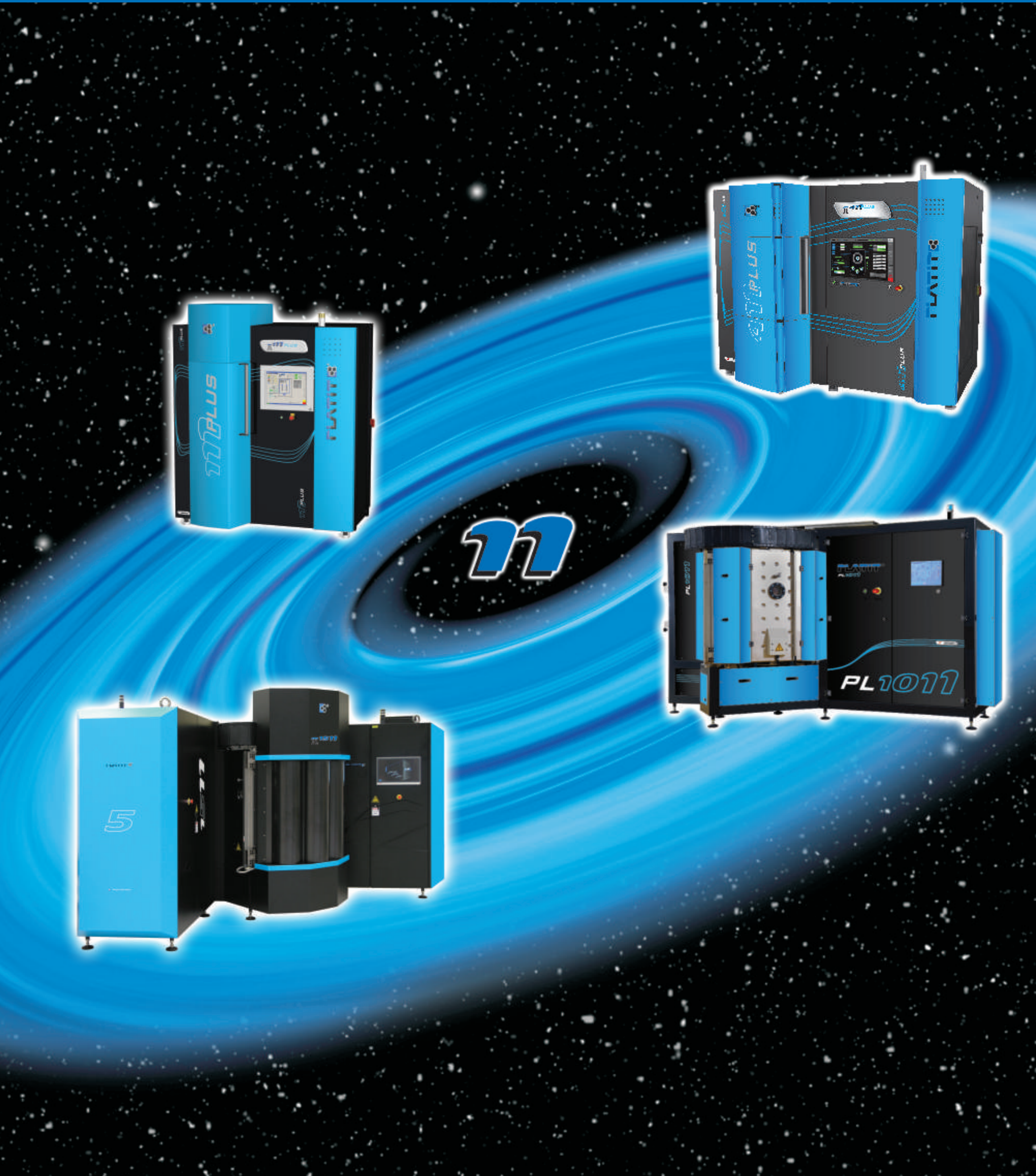
Short Catalog

11th Edition

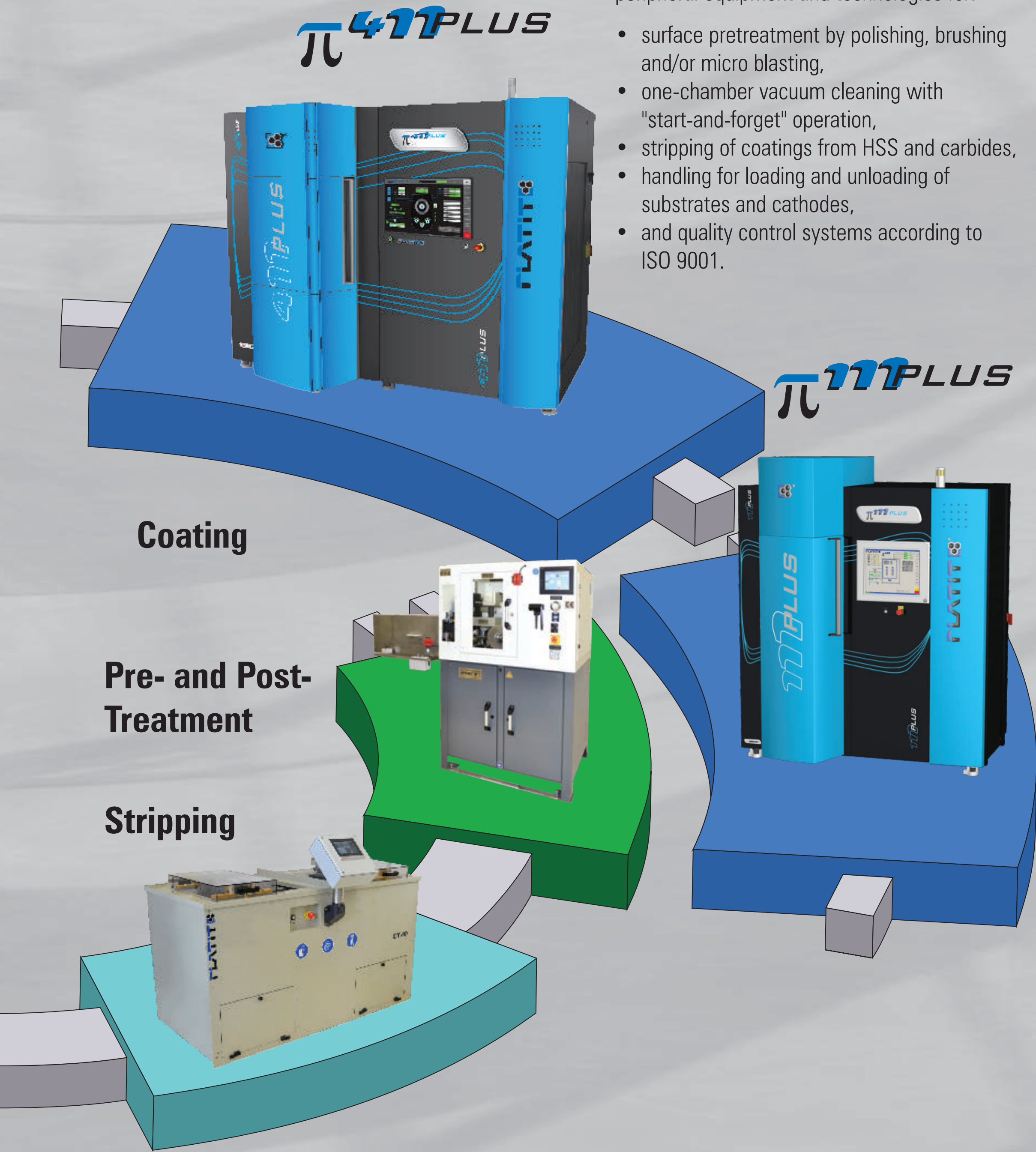


Turnkey Solutions

PLATIT®

PLATIT's turnkey systems include all necessary peripheral equipment and technologies for:

- surface pretreatment by polishing, brushing and/or micro blasting,
- one-chamber vacuum cleaning with "start-and-forget" operation,
- stripping of coatings from HSS and carbides,
- handling for loading and unloading of substrates and cathodes,
- and quality control systems according to ISO 9001.



PLATIT π111 PLUS

General Information

- The Start-Up hardcoating unit
- Based on PLATIT LARC® + technology (2 LAteral Rotating Cathodes)
- DLC^2 option

Hard Coatings

- Main standard coatings: TiN, AlTiN, nACo®
- Selected Triple**Coatings**^{3}® e.g. TiXCo^3®

Hardware

- Usable plasma volume: ø355 x H460 mm
- Max. load: 100 kg
- Optimal cycle time for shank tools (2 μm): ø10 x 70 mm, 288 pcs: 4 h
- 4 (up to 5) batches / day

VIRTUAL SHUTTER®
TUBE SHUTTER®
LARC GD®

PLATIT PL1011

General Information

- Workhorse of job coating centers
- High capacity hardcoating unit
- Based on PLATIT planar ARC technology
- DLC^2 option

Hard Coatings

- Main standard coatings: TiN, TiCN-grey, AlTiN-G
- Selected Triple**Coatings**^{3}® e.g. AlTiCrN^3®

