
1	2		3	4	5	6	7		8	9	10



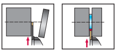
8 – Application



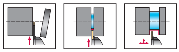
C **“Cut off”**
- Parting off
- Radial grooving



R **“Radius”**
- Copy turning
- Radial grooving
- Axial grooving
- Longitudinal turning
- Facing

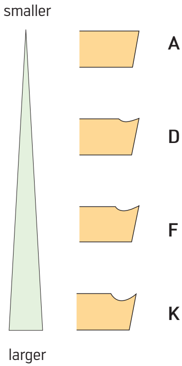


G **“Grooving”**
- Radial grooving
- Axial grooving
- Parting off

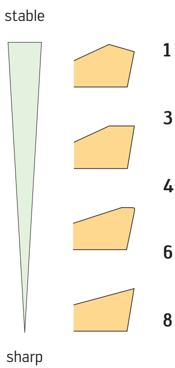


U **“Universal”**
- Longitudinal turning
- Radial grooving
- Axial grooving
- Facing
- Parting off

9 – Rake angle

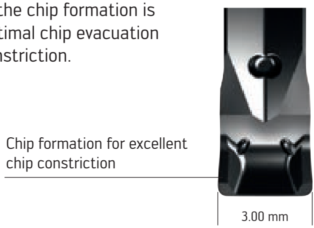


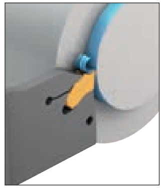
10 – Cutting edge



Geometries for parting off

The function of the chip formation is to guarantee optimal chip evacuation through chip constriction.





Chip constriction with the example of a CE4 geometry, material 42CrMo4, f: 0.12 mm.

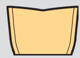
Insert width = 3.00 mm
Chip width = 2.95 mm

CF6 – The sharp one
– Extremely low burr and pip formation
– For small diameters and thin-walled tubes

CF5 – The positive universal one
– Low burr and pip formation
– For long-chipping materials

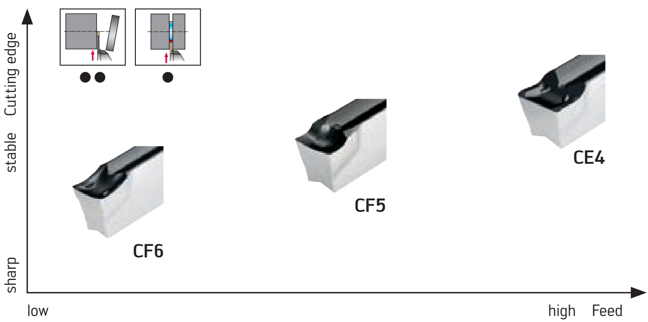
CE4 – The universal stable one
– Stable cutting edge for maximum feeds
– Very good chip constriction

View
Main cutting edge:
Curved



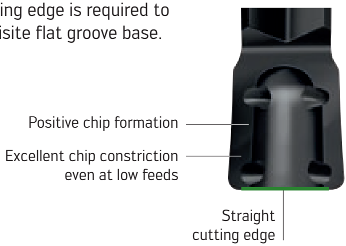
Example: CF5

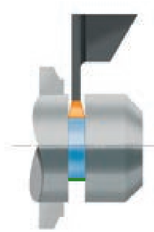
COMPARISON OF PARTING OFF GEOMETRIES



Geometries for grooving

A "straight" cutting edge is required to achieve the requisite flat groove base.





GD8
– For precision grooving
– Light to moderate feeds

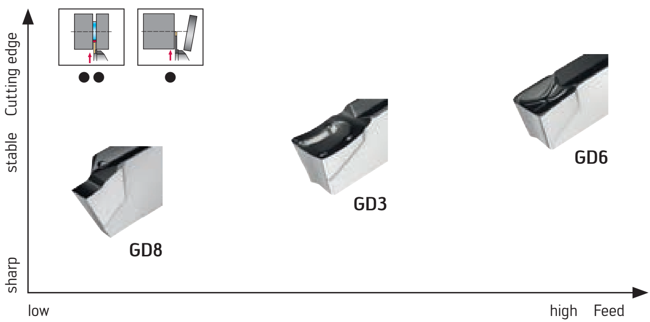
GD3
– Light to moderate feeds
– General parting off and grooving operations

GD6
– For long-chipping materials
– Moderate machining conditions

View
Main cutting edge:
Straight

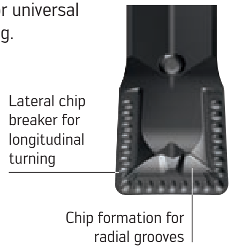
Example: GD8

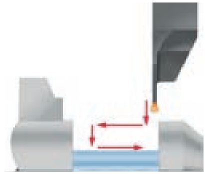
COMPARISON OF GROOVING GEOMETRIES



Geometries for recessing

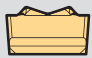
Lateral chip formation for universal use in longitudinal turning.





UF8
– Excellent chip control by means of a cutting edge with circumference fully ground
– Low to moderate feeds

View
Main cutting edge:



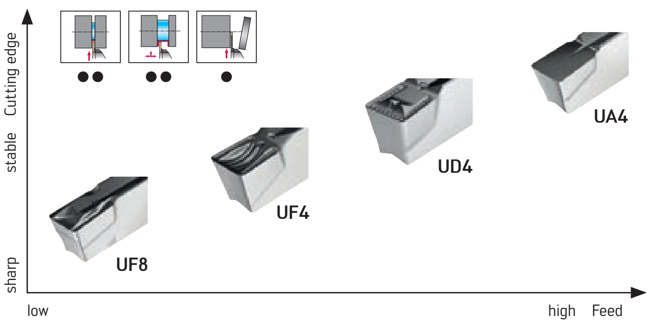
Example: UF8

UF4
– Moderate feeds
– Universal insert for 80% of all applications

UD4
– Excellent chip breaking on forged parts
– Stable cutting edge

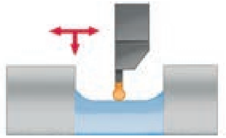
UA4
– For machining cast iron
– Moderate to high feeds

COMPARISON OF RECESSING GEOMETRIES



Geometries for copy turning

Indexable inserts for copy turning provide opportunities for efficiency when machining complex workpiece shapes.



RK8
– For copy and relief turning of ISO N materials
– Ground and polished cutting edge

View
Main cutting edge:

Example: RF8

RF8
– For copy and relief turning
– Reduced cutting forces due to positive cutting edge with fully ground circumference

RD4
– For copy turning, e.g. of forged parts
– Excellent chip control even at low depths of cut

COMPARISON OF COPY TURNING GEOMETRIES

Walter GPS – the fast and efficient way to the right application solution

Are you looking for the optimal machining solution for a particular application – be it milling, holemaking, threading or turning operations? With the Walter GPS machining navigation system, it takes just a few steps for you to find the right combination of tool, cutting data and machining strategy. Individually adapted to suit your material and your component.

PC, smartphone, tablet …
Use Walter GPS online on a device and operating system of your choosing.
Based on all the information on every tool by Walter, Walter Titex and Walter Prototyp, Walter GPS selects one or more application recommendations for you – including a tool and the specific cutting data for your material.

With Walter GPS, you will receive:

– Tool and cutting data recommendations perfectly adapted to suit your machining task

– Information about the machining strategy

– Tool costs and tool life for your machining

– Cost-efficiency calculations

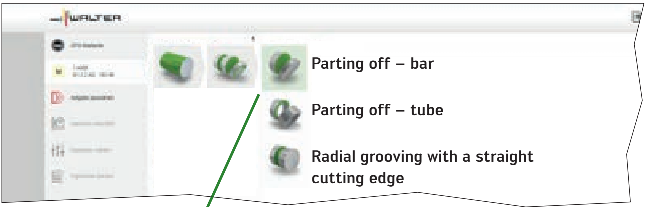
– Detailed reports for documentation purposes

You can find Walter GPS at: walter-tools.com

Walter GPS for grooving applications

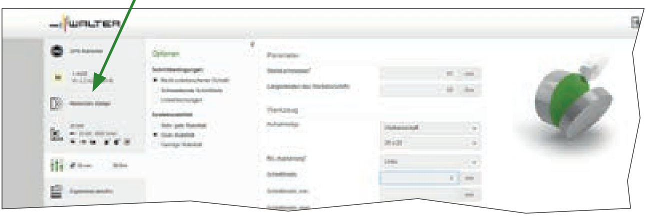
What to do:
Open up Walter GPS and click on your required type of search using the application.
The material and the task must now be selected (here: Turning).
Next, the details:

1. Select machining method



2. Enter the machining parameters

– Diameter
– Tool adaptor
– R/L version
– Optional: Cutting width

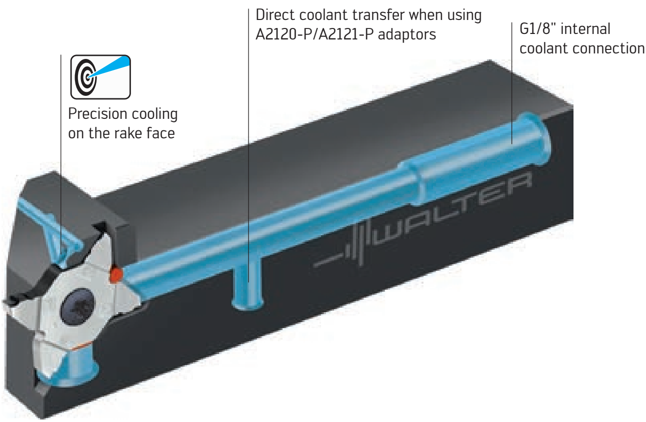


3. View the results

Four cutting edges with precision cooling

Walter Cut MX – G3011-P groove turning holder

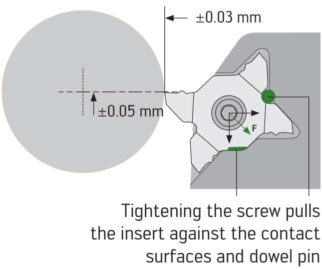
– Stable tangential insert clamping for optimal force absorption
– Maximum indexing accuracy thanks to dowel pin location in insert seat



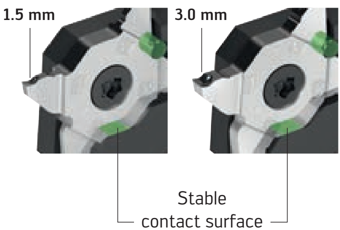
THE TECHNOLOGY

User-friendly thanks to self-aligning tangential screw clamping.

Maximum change accuracy thanks to dowel pin location in insert seat



Maximum stability and precision

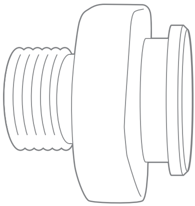


THE APPLICATION

– Grooving and parting off with four cutting edges
– DIN 471 circlip grooves with the tolerance class H13
– Grooving operations where maximum stability is required
  (e.g. grooving on inclined surfaces)
– Special profiles with Walter Xpress
– Use G3051-P for grooving on close shoulders

APPLICATION EXAMPLE

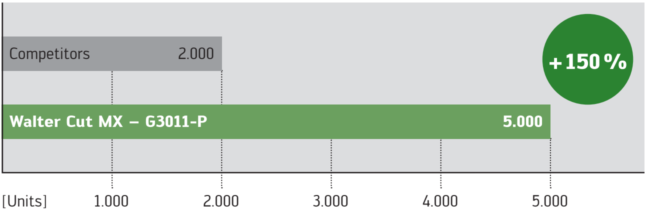
Grooving in stainless steel – Connector



Material:	X2CrNiMo17-12-2 (1.4404)
Tool:	G3011-C3R-MX22-2-P
Indexable insert:	MX22-2E200N02-CF5
Grade:	WSM23S

Cutting data:	Competitors Five-edged grooving insert	**Walter** **Four-edged grooving insert**
v_c [m/min]	75	75
f [mm]	0.05	0.07
Insert width [mm]	2.0	2.0
Cutting depth [mm]	2.5	2.5
Tool life quantity [units]	**2.000**	**5.000**

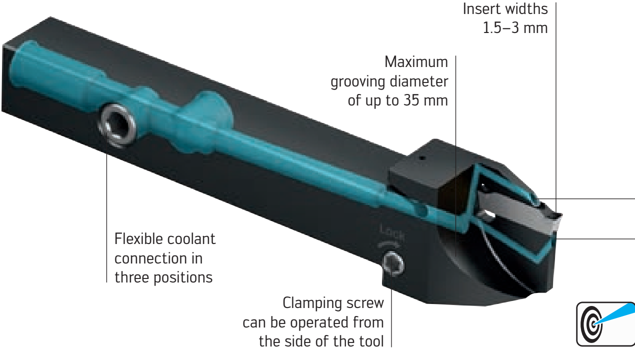
Comparison: Tool life quantity [units]



Innovative parting off system with SmartLock

Walter Cut DX – G4014 / G4014-P groove turning holder

- Grooving and parting off tool with precision cooling
- Screw clamping on the side for easy insert changeover
- New clamping method: 30% higher clamping forces compared to conventional tools on the market
- Innovative positive engagement at the rear insert locating surface
- Shank sizes: 10 × 10, 12 × 12, 16 × 16, 20 × 20 mm



THE TECHNOLOGY

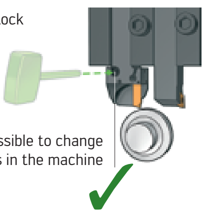
Raised insert design protects the top clamp and produces short chips

The positive engagement in the insert seat prevents the inserts from being incorrectly

INDEXABLE INSERT CHANGEOVER

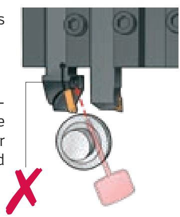
Walter – SmartLock

SmartLock



It is possible to change the inserts in the machine

Competitors



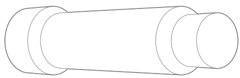
No insert change-over possible in the machine – toolholder must be removed

THE APPLICATION

– Automatic lathe and multi-spindle machines having up to 150 bar of coolant pressure
– Parting off with low burr and pip formation (by 6°, 7° and 15° angled parting off inserts)
– Grooving and parting off along the main or counter-spindle up to dia. 35 mm for flexible use
– For replaceable components (as tool operation can be modified)

APPLICATION EXAMPLE

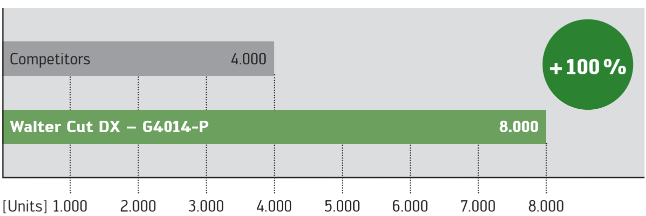
Axis dia. 10 mm – Parting off



Material:	X8CrNiS18-9 (DIN 1.4305)
Tool:	G4014.1616R-2T17DX18-P
Indexable insert:	DX18-1E200N02-CF5
Grade:	WSM33S

Cutting data:	Competitors G1011.1616R-2T15GX16-P GX16-1E200N02-CF5 WSM33S	**Walter** **G4014.1616R-2T17DX18-P** **DX18-1E200N02-CF5 WSM33S**
v_c [m/min]	80	80
f [mm]	0.12/0.05	0.12/0.05
Insert width [mm]	2.0	2.0
Cutting depth [mm]	5	5
Tool life quantity [units]	**4.000**	**8.000**

