SECOMAX™ PCD

CUT TO PERFECTION

SECO

SECOMAX™

PolyCrystalline Diamond

With SECOMAX PCD you can now cut to perfection combining the hardest material known to man with the toughness of a polycrystalline structure. Seco Tools offers its customers PCD tooling with the best cost effective solutions: it means expertise and service.

Seco Tools expertise

Due to the well documented issues of chemical attack on diamond from ferrous materials during machining, PCD has always been recommended for non ferrous applications. However, it is not clear cut as that. Under certain conditions, PCD is effective in machining bi-metal materials like aluminium and grey cast iron as well as compact graphite iron (CGI), both growth materials for use in engine block production. With the correct choice of PCD grade, edge preparations and cutting conditions, it is also possible to efficiently machine other materials such as titanium alloys, tungsten carbides, ceramics, graphites, reinforced plastics etc.

PCD

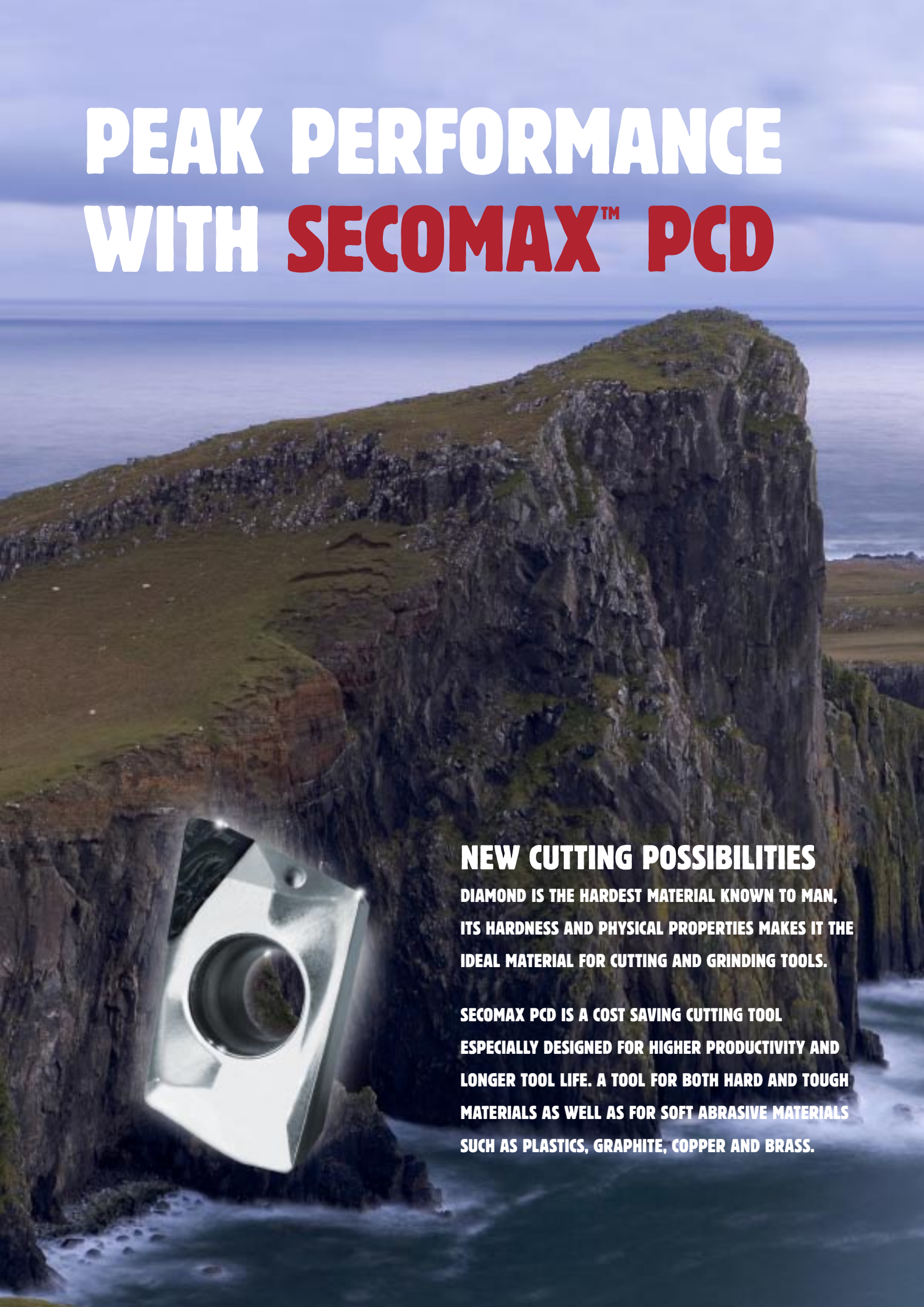
NEW POSSIBILITIES – AND NEW TOOLS FOR TIME SAVING AND COST EFFECTIVE CUTTING

Seco Tools unique Wiper for PCD is designed for higher feed and surface finish. PCD wear rates are linear to increasing the cutting speed. Wiper geometries allow productivity by increasing the feed rates. Unlike increasing cutting speeds, this has a little detrimental influence on tool life. The Wiper geometry also allows surface finishes to be maintained. Seco Tools offers standard PCD turning inserts with Wiper geometry.

Seco Tools service

With warehouse distribution centres in North America, Europe and Asia and production facilities in different countries, Seco Tools provides a product quality and delivery service which is unrivalled. The comprehensive range of inserts and cutters dedicated to PCD will help you to reduce your stock inventory. As a full range supplier, we have the solution to all your milling, turning, drilling and reaming requirements.

PEAK PERFORMANCE WITH SECOMAX™ PCD



NEW CUTTING POSSIBILITIES

DIAMOND IS THE HARDEST MATERIAL KNOWN TO MAN, ITS HARDNESS AND PHYSICAL PROPERTIES MAKES IT THE IDEAL MATERIAL FOR CUTTING AND GRINDING TOOLS.

SECOMAX PCD IS A COST SAVING CUTTING TOOL ESPECIALLY DESIGNED FOR HIGHER PRODUCTIVITY AND LONGER TOOL LIFE. A TOOL FOR BOTH HARD AND TOUGH MATERIALS AS WELL AS FOR SOFT ABRASIVE MATERIALS SUCH AS PLASTICS, GRAPHITE, COPPER AND BRASS.

WHAT MAKES IT SO GREAT?