Hardware

- Usable plasma volume: Ø700-H700 mm
- Max. load: 400 kg
- 4 planar cathodes with quick-exchange system
- Cycle time: 6 - 8 hours
- 3 (up to 4) batches / day

LARC GD®

See all standard coatings on pages 9 to 11

PLATIT π411PLUS

General Information

- The most flexible coating unit
- 4 cathodes can run simultaneously
- π411eco uses 3 LARC® cathodes only
- DLC^2 and OXI options
- CERC®: CEntral Rotating Cathode as a booster
- SCiL®: Sputtered Coating induced by LGD®
- LACS®: Lateral ARC and Central Sputtering simultaneously

Hard Coatings

- Main standard coatings: AlCrN^3, AlTiCrN$^{4®}$, nACo$^{4®}$, TiXCo$^{4®}$
- Triple**Coatings$^{3®}$**, QUAD**Coatings$^{4®}$**

Hardware

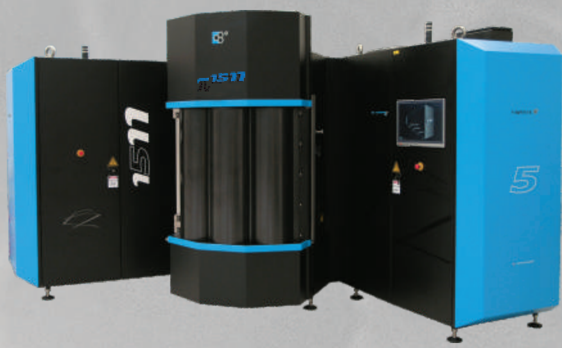
- Usable plasma volume: ø500 x H460 mm
- Max. load: 200 kg
- Optimal cycle time for shank tools (2 µm): ø10 x 70 mm, 504 pcs: 4 h
- 5 (up to 6) batches / day

VIRTUAL SHUTTER®
TUBE SHUTTER®
LARC GD®

PLATIT π1511

General Information

- High capacity hardcoating unit
- Based on PLATIT rotating (LARC®-XL) and planar-cathodic-ARC technology
- 5 cathodes can run simultaneously



Hard Coatings

- Main standard coatings: AlCrN^3, AlCrTiN$^{4®}$, TiXCo$^{4®}$
- Triple**Coatings$^{3®}$**, QUAD**Coatings$^{4®}$**