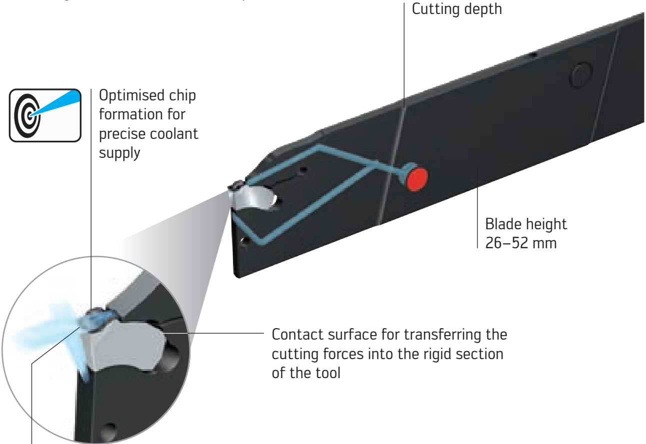
Comparison: Tool life quantity [units]



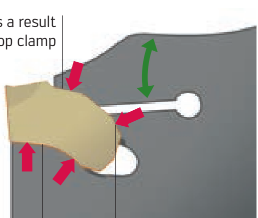
Universal use

Walter Cut SX – G2042-P deep parting blade

– G2042..N-P parting blades with precision cooling
– Can be used universally, neutral design
– Grooving to a cutting depth of up to 100 mm
– Parting off to a diameter of up to 200 mm



POSITIVE-LOCKING SX CLAMPING SYSTEM

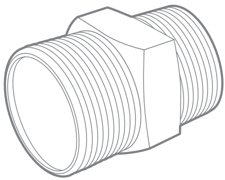


THE APPLICATION

Lathes of all types, in particular:
- Automatic lathes
- Multi-spindle machines
- Bar feed lathes
- Grooving and parting off along the primary or counter-spindle without interference contour

APPLICATION EXAMPLE

Parting off in stainless steel – Connector



Material: X6CrNiMoTi17-12-2 (1.4571)

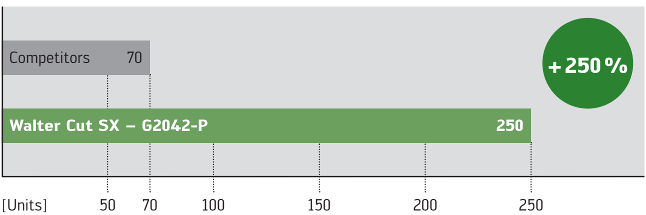
Tool: G2042.32N-3T50SX-P

Indexable insert: SX-3E300N02-CE4 WSM33S

Grade: WSM33S

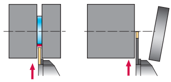
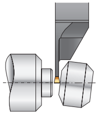
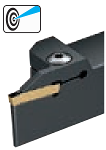
Cutting data:	Competitors XLCFN3203M31-FX FX3.1-E310N015-CE4 WSM33	**Walter** **G2042.32N-3T50SX-P** **SX-3E300N02-CE4 WSM33S**
v_c [m/min]	120	120
f [mm]	0.04	0.1
Insert width [mm]	3.1	3.0
Cutting depth [mm]	12	12
Tool life quantity [units]	**70**	**250**

Comparison: Tool life quantity [units]



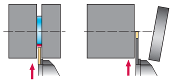
Walter Select – Groove turning holders and parting blades

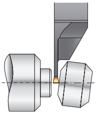
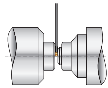
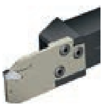
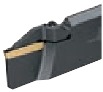
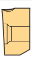
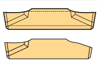
External machining – Radial

Application					
Space restrictions on the machine					
Stability of the tool		+			
Tools					
Designation		**G3011-P G3011-C...-P G3021-P G3051-P**	**G4014 G4014-P**	**G1011 G1011-P**	**G2012 G2012-P**
Max. parting off diameter D_{max} [mm]	Max. cutting depth T_{max} [mm]				
dia. 8	4	●●	●●	●●	●●
dia. 10	5	●●	●●	●●	●●
dia. 12	6	●●	●●	●●	●●
dia. 16	8		●●	●●	●●
dia. 24	12		●●	●●	●●
dia. 35	18		●●	●●	●●
dia. 42	21			●●	●●
dia. 52	26			●●	●●
dia. 65	33			●●	●●
dia. 80	40				●●
dia. 90	45				●●
dia. 120	60				
dia. 200	100				
Insert width s [mm]		0.5–5.56	1.5–3.0	2.0–8.0	1.5–10.0
Shank height h [mm]		10–25	10–20	12–32	12–32
Blade height h_4 [mm]		–	–	–	–
Walter Capto™ size d_1		C3–C6	–	–	–
Cutting insert type		 MX . . .	 DX . . .	 GX . . .	 SX . . .

-P = Precision cooling (first choice)

WALTER SELECT
●● Primary application
● Other application



			– Deep grooves – Long tool/counter-spindle overhang 			
	–	–	+			–
						
	G2612 G2622	G2016-P	G1041R/L G1041R/L-P	G1042N	G2042R/L G2042R/L-P	G2042N G2042N-P
	●●	●●	●●	●●	●●	●●
	●●	●●	●●	●●	●●	●●
	●●	●●	●●	●●	●●	●●
	●●	●●	●●	●●	●●	●●
	●●	●●	●●	●●	●●	●●
	●●	●●	●●	●●	●●	●●
	●●	●●	●	●	●●	●●
	●●	●●	●	●	●●	●●
	●●	●●	●	●	●●	●●
	●●	●●		●		●●
	●●	●●		●		●●
				●		●●
						●●
	1.5–8.0	12–19	1.5–4.0	3.0–6.0	2.0–4.0	2.0–10.0
	20–25	25–32	–	–	–	–
	–	–	26–32	26–32	26–32	26–52
	C3–C6	–	–	–	–	–
	 SX . . .	 UX . . .	 GX . . . E GX . . . F		 SX . . .	

Walter Select for cutting inserts for grooving and parting off

Step by step to the right cutting insert

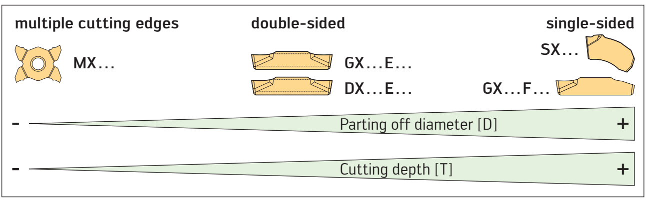
STEP 1

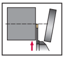
Determine the **material** to be machined.

Code letters	Machin-ing groups	Groups of the materials to be machined	
P	P1–P15	**Steel**	All types of steel and steel casting, with the exception of steel with an austenitic structure
M	M1–M3	**Stainless steel**	Austenitic stainless steel, austenitic-ferritic steel and steel casting
K	K1–K7	**Cast iron**	Grey cast iron, cast iron with spheroidal graphite, malleable cast iron, cast iron with vermicular graphite
N	N1–N10	**NF metals**	Aluminium and other non-ferrous metals, non-ferrous materials
S	S1–S10	**High-temperature alloys and titanium alloys**	Heat-resistant special alloys based on iron, nickel and cobalt, titanium and titanium alloys
H	H1–H4	**Hard materials**	Hardened steel, hardened cast iron materials, chilled cast iron
O	O1–O6	**Other**	Plastics, glass and carbon-fibre, reinforced plastics, graphite

STEP 2

Determine the **basic shape** of the cutting insert:

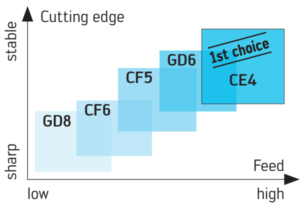




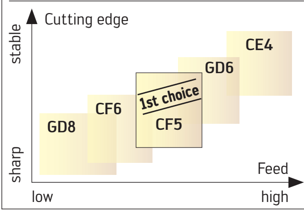
STEP 3 – PARTING OFF

Determine the **cutting insert geometry** via the cutting edge stability and feed.

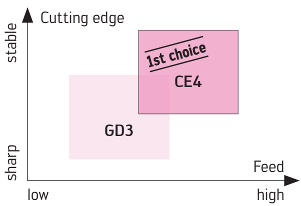
P Steel



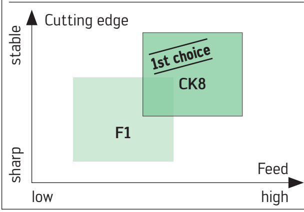
M/S Stainless steel



K Cast iron

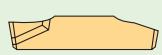


N NF metals

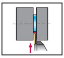


STEP 4 – PARTING OFF

Check whether your chosen geometry is available in the required insert width [s].
Identify the available system.

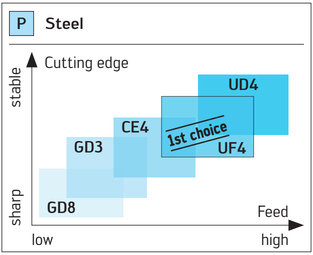
Chip formation Insert width s [mm]	 MX...	 DX...E	 GX...E	 GX...F	 SX...
CK8	–	–	2.0–4.0	–	2.0–6.0
GD8 [1)]	1.0–3.25	–	–	–	–
CF6	–	1.5–3.0	1.5–3.0	3.0	1.5–3.0
GD3 [1)]	–	–	2.0–6.0	–	–
CF5	0.8–5.56	1.5–3.0	1.5–5.0	3.0–5.0	1.5–6.0
GD6 [1)]	–	2.0–3.0	2.0–6.0	–	–
CE4	–	1.5–3.0	1.5–6.0	3.0–4.0	1.5–10.0
F1 [2)]	–	–	–	2.0–6.0	–

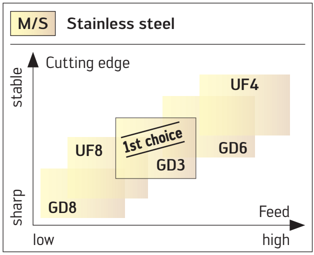
[1)] These grooving geometries are suitable for both parting off and grooving.
[2)] Laser-generated PCD chip geometry

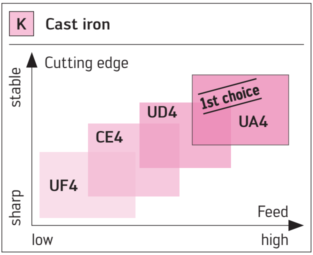


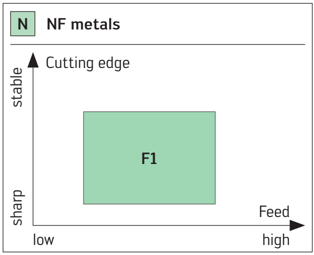
STEP 3 – GROOVING

Determine the **cutting insert geometry** via the cutting edge stability and feed.



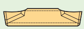
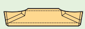
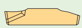






STEP 4 – GROOVING

Check whether your chosen geometry is available in the required insert width [s].
Identify the available system.

Chip formation Insert width s [mm]	 MX…	 DX…E	 GX…E	 GX…F	 SX…
GD8[1]	1.0–3.25	–	1.0–1.4	–	–
GD3[1]	–	–	2.0–6.0	–	–
GD6[1]	–	1.5–3.0	2.0–6.0	–	–
CE4[1]	–	–	1.5–6.0	3.0–4.0	1.5–10.0
UF8	–	–	1.7–8.0	–	–
UF4	–	–	2.0–8.0	_	8.0
UD4	–	–	2.0–8.0	–	–
F1[2]	–	–	–	2.0–6.0	–

[1] These grooving geometries are suitable for both parting off and grooving.
[2] Laser-generated PCD chip geometry

Application information – Parting off

As a general rule:

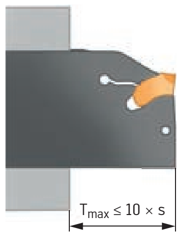
The most stable tool possible for parting off should always be selected. This prevents vibration and increases the tool life.

Insert width

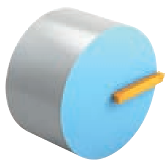
The insert width selected should be as narrow as possible, but as wide as necessary.
Reducing the insert width reduces the cutting force and saves material.

Cutting depth

1. The max. cutting depth [T_{max}] of the tool and the max. clamping length of the insert holder should not exceed 10 × the insert width [s].
   The smallest possible cutting depth should always be selected.



2. If the maximum cutting depth does not exceed the second cutting edge, double-edged Walter Cut GX or DX indexable inserts are the most efficient option. If the cutting depth is greater, single-edged Walter Cut SX cutting inserts are the first choice.

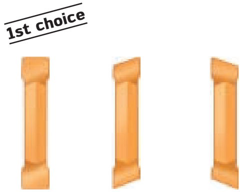


Application information – Parting off

Use a neutral cutting edge for:

– Improved chip formation
– Lower resultant cutting forces
– Longer tool life

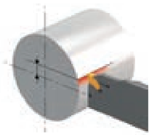
The design of the cutting inserts (right/left) can be determined by viewing the cutting edge from above where the parting off pip remains, unlike the tools, which are instead viewed from the front.



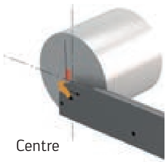
Neutral Right Left

Tip: In general, the following rules apply.

Direction of rotation of the machine spindle:	
Clockwise	→ right cutting insert
Anticlockwise	→ left cutting insert



Above the centre



Centre

Under the centre

Checking the centre height [f]

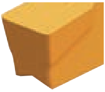
– Longer/more consistent tool life
– Reduced pip/burr formation

If the tool is positioned over or under centre, the effective cutting angles change during machining.

Reducing the feed

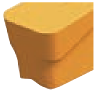
From a diameter of 1.5 × s [mm], reduce the feed [f] by approx. 50–75%.
Do not groove past the centre, as this creates a risk of fracture.
It is possible to groove past the centre to a maximum of corner radius +0.1 mm.*
For any further, a constant cutting speed and speed limitation should be used. This is based on the clamping unit and/or bar loader.

* Programming note:
With a corner radius of 0.3 mm, the x measurement should be adjusted in the direction of -0.4 mm.



Smaller corner radius

- Smaller pips
- Better chip control
- Lower feed



Larger corner radius

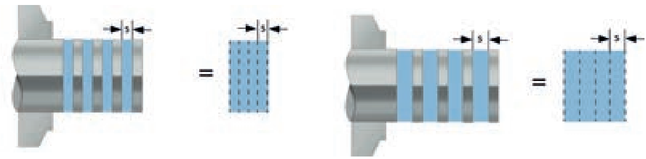
- Higher feed
- Longer tool life

Use the largest tool possible – in relation to the height of the support [h]

- Greater tool rigidity
- Lower vibration
- Longer tool life

Use the smallest insert width possible

- Lower cutting force
- Reduced material consumption

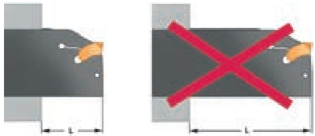


Clamp the workpiece at the shortest length possible and part off as close to the spindle as possible

Application information – Parting off

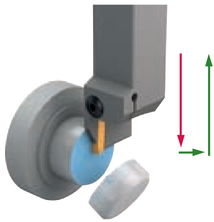
Mount the tool in the machine with the shortest possible overhang

– Better face flatness
– Reduced vibration tendency
– Longer tool life

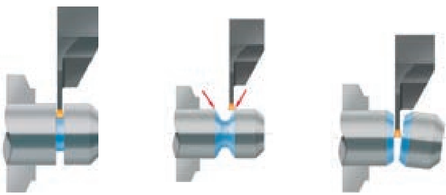


Retracting the tool

After parting off, do not retract the tool immediately. First, step off axially and then retract.



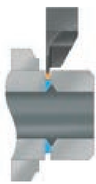
Chamfering and parting off



1. Pre-grooving 2. Chamfering 3. Parting off

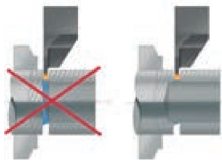
Internal chamfering before parting off

The peripheral cutting edges of the chamfering tool and parting off tool must be precisely aligned to achieve the most burr-free result possible.



