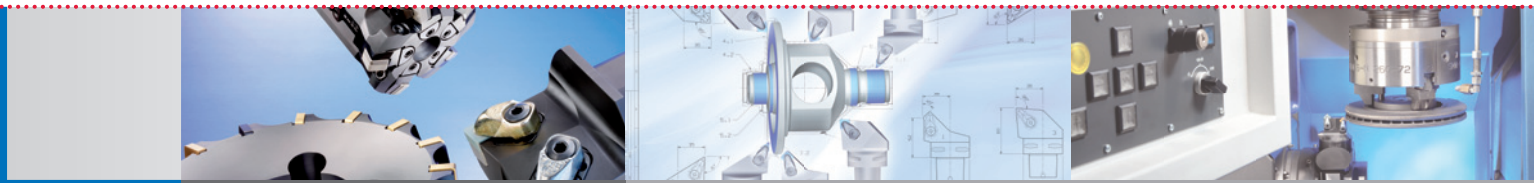
SPK COMPETENCIES

FOR THE MACHINING OF HARDENED STEEL



TOOLS | TECHNOLOGY | APPLICATION

SPK HD-LINE

CUTTING MATERIALS, TOOL SYSTEMS AND TECHNOLOGIES
FOR HARD TURNING IN THE GEAR, DRIVE AND BEARING INDUSTRY

SPK THE PRODUCTIVITY EXPERTS

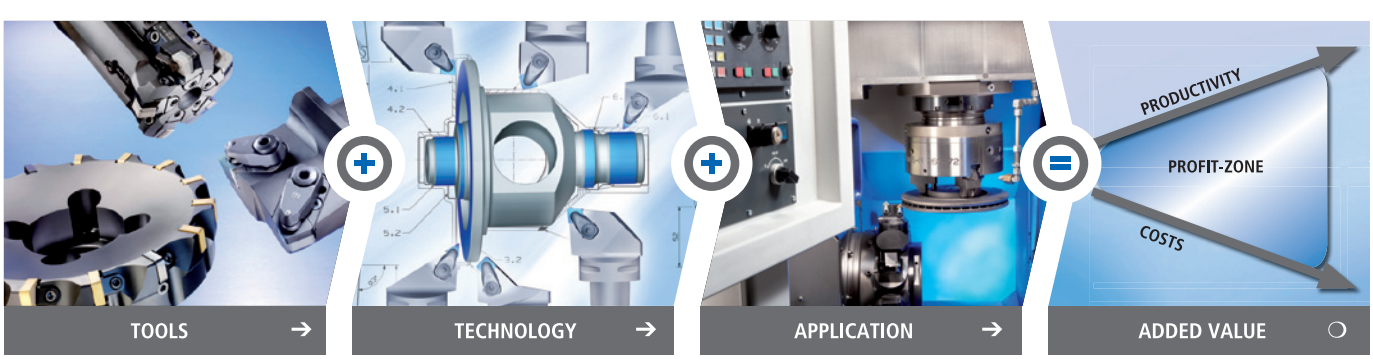
CeramTec THE CERAMIC EXPERTS

HARD TURNING

Increasingly, components made from hardened steel such as those used in the gear, drive or bearing industries are being machined using hard turning with modern cutting materials and tools. Accordingly, the high standards being set in surface quality and dimensional and shape accuracy must be achieved with process reliability.
Components in mass or batch production must be manufactured with the highest possible efficiency. In this context, hard turning is the production process that facilitates a drastic reduction in processing times, which leads to a significant decrease in machining costs and a measurable increase in productivity.
Further general conditions of production, corresponding to end user expectations, include a high-precision delivery at a reasonable price in the desired quality.
A hard turning process that is technically optimised for maximum efficiency is therefore essential:
The goal is to incorporate not only the appropriate high-performance tool systems, but also high-end machining technology, know-how and fine-tuned tool logistics into the hard turning procedure.
With its extensive product and service portfolio, SPK Cutting Tools – known as "SPK+ The Productivity Experts" – is rising to this challenge. The hard turning process is tailored according to customer requirements and is perfected in its entirety – from the cutting edges and technology used up to machine application and tool logistics.

SPK hard turning solutions for:

- Significantly reduced machining times
- Increased process reliability
- High process flexibility
- Excellent surface qualities
- Continuous and interrupted cuts
- Chip breakers for hard/ soft transitions
- High dimensional and shape accuracy



SPK-HD-LINE NEXT GENERATION MATERIALS FOR HIGH-SPEED HARD TURNING AND GREATER MACHINING FREEDOM THANKS TO:

- Up to 200% more tool life
- Cutting speed up to 240 m/min
- With a feed rate up to 0.5 mm

SPK HD-LINE

The brand new cutting material and layer system HD-LINE has been especially developed for high-performance hard turning operations. All HD-LINE grades have an exceptionally high edge stability and minimal crater wear. For the entire application spectrum – from continuous to lightly and heavily interrupted cuts – the high-performance specialists are well prepared with the range of new grades, which means that users can design the optimal hard turning process for their respective application using the cutting materials of the HD-LINE.
Both multi-tipped and Solid indexable inserts are therefore available for hard turning operations with the SPK HD-LINE.

SPK HD-LINE grades

Grades	Solid	Multi-tipped
WXM 155	●	
WXM 255	●	●
WXM 355	●	●
WXM 455		●

WXM 155 The cycle time pro

This new type of cutting material is setting new standards when it comes to efficiency. High thermal stability and red hardness make it extremely wear resistant. Materials with a hardness of up to 62 HRC can be easily machined with speeds up to v_c = 180 m/min in continuous cut.
The Solid versions support the flexible design of the hard turning processes. Adjusting the process design in this way can reduce machining times by 50% and sometimes more, when compared to multi-tipped PCBN.

WXM 255 The dimensional accuracy expert

The extraordinary wear resistance of this cutting material is setting new standards for shape and dimensional accuracy. Thanks to its thermally highly-stable binder and low chemical affinity to chrome, this grade is particularly suitable for machining hardened bearing steels. Extremely high tool lives can be achieved reliably in continuous cut. The outstanding crater wear resistance reduces the risk of cutting edge breakage and increases the process reliability.