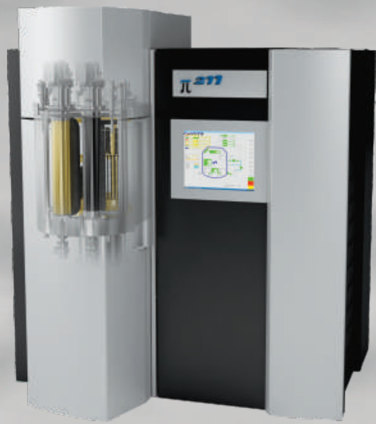
Hardware

- Usable plasma volume: ø700 x H700 mm
- Max. load: 400 kg
- Cycle time for molds and dies (4 µm): 8 h
- 3 batches / day

VIRTUAL SHUTTER®
TUBE SHUTTER®
LARC GD®

See all standard coatings on pages 9 to 11

Dedicated Coating Units



π^{211} for hard DLC^3 coatings

π^{311} predecessor of π^{411}

PL2001 for saw blades

PL1401 for broaches

π**603** for saw bands

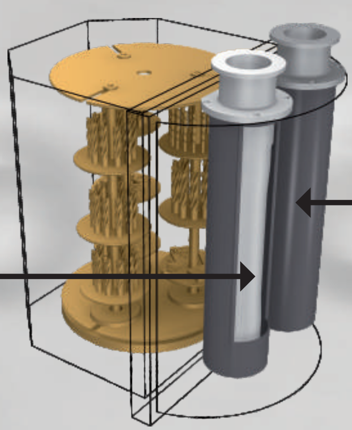
PLATIT®

Double Shuttering

VIRTUAL SHUTTER®

Target cleaning before coating

- TUBE SHUTTER® is closed
  - to protect the substrates from dust of the previous process
- ARC is burning towards the back
  - VIRTUAL SHUTTER® is on
- ARC works as getter pump and substantially improves vacuum
- Target is cleaned before deposition
  - without contaminating the substrates



TUBE SHUTTER®

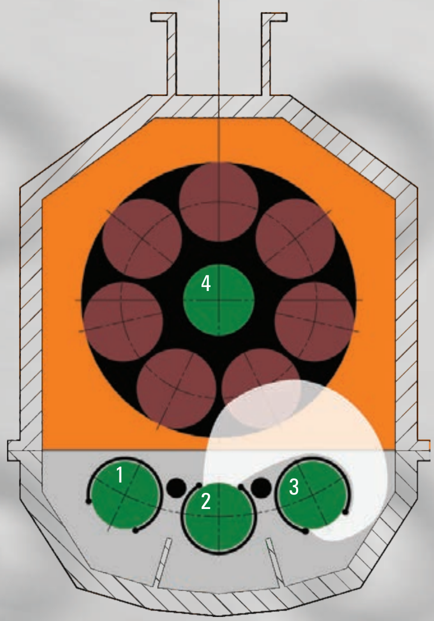
Deposition (coating)

- TUBE SHUTTER® is open
- ARC is burning towards the substrates
  - VIRTUAL SHUTTER® is off
- Smooth deposition with clean target

Advantages of the double shutters

- Adhesion layer is always deposited with clean targets
- Shuttering of all cathode types possible
- Simple handling, setting and maintenance of the shields and ceramic insulators
- Higher ARC current -> higher deposition rate possible (~+20-30%)

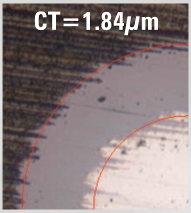
LARC GD® LARC® Glow Discharge



- LARC GD® is a new patented method, that only works with the LARC cathodes in combination with VIRTUAL SHUTTER® and TUBE SHUTTER®
- LARC GD® generates a highly efficient argon etching for special substrates with difficult surfaces (e.g. hobs, mold and dies)
- The electron stream between the cathodes 1 (or 3) and 2 creates high ion density plasma, which "cleans" even surfaces of complicated substrates
- Pulsing of LGD source ensures high LGD-process stability and suppresses micro-arcs (hard-arcs) generation.

Generations of Coatings Microstructures

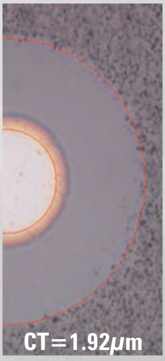
1st Generation — Monoblock Structure without Adhesion Layer



The **monoblock structure without adhesion layer** can be produced by the fastest, most economical process. All targets are made of the same material and run during the whole deposition process.

2nd Generation — Conventional Structures with Adhesion Layer

Monoblock

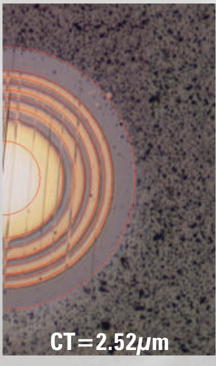


Especially at high aluminum content, **monoblock** coatings should be started with an adhesion layer (e.g. TiN or CrN).

Gradient (G)

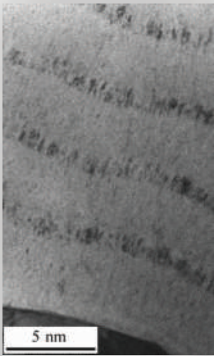
In **gradient structures** the ratio of hard components (e.g. cubic AlN) is continuously increased to obtain the highest hardness on the top of the coating.

Multilayer (ML) Period > 20 nm



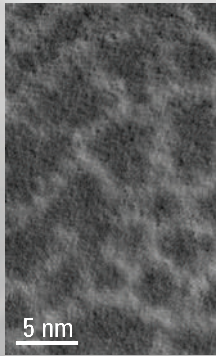
Multilayer structures have higher toughness at lower hardness than comparable monoblock coatings. The "sandwich" structure absorbs the cracks by the sublayers.