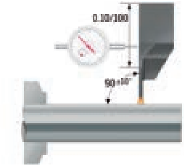
Parting off to a bore

The bore must be pre-drilled to be deep enough for the entire cutting edge width of the parting off tool to exit in the cylindrical section of the bore.



The tool must be aligned 90° to the axis of rotation

– Better face flatness
– Reduced vibration tendency



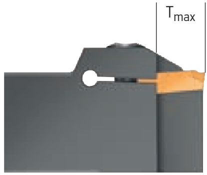
Precision cooling when parting off

Integrated precision cooling cools both the rake and flank faces exactly where it is needed. Combined with **Tiger·tec® Silver** indexable inserts, the tool demonstrates a two- to four-fold increase in tool life for parting off operations.

Vibration, chip jams and tool breakage, which would normally be a common occurrence given less than optimal conditions, are now a thing of the past. A higher quality surface finish is another of the benefits of this new design.

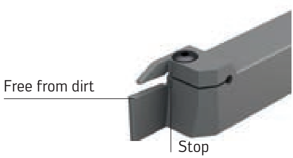
Application information – Parting off

Tool use



– Use the tool holder with the smallest possible cutting depth (T_{max}) for the application.

Cutting insert change



– When changing the cutting inserts, ensure that the new cutting insert lies securely against the tool holder stop.

– Before inserting the cutting insert, it is important to check to ensure that the insert seat is free from dirt and damage.

– Insert the cutting insert along the prismatic surfaces and into the insert seat, and watch out for resistance.

– Never tighten the clamping screw if there is no cutting insert in the insert seat.
Tighten the clamping screw to the recommended torques.

Tool	Tightening torque
G15..	5.0 Nm
G1011	5.0 Nm
G1111	4.0 Nm
G1221	4.0 Nm
G1041	3.5 Nm
G30..	5.0 Nm
G4014	≤ 12 mm 2.0 Nm
G4014	≥ 12 mm 3.0 Nm
XLDE	3.5 Nm

Application information –
Parting off with inclined cutting edges

When parting off solid material, the use of cutting inserts with lead angles reduces the formation of residual pips on the component that has been parted off.

Left-hand cutting insert:
Pips on the bar

Neutral cutting insert:
Pips on the workpiece

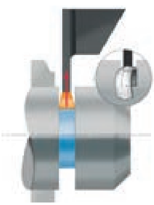
Right-hand cutting insert:
Pips on the workpiece

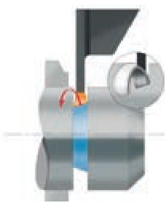
When parting off tubular material, the use of inclined cutting inserts prevents rings from forming. These rings could otherwise remain on the parted off component and interfere with the rest of the manufacturing process. It also leads to reduced burr formation.

Left-hand cutting insert:
Burr on the left of the tube

Neutral cutting insert:
Burr on the right of the tube

When inclined cutting inserts are used for parting off, the lead angle is likely to be detrimental to chip formation. The chip rolls at 90° to the main cutting edge, preventing it from forming a watch spring shape (as with a neutral cutting insert), and instead causing it to form a helical shape.

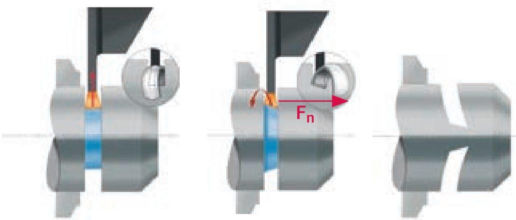




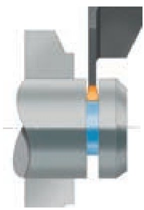
TIP:
One option for breaking the chamfer chip is to interrupt cutting briefly once a cutting depth of 1–2 × s is reached. Once cutting resumes, the chip flows in the existing groove and breaks.

Application information – Parting off with inclined cutting edges

TIP:
The feed values must be reduced by approximately 30% because the tool tends to run off-centre as a result of the axial force generated [F_n]. This can lead to vibration and convex parted off surfaces.



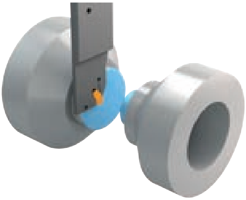
Effects on machining

	Neutral cutting insert	Inclined cutting insert
		
Stability and tool life	✓ good	✗ poor
Radial cutting forces (positive)	✗ high	✓ low
Axial cutting forces (negative)	✓ low	✗ high
Residual pip/burr formation	✗ large	✓ small
Risk of vibration	✓ low	✗ high
Surface quality and flatness	✓ good	✗ poor
Chip flow	✓ good	✗ poor

The use of inclined cutting inserts always has a negative effect on the cutting insert tool life (see table).
If possible, neutral cutting inserts should be used.
This statement applies particularly for machines with counter-spindles.

Application conditions – Reinforced blades

"Overhead" installation position
Contra blade

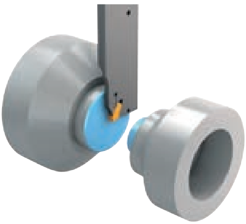


Main spindle Counter-spindle

M3 clockwise rotation

G2042.32R-..T.. SX-C
G1041.32R-..T.. GX..-C

"Normal" installation position

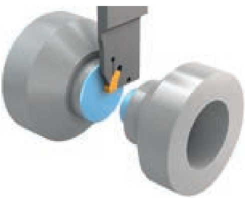


Main spindle Counter-spindle

M4 anticlock-wise rotation

G2042.32R-..T.. SX
G1041.32R-..T.. GX..

"Normal" installation position
Contra blade



Main spindle Counter-spindle

M4 anticlock-wise rotation

G2042.32L-..T.. SX-C
G1041.32L-..T.. GX..-C

Fault analysis – Parting off

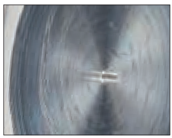
Large residual pip/burr

- Reduce the feed value by 50–75% at a diameter of 1.5 × s or above (s = cutting edge width)
- Use a cutting insert with a lead angle
- Use a narrower insert (reduction of the cutting forces)
- Choose a smaller corner radius
- Choose a more positive geometry
- Check the centre height

Poor surface/vibration

- Use a more stable tool
- Clamp the tool at a shorter length
- Check whether the insert seat is damaged
- Choose a more positive geometry
- Increase the feed

Damage caused by chips



- Use a chip formation with greater chip constriction
- Reduce the cutting speed
- Use a straight cutting insert
- Optimise the cooling (use of precision cooling tools)
- Increase the feed

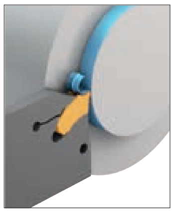
Poor chip formation

– Reduce the cutting speed
– Improve the cooling (use of precision cooling tools)
– Check the chip formation
– Increase the feed

Poor face flatness

– Use a cutting insert with as small a lead angle as possible or no lead angle at all
– Use a tool with the smallest possible cutting depth
– Reduce the feed for cutting inserts with a lead angle
– Choose a smaller corner radius
– Choose a more positive geometry
– Align the tool correctly

Chip formation when parting off



– Chip constriction inhibits friction on the side walls of the tool and reduces chip accumulation
– Enables higher feed values
– No damage to parted off surfaces
– Chips are rolled up helically and broken short, so that they can exit the groove with ease – "watch spring chip"
– Chip width measured at approx. 0.05–0.10 mm smaller than the insert width [s]

Walter Xpress – Delivery service

Custom solutions in next to no time

Walter offers a wide range of products that can be sourced through the Walter Xpress rapid delivery service: Tools – as well as indexable inserts (e.g. for turning and holemaking). The special custom solutions that you can order using this service just have to be “close to the standard tool”.

The greatest advantage of Walter Xpress is the fact that delivery times are exceptionally short: Three weeks for indexable insert special tools and four weeks for indexable inserts.

Short replenishment times mean that Walter Xpress is crucial in contributing towards a reduction in the number of tools you have in circulation, consequently cutting your costs. You also benefit from a higher degree of certainty when planning.

Here's how to use Walter Xpress
Special tools available with Xpress delivery can be ordered via your Walter contact partner or via the online form in the Xpress area of the Walter website.

Benefits for you:

– Same-day grooving insert calculations incl. drawing
– Four-week delivery time
– Special widths and radii with CF5 / GD8 chip formation geometry
– Reduction of cost per part by reducing travel distances and multiple grooving

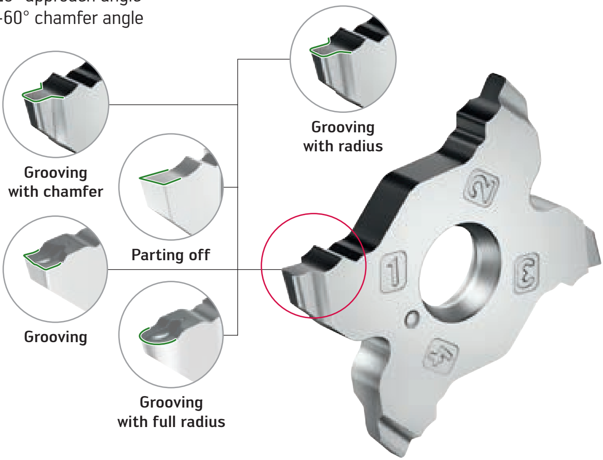
Find out more at:
walter-tools.com

Walter Xpress

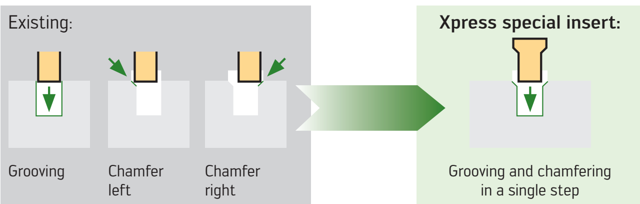
Special profiles in a four-week delivery time

THE INDEXABLE INSERT

– Insert widths from 0.5–5.5 mm
– Cutting depths up to 6 mm
– Radii from 0.05–5.4 mm
– 3–20° approach angle
– 30–60° chamfer angle



THE APPLICATION



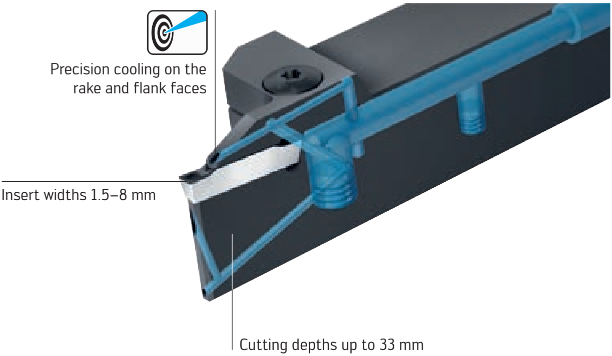
Chamfering and grooving is normally carried out with the grooving insert's corner radii.
Disadvantages:
Long runtime and high wear on the peripheral cutting edges.

An Xpress special insert is recommended for chamfering and grooving in series production.
Advantages:
Shorter runtime and longer tool life, since wear is distributed across the entire cutting edge.

Productive and universal

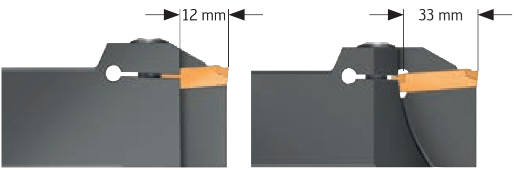
Walter Cut GX – G1011 / G1011-P groove turning holder

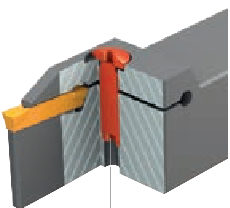
– Monoblock tools for grooving, parting off and recessing
– G1011-P with precision cooling directly at the cutting edge increases the tool life and productivity
– For double-edged GX16-, GX24-, GX30- and GX34- grooving inserts
– Simple and more reliable chip evacuation thanks to reduced tool head height



THE TECHNOLOGY

Optimum stability thanks to a selection of different cutting depths





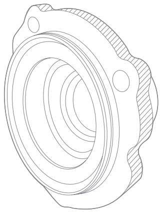
1. Maximum clamping force due to optimum screw position
2. Clamping screw can be accessed from above or below

THE APPLICATION

– Parting off, grooving and recessing operations up to a depth of 33 mm – double-edged.
– Double-edged parting off with GX34 to a diameter of up to 65 mm
– For use on lathes of all types
– First choice for all grooving/recessing operations

APPLICATION EXAMPLE

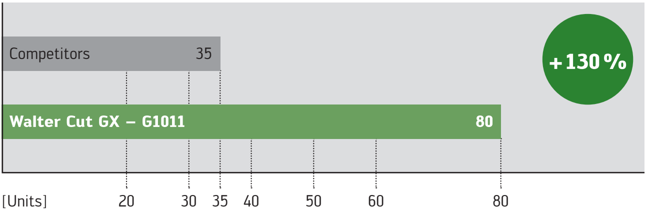
Recessing in steel – Gearbox cover



Material:	16MnCr5 (1.7131) R_m = 1200 N/mm²
Tool:	G1011.2525R-6T12GX24
Indexable insert:	GX24-4E600N08-UD4
Grade:	WKP33S

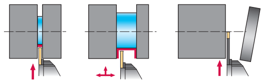
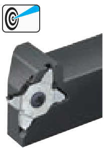
Cutting data:	Competitors N123L2-800-0008 TM4325	**Walter** **G1011.2525R-6T12GX24** **GX24-4E600N08-UD4 WKP33S**
v_c [m/min]	100	150
f [mm]	0.1	0.2
a_p [mm]	3.5	3.5
Insert width [mm]	8.0	6.0
Tool life quantity [units]	**35**	**80**

Comparison: Tool life quantity [units]



Walter Select – Groove turning holder for parting off/grooving/recessing

External machining – Radial

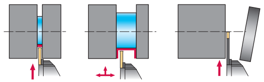
Application					
Stability of the tool		+			
Tools					
Designation		**G3011** **G3011-C...-P** **G3011-P** **G3051-P**	**G3021-P**	**G1011** **G1011-P**	**G1511** **G1511-P**
Max. parting off diameter D_{max} [mm]	Max. cutting depth T_{max} [mm]				
dia. 8	4	●●	●●	●●	●●
dia. 10	5	●●	●●	●●	●●
dia. 12	6	●●	●●	●●	●●
dia. 16	8			●●	
dia. 24	12			●●	
dia. 32	16			●●	
dia. 42	21			●●	
dia. 52	26			●●	
dia. 65	33			●●	
dia. 80	40				
dia. 90	45				
dia. 120	60				
dia. 200	100				
Insert width s [mm]		0.5–5.56	0.5–5.56	2.0–8.0	1.0–6.0
Shank height h [mm]		10–25	10–25	12–32	12–25
Walter Capto™ size d_1		C3–C6	–	–	–
Cutting insert type		 MX . . . E		 GX . . . E  GX . . . F	

-P = Precision cooling (first choice)

WALTER SELECT

●● Primary application

● Other application



				
	G1521	G1551	C...-NCAE (0°) C...-NCBE (0°) C...-NCLE (90°) C...-NCNE (90°)	NCAE (0°) NCBE (0°) NCLE (90°) NCNE (90°)
	●●	●●	●●	●●
	●●	●●	●●	●●
	●●	●●	●●	●●
			●●	●●
			●●	●●
			●●	●●
			●●	●●
	2.0–6.0		1.0–6.0	1.0–6.0
	16–25	20–25	–	20–25
	–	–	C3–C6	–
	 GX . . . E  GX . . . F			

Walter Select for cutting inserts for recessing

Step by step to the right cutting insert

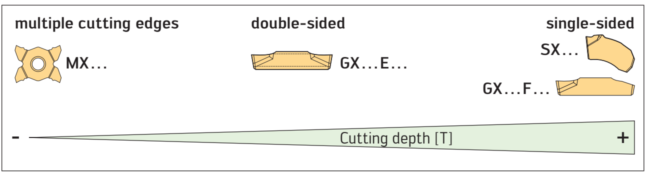
STEP 1

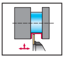
Determine the **material** to be machined.