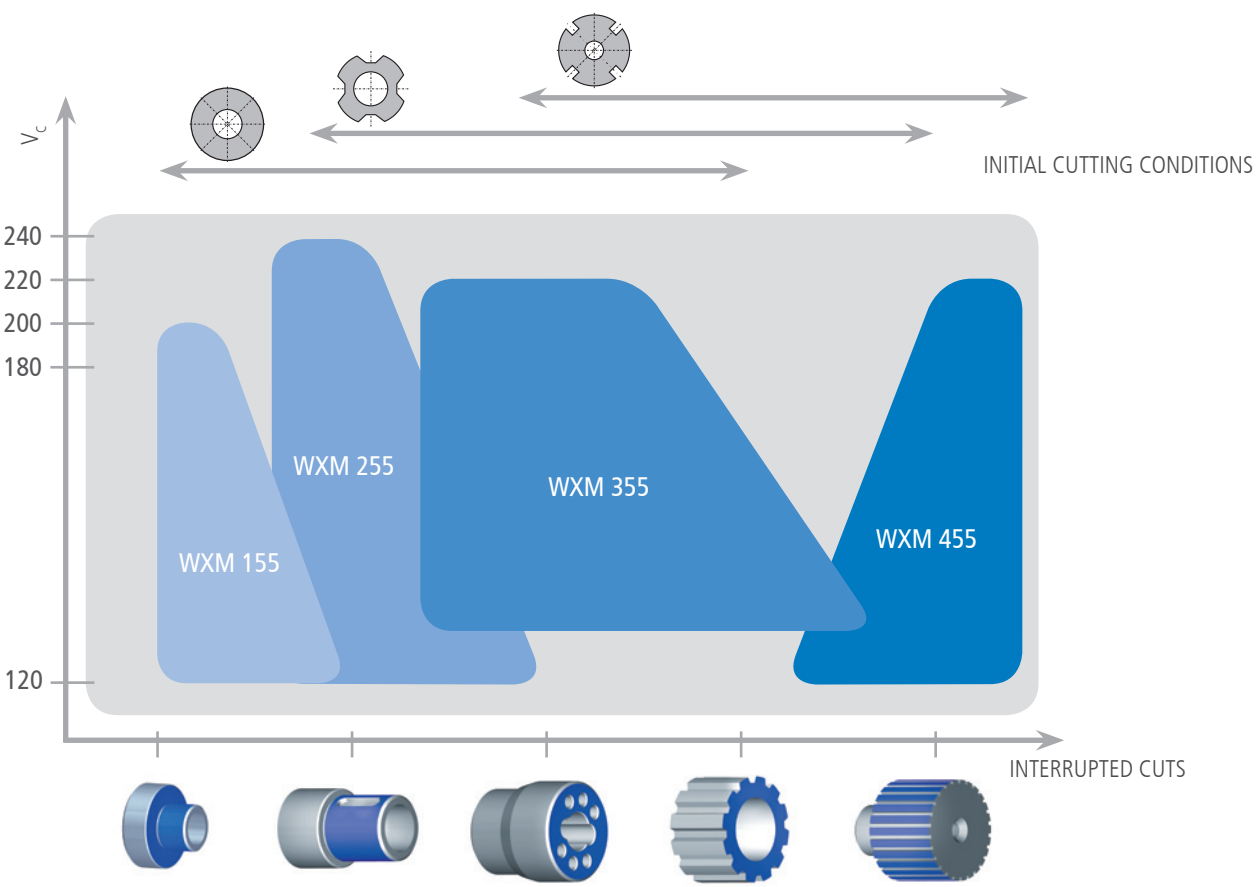
WXM 355 The all-rounder

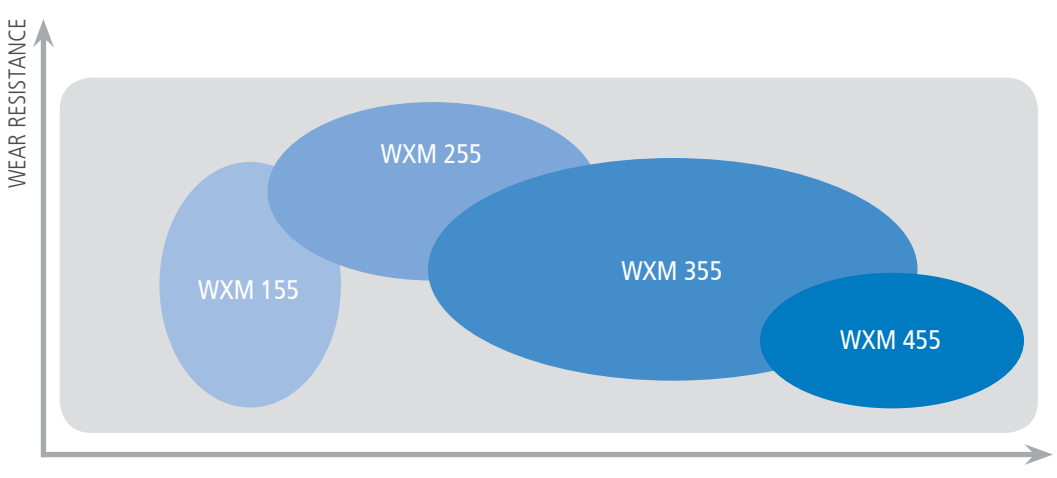
Regardless of the operation, WXM355 is the right choice. The balance of toughness and wear resistance make this grade ideal for case-hardened steel; the tool life window is also extended by up to 50%. The Solid version allows for reliable preturning as well as drawn cuts.

WXM 455 Specialist for interrupted cuts

The WXM 455 is the top choice for machining with the most heavily interrupted cuts. For these applications, the cutting material's toughness and resistance to abrasion is hugely important. This grade offers a high degree of toughness and, thanks to its optimised wear resistance, it can be implemented for machining with cutting speeds up to v_C = 220 m/min with heavily interrupted cuts.

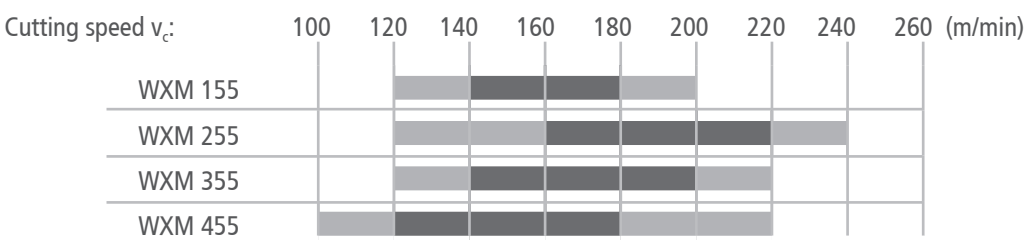
SPK HD-LINE SCOPE OF APPLICATION



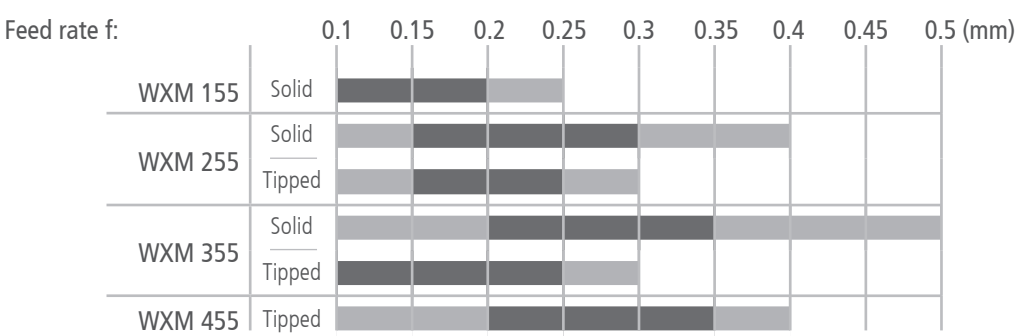


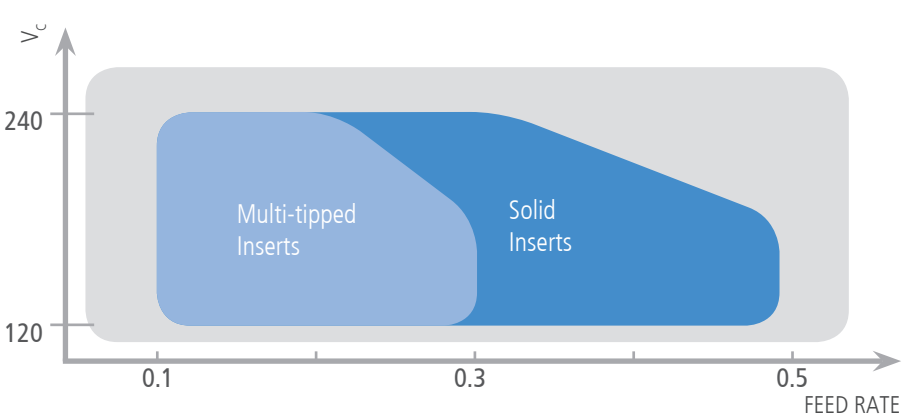
SPK HD-LINE RECOMMENDED APPLICATIONS

CUTTING SPEED RANGES



FEED RATE RANGES





SPK HD-LINE RECOMMENDED APPLICATIONS

Recommended values for turning hardened steels			
Hardness (HRC)	Cutting speed v_c (m/min)		Recommended value for chip thickness h (mm)
	Recommended value	Range	
48	300	150 - 400	≤ 0.18
52	250	130 - 300	≤ 0.16
56	200	100 - 260	≤ 0.14
60	180	80 - 240	≤ 0.12
64	150	80 - 180	≤ 0.10

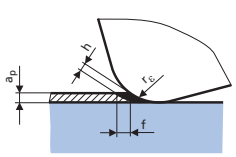
DETERMINING THE FEED RATE VALUES

When working with a small depth of cut for hard turning, the chips will have a "C" shape with a specific thickness h. In order to obtain the optimum chip formation, the feed rate should be determined according to the given formula, depending on the variable chip thickness h.