Diamond

Diamond is essentially pure carbon. Carbon is found in two forms; graphite and diamond. In the form of graphite, the carbon atoms are arranged hexagonally with a large distance between atoms in one plane, which makes the material weak. However, in the case of diamond, the carbon atoms are arranged in an isometric, or cubic, crystal arrangement. It is this unique arrangement of the closely linked carbon atoms that makes diamond the hardest material known to man.

Process

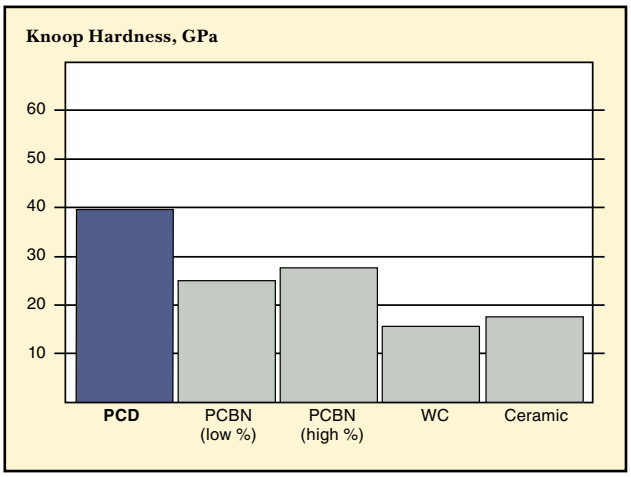
PCD is a synthesised, extremely tough, intergrown mass of randomly orientated diamond particles. It is produced by sintering together selected diamond particles at high pressure and temperature. The sintering process is rigidly controlled within the diamond stable region and an extremely hard and abrasion resistant structure is produced.

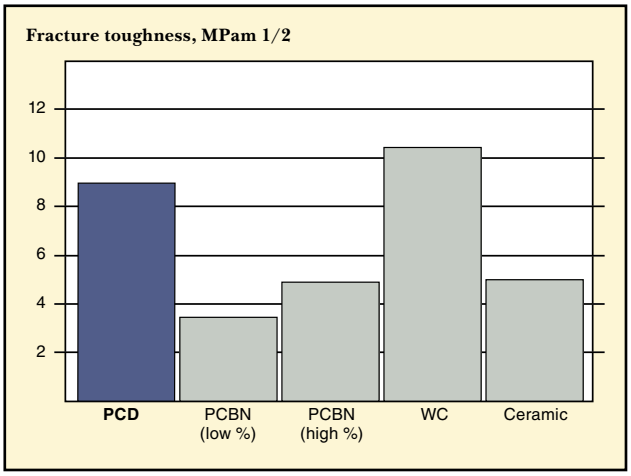
Features

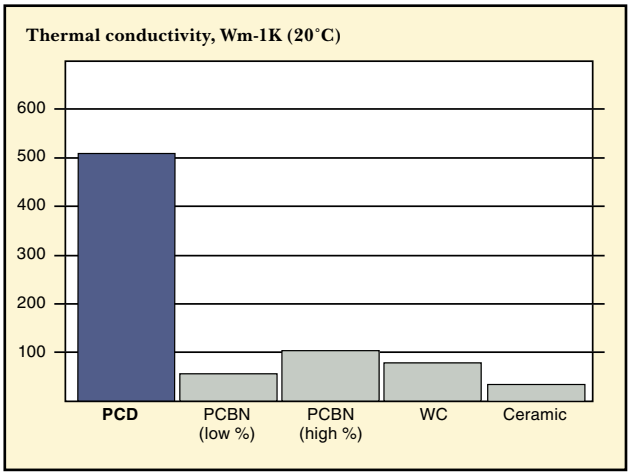
The combination of diamond in a polycrystalline form offers a formidable cutting tool offering superb hardness and therefore, wear resistance, coupled with excellent toughness thanks to its polycrystalline structure. In addition, diamond has the highest thermal conductivity of all cutting materials, allowing quick heat transfer from the cutting edge.

With the exception of PCD's high affinity with iron, PCD does not bond with work piece materials, so under correct cutting parameters, build-up edge is minimal.

All Secomax PCD tools have the rake faces mirror polished to provide the lowest friction coefficient and smooth cutting edges.

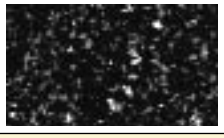
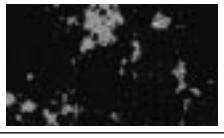






GRADE DIFFERENTIATION IS THE KEY TO PRODUCTIVITY

To optimize each customer's application, Seco Tools has a wide range of PCD grades. Fine grain for surface finish, high thermal stability for bi-metal, toughness for interrupted cut are available for dedicated solutions.

Grade*	Microstructure	Description
PCD05 Special		This grade with an average grain size of 1 micron has a well sintered, homogeneous structure. Suitable for milling and rough cutting of medium and high Si Al-alloys, high surface finish requirements in titanium alloys.
PCD10 Special		With a 2 microns grain size, this grade is dedicated to fine boring and reaming applications. The improved edge quality of this grade will out perform results in carbon fibres reinforced plastics.
PCD20		PCD20 is the first choice grade for general purposes. It has a 10 microns grain size.
PCD30		When machining very abrasive work pieces, this coarse grade of 25 microns grain size will make the difference. It is also recommended for interrupted cuts.
PCD30M Special		This multimodal grade (unique combination of 2 and 30 microns) offers thermal stability when you have to machine a combination of materials like aluminium alloy and grey cast iron.

** Special grades are available upon request.*

NEW CUTTING TOOLS FOR NEW MATERIALS

To meet the environmental challenges of today´s world, trends in vehicle production are focused on reducing fuel consumption and reducing vehicle weight. These requirements are being lead by the development of new materials with improved mechanical properties. While these material developments achieve the desired goals, the downside is that these new materials are invariably harder and more abrasive to machine.

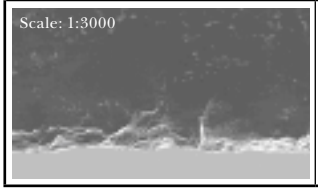
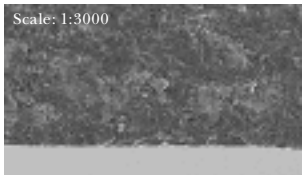
In the polycrystalline diamond (PCD) tool family, progress is also running fast. First synthesised in the 1950's, PCD is now used worldwide and is recognised as a formidable cost saving tooling solution.

The result is a cutting tool with unparalleled performance in a range of non ferrous workpiece materials, such as aluminium, plastics, reinforced plastics, ceramics, graphite and an extensive range of other workpiece materials.