Code letters	Machin-ing groups	Groups of the materials to be machined	
P	P1–P15	**Steel**	All types of steel and steel casting, with the exception of steel with an austenitic structure
M	M1–M3	**Stainless steel**	Austenitic stainless steel, austenitic-ferritic steel and steel casting
K	K1–K7	**Cast iron**	Grey cast iron, cast iron with spheroidal graphite, malleable cast iron, cast iron with vermicular graphite
N	N1–N10	**NF metals**	Aluminium and other non-ferrous metals, non-ferrous materials
S	S1–S10	**High-temperature alloys and titanium alloys**	Heat-resistant special alloys based on iron, nickel and cobalt, titanium and titanium alloys
H	H1–H4	**Hard materials**	Hardened steel, hardened cast iron materials, chilled cast iron
O	O1–O6	**Other**	Plastics, glass and carbon-fibre, reinforced plastics, graphite

STEP 2

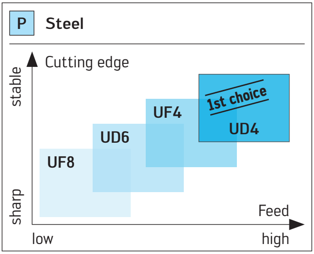
Determine the **basic shape** of the cutting insert:

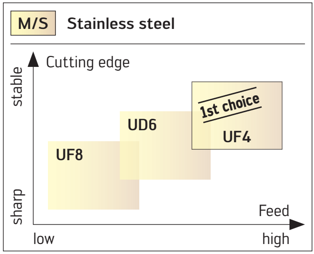


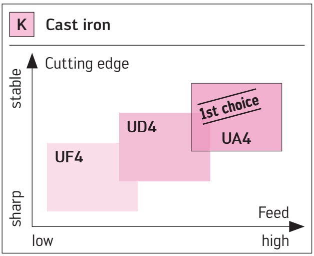


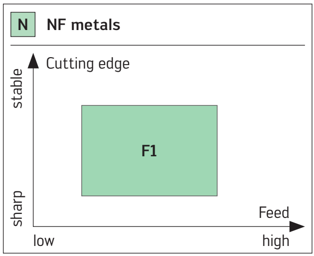
STEP 3 – RECESSING

Determine the **cutting insert geometry** via the cutting edge stability and feed.







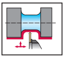


STEP 4 – RECESSING

Check whether your chosen geometry is available in the required insert width [s].
Identify the available system.

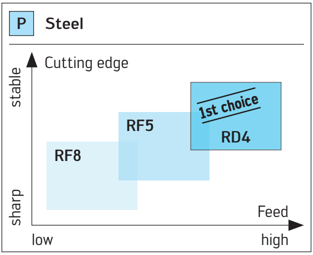
Chip formation Insert width s [mm]	 MX...	 GX...E	 GX...F	 SX...
UF8	–	1.7–8.0	–	–
UD6	–	2.0–6.0	–	–
CF5 [1)]	0.8–5.56	–	–	–
UF4	–	2.0–8.0	–	8.0
UD4	–	2.0–8.0	–	–
UA4	–	2.0–6.0	–	–
F1 [2)]	–	–	2.0–6.0	–

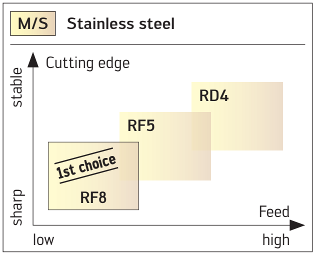
1) Only for finishing operations with max. $a_p = 0.3 \times s$
2) PCD cutting insert

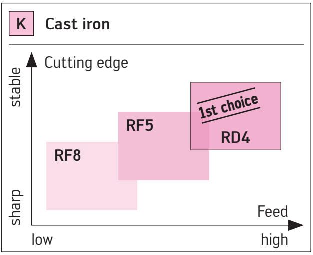


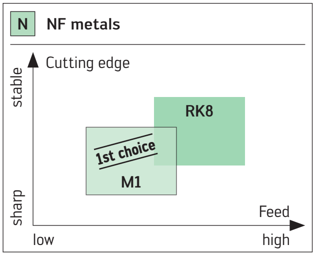
STEP 3 – COPY TURNING

Determine the **cutting insert geometry** via the cutting edge stability and feed.



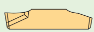






STEP 4 – COPY TURNING

Check whether your chosen geometry is available in the required insert width [s].
Identify the available system.

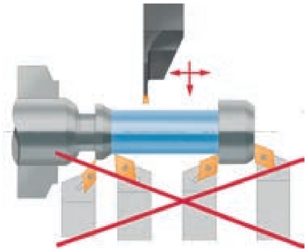
Chip formation Insert width s [mm]	 MX…	 GX…E	 GX…F	 SX…
RK8	–	6.0–8.0	–	–
RF8	–	2.0–8.0	–	–
RF5	1.57–5.0	–	–	–
RD4	–	2.0–8.0	–	–
M1[1)]	–	–	2.0–8.0	–

[1)] PCD cutting insert

Application information – Recessing

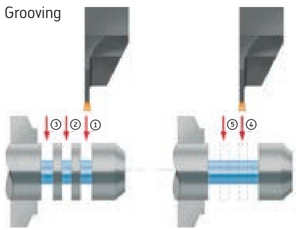
General

The use of recessing tools allows machining steps to be grouped together, saving on the number of tools used – in particular for machining between shoulders or when a limited number of tool spaces are available.

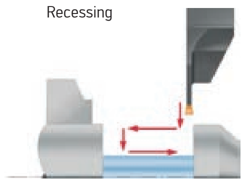


There are two different production strategies

For **grooving**, the feed moves in only one direction. Longitudinal turning with low material removal (approx. 0.1–0.3 mm) can only be carried out as a finishing operation. Grooving is effective when the groove depth is 1.5 times greater than the groove width.



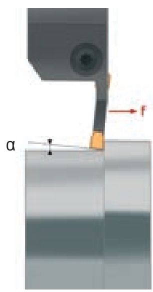
Recessing is a combination of grooving and longitudinal turning movements. It is used when the groove width is 1.5 times greater than the groove depth.



Positive engagement

A precise positive-locking connection between the cutting insert and the insert seat enables both radial and axial forces to be absorbed.

The longitudinal movement deflects the cutting insert [α].

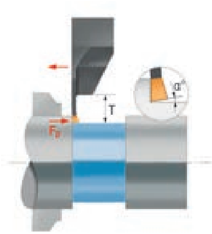


Application information – Recessing

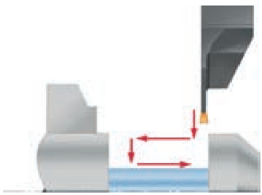
Deflection

Deflection means the deformation of the cutting insert support caused by a force [F_p]. This is necessary to create a minor clearance angle [α] during longitudinal turning.
The following factors influence the degree of deflection:

- Depth of cut [a_p]
- Feed [f]
- Cutting speed [v_c]
- Corner radius [r]
- Material to be machined
- Cutting depth of the tool [T]
- Width of the cutting insert support



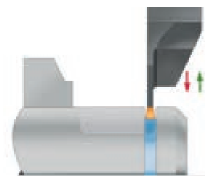
This enables recessing and longitudinal turning operations when using special chip forming geometries. Universal geometries are ideally suited for use (e.g. UD4, UF4).



Diameter compensation

The deflection produces different longitudinal ratios on the tool. In order to create an even diameter during a finishing operation, diameter compensation must take place when transitioning from the grooving movement to the longitudinal turning movement:

① Pre-machine the component up to the finishing operation
② Groove to the final diameter
③ Retract by 0.1 mm
④ Turn longitudinally
⑤ Measure the grooving diameter and longitudinal turning diameter; correct the retraction dimension (0.1 mm) by the difference in diameter



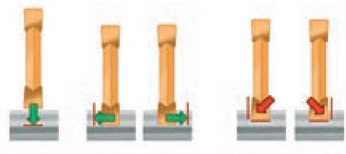
① Grooving (a_p longitudinal turning movement)
② Retract by 0.1 mm

Machining

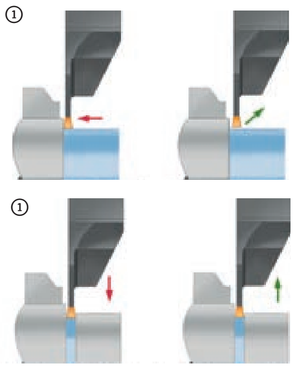
Certain tool paths must be adhered to in order to ensure a reliable machining process: For example, a tool must not be subjected to strain in two directions at the same time. Therefore, the cutting edge must be relieved after grooving before you start the longitudinal turning operation – the same is true when moving from longitudinal turning into grooving operations.

Rule of thumb – Recessing:

f_{start}	$0.05 \times s$
f_{max}	$0.07 \times s$
$a_{p\ min}$	$r + 0.1$ mm
$a_{p\ max}$	$0.7 \times s$



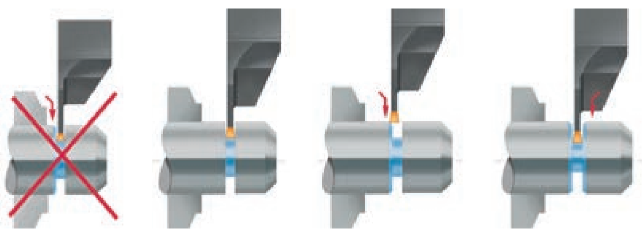
Machining sequence – Retracting



At the end of a longitudinal turning operation, retract by min. 0.1 mm: In the opposite direction to the direction of feed and away from the machined diameter, such that the cutting edge returns to its original position and the next grooving operation can take place.

Before you transition to the longitudinal turning operation, retract by approx. 0.1 mm again.

Producing a narrow groove with chamfer



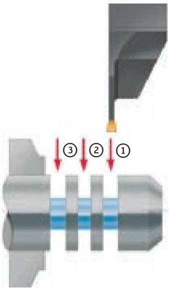
Grooving with 0.1 mm material removal on the diameter

Turn the chamfer and finish the first flank

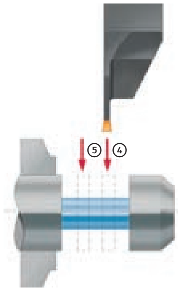
Turn the chamfer and finish the second flank

Application information – Recessing

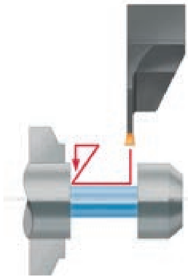
Producing a wide recess via multiple grooving



Pre-grooving
Web width = s – 2 × r



Pre-grooving



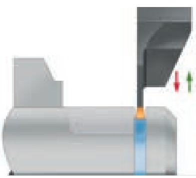
Finishing
$a_{p\ max} = r$

s = cutting edge width / r = corner radius / $a_{p\ max}$ = max. depth of cut

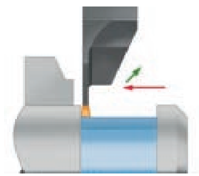
---

Producing a recess via recessing

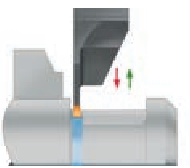
1. Roughing



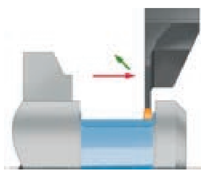
① Groove
② Retract by 0.1 mm



③ Turn longitudinally
④ Retract by 0.1 mm in two directions

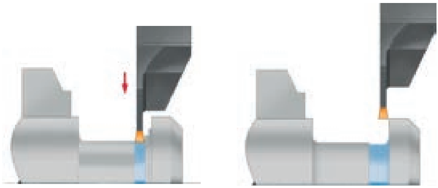


⑤ Groove
⑥ Retract by 0.1 mm

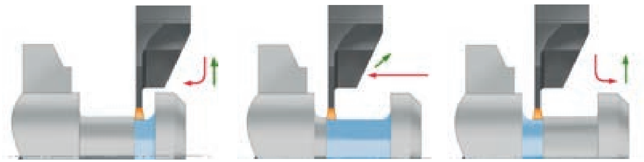


⑦ Turn longitudinally to approximately 0.5 mm before the shoulder
⑧ Retract by 0.1 mm in two directions

2. Finishing



① Pre-groove at the radius tangent point to the required finished diameter



② Finish the first shoulder and copy the radius
③ Retract by the diameter compensation dimension

④ Turn longitudinally until the radius tangent point is reached
⑤ Retract by 0.1 mm in two directions

⑥ Finish the second shoulder and copy the radius

Surface quality
Recessing in comparison to ISO turning:
A "wiper effect" is generated by deflecting the cutting insert when recessing (see figure A).
R_a values under 0.5 µm are attainable. These result in a good load-bearing capacity.

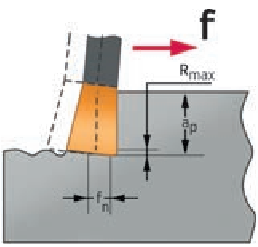


Fig. A

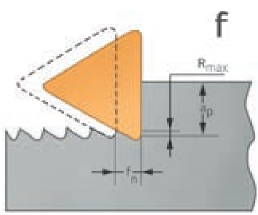
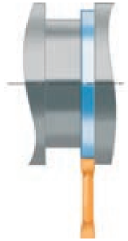


Fig. B

Application information – Recessing

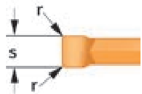
Side offset [s] – [r]

For side offset grooving, a universal "U" geometry should be used. The insert width should be at least between 0.5 × s and the cutting edge width of s – 1 × r.

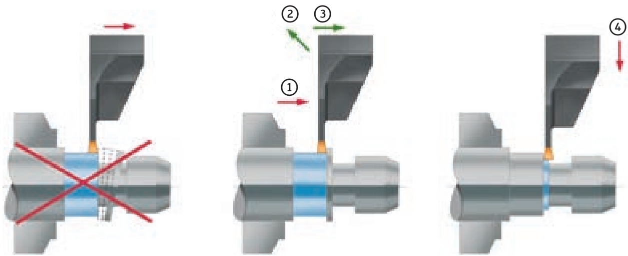


$a_{p\ min}$: **0.5 × s**
$a_{p\ max}$: **s – r**

Example:
s = 3.0 mm; r = 0.2 mm → $a_{p\ min}$: 1.5 mm
$a_{p\ max}$: 2.8 mm



Preventing ring formation



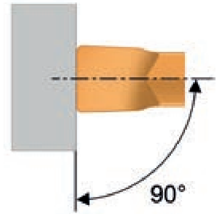
① Turn longitudinally up to approx. 0.5–1.5 mm in front of the tool exit

② Retract at an angle away from the corner

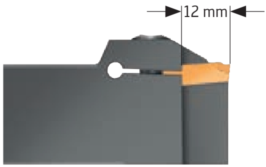
③ Position the tool above the ring

④ Remove the ring in the grooving operation

The tool must be aligned 90° to the axis of rotation
This is the only way to ensure that a clearance angle can be created when the tool is turned in both directions. Poor tool alignment generates vibrations and can lead to tool breakage.



Tool use
Use the tool holder with the smallest possible cutting depth (T_{max}) for the application.

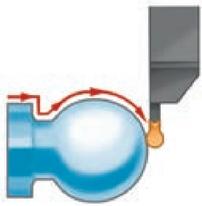


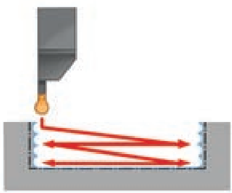
Application information – Copy turning

Cutting inserts for copy turning provide excellent opportunities for efficiency when machining complex workpiece shapes.