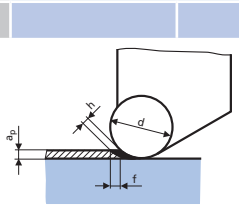
f = h • M

Example: recommended feed rate
Hardness 60 HRC
h ≤ 0.12
with r_ε = 1.6 mm where a_p = 0.5 mm
Feed rate f = 0.12 x 1.4 mm = 0.17 mm

Factor M for corner radii				
a_p (mm)	Corner radius r_ε			
	0.4	0.8	1.2	1.6
0.1	1.5	2.1	2.5	2.8
0.2	1.15	1.6	1.8	2.0
0.3	1.0	1.3	1.5	1.7
0.4	1.0	1.2	1.3	1.5
0.5		1.1	1.2	1.4



Factor M for round inserts		
a_p (mm)	Diameter d (mm) = IC	
	6.35	9.52
0.3	2.3	2.9
0.5	1.8	2.2
1.0		1.6
1.5		1.4
2.0		



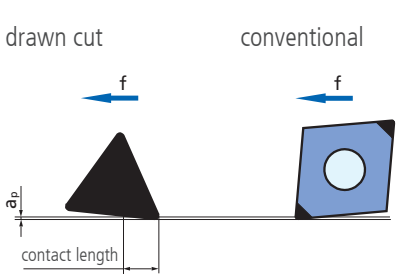
TIP

CUT DEPTHS a_p:

Conventional hard turning: a_p = 0.1 - 0.5 mm
Hard/soft transition: a_p max: = 4.0 mm

DRAWN CUTS:

- with Solid inserts, approx. $^2/_3$ of the insert length is usable
- select a small actual approach angle
- take advantage of good surface qualities by setting high feed rates



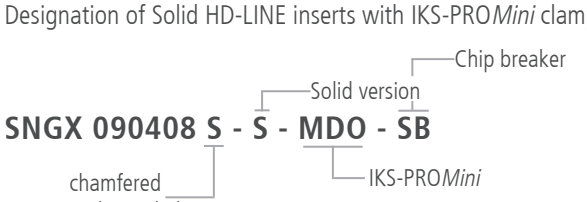
TYPES OF SOLID AND MULTI-TIPPED VERSIONS

Types of HD-Line inserts according to ISO 1832			
Symbol	Illustration	Description	SPK PCBN grades
B		one-side, multi-tipped PCBN inserts, 2 corners	WXM 255, WXM 355, WXM 455
C		one-side, multi-tipped PCBN inserts, 3 corners	WXM 255, WXM 355, WXM 455
D		one-side, multi-tipped PCBN inserts, 4 corners	WXM 255, WXM 355, WXM 455
L		two-side, multi-tipped PCBN inserts, 4 corners	WXM 255, WXM 355, WXM 455
M		two-side, multi-tipped PCBN inserts, 6 corners	WXM 255, WXM 355, WXM 455
N		two-side, multi-tipped PCBN inserts, 8 corners	WXM 255, WXM 355, WXM 455
S		PCBN Solid	WXM 155, WXM 255, WXM 355

DESIGNATION SYSTEM FOR INSERTS

Designation of multi-tipped HD-Line inserts with ZZ geometry

Designation of Solid HD-LINE inserts with IKS-PRO*Mini* clamping system



IKS-PRO*MINI* THE TOOL SYSTEM FOR HARD TURNING

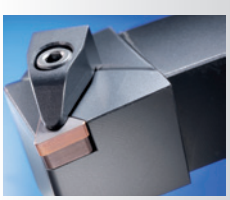
Thanks to our broad spectrum of clamping systems, we can provide the ideal tool for any hard turning application.
In order to meet the extremely high demands on positional and shape tolerances as well as surface quality, we have developed clamping systems which, in combination with our cutting materials, can reliably meet these strict tolerance requirements.

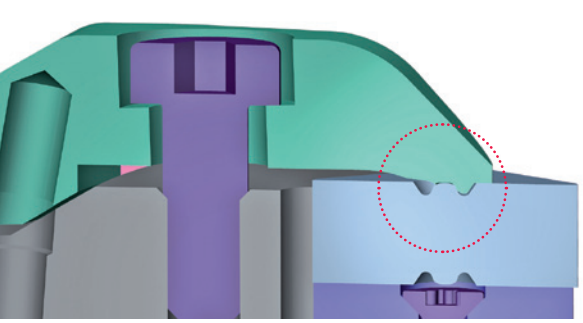
IKS-PRO*Mini*

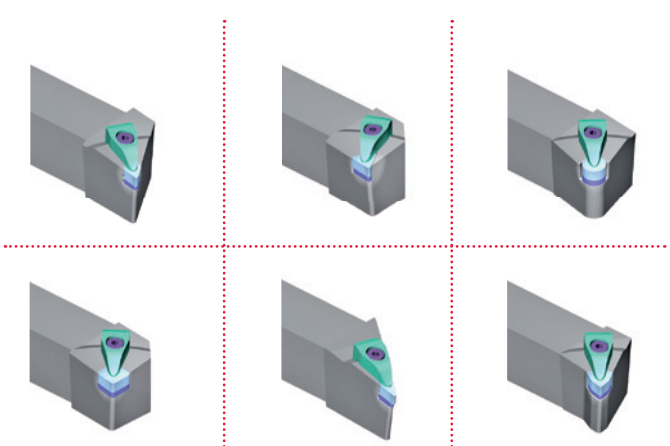
The newly developed IKS-PRO*Mini* clamping system is based on IKS-PRO. The proven notch geometry used in IKS-PRO has been further developed in order to meet the requirements of hard turning with Solid inserts. The form-fit and force-fit connection ensures the retraction of the insert into the insert seating and guarantees an extremely stable and secure clamp for hard turning. The cutting forces applied on the insert and the clamping system during hard fine machining are thereby optimally distributed across the entire insert seating and base. This makes the IKS-PRO*Mini* the optimum clamping system for achieving the most narrow tolerances using both continuous and lightly to heavily interrupted cuts; with absolute process reliability.
Moreover, thanks to its practical, simple and fast operation, IKS-PRO*Mini* allows users to meet the highest quality requirements quickly, safely and easily on a daily basis.
As a result, IKS-PRO*Mini* can significantly increase productivity through its rigid clamping characteristics, optimal cutting force distribution and simple use, while opening up further cost reduction possibilities for hard turning operations.

IKS-PRO*Mini*

High-performance clamping system for SPK HD-LINE Solid inserts.