Make the change

Offering an unrivalled delivery service is not the end of the story. Seco Tools has developed its production process to offer the ultimate in cutting edge quality. Below is one such example. On the left is the cutting edge of a major competitor and on the right is the equivalent cutting edge from Seco Tools.

Cutting edge comparison

Competitor	Seco Tools
	

100% control of the production with latest manufacturing.

FIELD TESTS AND REFERENCES

TOOL LIFE +3000 % — **PCD vs Tungsten carbide**

Material	Aluminium alloy + 6 % Si	
Operation	Face milling	
Criterion	Surface finish	
Toolholder	Special	
Insert	Special, PCD20	
Cutting data	v_c	3 000 m/min
	f_z	0.13 mm/tooth
	a_p	3 mm
	Coolant	Yes
Result	**WC**	1 000 parts
	PCD	30 000 parts

TOOL LIFE +750 % — **PCD vs Diamond coating**

Material	Aluminium alloy + 6 % Si	
Operation	Face milling	
Criterion	Surface finish	
Toolholder	Special	
Insert	Special, PCD20	
Cutting data	v_c	3 000 m/min
	f_z	0.13 mm/tooth
	a_p	3 mm
	Coolant	Yes
Result	**DC**	4 000 parts
	PCD	30 000 parts

FINISH IMPROVED — **PCD with Wiper feature**

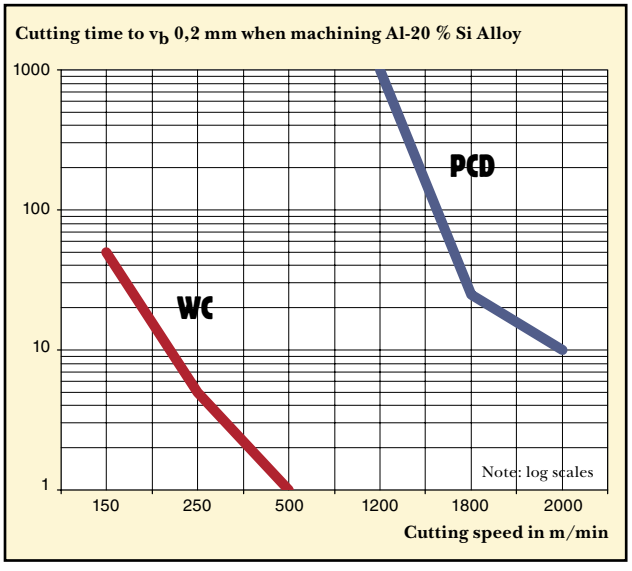
Material	Aluminium alloy + 14 % Si	
Operation	ID turning	
Criterion	Surface finish	
Toolholder	Special	
Insert	CCMW060204F-L1-WZ. PCD20	
Cutting data	v_c	966 m/min
	f	0.2 mm/rev
	a_p	0.2 mm
	Coolant	Yes
Result	Rmax = 3.8 microns without WZ	
	Rmax = 2.3 microns with WZ	

WORKPIECE MATERIALS

Aluminium alloys

Aluminium alloys have become desirable materials to address the weight reductions required by the transportation industry. Although aluminium alloy production is a greater initial demand on energy consumption, the properties of these alloys outperform other competing materials which in the long run prove much more beneficial. When pure, aluminium is soft and corrosion resistant. Alloying with elements like copper or magnesium for example provides the materials with higher strength properties. There are many aluminium alloys on the market, the most well known are the 2000 series and the 6000 series for automotive and aerospace industries. Then a split is made between forged and moulded alloys, with several different grades of each and various hardening treatment aptitudes.

With PCD the choice of cutting speed is down to the setup. The high abrasion resistance of PCD means that cutting speed, which tungsten carbide tooling can only dream about, are possible.



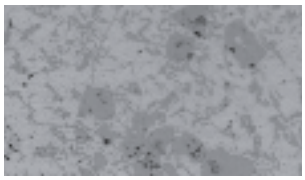
For low to medium silicon (Si) aluminium (Al) alloys, PCD offers the best chip resistance in milling applications and rough cutting.

The most common problem that can be encountered is built up edge. Even at high cutting speeds, this can happen with low Si Al alloys. Geometry and quality of the cutting edge must be carefully applied.

With such parameters, increased heat is generated when the greater contact time on the workpiece, and the effect is that tool life can be reduced.

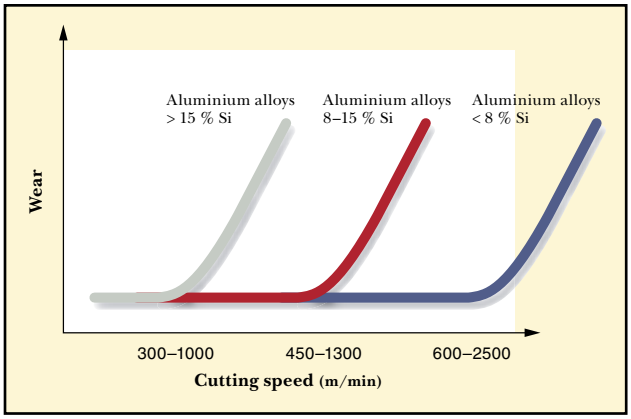
The abrasion resistance properties of PCD are fully utilised for the machining of high silicon content aluminium alloys. Some studies on these materials highlight the relation between tool wear and silicon particle size, larger Si particle size leads to increasing wear resistance of workpiece.

Difference in machining condition

Easy to machine	Difficult to machine
	
Low percentage of silicon	High percentage of silicon

The quality of the tooling will have its part to play in the success of an aluminium machining application: Low run-out will prevent inconsistent loads on the cutting edge.

With PCD tool, wear progresses gradually with cutting speed until a breaking point at which wear increases rapidly with increased cutting speed. When short tool life, reduce the cutting speed.

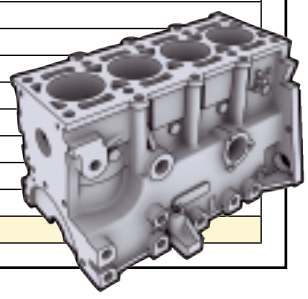


Tool life is largely independent of feed rate. High feed rates will generally give faster removal rates without reducing tool life as long as no chipping occurs. However, it should not exceed half the nose radius value. For the depth of cut, Seco Tools recommends a maximum of 65% of the cutting edge length.

The polished surface of the SECOMAX PCD insert means that coolant is not necessary. Nevertheless, coolant can be helpful when you have built-up edge or chip stacking around the cutting edge.