Nanolayer (NL) Period < 20 nm



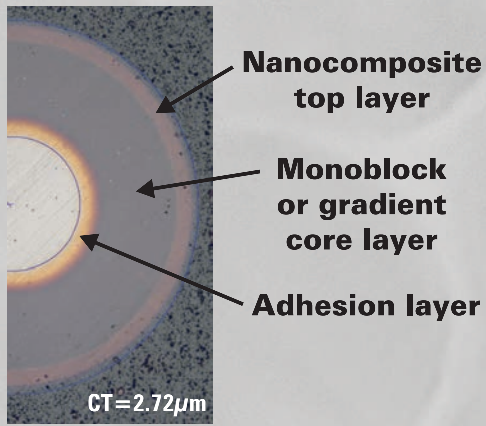
Nanolayer is the conventional structure for the so called Nanocoatings. It is a finer version of multilayers with a period of < 20 nm.

Nanocomposite (NC)

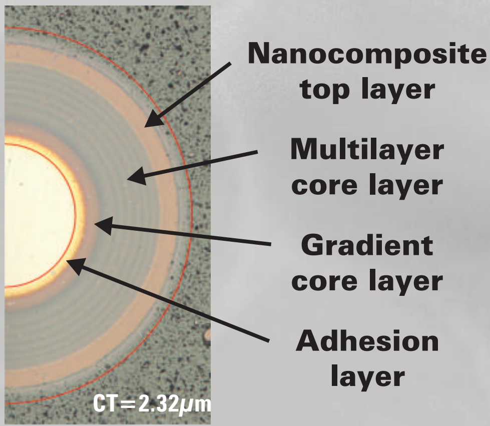


At depositing **Nanocomposites** the hard nanocrystalline grains (TiAlN or AlCrN) become embedded in an amorphous SiN-matrix.

3rd Generation: TripleCoatings3®



4th Generation: QUAD Coatings4®



Standard Coatings

The "parent" coatings determine the application fields of all "children" coatings in the same row. The "children" coatings specify PLATIT's standard coatings, which can be deposited by the machine of the columns. The exponent x (coating^{x}) describes the generation of the coating.

		π111PLUS	π411PLUS eco		π411PLUS	
	Nitride					
1	**TiN**	TiN^{1}	TiN^{1}		TiN^{1}	
2	**TiCN-grey**	TiCN^{2}-grey	TiCN^{2}-grey		TiCN^{2}-grey	
3	**TiAlN**	TiAlN^{2}-ML	TiAlN^{2}-ML		TiAlN^{2}-ML	
4	**AlTiN**	AlTiN^{2}	AlTiN^{2}		AlTiN^{2}	
5	**CrN**	CrN^{1}	CrN^{1}		CrN^{1}	
6	**CrTiN**	CrTiN^{2}-ML	CrTiN^{2}-ML		CrTiN^{2}-ML	
7	**ZrN**	ZrN^{2}	ZrN^{2}		ZrN^{2}	
8	**AlCrN**	AlCrN^{3}®-NL	AlCrN^{3}®-NL	AlCrN^{3}® +	AlCrN^{3}®-NL	AlCrN^{3}® +
9	**AlTiCrN**	AlTiCrN^{3}®	AlTiCrN^{3}®		AlTiCrN^{3}®	AlTiCrN^{4}®
10	**AlCrTiN**		ALL^{4} eco		AlCrTiN^{4}® = ALL^{4}®	ALL^{4} eco
11	**nACo**	nACo^{2}®	nACo^{3}®		nACo^{3}®	nACo^{4}®
12	**nACRo**	nACRo^{2}®	nACRo^{2}®	nACRo^{4}® eco	nACRo^{3}®	nACRo^{4}® eco
13	**TiXCo**	TiXCo^{3}®	TiXCo^{3}®		TiXCo^{3}®	TiXCo^{4}®
	Oxi-Nitride					
14	**nACoX**				nACoX^{4}®	
	DLC					
15	**VIc**	VIc^{2}®: DLC^{2}	VIc^{2}®: DLC^{2}		VIc^{2}®: DLC^{2}	
16	**cVIc**	cVIc^{1}®: TiCN^{1} + CBC^{1}	cVIc^{1}®: TiCN^{1} + CBC^{1}		cVIc^{1}®: TiCN^{1} + CBC^{1}	
17	**CROMVIc**	CROMVIc^{2}®: CrN^{1} + DLC^{2}	CROMVIc^{2}®: CrN^{1} + DLC^{2}		CROMVIc^{2}®: CrN^{1} + DLC^{2}	
18	**CROMTIVIc**	CROMTIVIc^{2}®: CrTiN^{2} + DLC^{2}	CROMTIVIc^{2}®: CrTiN^{2} + DLC^{2}		CROMTIVIc^{2}®: CrTiN^{2} + DLC^{2}	
19	**nACVIc**	nACVIc^{2}®: nACRo^{2}® + DLC^{2}	nACVIc^{2}®: nACRo^{2}® + DLC^{2}		nACVIc^{2}®: nACRo^{2}® + DLC^{2}	
	SCiL					
20	**TiN-SCiL**				TiN^{1}-SCiL®	
21	**TiCN-SCiL**				TiCN^{1}-SCiL®	TiCC^{1}-SCiL®
22	**TiB_2-SCiL**				TiB_2-SCiL®	
	LACS®					
23	**BorAC®**				BorAC®: AlCrN/BN-LACS®	
24	**BorAT®**				BorAT®: AlTiN/BN-LACS®	