SPECIAL SOLUTIONS

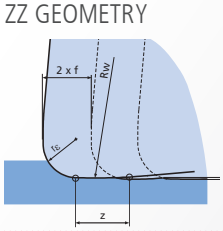
CUSTOMISED SOLUTIONS

The differing size and complexity of hardened components often demand sophisticated machining solutions that use special tools. Our engineering team assists customers with the credo of using as many standard tools as possible and as many special tools as required. Tool solutions are conceived for achieving optimum machining results and the highest level of efficiency.
Solid and multi-tipped versions are available for implementing customised inserts. As a manufacturing company, we produce special insert geometries and tools in our production facility in Germany. This gives our customers the advantage that we can supply even the most complex geometries within a short period of time. If adjustments need to be made on existing tools, these can also be performed quickly and flexibly.

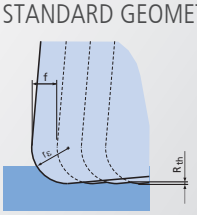
WIPER TECHNOLOGY

Advantages of wiper technology

ZZ GEOMETRY



STANDARD GEOMETRY



Equal feed rate
= doubled surface quality → **Increase inproduction quality**

Doubled feed rate
= machining times cut down by half → **Increase in productivity**

Every oak has been an acorn – this is probably the best way to describe the enormous increase in performance which can be achieved in finish-turning when using the ZZ geometry. The use of cutting inserts with a ZZ geometry allows for significantly higher surface qualities to be achieved in comparison with inserts featuring standard geometries. Alternatively, the main machining times can be reduced considerably without any consequences to high surface qualities. Therefore, the ZZ geometries represent one of the most efficient ways of increasing productivity in machining, especially in finishing operations.

Chamfer geometries

T-chamfer:
for continuous cuts

S-chamfer: with rounding
☼ 46 for lightly interrupted cuts
✧ 47 for heavily interrupted cuts

Numerous other chamfer geometries in different versions are available

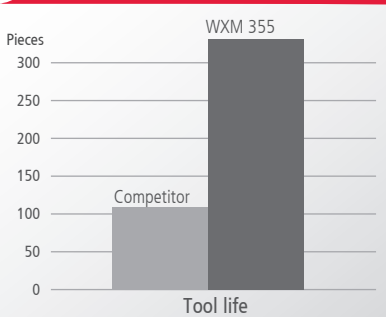
TYPES OF CUTTING EDGES

A range of different tried and tested chamfer geometries are available for the various hard turning operations. The chamfer selection will not only influence the tool life, but also the surface quality and dimensional accuracy of the workpiece. Optimising the chamfer may also cause a supplementary increase in productivity.

PERFORMANCE

Turning of an axle shaft using WXM 355		
Machining operation: finishing, axel shaft: hardened steel, 62 HRC, coolant: none		
	Competitor	SPK Cutting Tools
Grade:	PCBN	**WXM 355**
Insert:	CNGA 120408 T-B	TNGX 110408 T - S
Cutting speed v_c :	130 m/min	130 m/min
Feed rate f:	0.13 mm	0.13 mm
Depth of cut a_p :	up to 0.2 mm	up to 1.0 mm
Tool life N:	**120 pcs**	**340 pcs**
Number of cuts:	**7**	**3**
Machining times:	**100%**	**54%**

Performance comparison

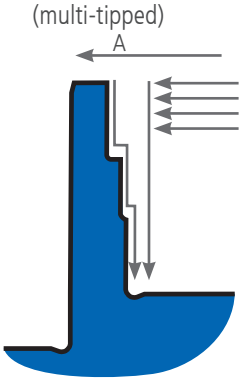


⊕ 2.8 times longer tool life

REDUCING MACHINING TIMES

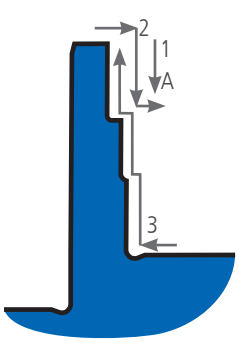
The machining time can be reduced by 46% through the use of Solid inserts, which allow for the optimisation of cut allocation from 7 to 3 cuts.

Starting situation (multi-tipped)



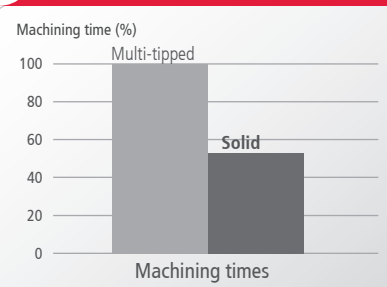
Old

Optimisation of SPK Cutting Tools (Solid)



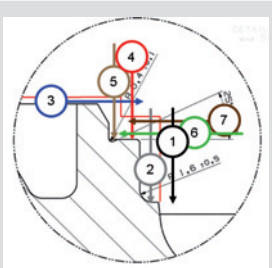
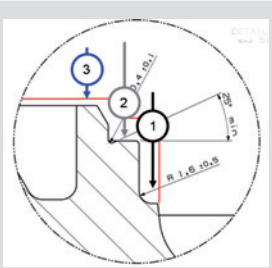
New

Performance comparison

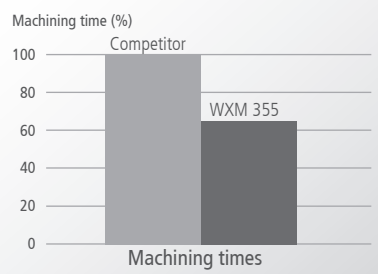


⊕ Machining time reduced by 46%

PERFORMANCE

Turning of a gear wheel using WXM 355		
Machining operation: roughing, hard/soft transition, material: 62 HRC, coolant: none		
	Competitor	SPK Cutting Tools
Grade:	PCBN	**WXM 355**
Insert:	CNGA 120412-BL	TNGX 110412 S - S **MDO**
Cutting speed v_c:	150-200 m/min	150-200 m/min
Feed rate f:	0.1 - 0.2 mm	0.1 - 0.2 mm
Depth of cut a_p:	up to 1.0 mm	up to 4.0 mm
Number of cuts:	**7**	**3**
Machining time	**100%**	**64%**
Allocation of cut		
	Before	**After**

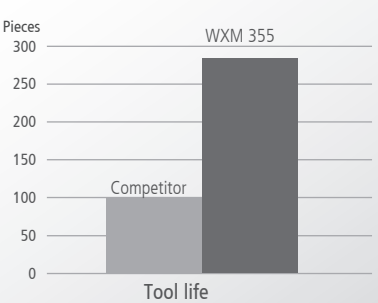
Performance comparison



⊕ Machining time reduced by 36%

Turning of a bushing using WXM 355		
Machining operation: roughing, hard/soft transition, material: CK 45, 58-60 HRC, coolant: none		
	Competitor	SPK Cutting Tools
Grade:	PCBN	**WXM 355**
Insert:	CNGA 120408 T-B	SNGX090412 S-S **MDO**
Cutting speed v_c:	170 m/min	170 m/min
Feed rate f:	0.15 mm	0.3 mm
Depth of cut a_p:	up to 0.5 mm	up to 4 mm
Tool life N:	**100 pcs**	**280 pcs**
Number of cuts:	**5**	**1**
Machining time:	**100%**	**30%**

Performance comparison



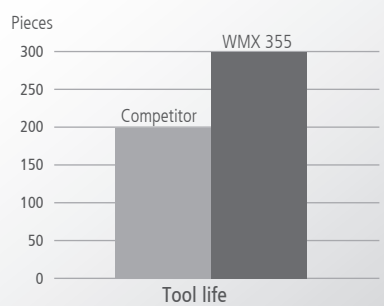
⊕ 280% tool life

⊕ Machining time reduced by 70%

PERFORMANCE

Turning of a speed variator disk/internal machining using WXM 355 Machining operation: finishing, material: case-hardened steel, 60-62 HRC, coolant: none		
	Competitor	SPK Cutting Tools
Grade:	PCBN	**WXM 355**
Insert:	DCGW 11T308	DCGW 11T308 S - BL
Cutting speed v_c:	170 m/min	170 m/min
Feed rate f:	0.07 - 0.09 mm	0.07 - 0.09 mm
Depth of cut a_p:	0.2 mm	0.2 mm
Tool life:	**200 pcs**	**300 pcs**