ENGINE BLOCK

Material	Aluminium alloy, 6 % Si	
Operation	Face milling	
Criterion	Surface finish	
Toolholder	Special	
Insert	Special, PCD30M	
Cutting data	v_c	3 500 m/min
	f_z	0.125 mm/tooth
	a_p	3 mm
	Coolant	Yes
Tool life	5 500 parts	



HYDRAULIC TRANSMISSION ELEMENT

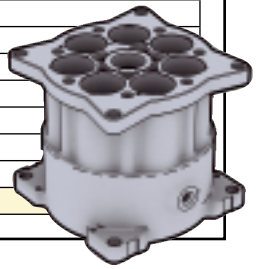
Material	Aluminium alloy, 18 % Si	
Operation	ID turning	
Criterion	Surface finish	
Toolholder	Special	
Insert	DCMW11T304F-L1, PCD30M	
Cutting data	v_c	762 m/min
	f	0.2 mm/rev
	a_p	0.3 mm
	Coolant	No
Tool life	3 600 parts	

TRANSMISSION HOUSING

Material	Aluminium alloy, 8 % Si	
Operation	Square shoulder milling	
Criterion	Tool life	
Toolholder	R220.69-0050-12-5A	
Insert	XOEX120404FR, PCD20	
Cutting data	v_c	600 m/min
	f_z	0.08 mm/tooth
	a_p	0.3 mm
	Coolant	Yes
Tool life	10 000 parts	

AIR CONDITIONING ELEMENT

Material	Aluminium alloy, 14 % Si	
Operation	ID turning	
Criterion	Surface finish	
Toolholder	Special	
Insert	CCMW060204F-L1-WZ. PCD20	
Cutting data	v_c	966 m/min
	f	0.2 mm/rev
	a_p	0.2 mm
	Coolant	Yes
Tool life	18 000 parts (7 holes/part)	



WORKPIECE MATERIALS CONTINUED

Metal Matrix Composites

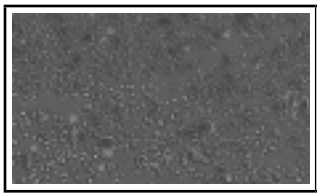
Metal Matrix Composites (MMC) is produced from either an aluminium or titanium base with aluminium being by far the most common base material. Added to the base material is a ceramic reinforcement, most commonly in the form of particle, but occasionally the more difficult to machine fibre form can also be found. A range of ceramic materials are used in MMC, but by far the most common is Si. This is added in concentrations of 15–40 % depending on the required materials wear resistance.

These materials are replacing step by step heavier materials like cast iron in parts like:

- Brake discs
- Engine blocks
- Pistons
- Liners

When machining MMC's, cutting speed should be adapted to the ceramic content of the material. The higher the ceramic reinforcement, the more abrasive the workpiece and therefore, the lower the cutting speed should be in order to protect the cutting edge.

Positive cutting edges are commonly accepted in aluminium machining, but negative inserts provide strengthened edges for severely reinforced materials.



MMC material, aluminium based, reinforced with 2–3 microns SiC particles.

BRAKE DISC

Material	MMC, 20 % Si	
Operation	OD turning	
Criterion	Surface finish	
Toolholder	Special	
Insert	Special, PCD30M	
Cutting data	v_c	300 m/min
	f	0.3 mm/rev
	a_p	2 mm
Tool life	46 minutes	

Bi-metal

Machining two different materials present in one component is often quite a challenge. One of the most common applications is the face milling of SiAl engine blocks that have grey cast iron cylinder sleeves. Machining these bi-metal components creates a challenge to the tooling supplier as one cutting tool material that works well on one of the metals often is not so efficient on the other. In the case of face milling SiAl engine blocks, the solution can be found with PCD, providing the following advice is implemented.

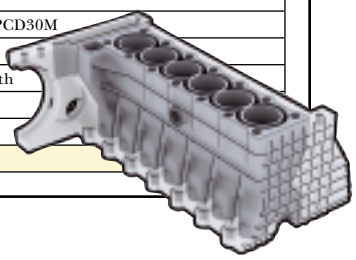
When using PCD, you have to consider following; PCD is the perfect cutting tool for the aluminium. It can machine at high cutting speeds with excellent tool life. Machining ferrous grey cast iron with PCD will lead to rapid chemical wear. Chemical wear requires heat to develop, therefore, to minimize the chemical wear on the PCD tool, cutting speed should be low and flood coolant employed.

Best grade for such operation is a grade like PCD30M with a coarse grain size and as high thermal stability as possible. By applying the correct grade at low cutting speeds with flood coolant it is possible to effectively machine bi-metal components such as Si Al engine blocks.

Other bi-metal engines exist, composed of aluminium alloy for the body (low Si content), and sintered materials for the liners, *or*
MMC materials for the liners (see previous section for more information on MMC).
See page 12 for typical machining data.

ENGINE BLOCK

Material	Aluminium 6 % Si + cast iron	
Operation	Face milling	
Criterion	Surface finish	
Toolholder	R220.13-8250-12C	
Insert	SEHN1203AFFN-E08, PCD30M	
Cutting data	v_c	400 m/min
	f_z	0.12 mm/tooth
	a_p	1 mm
	Coolant	Yes
Tool life	150 minutes	



Carbon fibres composites

With the goal of improving the power to weight ratio, composite materials have been developed by mixing fibres (carbon, glass, SiC, aramides, etc), in a matrix of plastic, aluminium, titanium, etc. Fibres can be short or long, oriented or parallel. Each of these parameters will have an influence on the material properties and cutting action.

The most common composite is CFRP (Carbon Fibres Reinforced Plastics) for aerospace for which PCD tools are especially effective. The machining operations should give a balance between the risk of flaking the workpiece fibres by employing too much feed speed, and the risk of chipping the cutting edge, if cutting speed is too high.

Even if a sharp cutting edge is required to penetrate the soft core, the reinforcement of carbon fibres will quickly dull the edge. It is even more apparent with glass reinforcement. Typical CFRP components are aerospace spars. You can also find bearings, pump parts and bushes made of such components materials.

AEROSPACE COMPONENT

Material	Epoxy resin with unidirectionnal glassroving	
Operation	Square shoulder milling	
Criterion	v_b 0,2 - Fibres flaking	
Tool	Special MiniMaster PCD20	
Cutting data	v_c	25–55 m/min, 182–250 m/min
	f_z	0.1 mm/tooth
	a_p	2 mm
	Coolant	Air blasting
Tool life	750–200 cm³ chip removal at v_c 25–55 3000–1000 cm³ chip removal at v_c 182–250	

Titanium alloys

Classified as superalloys, titanium alloys show exceptional mechanical and chemical properties often at elevated temperatures, but detrimental to machinability. With PCD tooling, you can machine at three times the cutting speed of tungsten carbide and count tool life in hours.