		PL1011	π1511
	Nitride		
1	**TiN**	TiN^{1}	TiN^{1}
2	**TiCN-grey**	TiCN^{2}-grey	TiCN^{2}-grey
3	**TiAlN**	TiAlN^{2}-ML	
4	**AlTiN**	AlTiN^{2}	AlTiN^{3}®
5	**CrN**	CrN^{1}	CrN^{1}
6	**CrTiN**	CrTiN^{2}-ML	CrTiN^{3}®
7	**ZrN**	ZrN^{2}	
8	**AlCrN**	AlCrN^{2}	AlCrN^{3}®-NL
9	**AlTiCrN**	AlTiCrN^{3}®	AlTiCrN^{4}®
10	**AlCrTiN**		AlCrTiN^{4}® = ALL^{4}®
11	**nACo**		nACo^{4}®
12	**nACRo**		nACRo^{4}®
13	**TiXCo**		TiXCo^{4}®
	Oxi-Nitride		
14	**nACoX**		nACoX^{4}®
	DLC		
15	**VIc**		
16	**cVIc**	cVIc^{1}®: TiCN^{1} + CBC^{1}	
17	**CROMVIc**	CROMVIc^{2}®: CrN^{1} + DLC^{2}	
18	**CROMTIVIc**	CROMTIVIc^{2}®: CrTiN^{2} + DLC^{2}	
19	**nACVIc**		

Coating Properties

Group	No.	Coating	*	π111 PLUS	π411 eco	π411	π1511	PL1011	Color	Nano-hardness up to [GPa]	Thickness [µm]	Friction- (fretting) coefficient	Max. usage temperature [°C]
Nitrides	1	TiN	*	√	√	√	√	√	gold	26	1 - 7	0.4	600
Nitrides	2	TiCN-grey	*	√	√	√	√	√	violet	38	1 - 4	0.25	400
Nitrides	3	TiAlN		√	√	√		√	violet-black	36	1 - 4	0.5	700
Nitrides	4	AlTiN		√	√	√	√	√	black	32	1 - 4	0.6	900
Nitrides	5	CrN	*	√	√	√	√	√	metal-silver	20	1 - 7	0.5	700
Nitrides	6	CrTiN	*	√	√	√	√	√	metal-silver / gold	30	1 - 7	0.40	600
Nitrides	7	ZrN	*	√	√	√		√	white-gold	22	1 - 4	0.40	550
Nitrides	8	AlCrN		√	√	√	√	√	blue-grey	36	1 - 7	0.5	900
Nitrides	9	AlTiCrN		√	√	√	√	√	blue-grey	37	1 - 4	0.5	850
Nitrides	10	ALL^{4}®=AlCrTiN				√	√		blue-grey	37	1 - 5	0.45	850
Nitrides	11	nACo®		√	√	√	√		violet-blue	41	1 - 4	0.4	1200
Nitrides	12	nACRo®		√	√	√	√		blue-grey	40	1 - 7	0.45	1100
Nitrides	13	TiXCo®		√	√	√	√		copper	44	1 - 4	0.35	900
OXI	14	nACoX^{4}®			√	√	√		black	30 - 41	4 - 15	0.40	1200
DLC	15	Vic®	*	√	√	√			grey	20 - (>50)	0.4 - 1	0.15	400
DLC	16	cVIc®	*	√	√	√		√	grey	26 - (>50)	1 - 2	0.15	400
DLC	17	CROMVIc®	*	√	√	√		√	grey	20 - (>50)	1 - 3	0.10	450
DLC	18	CROMTIVIc®	*	√	√	√		√	grey	30	1 - 4	0.10	450
DLC	19	nACVIc®		√	√	√			grey	40	1 - 10	0.15	450
SCiL	20	TiN-SCiL®				√			gold	26	1 - 7	0.35	600
SCiL	21	TiCN-SCiL®				√			violet	38	1 - 4	0.25	400
SCiL	22	TiB_2-SCiL®				√			light grey B	30	0.5 -1.5	0.35	600
LACS®	23	BorAC®: AlCrN/BN				√			blue grey B	30 - 50	1 - 7	0.5	900
LACS®	24	BorAT®: AlTiN/BN				√			violet-black B	40 - 50	1 - 4	0.6	900

Main Coatings of the π411PLUS Options

Options / Machines	Conventional Coatings	Nanocomposite Coatings	TripleCoatings^{3}®	QUAD Coatings^{4}®
π411 eco	TiN, TiCN, CrN, CrTiN, ZrN, AlTiN, AlCrN	nACo^{2}®, nACRo^{2}®	AlCrN^{3}®, TiXCo^{3}®, AlTiCrN^{3}®	ALL^{4}® eco, nACRo^{4}® eco
π411DLC	cVIc®, CROMVIc^{2}®, CROMTIVIc^{2}®	nACVIc^{2}®		
π411TURBO	TiN, TiCN, CrN, CrTiN, ZrN, AlTiN, AlCrN	nACo^{2}®, nACRo^{2}®	nACo^{3}®, nACRo^{3}®, AlCrN^{3}®, TiXCo^{3}®, AlTiCrN^{3}®	nACo^{4}®, nACRo^{4}®, TiXCo^{4}®, AlTiCrN^{4}®, AlCrTiN^{4}=ALL^{4}®+Tribo
π411OXI				nACoX^{4}®
π411SCIL	TiN, TiB_2		TiCC	
π411LACS	AlTiN-LACS, AlCrN-LACS		BorAC®=AlCrN/BN BorAT®=AlTiN/BN	