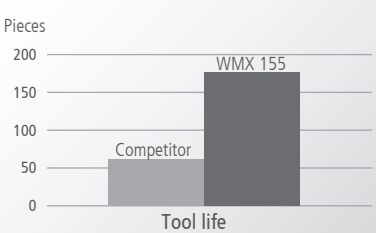
Performance comparison



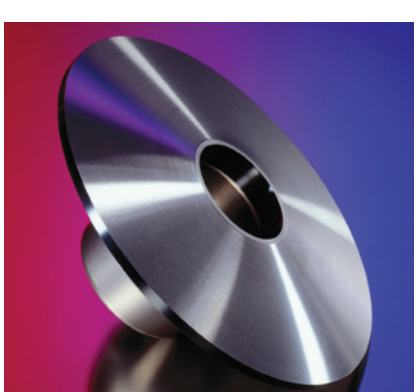
⊕ 150% tool life

Turning of a speed variator disk/external machining using WXM 155 Machining operation: finishing, material: case-hardened steel, 60-62 HRC, coolant: none		
	Competitor	SPK Cutting Tools
Grade:	PCBN	**WXM 155**
Insert:	RNGN 060300	SNGX 090412 S - S **MDO**
Cutting speed v_c:	180 m/min	180 m/min
Feed rate f:	0.18 mm	0.18 mm
Depth of cut a_p:	0.2 mm	0.2 mm
Tool life:	**60 pcs**	**175 pcs**

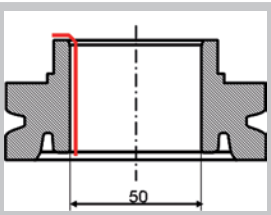
Performance comparison



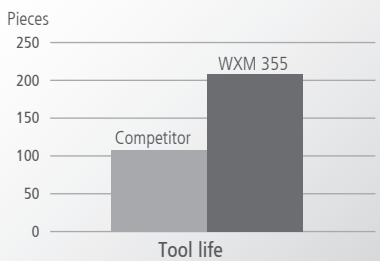
⊕ 300% tool life



PERFORMANCE

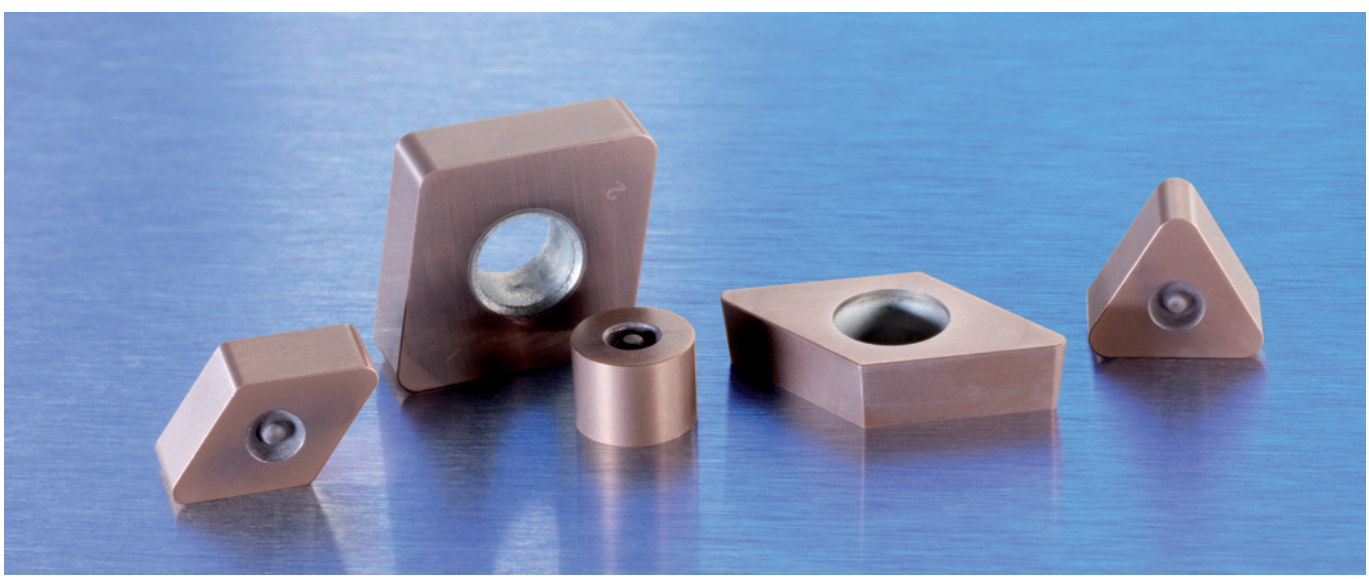
Turning of a gear wheel using WXM 355		
Machining operation: finishing, material: 16MnCrS5, 58-62 HRC, coolant: none		
	Competitor	SPK Cutting Tools
Grade:	PCBN	**WXM 355**
Insert:	CNMA 120408 T - D	CNGA 120408 S - LL
Cutting speed v_c:	180 m/min	180 m/min
Feed rate f:	0.1 mm	0.1 mm
Depth of cut a_p:	0.15 mm	0.15 mm
Tool life:	**120 pcs**	**210 pcs**
		

Performance comparison



⊕ 175% tool life

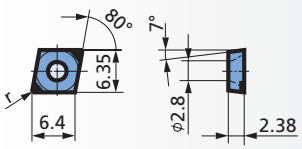
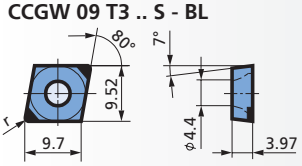
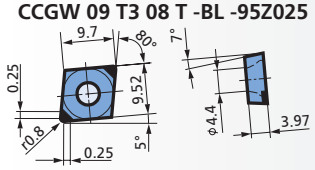
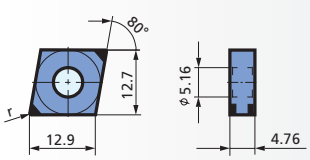
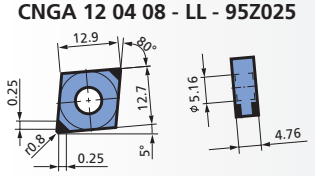
SPK HD-LINE INSERTS FOR MACHINING HARDENED STEEL



INSERTS IN MULTI-TIPPED AND SOLID VERSIONS

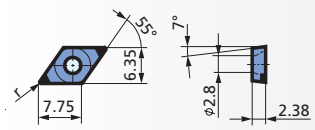
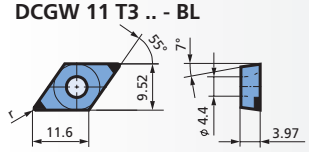
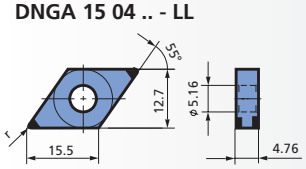
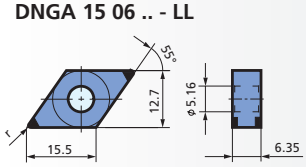
SPK HD-LINE Inserts