AEROSPACE COMPONENT

Material	TA6V	
Operation	OD turning	
Criterion	Cycle time / Tool life / Surface finish	
Tool	Standard	
Insert	Special, PCD05	
Cutting data	v_c	150 m/min
	f	0.1 mm/rev
	a_p	0.2 mm
	Coolant	Yes
Cutting speed	3 times compared to WC	
Tool life	2 to 10 hours	
Surface	Surface roughness within the 2 microns rejection criterion	

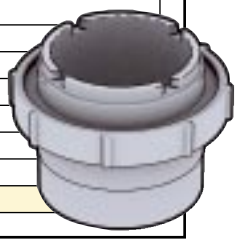
Plastics and reinforced plastics

The general perception is that plastic materials are easy to machine. However, soft plastics are not always so stable, and the machining process, which always generates heat, can affect dimensional and material properties like surface texture and colour, if the correct cutting tool is not applied. See previous section for more details on reinforcement effects.

PCD tools are particulary effective on abrasive plastics where plastics are reinforced with carbon fibres (CF) or glass fibres (GF).

HOME APPLIANCE ELEMENT

Material	Plastic +30 % carbon	
Operation	ID turning	
Criterion	Surface finish	
Toolholder	Special	
Insert	TCMW110204F-L1, PCD30M	
Cutting data	v_c	600 m/min
	f	0.25 mm/tooth
	a_p	0.3 mm
	Coolant	No
Tool life	600 parts	



Graphite

Most of the machining is done on synthetic graphite for the production of electrodes. Graphite is soft but very abrasive. Even at cutting speed of 1000 m/min, the tool life of PCD tooling is unbeatable.

ELECTRODE

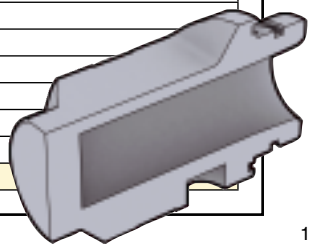
Material	Graphite	
Operation	Copy milling	
Tool	Special MiniMaster PCD20	
Cutting data	v_c	600 m/min
	f_z	0.2 mm/tooth
	a_p	5 mm
	Coolant	Air blasting
Tool life	20 hours	

Copper and brass

When not alloyed, this is a quite easy material to machine. Reduce cutting speed when copper is reinforced with beryllium.

HOME APPLIANCE ELEMENT

Material	Copper	
Operation	OD turning	
Insert	Standard PCD20	
Cutting data	v_c	600 m/min
	f	0.35 mm/rev
	a_p	2 mm
	Coolant	Yes
Tool life	10 hours	



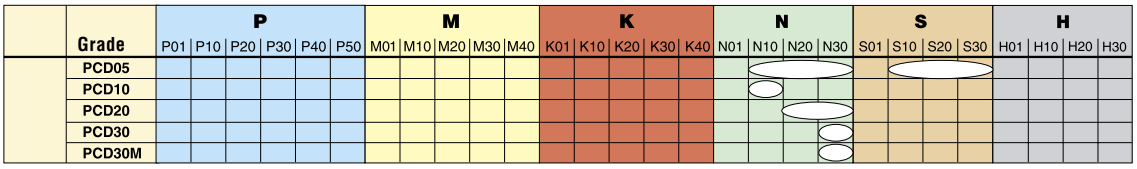
CUTTING DATA

The cutting speeds and feed rates shown in the table are often large. This is due to PCD's unique characteristics of unsurpassed hardness coupled with toughness which allows PCD cutting tools to be effective in a wide cutting speed range.

Cutting speed: Machining at the low end of the cutting speed recommendation will give optimum tool life, but will reduce productivity. Machining at the high end of the cutting speed recommendation will reduced tool life but give the optimum productivity.
Feed rate: Machining at the low end of the feed rate recommendation will give optimum surface finish, but will reduce productivity and tool life due to the increased contact time. Machining at the high end of the feed rate recommendation will give increased tool life and productivity, but the risk of edge chipping is increased.
Coolant: Where the component or operation requires no coolant, PCD can be effectively employed providing excessive heat is not generated in the cutting zone during machining. Heat build up can be controlled by limiting cutting speeds, feed rates and depth of cuts. Too much heat generated when machining will reduce PCD tool life and increase the risk of the PCD tip de-brazing. The most effective way to reduce heat during machining is to employ coolant. Therefore, coolant is always recommended when ever possible.