Main Application Fields

			Cutting	Forming	Machine Component
1	TiN	*	universal use	molds and dies	universal use, also for decorative purposes
2	TiCN-grey	*	tapping, milling for HSS and HM with coolant	molds and dies, punching	
3	TiAlN		drilling and universal use, also for weak machines		
4	AlTiN		milling, hobbing, high performance machining, also dry		
5	CrN	*	cutting wood, light metals like copper, and Al alloys with low Si	molds and dies	
6	CrTiN	*	cutting and forming high alloyed materials with HSS tools	molds and dies with higher hardness, extrusion	tool holders, corrosion prot., medical tools
7	ZrN	*	machining aluminum, magnesium, titanium alloys		for decorative purposes
8	AlCrN		dry milling, hobbing, sawing	fine blanking, punching	
9	AlTiCrN®		universal; wet and dry cutting	molds and dies, stamping, deep drawing, bending, fine punching	
10	ALL$^{4®}$= AlCrTiN		universal, cutting of abrasive materials	molds and dies, forging, fine blanking	
11	nACo®		turning, hard machining on stable machine, drilling, reaming, grooving		
12	nACRo®		tough wet cutting of difficult materials (superalloys), micro tools	friction welding, extrusion, die casting	
13	TiXCo®		for superhard cutting		
14	nACoX®		HSC dry turning and milling		for components with highly abrasive load
15	VIc®	*	cutting light metals, wood, composites and graphite with carbide tools	punches and forming tools from carbide	wear components from carbide
16	cVIc®	*	aluminum machining to avoid built-up edges	molds and dies, punches for lower friction	wear components from non-carbide
17	CROMVIc®	*	cutting wood, light metals like copper/ Al alloys with low Si, also for MQL	universal use for forming with lower friction	car parts, blisks, sawing parts, copper parts
18	CROMTIVIc®	*	cutting high alloyed materials with HSS tools also with MQL	molds and dies with lower friction	car parts, blisks, sewing parts
19	nACVIc®		tapping of high alloyed materials and titanium	molds and dies, punching	
20	TiN-SCiL®		tapping, thread forming, gun drilling, reaming		
21	TiCC		tapping, thread forming, gun drilling, reaming with MQL		
22	TiB_2		cutting light metals, especially aluminum with low Si		
23	BorAC®		dry milling, hobbing, sawing	fine blanking, punching	
24	BorAT®		drilling, dry cutting		

***LT:** Low temperature processes possible. **VIc®**: DLC (Diamond Like Coating)

Nanocomposite coatings: **nACo®**: TiAlN/SiN – **nACRo®**: CrAlN/SiN – **TiXCo®**: TiN/SiN – **SCiL®**: Sputtered Coatings induced by LARC-GD®

The given physical values may vary at different coating structures (gradient, mono-, multi- and nanolayers).

The main application fields of the coating components:

- Ti: general component, for wet machining, drilling, turning
- C: for forming and cutting of sticky materials at low temperature, for machine components as DLC
- Al: for universal use, for abrasive materials, for dry machining
- Cr: for abrasive and high alloyed materials, also at dry machining, for wood
- Si: general and hard machining as Nanocomposites for rigid machines, for finishing
- O: for high temperature machining, for turning, milling

Coating Guide

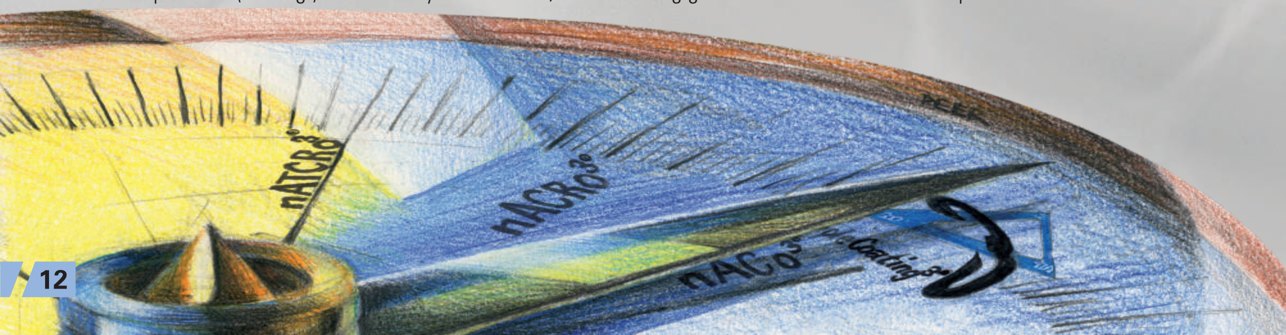
Coating Usage Recommendations

	Cutting				Chipless Forming		
	Turning	Milling - Hobbing Gear Cutting Sawing	Drilling Reaming Broaching	Tapping	Injection molding	Stamping Punching	Forming Deep Drawing Extrusion
Steels unalloyed < 1000 N/mm^2	nACo AlTiN	ALL^{4}® nACRo	nACo AlTiN	AlTiCrN TiCN	nACVIc CrTiN	AlCrN nACVIc	AlTiCrN (+CrCN) TiCN
Steels unalloyed > 1000 N/mm^2	nACo AlTiN	ALL^{4}® nACRo	nACo AlTiN	AlTiCrN TiCN	nACVIc CrN	AlCrN ALL^{4}®	AlTiCrN (+CrCN) TiCN
Steels hardened < 55 HRC	nACo TiXCo	nACo TiXCo	nACo TiXCo	nACo TiCN		AlCrN ALL^{4}®	
Steels hardened > 55 HRC	TiXCo nACo	TiXCo nACo	TiXCo nACo	TiXCo nACo		AlCrN TiXCo	
Stainless steel	nACo nACoX^{4}®	ALL^{4}® nACRo	nACo TiXCo	ALL^{4}® TiCN	ALL^{4}® (+CrCN) CROMTIVIc	ALL^{4}® (+CrCN) CROMTIVIc	ALL^{4}® (+CrCN) CROMTIVIc
Superalloys Ni-based	nACoX^{4}® nACo	nACoX^{4}® AlTiCrN	TiXCo nACo	nACVIc TiCN	nACVIc CROMTIVIc	nACVIc CROMTIVIc	nACVIc CROMTIVIc
Superalloys Ti-based	ALL^{4}® nACRo	nACRo ALL^{4}®	nACRo ALL^{4}®	CROMTIVIc TiCN	nACVIc CROMTIVIc	nACVIc CROMTIVIc	nACVIc CROMTIVIc
Cast iron	nACo AlTiN	nACo AlTiN	nACo AlTiN	nACRo AlTiCrN			
Aluminum Si > 12%	nACRo TiCN	nACRo TiCN	nACRo TiCN	nACRo TiCN	nACRo TiCN	AlCrN	nACVIc CROMTIVIc
Aluminum Si < 12%	TiB_2 ZrN	TiB_2 ZrN	TiB_2 ZrN	TiB_2 ZrN	TiB_2 ZrN	TiB_2 ZrN	TiB_2 ZrN
Copper	CROMVIc^{3}® CrN	CROMVIc^{3}® CrN	CROMVIc^{3}® CrN	CROMVIc^{3}® CrN	CROMVIc^{3}® CrN	CROMVIc^{3}® CrN	CROMVIc^{3}® CrN
Bronze, Brass, Plastic	TiCN CROMTIVIc	TiCN CROMTIVIc	TiCN CROMTIVIc	TiCN CROMTIVIc	TiCN CROMTIVIc	TiCN CROMTIVIc	TiCN CROMTIVIc
Graphite	CROMVIc^{3}® TiXCo^{3}®	CROMVIc^{3}® TiXCo^{3}®	CROMVIc^{3}® TiXCo^{3}®	CROMVIc^{3}® TiXCo^{3}®			
Carbon-fibre composites	CROMVIc^{3}® TiXCo	CROMVIc^{3}® TiXCo	CROMVIc^{3}® TiXCo	CROMVIc^{3}® TiXCo			
Wood	CROMTIVIc nACVIc	CROMTiVic nACVIc	CROMTiVic nACVIc	CROMTiVic nACVIc			