Multi-tipped

INSERT	ISO	GRADE	SPK-REF.NO.
CCGW 06 02 .. T - BL 	CCGW 06 02 02 T - BL	WXM255	12.57.405.44.3
	CCGW 06 02 04 T - BL	WXM255	12.57.406.44.3
	CCGW 06 02 04 T - BL	WXM455	12.57.406.46.5
CCGW 09 T3 .. S - BL 	CCGW 09 T3 04 S - BL	WXM355	12.57.401.46.4
	CCGW 09 T3 08 S - BL	WXM355	12.57.402.46.4
CCGW 09 T3 08 T -BL -95Z025 	CCGW 09 T3 08 T - BL 95Z025	WXM255	12.57.407.44.3
	CCGW 09 T3 08 T - BL 95Z025	WXM455	12.57.407.46.5
CNGA 12 04 .. - LL 	CNGA 12 04 04 T - LL	WXM255	12.56.421.44.3
	CNGA 12 04 04 S - LL	WXM355	12.56.421.46.4
	CNGA 12 04 04 S - LL	WXM455	12.56.421.46.5
	CNGA 12 04 08 T - LL	WXM255	12.56.422.44.3
	CNGA 12 04 08 S - LL	WXM355	12.56.422.46.4
	CNGA 12 04 08 S - LL	WXM455	12.56.422.46.5
	CNGA 12 04 12 T - LL	WXM255	12.56.423.44.3
	CNGA 12 04 12 S - LL	WXM355	12.56.423.46.4
	CNGA 12 04 12 S - LL	WXM455	12.56.423.46.5
CNGA 12 04 08 - LL - 95Z025 	CNGA 12 04 08 T - LL 95Z025	WXM255	12.56.429.44.3
	CNGA 12 04 08 S - LL 95Z025	WXM455	12.56.429.46.5

SPK HD-LINE Inserts

Multi-tipped

INSERT	ISO	GRADE	SPK-REF.NO.
DCGW 07 02 .. - BL 	DCGW 07 02 04 T - BL	WXM255	12.57.410.44.3
	DCGW 07 02 04 S - BL	WXM455	12.57.410.46.5
	DCGW 07 02 08 T - BL	WXM255	12.57.411.44.3
	DCGW 07 02 08 S - BL	WXM455	12.57.411.46.5
DCGW 11 T3 .. - BL 	DCGW 11 T3 04 T - BL	WXM255	12.57.408.44.3
	DCGW 11 T3 04 S - BL	WXM355	12.57.408.46.4
	DCGW 11 T3 04 S - BL	WXM455	12.57.408.46.5
	DCGW 11 T3 08 T - BL	WXM255	12.57.409.44.3
	DCGW 11 T3 08 S - BL	WXM355	☼12.57.409.46.4
	DCGW 11 T3 08 S - BL	WXM355	✧12.57.409.47.4
	DCGW 11 T3 08 S - BL	WXM455	12.57.409.46.5
DNGA 15 04 .. - LL 	DNGA 15 04 04 T - LL	WXM255	12.56.430.44.3
	DNGA 15 04 04 S - LL	WXM455	12.56.430.46.5
	DNGA 15 04 08 T - LL	WXM255	12.56.431.44.3
	DNGA 15 04 08 S - LL	WXM355	12.56.431.46.4
	DNGA 15 04 08 S - LL	WXM455	12.56.431.46.5
DNGA 15 06 .. - LL 	DNGA 15 06 04 T - LL	WXM255	12.56.424.44.3
	DNGA 15 06 04 S - LL	WXM455	12.56.424.46.5
	DNGA 15 06 08 T - LL	WXM255	12.56.425.44.3
	DNGA 15 06 08 S - LL	WXM355	12.56.425.46.4
	DNGA 15 06 08 S - LL	WXM455	12.56.425.46.5
	DNGA 15 06 12 T - LL	WXM255	12.56.426.44.3
	DNGA 15 06 12 S - LL	WXM355	☼12.56.426.46.4
	DNGA 15 06 12 S - LL	WXM355	✧12.56.426.47.4
	DNGA 15 06 12 S - LL	WXM455	12.56.426.46.5

Chamfer geometries

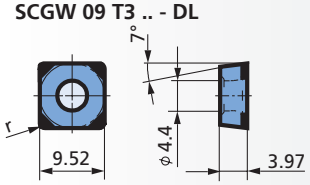
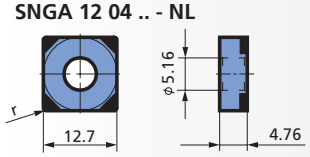
S-chamfer: with rounding 

☼ 46 for lightly interrupted cuts

✧ 47 for heavily interrupted cuts

SPK HD-LINE Inserts

Multi-tipped

INSERT	ISO	GRADE	SPK-REF.NO.
SCGW 09 T3 .. - DL 	SCGW 09 T3 04 T - DL	WXM255	12.17.419.44.3
	SCGW 09 T3 04 S - DL	WXM355	12.17.419.46.4
	SCGW 09 T3 04 S - DL	WXM455	12.17.419.46.5
	SCGW 09 T3 08 T - DL	WXM255	12.17.420.44.3
	SCGW 09 T3 08 S - DL	WXM355	12.17.420.46.4
	SCGW 09 T3 08 S - DL	WXM455	12.17.420.46.5
SNGA 12 04 .. - NL 	SNGA 12 04 04 T - NL	WXM255	12.16.404.44.3
	SNGA 12 04 04 S - NL	WXM455	12.16.404.46.5
	SNGA 12 04 08 T - NL	WXM255	12.16.405.44.3
	SNGA 12 04 08 S - NL	WXM355	☼12.16.405.46.4
	SNGA 12 04 08 S - NL	WXM355	✧12.16.405.47.4
	SNGA 12 04 08 S - NL	WXM455	12.16.405.46.5
	SNGA 12 04 12 T - NL	WXM255	12.16.406.44.3
	SNGA 12 04 12 S - NL	WXM355	12.16.406.46.4
	SNGA 12 04 12 S - NL	WXM455	12.16.406.46.5

Chamfer geometries

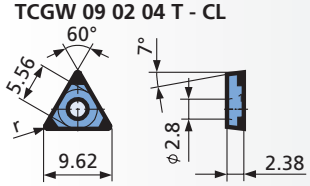
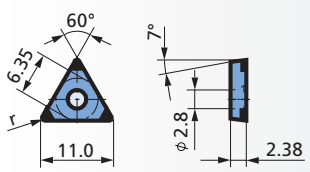
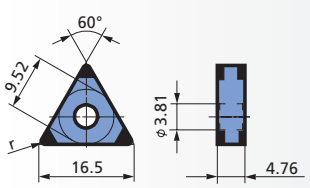
S-chamfer: with rounding

☼ 46 for lightly interrupted cuts

✧ 47 for heavily interrupted cuts

SPK HD-LINE Inserts

Multi-tipped

INSERT	ISO	GRADE	SPK-REF.NO.
TCGW 09 02 04 T - CL 	TCGW 09 02 04 T - CL	WXM255	12.37.405.44.3
	TCGW 09 02 04 S - CL	WXM455	12.37.405.46.5
TCGW 11 02 .. - CL 	TCGW 11 02 04 T - CL	WXM255	12.37.403.44.3
	TCGW 11 02 04 S - CL	WXM355	12.37.403.46.4
	TCGW 11 02 04 S - CL	WXM455	12.37.403.46.5
	TCGW 11 02 08 T - CL	WXM255	12.37.404.44.3
	TCGW 11 02 08 S - CL	WXM355	12.37.404.46.4
	TCGW 11 02 08 S - CL	WXM455	12.37.404.46.5
TNGA 16 04 .. - ML 	TNGA 16 04 04 T - ML	WXM255	12.36.405.44.3
	TNGA 16 04 04 S - ML	WXM455	12.36.405.46.5
	TNGA 16 04 08 T - ML	WXM255	12.36.406.44.3
	TNGA 16 04 08 S - ML	WXM355	☼12.36.406.46.4
	TNGA 16 04 08 S - ML	WXM355	✧12.36.406.47.4
	TNGA 16 04 08 S - ML	WXM455	12.36.406.46.5
	TNGA 16 04 12 T - ML	WXM255	12.36.407.44.3
	TNGA 16 04 12 S - ML	WXM355	☼12.36.407.46.4
	TNGA 16 04 12 S - ML	WXM355	✧12.36.407.47.4
	TNGA 16 04 12 S - ML	WXM455	12.36.407.46.5