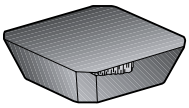
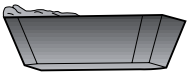
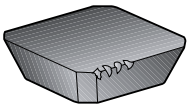
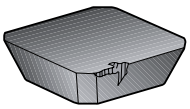
Aluminium alloys	**Operation**	v_c (m/min)	f (mm/rev)[2]	a_p (mm) [3]	**First choice**	**Optimisation**
< 8 % Si	Turning	600–3500	0.1–0.4	0.2–5	PCD20	PCD20
	Slot milling	400–2000	0.05–0.2	0.2–5	PCD20	PCD20
	Face milling	600–3500	0.05–0.3	0.2–5	PCD20	PCD20
	Boring	100–600	0.05–0.1	0.1–0.2	PCD20	PCD10
8–15 % Si	Turning	450–2500	0.1–0.4	0.2–5	PCD20	PCD20
	Slot milling	300–1500	0.05–0.2	0.2–5	PCD20	PCD20
	Face milling	400–2500	0.05–0.2	0.2–5	PCD20	PCD20
	Boring	100–600	0.05–0.1	0.1–0.2	PCD20	PCD10
> 15 % Si	Turning	300–1000	0.1–0.4	0.2–3	PCD30	PCD05
	Slot milling	200–400	0.05–0.1	0.2–3	PCD30	PCD05
	Face milling	300–1000	0.05–0.1	0.2–3	PCD30	PCD05
	Boring	100–400	0.05–0.1	0.1–0.2	PCD20	PCD05
MMC materials, aluminium based	**Operation**	v_c (m/min)	f (mm/rev)[2]	a_p (mm) [3]	**First choice**	**Optimisation**
SiC particles 15–30 %	Turning	200–800	0.1–0.5	0.2–3	PCD30	PCD05
	Milling	200–500	0.1–0.3	0.2–3	PCD30	PCD05
Bi–metal	**Operation**	v_c (m/min)	f (mm/rev)[2]	a_p (mm) [3]	**First choice**	**Optimisation**
Aluminium/Grey cast iron	Milling	100–500	0.08–0.2	0.5–1	PCD20	PCD30M
Aluminium/Sintered metal		100–300	0.08–0.2	0.5–1	PCD20	PCD30M
Plastics	**Operation**	v_c (m/min)	f (mm/rev)[2]	a_p (mm) [3]	**First choice**	**Optimisation**
Soft plastic	Turning/Milling	100–1500	0.1–0.4	0.2–3	PCD20	PCD20
Reinforced plastic (different from GFRP)		100–1000	0.1–0.3	0.2–2	PCD20	PCD20
GFRP		100–800	0.05–0.2	0.2–2	PCD20	PCD05
Other materials	**Operation**	v_c (m/min)	f (mm/rev)[2]	a_p (mm) [3]	**First choice**	**Optimisation**
Copper, brass, bronze	Turning/Milling	600–1200	0.1–0.5	0.2–3	PCD20	PCD20
Bronze/beryllium		150–500	0.05–0.3	0.2–3	PCD30	PCD30M
Carbon fibres composites[1]		400–800	0.1–0.2	0.2–3	PCD20	PCD20
Graphite		100–1500	0.1–0.2	0.2–3	PCD20	PCD20
Titanium alloys		50–300	0.1–0.2	0.2–0.5	PCD20	PCD05
Green carbide		80–200	0.1–0.5	0.1–0.5	PCD20	PCD20
Cemented carbide		10–40	0.02–0.2	0.1–0.5	PCD30	PCD30M
Green ceramic		100–600	0.1–0.2	0.1–2	PCD20	PCD20
Fired ceramic		30–100	0.1–0.2	0.1–2	PCD30	PCD30M

[1] Cutting parameters to adjust according to reinforcement type, size, and content.
[2] For milling operations, feed is expressed in mm/tooth
[3] Adjust feed / depth of cut to optimise insert load. For larger depth of cuts, adjust tip size.



The parameter guide should be viewed as typical machining parameters for the various grades of SECOMAX PCD. There are always exceptions where successful application parameters have been used which are outside the parameter guide ranges shown.

TROUBLESHOOTING

Problem		Possible cause	Suggested actions
Rapid wear		**Improper grade**	Change to coarser PCD grade
		Presence of Fe/Ni/Co	Check material composition Reduce cutting speed Use coolant
Built up edge		**High speed**	Reduce cutting speed to reduce heat generation or use coolant
		Incorrect cutting edge selection	Choose a sharper edge
		Low speed	Increase speed to improve cutting action
		Improper grade	Change to finer PCD grade
Edge chipping		**Poor rigidity**	Minimize vibration Check set-up, run-out Change nose angle
		Operating conditions	Review for proper speeds and feeds
		Improper edge design (radius or honing)	Increase nose radius or move to chamfer Add a honing or slight chamfer on the edge
		High run-out	Check set-up
		Improper grade	Change to a tougher grade (PCD10 → PCD20 → PCD30 → PCD30M → PCD05)
Edge breakage		**Improper grade**	Change to a tougher grade (PCD10 → PCD20 → PCD30 → PCD30M → PCD05)
Poor surface finish		**Improper grade**	Change to finer PCD grade
		High feed speed	Check set-up
		Poor set-up of Wiper insert	Check offset of Wiper / Other inserts
Flaking of workpiece		**Large depth of cut**	Reduce depth of cut
			Add entry chamfer on the part

PCD INSERT PROGRAMME

Turning	ISO designation	ANSI designation	Grade
	CCMW 06 02 02F-L1	CCMW 21.50.5F-L1	PCD20
	06 02 04F-L1	21.51F-L1	PCD20
	06 02 08F-L1	21.52F-L1	PCD20
	06 02 04F-L1-WZ	21.51F-L1-WZ	PCD20
	06 02 08F-L1-WZ	21.52F-L1-WZ	PCD20
	09 T3 02F-L1	CCMW 32.50.5F-L1	PCD20
	09 T3 04F-L1	32.51F-L1	PCD20
	09 T3 04F-L1-WZ	32.51F-L1-WZ	PCD20
	12 04 04F-L1	CCMW 431F-L1	PCD20
	12 04 08F-L1	432F-L1	PCD20
	CPGW 06 02 04F-L1	CPGW 21.51F-L1	PCD20
	06 02 08F-L1	21.52F-L1	PCD20
	DCMW 07 02 02F-L1	DCMW 21.50.5F-L1	PCD20
	07 02 04F-L1	21.51F-L1	PCD20
	11 T3 02F-L1	32.50.5F-L1	PCD20
	11 T3 04F-L1	32.51F-L1	PCD20
	RCGN 09 03 00F -LF	RCGN 32F-LF	PCD20
	RNGN 09 03 00F-LF	RNGN 32F-LF	PCD20
	12 03 00F-LF	42F-LF	PCD20
	SPGN 12 03 08F-L1	SPGN 422F-LF	PCD20
	TCMW 09 02 04F-L1	TCMW 1.81.51F-L1	PCD20
	11 02 02F-L1	21.50.5F-L1	PCD20
	11 02 04F-L1	21.51.F-L1	PCD20
	16 T3 04F-L1	32.51-L1	PCD20
	TPGN 11 03 04F-L1	TPGN 221F-L1	PCD20
	11 03 08F-L1	222F-L1	PCD20
	16 03 02F-L1	320.5F-L1	PCD20
	16 03 04F-L1	321F-L1	PCD20
	16 03 08F-L1	322F-L1	PCD20
	VBMW 16 04 02F-L1	VBMW 330.5F-L1	PCD20
	16 04 04F-L1	331F-L1	PCD20
	CCMW 06 02 04F-L1	CCMW 21.51F-L1	PCD30
	RNGN 09 03 00F-LF	RNGN 32F-LF	PCD30

Milling	ISO designation	Grade
	APHT 16 04 08FR-M08	PCD20
	SEEX 09 T3 AFFN-L1	PCD20
	SEHN 12 03 AFFN-E08	PCD20
	XOEX 09 03 04FR	PCD20
	XOEX 12 04 04FR	PCD20
	XOEX 09 03 04FR	PCD30
	XOEX 12 04 04FR	PCD30

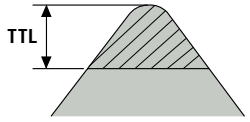
Special (limited stock)	ISO designation	Grade
	OFEX 05 T3 05FN-M05	PCD20
	OFEN 07 04 05FN-M09	PCD20
	XCHX 13 T3 04FR-M06	PCD20
	MM16-16011-P30015-M05	PCD20
	MM10-10007-P30010-M03	PCD30
	MM10-10010-B90PF-M03	PCD30
	MM12-12008-P30015-M04	PCD30
	MM12-12012-B90PF-M04	PCD30
	MM16-16016-B90PF-M05	PCD30

EDGE PREPARATION:
F is a sharp edge preparation (no hone).
WZ turning inserts are designed to have an effective Wiper angle of 95° (setting angle for Seco toolholder).