– Use cutting inserts for copy turning to achieve outstanding chip control and high surface finish quality

– With unstable clamping, ramp to avoid vibration



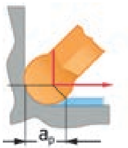


Application information – Copy turning

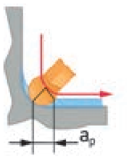
Preventing vibration during copy turning

– The radius of the indexable insert should always be smaller than the workpiece radius in order to avoid a large wrap (contact) angle.
– Reduce the feed in the workpiece radius range by 50% in comparison to the longitudinal cut.

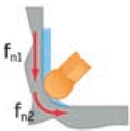
Insert radius = workpiece radius
Not recommended.

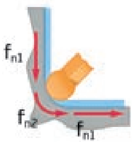


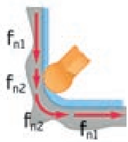
Insert radius < workpiece radius
Recommended.



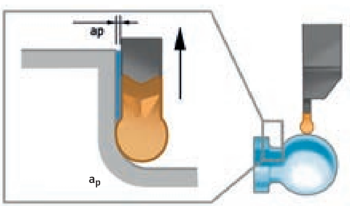
f_{n1} = longitudinal cuts = max. chip thickness 0.15–0.40 mm
f_{n2} = radius machining = 50% max. chip thickness







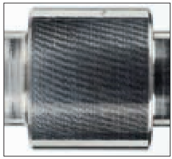
Maximum a_p when cutting with RD4 or RF8 geometries



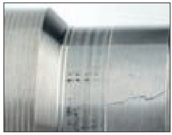
Insert width s [mm]	$a_{p\ max}$ – RD4 [mm]	$a_{p\ max}$ – RF8 [mm]
2.0	0.10	0.10
3.0	0.20	0.25
4.0	0.30	0.20
5.0	0.35	0.25
6.0	0.45	0.30
8.0	0.70	0.35

Fault analysis – Recessing

Vibration during turning
– Check the tool alignment
– Deflection of the cutting insert is too low
– Use a narrower insert (deflects more sharply)
– Use a smaller corner radius
– Clamp the workpiece at a shorter length



Step in turning diameter
– Correct the retraction dimension before the finishing cut
– Ensure even material removal
– Check whether the insert seat is damaged
– Increase the cutting speed
– Use a more positive geometry



Damage caused by chips
– Use a chip formation with greater chip constriction
– Reduce the cutting speed
– Optimise the cooling (use of precision cooling tools)

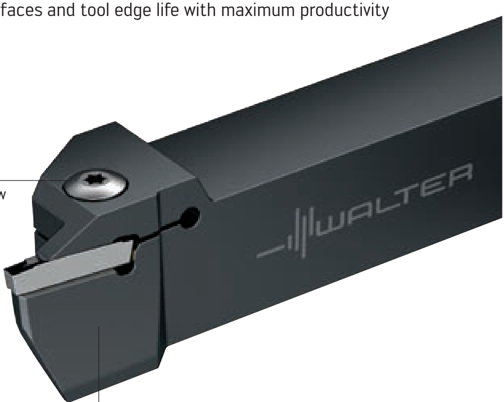
Ring formation
– Check the program sequence

Poor chip formation
– Reduce the cutting speed
– Increase the feed
– Improve the cooling (use of precision cooling tools)
– Check the chip formation

Highly reliable monoblock tool

Walter Cut GX – G1111 groove turning holder

– Clamping screw can be accessed from above or below
– Two cutting depths available for optimum tool stability
– For excellent surfaces and tool edge life with maximum productivity

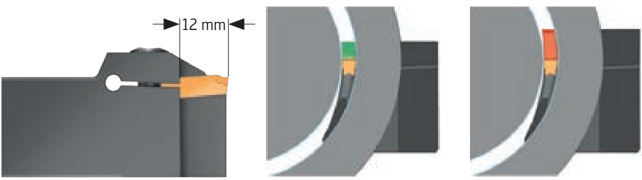


THE TECHNOLOGY

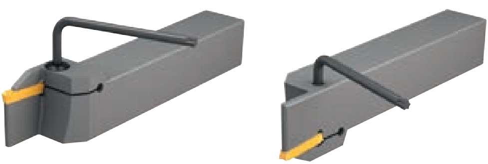
Low tool head height enables good chip evacuation

Walter: Plenty of room for chips

Competitor: Chips accumulate at the top clamp



Simple replacement of the cutting edge in overhead use

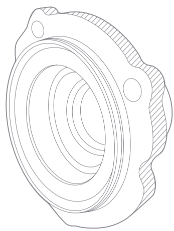


THE APPLICATION

– Axial grooves from dia. 34 mm
– Cutting depths up to 25 mm
– Insert width from 3 mm
– For use on lathes of all types
– First choice for all axial grooving/recessing operations
– All GX24 chip formations can be used

APPLICATION EXAMPLE

Axial grooving in grey cast iron – Housing



Material: GG25 nitrided (EN-GJL-250)

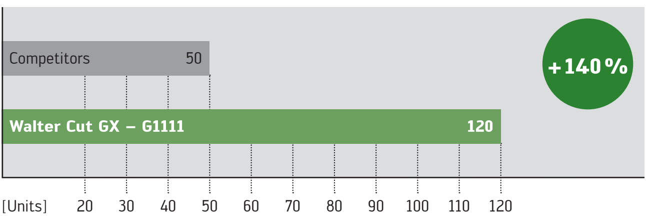
Tool: G1111.2525R-4T12-064GX24

Indexable insert: GX24-3E400N04-UD4

Grade: WKP13S

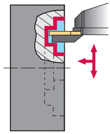
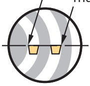
Cutting data:	Competitors A4G0305M03U04GUP KCP10	**Walter** **G1111.2525R-4T12-064GX24** **GX24-3E400N04-UD4 WKP13S**
n [rpm]	350	350
f [mm]	0.05	0.08
Insert width [mm]	3.0	4.0
Cutting depth [mm]	4	4
Tool life quantity [units]	**50**	**120**

Comparison: Tool life quantity [units]

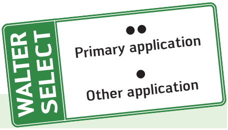


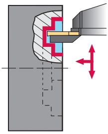
Walter Select – Groove turning holder for axial grooving and recessing

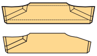
External machining – Axial

Application			
Stability of the tool	+		
Tools 			
Designation	**G1111**	**G1511** **G1511-P**	
Max. cutting depth T_{max} [mm]			
6	●●	●●	
12	●●		
15	●●		
21	●●		
25	●		
Insert width s [mm]	3.0–6.0	2.0–6.0	
Smallest D_{min} [mm]	34	43	
Shank height h [mm]	25	12–25	
Walter Capto™ size d_1	–	–	
Cutting insert type	 GX . . . E  GX . . . F		

-P = Precision cooling





			
	G1521	C...-NCEE (0°) C...-NCFE (0°) C...-NCHE (90°) C...-NCOE (90°)	NCEE (0°) NCFE (0°) NCHE (90°) NCOE (90°)
	●●	●●	●●
		●●	●●
		●●	●●
		●●	●●
	2.0–6.0	3.0–6.0	
	43	50	50
	16–25	–	20–32
	–	C3–C6	–
	 GX . . . E GX . . . F		

Walter Select for cutting inserts for axial grooving

Step by step to the right cutting insert

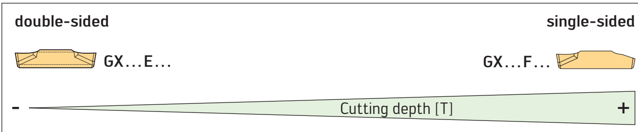
STEP 1

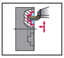
Determine the **material** to be machined.

Code letters	Machin-ing groups	Groups of the materials to be machined	
P	P1–P15	**Steel**	All types of steel and steel casting, with the excep-tion of steel with an austenitic structure
M	M1–M3	**Stainless steel**	Austenitic stainless steel, austenitic-ferritic steel and steel casting
K	K1–K7	**Cast iron**	Grey cast iron, cast iron with spheroidal graphite, malleable cast iron, cast iron with vermicular graphite
N	N1–N10	**NF metals**	Aluminium and other non-ferrous metals, non-ferrous materials
S	S1–S10	**High-temperature alloys and titanium alloys**	Heat-resistant special alloys based on iron, nickel and cobalt, titanium and titanium alloys
H	H1–H4	**Hard materials**	Hardened steel, hardened cast iron materials, chilled cast iron
O	O1–O6	**Other**	Plastics, glass and carbon-fibre, reinforced plastics, graphite

STEP 2

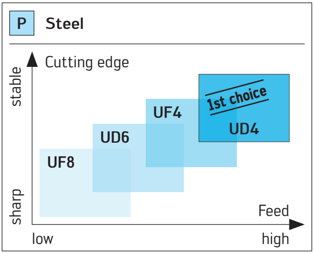
Determine the **basic shape** of the cutting insert:

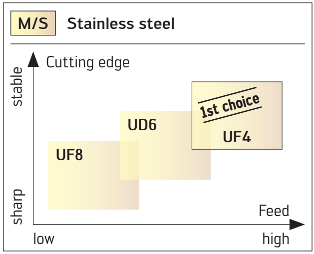


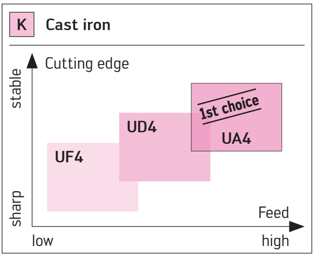


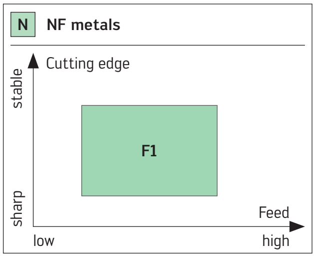
STEP 3 – AXIAL RECESSING

Determine the **cutting insert geometry** via the cutting edge stability and feed.



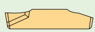




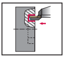


STEP 4 – AXIAL RECESSING

Check whether your chosen geometry is available in the required insert width [s].
Identify the available system.

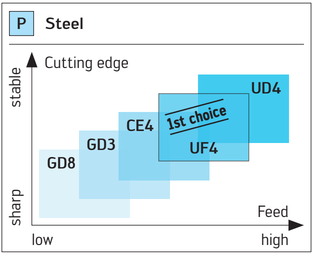
Chip formation Insert width s [mm]	 GX…E	 GX…F
UF8	1.7–8.0	–
UD6	2.0–6.0	–
UF4	2.0–8.0	–
UD4	2.0–8.0	–
UA4	2.0–6.0	–
F1[1]	–	2.0–6.0

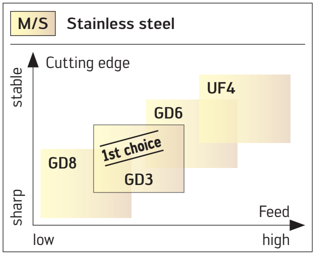
[1] PCD cutting insert

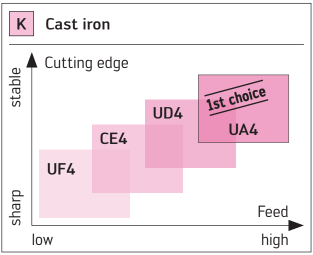


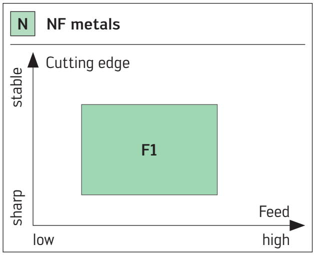
STEP 3 – AXIAL GROOVING

Determine the **cutting insert geometry** via the cutting edge stability and feed.







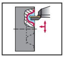


STEP 4 – AXIAL GROOVING

Check whether your chosen geometry is available in the required insert width [s].
Identify the available system.

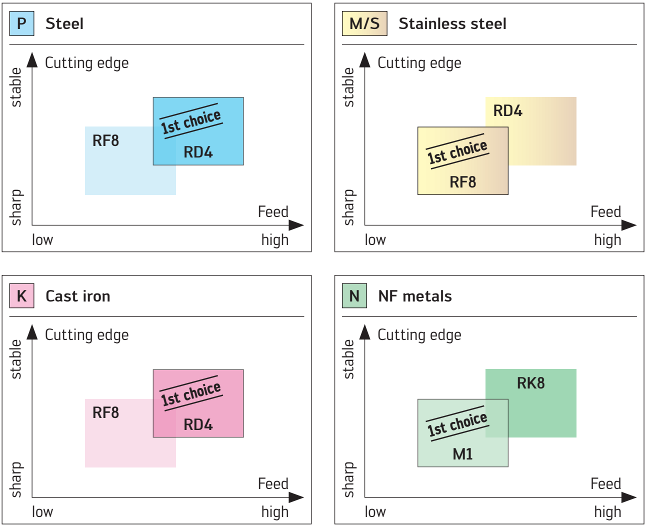
Chip formation Insert width s [mm]	 GX…E	 GX…F
GD8	1.0–1.4	–
GD3	2.0–6.0	–
GD6	2.0–6.0	–
CE4	2.0–6.0	3.0–4.0
UF4	2.0–8.0	–
UD4	2.0–8.0	–
F1[1)]	–	2.0–6.0

[1)] PCD cutting insert



STEP 3 – AXIAL COPY TURNING

Determine the **cutting insert geometry** via the cutting edge stability and feed.



STEP 4 – AXIAL COPY TURNING

Check whether your chosen geometry is available in the required insert width [s].
Identify the available system.

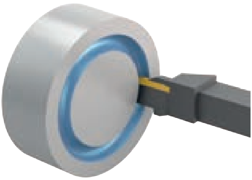
Chip formation Insert width s [mm]	 GX…E	 GX…F
RK8	6.0–8.0	–
RF8	2.0–8.0	–
RD4	2.0–8.0	–
M1[1)]	–	2.0–8.0

[1)] PCD cutting insert

Axial grooving operations require specific tools

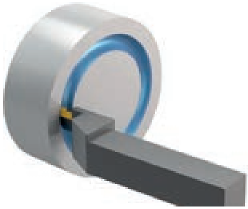
- The tool curvature of the groove turning holder depends on the workpiece radius
- When choosing the tool, take into account the inner and outer diameter of the groove
- Select the largest possible diameter range for the first groove

Standard variant



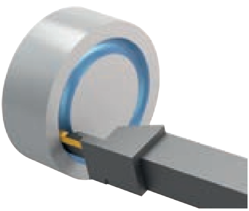
Right-hand axial tool
Shank design 0°
Tool curvature: External position

Standard variant



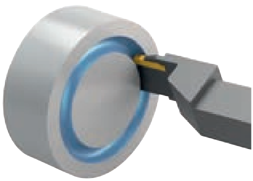
Left-hand axial tool
Shank design 0°
Tool curvature: External position

Contra variant



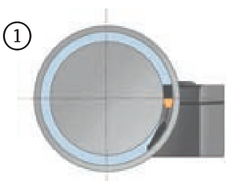
Right-hand axial tool
Shank design 0°
Tool curvature: Internal position

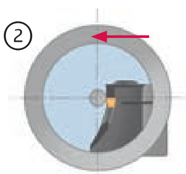
Contra variant



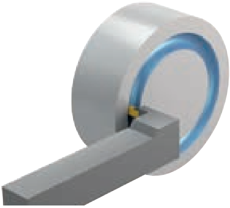
Left-hand axial tool
Shank design 0°
Tool curvature: Internal position

Important:
- The larger the diameter range of the first groove, the better the chip evacuation
- If possible, always begin at the outer diameter ① and work inwards ②



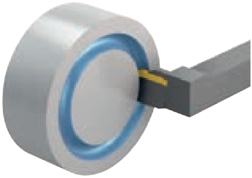


Standard variant



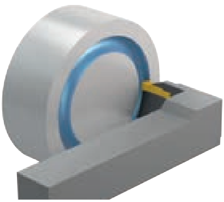
Right-hand axial tool
Shank design 90°
Tool curvature: External position

Standard variant



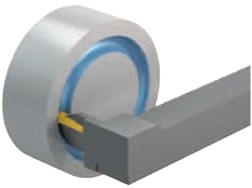
Left-hand axial tool
Shank design 90°
Tool curvature: External position

Contra variant



Right-hand axial tool
Shank design 90°
Tool curvature: Internal position

Contra variant



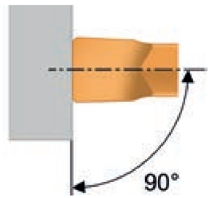
Left-hand axial tool
Shank design 90°
Tool curvature: Internal position

Application information:
Diameter range when using the G1511 / G1521 tools for axial grooving

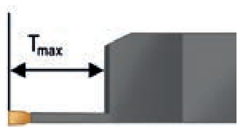
Diameter range		
Grooving insert width s [mm]	Minimum axially cut groove D_{min} [mm]	
	GX16 D_{min}	GX24 D_{min}
2	112	120
2.5	92	240
3	81	65
4	75	62
5	63	51
6	53	43

Application information

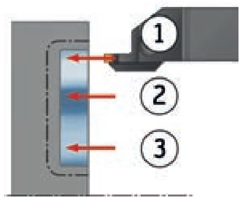
The tool must be aligned 90°
to the axis of rotation!
Firstly check the parallelism of the cutting edge and the surface to be machined. Exact positioning enables good surface finish quality when facing in both directions.