Chamfer geometries

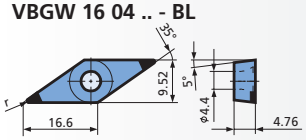
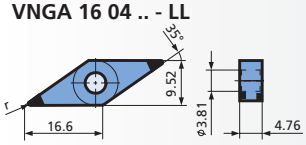
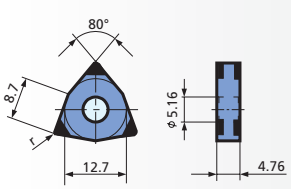
S-chamfer: with rounding

☼ 46 for lightly interrupted cuts

✧ 47 for heavily interrupted cuts

SPK HD-LINE Inserts

Multi-tipped

INSERT	ISO	GRADE	SPK-REF.NO.
VBGW 16 04 .. - BL 	VBGW 16 04 02 S - BL	WXM355	12.57.423.46.4
	VBGW 16 04 04 T - BL	WXM255	12.57.412.44.3
	VBGW 16 04 04 S - BL	WXM355	12.57.412.46.4
	VBGW 16 04 04 S - BL	WXM455	12.57.412.46.5
	VBGW 16 04 08 T - BL	WXM255	12.57.413.44.3
	VBGW 16 04 08 S - BL	WXM355	12.57.413.46.4
	VBGW 16 04 08 S - BL	WXM455	12.57.413.46.5
	VBGW 16 04 12 T - BL	WXM255	12.57.414.44.3
	VBGW 16 04 12 S - BL	WXM355	12.57.414.46.4
	VBGW 16 04 12 T - BL	WXM455	12.57.414.46.5
VNGA 16 04 .. - LL 	VNGA 16 04 04 T - LL	WXM255	12.56.427.44.3
	VNGA 16 04 04 S - LL	WXM455	12.56.427.46.5
	VNGA 16 04 08 T - LL	WXM255	12.56.428.44.3
	VNGA 16 04 08 S - LL	WXM455	12.56.428.46.5
WNGA 08 04 .. - ML 	WNGA 08 04 08 S - ML	WXM355	☼12.66.406.46.4
	WNGA 08 04 08 S - ML	WXM355	✧12.66.406.47.4
	WNGA 08 04 12 S - ML	WXM355	☼12.66.407.46.4
	WNGA 08 04 12 S - ML	WXM355	✧12.66.407.47.4

Chamfer geometries

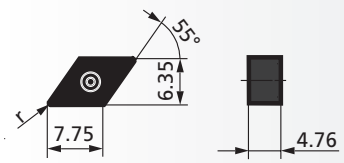
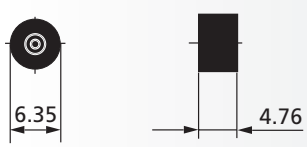
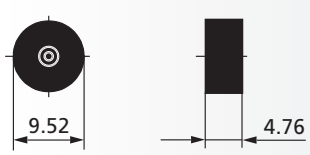
S-chamfer: with rounding

☼ 46 for lightly interrupted cuts

✧ 47 for heavily interrupted cuts

SPK HD-LINE Inserts

Solid

INSERT	ISO	GRADE	SPK-REF.NO.
DNGX 07 04 .. S-S MDO 	DNGX 07 04 04 S-S MDO	WXM155	☼12.52.062.46.2
	DNGX 07 04 04 S-S MDO	WXM155	✧12.52.062.47.2
	DNGX 07 04 04 S-S MDO	WXM355	12.52.062.46.4
	DNGX 07 04 08 S-S MDO	WXM155	☼12.52.063.46.2
	DNGX 07 04 08 S-S MDO	WXM155	✧12.52.063.47.2
	DNGX 07 04 08 S-S MDO	WXM355	☼12.52.063.46.4
	DNGX 07 04 08 S-S MDO	WXM355	✧12.52.063.47.4
	DNGX 07 04 12 S-S MDO	WXM155	☼12.52.064.46.2
	DNGX 07 04 12 S-S MDO	WXM155	✧12.52.064.47.2
	DNGX 07 04 12 S-S MDO	WXM355	☼12.52.064.46.4
	DNGX 07 04 12 S-S MDO	WXM355	✧12.52.064.47.4
RNGX 06 04 00 -S MDO 	RNGX 06 04 00 S-S MDO	WXM155	☼12.42.035.46.2
	RNGX 06 04 00 S-S MDO	WXM155	✧12.42.035.47.2
	RNGX 06 04 00 T-S MDO	WXM255	12.42.035.44.3
	RNGX 06 04 00 S-S MDO	WXM355	☼12.42.035.46.4
	RNGX 06 04 00 S-S MDO	WXM355	✧12.42.035.47.4
RNGX 09 04 00 -S MDO 	RNGX 09 04 00 S-S MDO	WXM155	☼12.42.036.46.2
	RNGX 09 04 00 S-S MDO	WXM155	✧12.42.036.47.2
	RNGX 09 04 00 T-S MDO	WXM255	12.42.036.44.3
	RNGX 09 04 00 S-S MDO	WXM355	☼12.42.036.46.4
	RNGX 09 04 00 S-S MDO	WXM355	✧12.42.036.47.4

Chamfer geometries

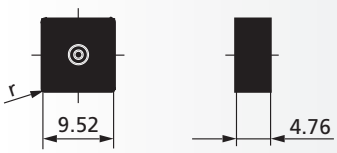
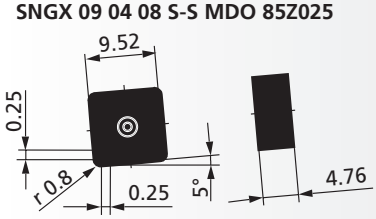
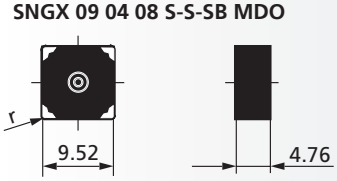
S-chamfer: with rounding 