Primary Recommendation: If available, use this coating for the application. — coating A

Alternate Recommendation: Use this coating when the primary recommendation is not available. — coating B

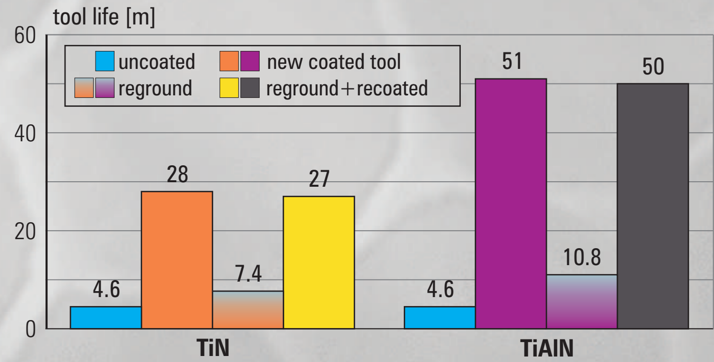
- Thickness and structure can and should be different according to the different application processes even for the same coating.
- The exponent x (coating^{x}) is defined by the machine, which coating generation the machine can deposit.



Conventional Applications

Solid Carbide Drills

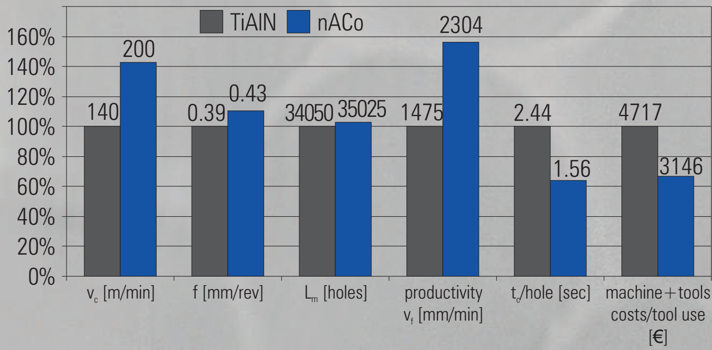
Tool Life Comparison



Work piece: wheel hub, Material: 38MnV35, R_m=800 N/mm², Ext. coolant: emulsion 7%, carbide K40UF, d=12.6 mm, a_p=13.5 mm, v_c=78 m/min, f=0.25 mm/rev. - Source: Daimler, Germany

Drilling

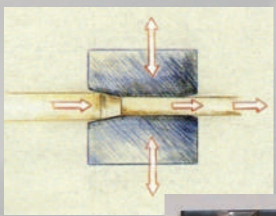
Productivity Improvement with Higher Speed and Feed

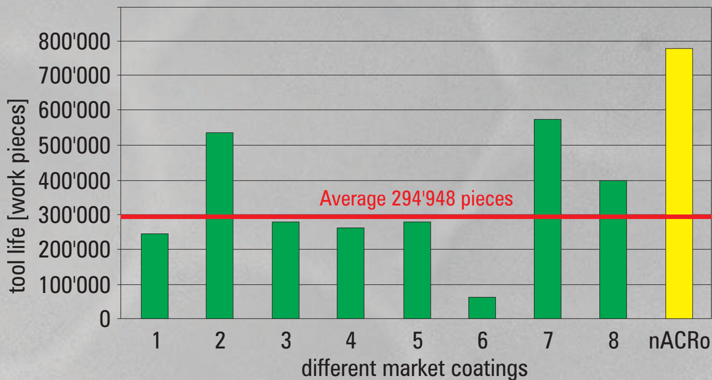


Work piece material: GGG40 – a_p=60 mm
Solid carbide step drill: d=7.1/12 mm – Internal cooling with 70 bar - 5 % emulsion
Source: Sauer Danfoss, Steerings, Denmark