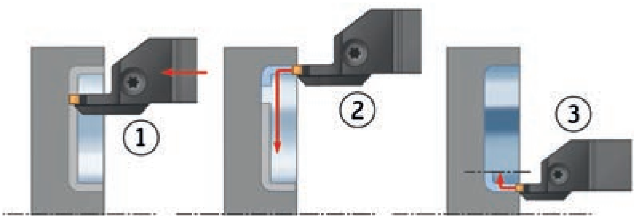
Tool selection
According to the required machining depth:
Choose a short cutting depth T_{max}.
→ This minimises the risk of vibration



Machining sequence – Roughing
- The first groove ① must always be carried out at the largest diameter
- The cutting action ② and ③ should be 0.5–0.8 times the width of the cutting insert
- Material removal at the flanks and at the bottom: At least the size of the corner radius

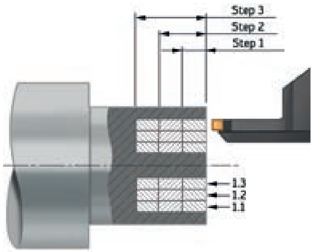


Machining sequence – Finishing

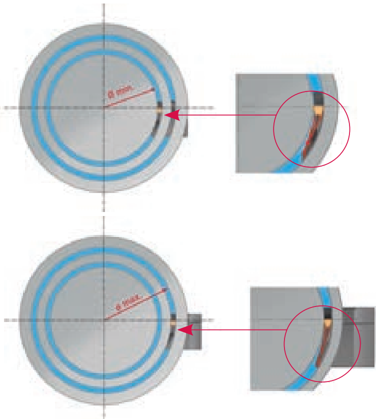


- Start the first finishing cut ① in the specified diameter range directly after the radius
- In cut ②, the outer diameter is finished: Work inwards – until the end of the second radius of the inner diameter
- Finally, carry out cut ③: Finishing of the inner diameter and radius

Deep grooving
With large cutting depths, difficult materials or poor chip breaking, step-by-step grooving is recommend in order to enable chip clearance.



Rule of thumb
The larger the diameter range of the first groove:
– The better the chip evacuation
– The higher the tool stability
  (see course of the lines of force)

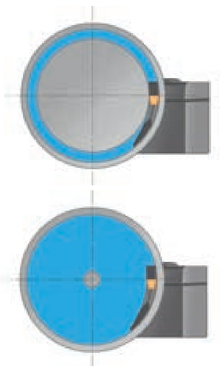


Correct usage

If the tool body of the workpiece is wearing against the component:
– Check the diameter range of the tool
– The tool is possibly not parallel to the axis
– Check the centre height

When approaching the inner diameter:
– Slightly lower the tool to under the centre height

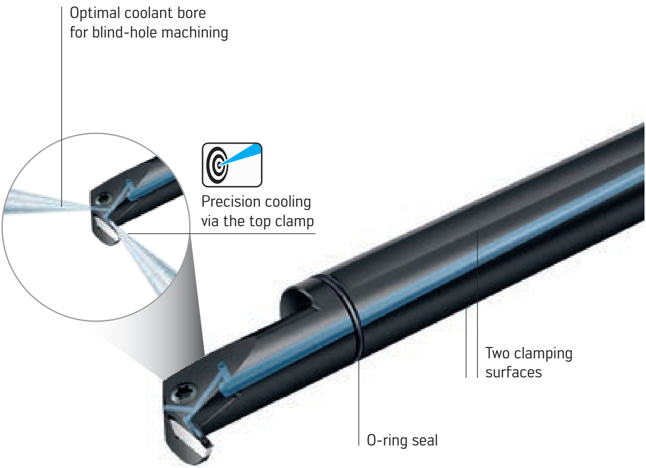
When approaching the outer diameter:
– Place the tool slightly over the centre height



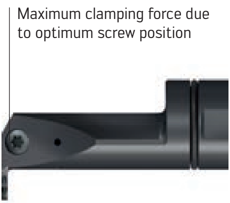
Cooling via the top clamp

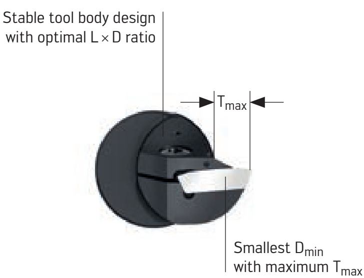
Walter Cut GX – G1221-P boring bar

- Precision cooling for high process reliability and long tool life
- Sealable axial coolant bore for blind-hole machining
- Interface between basic adaptor and tool, free from pressure loss thanks to O-ring seal
- Unique chip flushing effect due to the axial coolant bore for blind-hole machining



THE TECHNOLOGY



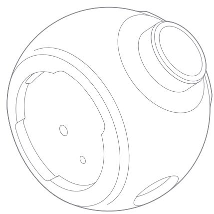


THE APPLICATION

– Internal grooving and recessing to a cutting depth of up to 12 mm
– From D_{min} = 16 mm
– Optimal for blind-hole machining

APPLICATION EXAMPLE

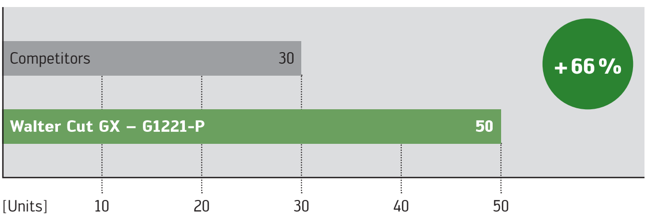
Internal grooving in stainless steel – Valve housing



Material:	X2CrNiMo17-12-2 (1.4404)
Tool:	G1221-40SR-5T12-GX24-P
Indexable insert:	GX24-3E500N25-RF8
Grade:	WSM23S

Cutting data:	Competitors Special tool N151.2-500-40-5P GC235	**Walter** **G1221-40SR-5T12-GX24-P** **GX24-3E500N25-RF8 WSM23S**
v_c [m/min]	180	180
f [mm]	0.33	0.33
Insert width [mm]	5.00 (R2.5)	5.00 (R2.5)
Cutting depth [mm]	1.0–3.0	1.0–3.0
Tool life quantity [units]	**30**	**50**

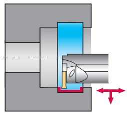
Comparison: Tool life quantity [units]



Walter Select – Groove turning holder for internal grooving and recessing

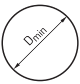
Internal turning – Radial

Application



Stability of the tool +

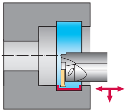
Tools



Designation		G1221-P	I12
D_{min} [mm]	Max. cutting depth T_{max} [mm]		
dia. 16	3	●●	●●
dia. 16	4	●●	
dia. 20	4	●●	
dia. 20	6	●●	
dia. 25	5	●●	
dia. 25	8	●●	
dia. 32	6	●●	
dia. 32	10	●●	
dia. 40	9	●●	
dia. 50	10/12	●●	
dia. 60	19		
Width of indexable inserts		1.7–6.0	2.0–2.5
Shank diameter d_1 [mm]		16–40	16
Type of indexable insert		 GX09/16/24	 GX09

-P = Precision cooling (first choice)

WALTER SELECT
●● Primary application
● Other application



	1.5 × D 	2.5 × D 
	NCAI	**NCCI**
	●●	●●
	●●	●●
	●●	●●
	●●	●●
	●●	●●
	●●	●●
	1.7–6.0	1.0–2.3
	20–50	20–50
	 GX09/GX16/GX24	

Walter Select for cutting inserts for internal grooving and recessing

Step by step to the right cutting insert

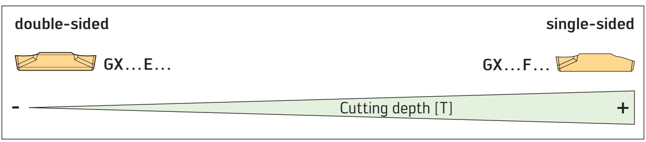
STEP 1

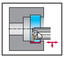
Determine the **material** to be machined.

Code letters	Machin-ing groups	Groups of the materials to be machined	
P	P1–P15	**Steel**	All types of steel and steel casting, with the excep-tion of steel with an austenitic structure
M	M1–M3	**Stainless steel**	Austenitic stainless steel, austenitic-ferritic steel and steel casting
K	K1–K7	**Cast iron**	Grey cast iron, cast iron with spheroidal graphite, malleable cast iron, cast iron with vermicular graphite
N	N1–N10	**NF metals**	Aluminium and other non-ferrous metals, non-ferrous materials
S	S1–S10	**High-temperature alloys and titanium alloys**	Heat-resistant special alloys based on iron, nickel and cobalt, titanium and titanium alloys
H	H1–H4	**Hard materials**	Hardened steel, hardened cast iron materials, chilled cast iron
O	O1–O6	**Other**	Plastics, glass and carbon-fibre, reinforced plastics, graphite

STEP 2

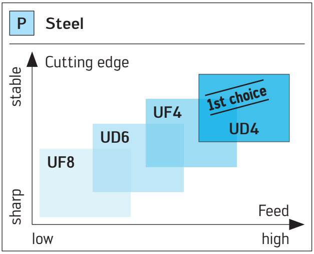
Determine the **basic shape** of the cutting insert:

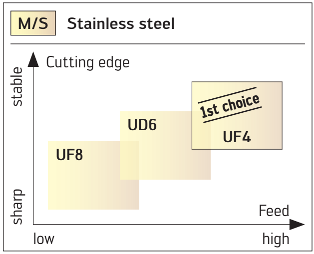


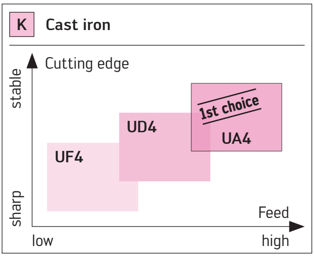


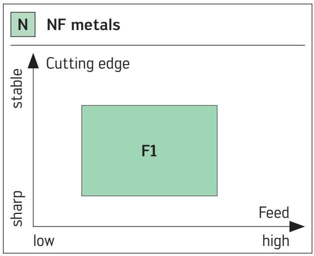
STEP 3 – INTERNAL RECESSING

Determine the **cutting insert geometry** via the cutting edge stability and feed.







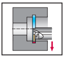


STEP 4 – INTERNAL RECESSING

Check whether your chosen geometry is available in the required insert width [s].
Identify the available system.

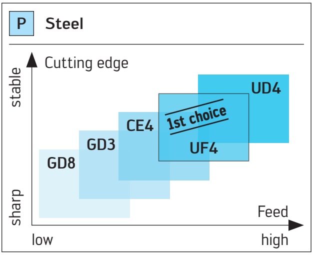
Chip formation Insert width s [mm]	 GX...E	 GX...F
UF8	1.7–6.0	–
UD6	2.0–6.0	–
UF4	2.0–6.0	–
UD4	2.0–6.0	–
UA4	2.0–6.0	–
F1[1]	–	2.0–6.0

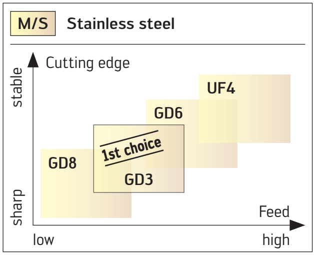
[1] PCD cutting insert

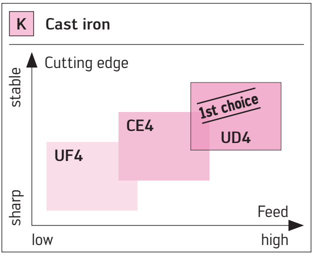


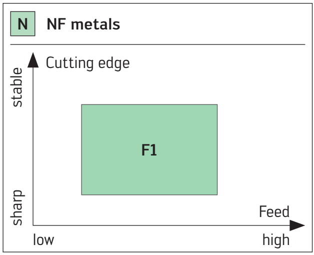
STEP 3 – INTERNAL GROOVING

Determine the **cutting insert geometry** via the cutting edge stability and feed.







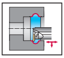


STEP 4 – INTERNAL GROOVING

Check whether your chosen geometry is available in the required insert width [s].
Identify the available system.

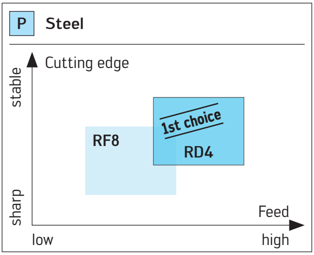
Chip formation Insert width s [mm]	 GX…E	 GX…F
GD8	1.0–1.4	–
GD3	2.0–6.0	–
GD6	2.0–6.0	–
CE4	2.0–6.0	3.0–4.0
UF4	2.0–8.0	–
UD4	2.0–8.0	–
F1[1)]	–	2.0–6.0

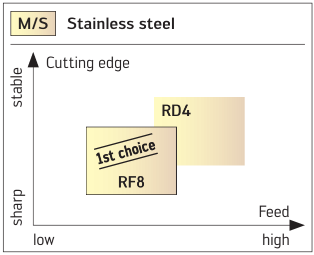
[1)] PCD cutting insert

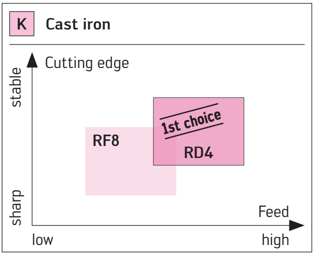


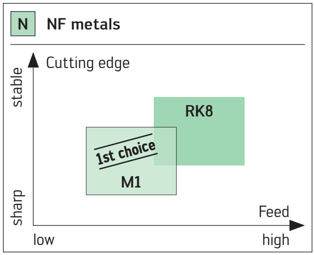
STEP 3 – INTERNAL COPY TURNING

Determine the **cutting insert geometry** via the cutting edge stability and feed.









STEP 4 – INTERNAL COPY TURNING

Check whether your chosen geometry is available in the required insert width [s].
Identify the available system.