☼ 46 for lightly interrupted cuts

✧ 47 for heavily interrupted cuts

SPK HD-LINE Inserts

Solid

INSERT	ISO	GRADE	SPK-REF.NO.
SNGX 09 04 .. -S MDO 	SNGX 09 04 08 S-S MDO	WXM155	☼12.12.080.46.2
	SNGX 09 04 08 S-S MDO	WXM155	✧12.12.080.47.2
	SNGX 09 04 08 T-S MDO	WXM255	12.12.080.44.3
	SNGX 09 04 08 S-S MDO	WXM355	☼12.12.080.46.4
	SNGX 09 04 08 S-S MDO	WXM355	✧12.12.080.47.4
	SNGX 09 04 12 S-S MDO	WXM155	☼12.12.081.46.2
	SNGX 09 04 12 S-S MDO	WXM155	✧12.12.081.47.2
	SNGX 09 04 12 T-S MDO	WXM255	12.12.081.44.3
	SNGX 09 04 12 S-S MDO	WXM355	☼12.12.081.46.4
	SNGX 09 04 12 S-S MDO	WXM355	✧12.12.081.47.4
	SNGX 09 04 16 S-S MDO	WXM155	☼12.12.082.46.2
	SNGX 09 04 16 S-S MDO	WXM155	✧12.12.082.47.2
	SNGX 09 04 16 T-S MDO	WXM255	12.12.082.44.3
	SNGX 09 04 16 S-S MDO	WXM355	☼12.12.082.46.4
	SNGX 09 04 16 S-S MDO	WXM355	✧12.12.082.47.4
SNGX 09 04 08 S-S MDO 85Z025 	SNGX 09 04 08 S-S-MDO 85Z025	WXM155	☼12.12.083.46.2
	SNGX 09 04 08 S-S-MDO 85Z025	WXM155	✧12.12.083.47.2
	SNGX 09 04 08 T-S-MDO 85Z025	WXM255	12.12.083.44.3
	SNGX 09 04 08 S-S-MDO 85Z025	WXM355	12.12.083.46.4
SNGX 09 04 08 S-S-SB MDO 	SNGX 09 04 08 S-S-SB MDO	WXM155	☼12.12.084.46.2
	SNGX 09 04 08 S-S-SB MDO	WXM155	✧12.12.084.47.2
	SNGX 09 04 08 S-S-SB MDO	WXM355	☼12.12.084.46.4
	SNGX 09 04 08 S-S-SB MDO	WXM355	✧12.12.084.47.2

Chamfer geometries

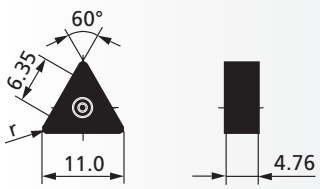
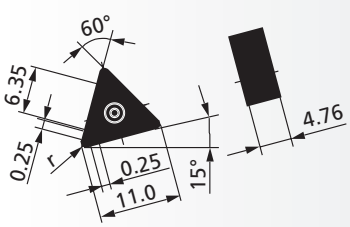
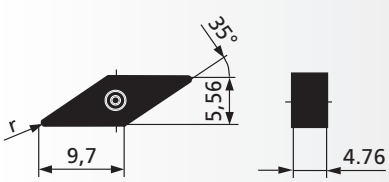
S-chamfer: with rounding 

☼ 46 for lightly interrupted cuts

✧ 47 for heavily interrupted cuts

SPK HD-LINE Inserts

Solid

INSERT	ISO	GRADE	SPK-REF.NO.
TNGX 11 04 .. -S MDO 	TNGX 11 04 08 S-S MDO	WXM155	☼12.32.036.46.2
	TNGX 11 04 08 S-S MDO	WXM155	✧12.32.036.47.2
	TNGX 11 04 08 T-S MDO	WXM255	12.32.036.44.3
	TNGX 11 04 08 S-S MDO	WXM355	☼12.32.036.46.4
	TNGX 11 04 08 S-S MDO	WXM355	✧12.32.036.47.4
	TNGX 11 04 12 S-S MDO	WXM155	☼12.32.037.46.2
	TNGX 11 04 12 S-S MDO	WXM155	✧12.32.037.47.2
	TNGX 11 04 12 T-S MDO	WXM255	12.32.037.44.3
	TNGX 11 04 12 S-S MDO	WXM355	☼12.32.037.46.4
	TNGX 11 04 12 S-S MDO	WXM355	✧12.32.037.47.4
TNGX 11 04 08 -S MDO 105Z025 	TNGX 11 04 08 S-S-MDO 105Z025	WXM155	☼12.32.038.46.2
	TNGX 11 04 08 S-S-MDO 105Z025	WXM155	✧12.32.038.47.2
	TNGX 11 04 08 T-S-MDO 105Z025	WXM255	12.32.038.44.3
	TNGX 11 04 08 S-S-MDO 105Z025	WXM355	12.32.038.46.4
VNGX 09 04 .. S-S MDO 	VNGX 09 04 04 S-S-MDO	WXM155	☼12.52.065.46.2
	VNGX 09 04 04 S-S-MDO	WXM155	✧12.52.065.47.2
	VNGX 09 04 04 S-S-MDO	WXM355	12.52.065.46.4
	VNGX 09 04 08 S-S-MDO	WXM155	☼12.52.066.46.2
	VNGX 09 04 08 S-S-MDO	WXM155	✧12.52.066.47.2
	VNGX 09 04 08 S-S-MDO	WXM355	12.52.066.46.4
	VNGX 09 04 12 S-S MDO	WXM155	☼12.52.067.46.2
	VNGX 09 04 12 S-S MDO	WXM155	✧12.52.067.47.2
	VNGX 09 04 12 S-S MDO	WXM355	12.52.067.46.4

Chamfer geometries

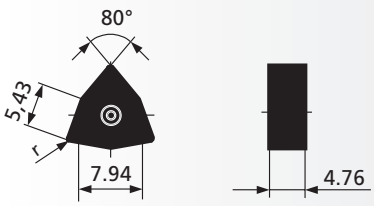
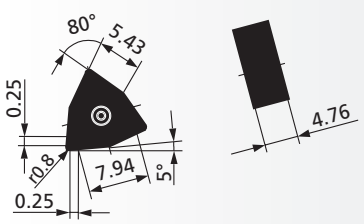
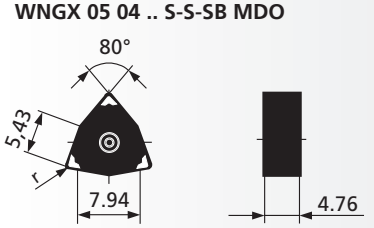
S-chamfer: with rounding

☼ 46 for lightly interrupted cuts

✧ 47 for heavily interrupted cuts

SPK HD-LINE Inserts

Solid

INSERT	ISO	GRADE	SPK-REF.NO.
WNGX 05 04 .. -S MDO 	WNGX 05 04 08 S-S MDO	WXM155	☼12.62.007.46.2
	WNGX 05 04 08 S-S MDO	WXM155	✧12.62.007.47.2
	WNGX 05 04 08 T-S MDO	WXM255	12.62.007.44.3
	WNGX 05 04 08 S-S MDO	WXM355	☼12.62.007.46.2
	WNGX 05 04 08 S-S MDO	WXM355	✧12.62.007.47.2
	WNGX 05 04 12 S-S MDO	WXM155	☼12.62.010.46.2
	WNGX 05 04 12 S-S MDO	WXM155	✧12.62.010.47.2
	WNGX 05 04 12 T-S MDO	WXM255	12.62.008.44.3
	WNGX 05 04 12 S-S MDO	WXM355	☼12.62.008.46.4
	WNGX 05 04 12 S-S MDO	WXM355	✧12.62.008.47.4
WNGX 05 04 08 S-S MDO 95Z025 	WNGX 05 04 08 S-S-MDO 95Z025	WXM155	☼12.62.009.46.2
	WNGX 05 04 08 S-S-MDO 95Z025	WXM155	✧12.62.009.47.2
	WNGX 05 04 08 T-S MDO 95Z025	WXM255	12.62.009.46.4
	WNGX 05 04 08 S-S MDO 95Z025	WXM355	12.62.009.44.3
WNGX 05 04 .. S-S-SB MDO 	WNGX 05 04 12 S-S-SB MDO	WXM155	☼12.62.010.46.2
	WNGX 05 04 12 S-S-SB MDO	WXM155	✧12.62.010.47.2
	WNGX 05 04 12 S-S-SB MDO	WXM355	☼12.62.010.46.4
	WNGX 05 04 12 S-S-SB MDO	WXM355	✧12.62.010.47.4

Chamfer geometries

S-chamfer: with rounding 

☼ 46 for lightly interrupted cuts

✧ 47 for heavily interrupted cuts

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