True tip length (TTL) in mm per nose radius (r_ε) - tip type is L1

Insert shape	Nose angle	r_ε=0.2 mm	r_ε=0.4 mm	r_ε=0.8 mm
C	80°	1.5	1.5	1.5
D	55°	1.9	1.8	-
S	90°	-	-	1.6
T	60°	1.8	1.7	1.6
V	35°	2.8	2.3	-

Depth of cut should not exceed 65 % of TTL.



MILLING CUTTER PROGRAMME

	Reference	D_c		KG		Insert
Square shoulder milling	**R217.69-1612.0-09-1A**	12	1	0.2	37500	XOEX09
	R217.69-1416.0-09-2A	16	2	0.3	32400	
	R217.69-1616.0-09-2A	16	2	0.2	32400	
	R217.69-1820.0-09-2A	20	2	0.4	29000	
	R217.69-2020.0-09-2A	20	2	0.4	29000	
	R217.69-2225.0-09-3A	25	3	0.6	26000	
	R217.69-2525.0-09-3A	25	3	0.6	26000	
	R217.69-3032.0-09-3A	32	3	1	22900	
	R217.69-3232.0-09-3A	32	3	1.2	22900	
	R217.69-2020.3-09TA	20	3	0.2	29000	
	R217.69-2525.3-09TA	25	4	0.4	26000	
	R220.69-0040-09-4A	40	4	0.3	20500	
	R220.69-0050-09-5A	50	5	0.4	18300	
	R220.69-0040-09-6A	40	6	0.3	20500	
	R220.69-0050-09-7A	50	7	0.4	18300	
	R220.69-0063-09-8A	63	8	0.5	16300	
	R220.69-0080-09-10A	80	10	1	14400	
	R220.69-0100-09-12A	100	12	1.6	12300	
	R217.69-1820.0-12-2A	20	2	0.3	23200	XOEX12
	R217.69-2020.0-12-2A	20	2	0.4	23200	
	R217.69-2225.0-12-2A	25	2	0.5	20800	
	R217.69-2525.0-12-2A	25	2	0.6	20800	
	R217.69-2525.0-12-3A	25	3	0.6	20800	
	R217.69-3032.0-12-3A	32	3	1	18400	
	R217.69-3232.0-12-3A	32	3	1.2	18400	
	R217.69-0320.2-12-2	20	2	0.3	23200	
	R217.69-0325.2-12-3	25	3	0.4	20800	
	R217.69-0332.2-12-4	32	4	0.4	18400	
	R217.69-2020.3-12-2A	20	2	0.2	23200	
	R217.69-2525.3-12-3A	25	3	0.4	20800	
	R217.69-3232.3-12-3A	32	3	0.6	18400	
	R217.69-3232.3-12-4A	32	4	0.6	18400	
	R217.69-2025.3S-12-3A	25	3	0.3	20800	
	R217.69-2532.3S-12-4A	32	4	0.5	18400	
	R217.69-3240.3S-12-5A	40	5	0.8	16400	
	R217.69-1020.RE-12-2A	20	2	0.1	23200	
	R217.69-1225.RE-12-3A	25	3	0.1	20800	
	R217.69-1632.RE-12-3A	32	3	0.2	18400	
	R217.69-1632.RE-12-4A	32	4	0.2	18400	
	R220.69-0125-12-8C	125	8	3.1	9200	
	R220.69-8160-12-10C	160	10	5	8200	
	R220.69-8200-12-12C	200	12	7.5	7300	
	R220.69-8250-12-16C	250	16	13	6500	
Face milling	**Reference**	**D_c**		**KG**		**Insert**
	R220.53-0032-09-4A	32	4	0.2	19800	SE..09T3
	R220.53-0040-09-4A	40	4	0.4	17700	
	R220.53-0050-09-5A	50	5	0.4	15800	
	R220.53-0063-09-6A	63	6	0.6	14100	
	R220.53-0080-09-6A	80	6	1.2	12500	
	R220.53-0100-09-7A	100	7	1.8	11200	
	R220.53-0040-09-5A	40	5	0.4	17700	
	R220.53-0050-09-6A	50	6	0.4	15800	
	R220.53-0063-09-7A	63	7	0.6	14100	
	R220.53-0080-09-8A	80	8	1.2	12500	
	R220.53-0100-09-10A	100	10	1.8	11200	
	R220.53-0080-09-5C	80	5	1.65	7400	
	R220.53-0100-09-6C	100	6	2.56	6600	
	R220.53-0125-09-8C	125	8	4.19	5900	
	R220.53-8160-09-10C	160	10	6.6	5200	
	R220.53-8200-09-12C	200	12	9.55	4700	
	R220.53-8250-09-16C	250	16	17.26	4200	
	R220.53-8160-09-7C	160	7	6.54	5200	
	R220.53-8200-09-8C	200	8	9.42	4700	
	R220.53-8250-09-10C	250	10	17.11	4200	
	R220.53-8315-09-12C	315	12	32.76	3700	
	R220.53-8400-09-16C	400	16	51.3	3300	
	R220.53-8500-09-20C	500	20	80.7	2900	
	R220.53-0080-09-6C	80	6	1.67	7400	
	R220.53-0100-09-8C	100	8	2.58	6600	
	R220.53-0125-09-10C	125	10	4.23	5900	
	R220.53-8160-09-14C	160	14	6.63	5200	
	R217.53-2020.3S-09-2A	20	2	0.2	25100	
	R217.53-2025.3S-09-3A	25	3	0.3	22400	
	R217.53-2032.3S-09-4A	32	4	0.4	19800	

MILLING CUTTER GUIDE

Cutter Family Range	First choice for
R220.13 SEHN12..	For large diameters, Wiper flat length ~1.6 mm.
R220.33 SEHN12..	For surface finish. Due to setting angle (/R220.13), Wiper flat length close to 8 mm.
R220.43 (OCTOMILL) OFEN07.. OFEX05..	Roughing due to tip size. Finishing for Wiper flat length, but must be properly set, and feed adjusted. Two different sizes of insert, large selection of cutters.
R220.69 XCXH13..	Square shoulder milling.
R220.69 APHT16..	Square shoulder milling, and face milling (surface finish) (setting via cassettes, not possible with XC13).
R220.69 XOEX09.. (MICRO TURBO) XOEX12.. (SUPER TURBO)	Square shoulder milling. Shape of the insert for chip formation (low Si alloys).
R220.53 (QUATTROMILL) SEEX09..	Very positive cutter, useful for long chip formation materials. To be chosen when R220.13 is not suitable.