Chip formation Insert width s [mm]	 GX...E	 GX...F
RK8	6.0–8.0	–
RF8	2.0–8.0	–
RD4	2.0–8.0	–
M1[1)]	–	2.0–8.0

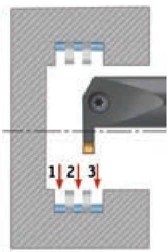
[1)] PCD cutting insert

Application information

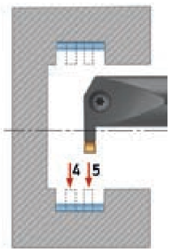
Machining sequence – Internal grooving

When internal grooving deep grooves, multiple grooving can be used as a strategy for better chip control.

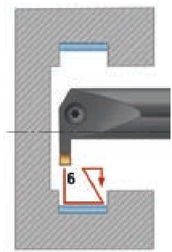
Producing a wide groove via multiple grooving



Pre-grooving
Web width = s – 2 × r



Pre-grooving



Finishing
$a_{p\ max} - r$

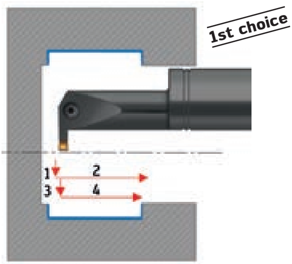
s = cutting edge width / r = corner radius / $a_{p\ max}$ = max. depth of cut

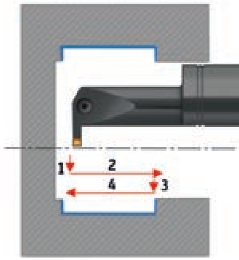
---

Internal recessing

In order to ensure that chips are directed outwards, when recessing long grooves (in contrast to external recessing), it is important to always work towards the entrance of the bore.

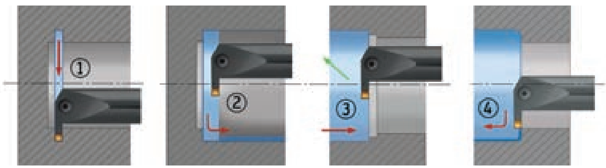
Machining sequence – Roughing





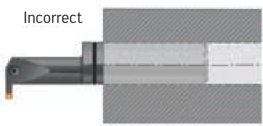
If the chip formation allows, conventional recessing can also be used as an alternative.

Machining sequence – Finishing

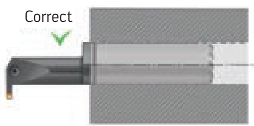


- Start the first finishing cut ① directly after the radius
- In the second cut ②, the left flank is finished
- In the third cut ③, turn in the "Z"+ direction, until the end of the second radius of the right flank
- Finally, carry out cut ④: Finishing of the right flank and radius

Correct use of G1221-P



Coolant can exit along the boring bar because the seal in the clamping unit is open.



Coolant cannot escape because the seal in the clamping unit is closed.

Precision cooling system overview

VDI adaptors for square shanks

Walter Capto™ adaptors for square shanks

A2120-VDI-P

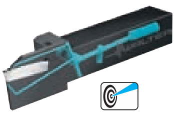
A2121-VDI-P

A2120-C-P

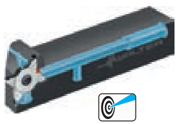
A2121-C-P

One-piece shank tools

e.g. G1011...-P



e.g. G3011...-P



Machine-specific adaptors for BMT and Doosan machines for square shanks*

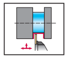
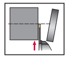
A2120-DO-P

A2121-DO-P

A2120-BT-P

-P = Precision cooling

* Further manufacturers available upon request.

VDI adaptors
for parting blades

Clamping blocks
for parting blades

A2110...-P

A2111...-P

SBN

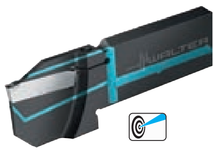
G2661...-P

Neutral
parting blades

Reinforced
parting blades

e.g. G2042...-P

e.g. G1041...-P



Machine-specific adaptors for BMT,
Doosan and Nakamura machines
for parting blades*

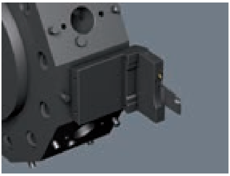
A2110-BT...-P

A2110-DO...-P

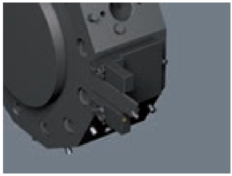
A2110-NA...-P

Range of applications with VDI double serrations

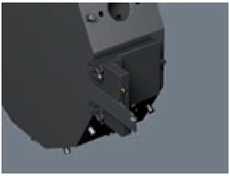
A2110-P blade adaptors – Star turrets



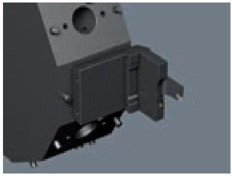
A2110...32R...P



A2110...32R...P
Overhead installation position

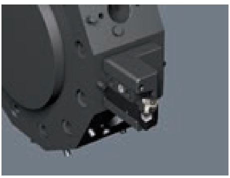


A2110...32L...P

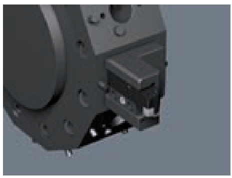


A2110...32L...P
Overhead installation position

A2110-P square shank adaptors – Star turrets

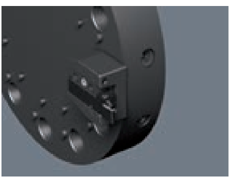


A2120...25N...P

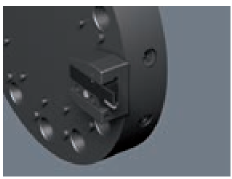


A2120...25N...P
Overhead installation position

A2121-P square shank adaptors – Disc turrets



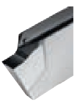
A2121...25R...P



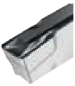
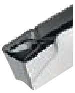
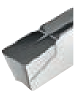
A2121...25L...P
Overhead installation position

Geometry overview of cutting inserts

GX system: Grooving and parting off

Geometry	Remarks/ field of applications	Material groups P Steel	M Stainless steel	K Cast iron	N NF metals	S Materials with difficult cutting properties	H Hard materials	O Other	s [mm]	f [mm]
	**CK8** – Light to moderate feeds – Polished rake face		•		••	•			2	0.04–0.15
									2.5	0.05–0.15
									3	0.08–0.20
									4	0.10–0.22
									5	0.10–0.25
	**CF6** – Extremely low burr and pip formation – For small diameters and thin-walled tubes	••	••		••	••		•	2	0.03–0.10
									2.5	0.03–0.12
									2.5	0.03–0.15
									3	0.04–0.20
	**CF5** – Reduced burr and pip formation – For long-chipping materials	••	••	•	••	••		•	2	0.04–0.15
									2.5	0.05–0.15
									3	0.08–0.20
									4	0.10–0.22
									5	0.10–0.25
	**CE4** – Stable cutting edge for maximum feeds – Very good chip constric-tion	••	•	••	•	•	•		2	0.06–0.15
									2.5	0.07–0.18
									3	0.09–0.30
									4	0.10–0.32
									5	0.12–0.35
									6	0.12–0.40
	**GD8** – For precision grooving – Light to moderate feeds	••	•	•	•	•			1	0.03–0.06
									1.5	0.03–0.09
									2	0.04–0.10
									2.5	0.04–0.14
									3	0.04–0.14
	**GD3** – Light to moderate feeds – Soft cutting action	••	••	•	•	•		•	2	0.04–0.12
									2.5	0.06–0.14
									3	0.06–0.18
									4	0.10–0.20
									5	0.12–0.25
									6	0.14–0.28
	**GD6** – For long-chipping materials – Moderate machining conditions	••	••	•	•	••			2	0.04–0.12
									2.5	0.06–0.17
									3	0.08–0.18
									4	0.10–0.22
									5	0.12–0.24
									6	0.14–0.30
	**F1** – Light to moderate feeds – PCD tipped				••	•			2	0.04–0.12
									3	0.05–0.16
									4	0.06–0.22
									5	0.06–0.25
									6	0.06–0.28

GX system: Grooving, parting off and recessing

Geometry	Remarks/ field of applications	Material groups P Steel	M Stainless steel	K Cast iron	N NF metals	S Materials with difficult cutting properties	H Hard materials	O Other	s [mm]	a_p [mm]	f [mm]
	**UF8** – Chip formation with circumference fully ground, excellent chip control – Low to moderate feeds	●●	●●	●	●●	●●			1.6	0.3–1.0	0.05–0.17
									2	0.3–1.2	0.05–0.22
									3	0.4–1.5	0.07–0.24
									4	0.3–2.2	0.07–0.30
									5	0.3–2.6	0.11–0.35
									6	0.3–3.2	0.11–0.35
									8	1.0–4.2	0.13–0.40
	**UD6** – Moderate feeds – Soft cutting action	●	●●		●				2	0.3–2.5	0.06–0.15
									2.5	0.3–2.5	0.08–0.14
									3	0.4–3.0	0.10–0.20
									4	0.5–3.5	0.12–0.25
									5	0.5–3.0	0.12–0.30
									6	0.6–3.5	0.14–0.35
	**UF4** – Moderate feeds – Universal insert for 80% of all applications	●●	●●	●●	●	●			2	0.3–2.5	0.10–0.15
									2.5	0.3–2.5	0.10–0.18
									3	0.4–3.0	0.10–0.20
									4	0.5–3.5	0.10–0.30
									5	0.5–3.5	0.12–0.35
									6	0.6–4.0	0.14–0.40
									8	0.9-4.0	0.18-0.55
	**UD4** – Excellent chip breaking with forged parts – Stable cutting edge	●●	●	●●					3	0.4–2.0	0.08–0.20
									4	0.5–2.8	0.10–0.30
									5	0.5–3.0	0.12–0.35
									6	0.6–3.5	0.14–0.40
									8	0.9–4.0	0.14–0.40
	**UA4** – For machining cast iron – Moderate to high feeds			●●			●		2	0.3–2.5	0.08–0.15
									2.5	0.3–2.5	0.10–0.20
									3	0.4–3.0	0.10–0.22
									4	0.5–3.5	0.10–0.35
									5	0.5–3.0	0.12–0.35
									6	0.6–3.5	0.14–0.40
	**VG7** – For finishing operations behind the collar of a component – Enormous savings on material possible	●●	●●	●	●●	●●			2.8	0.2-2.5	0.05-0.25

●● Primary application
● Additional application

Geometry overview of cutting inserts

GX system: Full radius cutting inserts for grooving and copy turning

Geometry	Remarks/ field of applications	P Steel	M Stainless steel	K Cast iron	N NF metals	S Materials with difficult cutting properties	H Hard materials	O Other	s [mm]	a_p [mm]	f [mm]
		Material groups									
	**RK8** – For copy and relief turning of ISO N materials – Polished cutting edge with circumference fully ground				••			•	6	4.0	0.10–0.30
									8	5.0	0.10–0.35
	**RF8** – For copy and relief turning – Reduced cutting forces due to positive cutting edge with circumference fully ground	••	••	•	•	••			2	0.1–1.0	0.08–0.25
									3	0.1–1.5	0.10–0.30
									4	0.1–2.0	0.12–0.45
									5	0.1–2.5	0.15–0.50
									6	0.1–3.0	0.15–0.55
									8	0.2–4.0	0.18–0.60
	**RD4** – For copy turning, e.g. of forged parts – Excellent chip control even at low depths of cut	••	•	••		•			2	0.2–1.0	0.08–0.25
									3	0.5–1.5	0.10–0.35
									4	0.5–2.0	0.15–0.50
									5	0.5–2.5	0.17–0.70
									6	0.5–3.0	0.17–0.70
									8	0.6–4.5	0.17–0.70
	**M1** – For copy and relief turning – Stable cutting edge – PCD tipped				••	•			2	0.1–1.0	0.05–0.25
									3	0.1–1.5	0.05–0.30
									4	0.1–2.0	0.05–0.35
									5	0.1–2.5	0.05–0.40
									6	0.2–3.0	0.05–0.50
									8	0.2–4.0	0.05–0.60

•• Primary application
• Additional application

MX system: Cutting inserts for grooving, parting off, recessing and thread turning

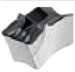
Geometry	Remarks/ field of applications	Material groups P Steel	M Stainless steel	K Cast iron	N NF metals	S Materials with difficult cutting properties	H Hard materials	O Other	s [mm]	a_p [mm]	f [mm]
	**GD8** – Circumference fully ground for precision grooves, e.g. DIN 471 circlip grooves – Extremely soft cutting action	●●	●	●	●	●			1		0.03–0.06
									1.5		0.03–0.09
									2		0.04–0.10
									2.5		0.04–0.14
									3		0.04–0.14
	**CF5** – Excellent chip control, e.g. even with long-chipping materials – Low burr/centre pip formation	●●	●●	●	●	●●			1		0.03–0.07
									1.5		0.03–0.10
									2		0.04–0.14
									2.5		0.04–0.16
									3		0.04–0.16
									4		0.10–0.22
									5		0.10–0.25
	**RF5** – Circumference fully ground for full radius grooves and for copy turning – For low to moderate feeds	●●	●●	●	●	●●			2		0.04–0.14
									2.5		0.04–0.18
									3		0.04–0.20
									4		0.06–0.22
									5		0.06–0.25
	**AG60** – 60° partial profile external thread – Pitch range 0.5–3.0 mm	●●	●●	●	●	●●			3.35		–
									5.65		–
	**VG8** – For finishing operations behind the collar of a component – Enormous savings on material compared to standard ISO indexable inserts	●●	●●	●	●●	●●			2.8	0.2–2.5	0.05–0.25

Additional shapes via Walter Xpress

●● Primary application
● Additional application

Geometry overview of cutting inserts

SX system: Grooving and parting off

Geometry	Remarks/ field of applications	Material groups P Steel	 M Stainless steel	 K Cast iron	 N NF metals	 S Materials with difficult cutting properties	 H Hard materials	 O Other	s [mm]	f [mm]
	**CK8** – Light to moderate feeds – Polished rake face				••	•			2 2.5 3 4 5	0.04–0.15 0.05–0.15 0.08–0.20 0.10–0.22 0.10–0.25
	**CF6** – Low burr/centre pip formation – Low cutting force	••	••		••	••		•	1.5 2 3	0.03–0.10 0.03–0.12 0.04–0.20
	**CF5** – Good chip control, e.g. even with long-chipping materials – Minimal burr and pip formation	••	••	•	••	••		•	1.5 2 3 4 5 6	0.03–0.13 0.04–0.15 0.08–0.20 0.10–0.20 0.10–0.25 0.12–0.28
	**CE4** – Good chip constriction – Stable cutting edge for maximum feeds	••	•	••	•	•	•		1.5 2 3 4 5 6 8 10	0.05–0.13 0.06–0.15 0.09–0.30 0.10–0.32 0.12–0.35 0.12–0.40 0.20–0.50 0.25–0.55
	**UF4** – Moderate feeds – Universal inserts for recessing	••	••	••	•	•			8	0.18–0.55

•• Primary application
• Additional application

UX system: Grooving and widening

Geometry	Remarks/ field of applications	Material groups: P Steel	M Stainless steel	K Cast iron	N NF metals	S Materials with difficult cutting properties	H Hard materials	O Other	s [mm]	f [mm]
	**GD2** – Universal chip formation – For grooving and widening wide grooves – Very short chips – Low to high feeds	●●		●●					12	0.20–0.40
									19	0.25–0.60

●● Primary application
● Additional application

Cutting tool material application chart – Grooving

Carbide

Walter grade designation	Standard designation	P Steel	M Stainless steel	K Cast iron	N NF metals	S Materials with difficult cutting properties	H Hard materials	O Other
WSM13S	HC – M 10		••					
	HC – S 10					••		
	HC – P 10	•						
WSM23S	HC – M 20		••					
	HC – S 20					••		
	HC – P 20	••						
WSM33S	HC – S 30					••		
	HC – M 30		••					
	HC – P 30	••						
WSM43S	HC – S 45					••		
	HC – M 45		••					
	HC – P 45	••						
WKP13S	HC – P 10	••						
	HC – K 20			••				
	HC – H 10						•	
WKP23S	HC – P 20	••						
	HC – K 25			••				
WKP33S	HC – P 30	••						
	HC – K 30			••				
WK1	HW – N 10				••			
	HW – S 10					•		
WDN10	DP – N 10	••			••			

HC = Coated carbide
HW = Uncoated carbide
DP = Polycrystalline diamond

•• Primary application
• Additional application

Range of applications (01 05 10 15 20 25 30 35 40 45)	Coating method	Coating composition	Indexable insert example
	PVD	$TiAlN + Al_2O_3$ (Al)	
	PVD	$TiAlN + Al_2O_3$ (Al)	
	PVD	$TiAlN + Al_2O_3$ (Al)	
	PVD	$TiAlN + Al_2O_3$ (Al)	
	CVD	$TiCN + Al_2O_3$ (+ TiCN)	
	CVD	$TiCN + Al_2O_3$ (+ TiCN)	
	CVD	$TiCN + Al_2O_3$ (+ TiCN)	
	–	–	
	PCD	–	

Cutting data – Grooving and recessing

●● Recommended application (the specified cutting data is regarded as starting values for the recommended application)
● Possible application

Material group	Overview of the main material groups and code letters			Brinell hardness HB	Tensile strength R_m N/mm²	Machining group	(with coolant)	(without coolant)
P	Non-alloyed steel	C ≤ 0.25%	Annealed	125	430	P1	●●	●
		C > 0.25 to ≤ 0.55%	Annealed	190	640	P2	●●	●
		C > 0.25 to ≤ 0.55%	Heat-treated	210	710	P3	●●	●
		C > 0.55%	Annealed	190	640	P4	●●	●
		C > 0.55%	Heat-treated	300	1010	P5	●●	●
		Free-machining steel (short-chipping)	Annealed	220	750	P6	●●	●
	Low-alloyed steel	Annealed		175	590	P7	●●	●
		Heat-treated		285	960	P8	●●	●
		Heat-treated		380	1280	P9	●●	●
		Heat-treated		430	1480	P10	●●	●
	High-alloyed steel and high-alloyed tool steel	Annealed		200	680	P11	●●	●
		Hardened and tempered		300	1010	P12	●●	●
		Hardened and tempered		380	1280	P13	●●	●
	Stainless steel	Ferritic/martensitic, annealed		200	680	P14	●●	●
		Martensitic, heat-treated		330	1110	P15	●●	●
M	Stainless steel	Austenitic, quench hardened		200	680	M1	●●	●
		Austenitic, precipitation hardened (PH)		300	1010	M2	●●	●
		Austenitic/ferritic, duplex		230	780	M3	●●	●
K	Malleable cast iron	Ferritic		200	400	K1	●●	●
		Pearlitic		260	700	K2	●●	●
	Grey cast iron	Low tensile strength		180	200	K3	●●	●
		High tensile strength/austenitic		245	350	K4	●●	●
	Cast iron with spheroidal graphite	Ferritic		155	400	K5	●●	●
		Pearlitic		265	700	K6	●●	●
	GGV (CGI)			230	400	K7	●●	●
N	Wrought aluminium alloys	Not hardenable		30	–	N1	●●	●
		Hardenable, hardened		100	340	N2	●●	●
	Cast aluminium alloys	≤ 12% Si, not hardenable		75	260	N3	●●	●
		≤ 12% Si, hardenable, hardened		90	310	N4	●●	●
		> 12% Si, not hardenable		130	450	N5		
	Magnesium-based alloys			70	250	N6		
	Copper and copper alloys (bronze/brass)	Unalloyed, electrolytic copper		100	340	N7	●●	●
		Brass, bronze, red brass		90	310	N8	●●	●
		Cu alloys, short-chipping		110	380	N9	●●	●
		High tensile, Ampco		300	1010	N10		
S	Heat-resistant alloys	Fe-based	Annealed	200	680	S1	●●	●
			Hardened	280	940	S2	●●	●
		Ni- or Co-based	Annealed	250	840	S3	●●	●
			Hardened	350	1180	S4	●●	●
			Cast	320	1080	S5	●●	●
	Titanium alloys	Pure titanium		200	680	S6	●●	●
		α and β alloys, hardened		375	1260	S7	●●	●
		β alloys		410	1400	S8	●●	●
O	Thermoplastics	Without abrasive fillers				O1	●●	
	Thermosets	Without abrasive fillers				O2	●●	
	Plastics	Glass-fibre-reinforced, GFRP				O3	●●	
		Glass-fibre-reinforced, CFRP				O4	●●	
		Aramid-fibre-reinforced, AFRP				O5	●●	
	Graphite (technical)					O6	●●	

Note:
The cutting data indicates standard values.
Adjustment in individual cases is recommended.
Dry machining reduces tool life on average by 20–30%.

	Cutting material grades							
	Starting values for cutting speed v_c [m/min]							
	HC							DP
	WSM13S	WSM23S	WSM33S	WSM43S	WKP13S	WKP23S	WKP33S	WDN10
	200	190	180	170	220	200	180	
	180	170	170	160	200	180	170	
	170	160	150	140	190	170	160	
	190	180	170	160	200	180	170	
	160	150	140	130	170	150	150	
	190	180	170	160	200	180	170	
	190	180	160	150	200	180	160	
	160	150	110	100	170	150	150	
	160	150	100	100	170	150	130	
					100	80	60	
	140	130	120	110	180	170	160	
	120	110	90	80	160	150	140	
					100	80	60	
	190	180	160	140	200	180	160	
	120	100	80	60	130	120	110	
	190	170	150	130				
	120	100	80	60	130	120	110	
	170	150	130	110				
	190	180	170		190	160	140	
	170	160	150		170	130	100	
	220	210	200		350	330	250	
	180	170	160		310	300	290	
	220	210	200		300	290	280	
	180	170	160		260	250	240	
					220	200	180	
								2800
								1800
								2000
								1600
								550
								1600
								900
								850
								550
								300
	110	100	90	80				
	60	50	40	30				
	90	80	70	60				
	80	70	60	50				
	80	70	60	50				
	160	150	130	120				220
	45	40	35	30				180
	35	30	25					160
								1200
								1200
								900
								700
								700
								300

HC = Coated carbide DP = Polycrystalline diamond

Cutting data – Parting off

●● Recommended application (the specified cutting data is regarded as starting values for the recommended application)
● Possible application

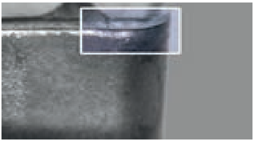
Material group	Overview of the main material groups and code letters			Brinell hardness HB	Tensile strength R_m N/mm²	Machining group		
P	Non-alloyed steel	C ≤ 0.25%	Annealed	125	430	P1	●●	●
		C > 0.25 to ≤ 0.55%	Annealed	190	640	P2	●●	●
		C > 0.25 to ≤ 0.55%	Heat-treated	210	710	P3	●●	●
		C > 0.55%	Annealed	190	640	P4	●●	●
		C > 0.55%	Heat-treated	300	1010	P5	●●	●
		Free-machining steel (short-chipping)	Annealed	220	750	P6	●●	●
	Low-alloyed steel	Annealed		175	590	P7	●●	●
		Heat-treated		285	960	P8	●●	●
		Heat-treated		380	1280	P9	●●	●
		Heat-treated		430	1480	P10	●●	●
	High-alloyed steel and high-alloyed tool steel	Annealed		200	680	P11	●●	●
		Hardened and tempered		300	1010	P12	●●	●
		Hardened and tempered		380	1280	P13	●●	●
	Stainless steel	Ferritic/martensitic, annealed		200	680	P14	●●	●
		Martensitic, heat-treated		330	1110	P15	●●	●
M	Stainless steel	Austenitic, quench hardened		200	680	M1	●●	●
		Austenitic, precipitation hardened (PH)		300	1010	M2	●●	●
		Austenitic/ferritic, duplex		230	780	M3	●●	●
K	Malleable cast iron	Ferritic		200	400	K1	●●	●
		Pearlitic		260	700	K2	●●	●
	Grey cast iron	Low tensile strength		180	200	K3	●●	●
		High tensile strength/austenitic		245	350	K4	●●	●
	Cast iron with spheroidal graphite	Ferritic		155	400	K5	●●	●
		Pearlitic		265	700	K6	●●	●
	GGV (CGI)			230	400	K7	●●	●
N	Wrought aluminium alloys	Not hardenable		30	–	N1	●●	●
		Hardenable, hardened		100	340	N2	●●	●
	Cast aluminium alloys	≤ 12% Si, not hardenable		75	260	N3	●●	●
		≤ 12% Si, hardenable, hardened		90	310	N4	●●	●
		> 12% Si, not hardenable		130	450	N5		
	Magnesium-based alloys			70	250	N6		
	Copper and copper alloys (bronze/brass)	Unalloyed, electrolytic copper		100	340	N7	●●	●
		Brass, bronze, red brass		90	310	N8	●●	●
		Cu alloys, short-chipping		110	380	N9	●●	●
		High tensile, Ampco		300	1010	N10		
S	Heat-resistant alloys	Fe-based	Annealed	200	680	S1	●●	●
			Hardened	280	940	S2	●●	●
		Ni- or Co-based	Annealed	250	840	S3	●●	●
			Hardened	350	1180	S4	●●	●
			Cast	320	1080	S5	●●	●
	Titanium alloys	Pure titanium		200	680	S6	●●	●
		α and β alloys, hardened		375	1260	S7	●●	●
		β alloys		410	1400	S8	●●	●
O	Thermoplastics	Without abrasive fillers				O1	●●	
	Thermosets	Without abrasive fillers				O2	●●	
	Plastics	Glass-fibre-reinforced, GFRP				O3	●●	
		Glass-fibre-reinforced, CFRP				O4	●●	
		Aramid-fibre-reinforced, AFRP				O5	●●	
	Graphite (technical)					O6	●●	

Note:
The cutting data indicates standard values.
Adjustment in individual cases is recommended.
Dry machining reduces tool life on average by 20–30%.

Cutting material grades						
Starting values for cutting speed v_c [m/min]						
HC					HW	DP
WSM13S	WSM23S	WSM33S	WSM43S	WKP23S	WK1	WDN10
190	180	170	160	190		
180	170	160	150	170		
160	150	140	130	160		
180	170	160	150	170		
150	140	130	120	140		
180	170	160	150	170		
180	170	150	140	170		
150	140	100	90	140		
150	140	90	90	140		
130	120	110	100	120		
110	100	80	70	100		
180	170	150	130			
100	90	70	50			
170	160	140	120			
100	90	70	50			
150	140	120	100			
180	170	160		180		
160	150	140		160		
230	220	210		230		
190	180	170		190		
210	200	190		210		
170	160	150		170		
				190		
					900	2800
					600	1800
					350	2000
					250	1600
						550
						1600
					400	900
					300	850
					200	550
						300
100	90	80	70			
50	40	30	25			
80	70	60	50			
70	60	50	40			
70	60	50	40			
150	140	130	110			220
50	40	30	25			180
40	30	25				160
						1200
						1200
						900
						700
						700
						300

HC = Coated carbide HW = Uncoated carbide DP = Polycrystalline diamond

Wear analysis and counter-measures

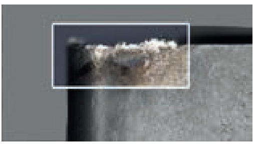


Flank face wear is caused by abrasion between the workpiece and the tool at the flank face of the indexable insert.

Measures
1. Reduce the cutting speed
2. Use a more wear-resistant cutting tool material
3. Increase the feed
4. Increase the coolant pressure/ check the alignment

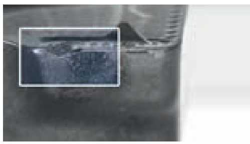
Crater wear is caused by diffusion and abrasion on the rake face.

Measures
1. Reduce the cutting speed
2. Use a more wear-resistant cutting tool material
3. Reduce the feed
4. Use a geometry with a greater rake angle
5. Increase the coolant pressure/ check the alignment



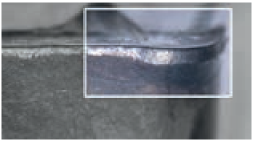
Micro galling causes parts of the workpiece material to stick to the cutting edge, resulting in a build-up on the cutting edge.

Measures
1. Increase/reduce the cutting speed
2. Use an indexable insert with a sharper cutting edge
3. Use a cutting tool material with a treated (smoother) surface
4. Increase the coolant pressure/ check the alignment



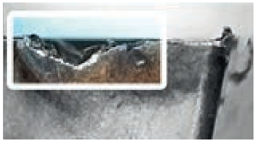
Fractures are caused by vibration, interrupted cuts, chip impacts and thermal shocks in combination with cutting tool material substrates that are too hard.

Measures
1. Reduce the cutting speed
2. Use a tougher cutting tool material
3. Reduce the feed
4. Check the tool stability if vibration occurs
5. Use more stable geometry
6. Use screw clamping instead of a self-clamping system



Plastic deformation is caused by excessive heat development combined with excessive mechanical stress.

Measures
1. Use a more wear-resistant cutting tool material
2. Reduce the feed
3. Reduce the depth of cut
4. Reduce the cutting speed
5. Increase the coolant pressure/ check the alignment



Notch wear often occurs during the machining of workpieces with a hard surface (forged or cast).

Measures
1. Reduce the cutting speed
2. Reduce the feed
3. Use a more wear-resistant cutting tool material
4. Use a less sharp indexable insert
5. Vary the depth of cut
6. Increase the coolant pressure/ check the alignment

Thermal cracks are caused by fluctuations in temperature (thermal shock).

Measures
1. Reduce the cutting speed
2. Reduce the feed
3. Use a tougher cutting tool material
4. Use a less sharp indexable insert
5. Turn off the coolant supply when machining interrupted cuts

Hardness comparison table
Tensile strength, Brinell, Vickers and Rockwell hardness (extract from DIN 50150)

Tensile strength Rm N/mm^2	Vickers hardness HV	Brinell hardness HB	Rockwell hardness HRC
255	80	76.0	
320	100	95.0	
385	120	114	
450	140	133	
510	160	152	
575	180	171	
640	200	190	
705	220	209	
770	240	228	20.3
835	260	247	24.0
900	280	266	27.1
965	300	285	29.8
1030	320	304	32.2
1095	340	323	34.4
1155	360	342	36.6
1220	380	361	38.8
1290	400	380	40.8
1350	420	399	42.7
1420	440	418	44.5
1485	460	437	46.1
1555	480	(456)	47.7
1630	500	(475)	49.1
1700	520	(494)	50.5
1775	540	(513)	51.7
1845	560	(532)	53.0
1920	580	(551)	54.1
1995	600	(570)	55.2
2070	620	(589)	56.3
2145	640	(608)	57.3
	660		58.3

Any hardness values converted on the basis of this table will be approximate only.
See DIN 50150.

Material property	Unit/ test method	Symbol
Tensile strength	N/mm^2	R_m
Vickers hardness	Diamond pyramid 136° Testing force F ≥ 98 N	HV
Brinell hardness Calculated from: HB = 0.95 × HV	$0.102 \times F/D^2 = 30\ N/mm^2$ F = testing force in N D = sphere diameter in mm	HB
Rockwell hardness C	Diamond cone 120° Overall testing force 1471 ± 9 N	HRC

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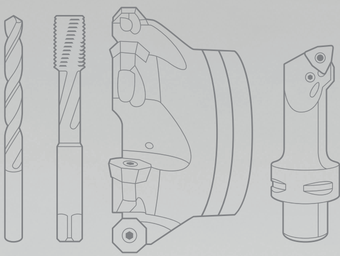

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