NOTE:
All PCD milling inserts for these cutters are designed with Wiper flat for surface finish.

ARGENTINA Seco Tools S.A. Tel. 54 11 4892-0060 Fax 54 11 4723-8600. **AUSTRALIA** Seco Tools Australia Pty. Ltd. Tel. 1300 55 7326 Fax 1300 65 7326. **AUSTRIA** Seco Tools GmbH Tel. (2253) 21040 Fax (2253) 21040-11. **BELGIUM** S.A. Seco Tools Benelux N.V. Tel. (02) 389 09 60 Fax (02) 389 09 89. **BOSNIA** See Solvenia. **BRAZIL** Seco Tools Ind. Com. Ltda. Tel. (0xx15) 2101-8631/34 Fax (0xx15) 2101-8605. **BULGARIA** See Sweden. **CANADA** Seco Tools Canada Inc. Tel. (905) 693 1780 Fax (905) 693 1788. **CHINA** Seco Tools (Shanghai) Co. Ltd. Tel. + 86 - 21- 5426 5500 Fax + 86-21-64855685. **COLOMBIA** Rexo Tools Tel.(57 1)-6606030/31/32/33/35/37 Fax (57 1)-3110026. **CROATIA** See Slovenia. **CZECH REPUBLIC** Seco Tools CZ s.r.o. Tel. 549 249 241 / 549 216 399 Fax 549 245 740. **DENMARK** Seco Tools A/S Tel. 43 44 76 00 Fax 43 44 50 30. **ECUADOR** See Sweden. **FINLAND** Seco Tools Oy Tel. (09) 2511 72 00 Fax (09) 2511 72 01. **FRANCE** Seco Tools France Tel. 0825 826 379 Fax 02 48 67 27 05, Seco EPB Tel. 03 88 71 38 89 Fax 03 88 70 98 98. **GERMANY** Seco Tools GmbH Tel. (0211) 2401-0 Fax (0211) 2401275. **GREECE** Athens Mechanica Tel. 2105231284-5 Fax 2105231286. **HONGKONG** Seco Tools (Shanghai) Co. Ltd. Tel. 86- 21 - 5426 5500 Fax +86 - 21 - 64855685. **HUNGARY** Seco Tools KFT Tel. (36-1) 267-6720 / 383-6568 Fax (36-1) 267- 6721. **INDIA** Seco Tools India (P) Ltd. Tel. 02137-667300 Fax 02137-667430. **INDONESIA** See Singapore. **ITALY** Seco Tools Italia S.p.A. Tel. 031-978111 Fax 840-000938. **JAPAN** Seco Tools Japan. K.K. Tel. 03-3239-3071 Fax 03-3230-4955. **MACEDONIA** See Slovenia. **MALAYSIA** Seco Tools Malaysia Sdn Bhd Tel. 03-90591833 Fax 03-90594833. **MEXICO** Seco Tools de Mexico Tel./Fax 210-543-2200.**NETHERLANDS** Seco Tools Benlux N.V. Tel. 0183-636600 Fax 0183- 6606. **NEW ZEALAND** Seco Tools New Zealand Ltd. Tel. 09-415 8441 Fax 09-415 8442. **NORWAY** Seco Tools A/S Tel. 67927300 Fax 67927302. **PHILIPPINES** See Singapore. **POLAND** Seco Tools (Poland) Sp. z.o.o. Tel. (0-22) 637 53 86/85 Fax (0-22) 637 53 84. **PORTUGAL** Seco Tools Portugal, Lda. Tel. 256 371 650 Fax 256 371659. **ROMANIA** Seco Tools Romania S.R.L. Tel 40 268 414 723 Fax 40 268 476 772. **RUSSIA** Seco AB Moscow Representative Office. Tel +7(495)-680-1322 Fax +7(495)-680 6241. **SERBIA AND MONTENEGRO** See Slovenia. **SINGAPORE** Seco Tools (S.E.A.) Pte. Ltd. Tel. (65) 68 41 28 02 Fax (65) 68 41 28 01. **SLOVAKIA** Seco Tools SK s.r.o. Tel. 421 33 55 13 537, 421 33 53 41 911 Fax 421 33 55 13 538. **SLOVENIA** Seco Tools SI d.o.o. Tel. 003 86 2 450 23 40 Fax 00386 2 450 23 41. **SOUTH AFRICA** Seco Tools S.A. (Pty) Ltd. Tel. (011) 36 22 660 Fax 011 362-1893. **SOUTH KOREA** Seco Tools Korea Ltd. Tel. 041 622 -9785 to 9 Fax 041 622-9784. **SPAIN** Seco Tools España S.A. Tel. 934 745 533 Fax 934 745 550. **SWEDEN** Seco Tools AB Tel. 223 400 00 Fax 223 718 60 Telex 7510. **SWITZERLAND** Seco Tools AG Tel.0041-32 332 78 78 Fax 0041-32 332 78 79. **TAIWAN** Seco Tools Taiwan Tel. 02-26577918 Fax 02-26579461. **THAILAND** Seco Tools Thailand Tel. 02-7467 801 Fax 02-7467 802. **TURKEY** Seco Kestak A.S. Tel. (212) 613 40 43 / 613 40 44 Fax (212) 613 40 42. **UNITED KINGDOM** Seco Tools (U.K.) Ltd. Tel (01789) 764341 Fax (01789) 761170. **USA** Seco Tools Inc. Tel. 586-497 5000 Fax 586-497 5627/5629.

Seco Tools AB, SE-737 82 Fagersta, Sweden. Tel. +46 223 400 00.
www.secotools.com

02572747 ST20076104 GB SECO TOOLS AB, intryck.se, Grafiska Byrån Örebro/PA Group Karlstad 2007