Rotating Stamping

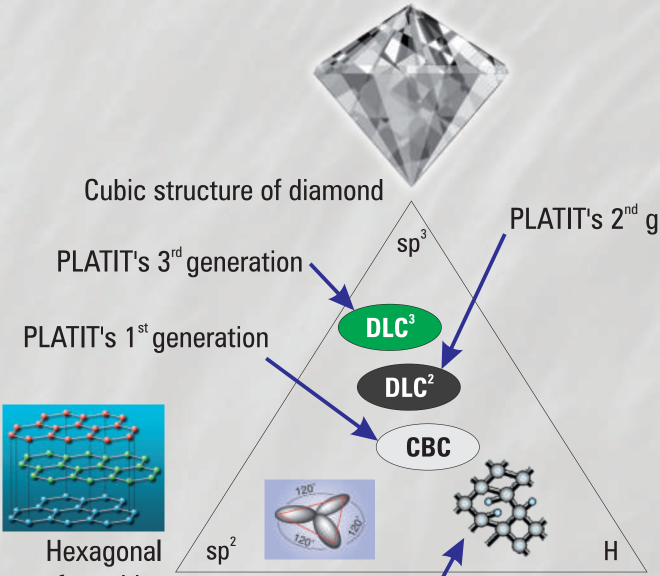
Tool Life Comparison

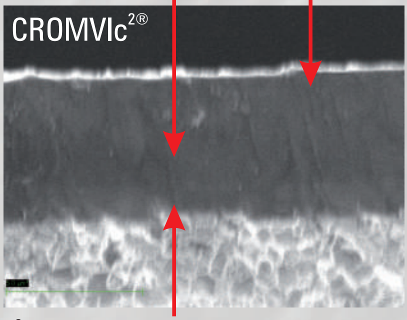




Source; GFE, Schmalkalden, Germany
Fa. Thyssen Krupp Presta Ilsenburg, Germany

DLC-Coatings





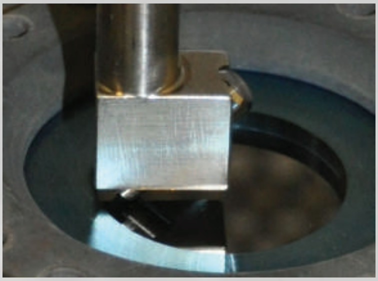
Comparison of the Most Important Features of PLATIT's DLC-coatings

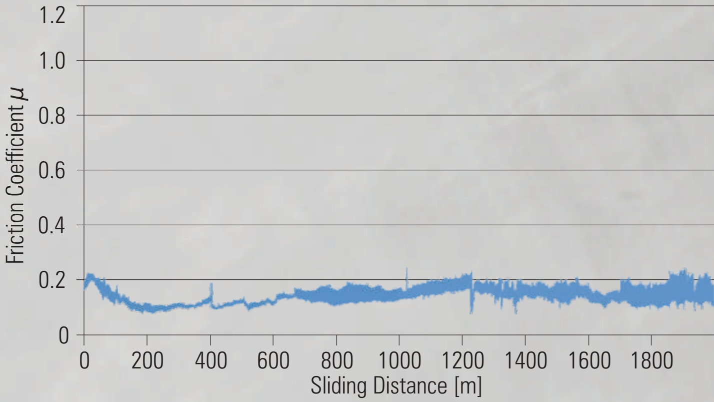
	1st generation	2nd generation	3rd generation
Name	**DLC^1 (CBC) - X-VIc®**	**DLC^2 - X-VIc$^{2®}$**	**DLC^3 - X-VIc$^{3®}$**
Availability	Basis coating + DLC^1	Recommended as top coating Basis coating + DLC^2	Basis coating + DLC^3 for non-carbide Also without basis coating for carbide
Most common coatings	cVIc$^{1®}$	VIc$^{2®}$, cVIc$^{2®}$, CROMVIc$^{2®}$, CROMTIVIc$^{2®}$, nACVIc$^{2®}$	VIc$^{3®}$, cVIc$^{3®}$, CROMVIc$^{3®}$
Coating process	PVD	PVD+PECVD	PVD, filtered ARC
Deposition temperature	200 - 500°C	200 - 500°C	< 200°C
Composition	a-C:H:Me - Metal doped DLC	a-C:H:Si - Silicon doped metal free DLC	ta-C - Hydrogen-free DLC
Heat resistance	< 400°C	< 450°C	< 450°C
Internal stress	medium	lower due to Si	high
Typical thickness	up to 3 μm	up to 3 μm	up to 1 μm
Electrical conductivity	good	none	none
Hardness	up to 20 GPa	up to 25 GPa	> 50 GPa
Roughness	Ra~0.1μm - Rz~coating thickness	Ra~0.03μm - Rz~coating thickness	Ra~0.02μm - Rz~coating thickness
Friction coefficient to steel	μ~0.15	μ~0.1	μ~0.1
Wear resistance	Wear through after a short time	Wear through after long time	Wear through after extra long time
Main application goal	Improvement of tool's run-in behavior Lubrication by forming transfer films	Reducing friction for machine components	Cutting light metals, composites and graphite

PLATIT®

Application with DLC Coatings

Coefficient of Friction at 400°C: nACVIc$^{2®}$: μ=0.12 ±0.02

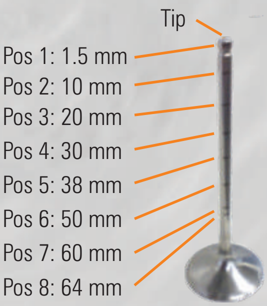


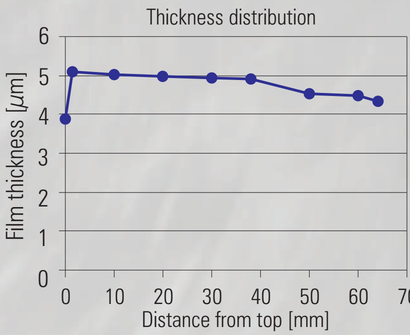


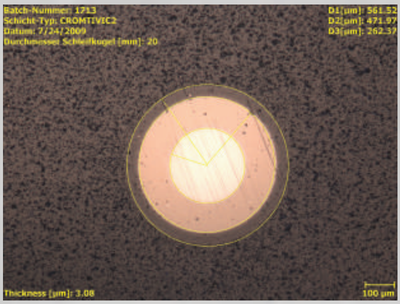
Pin on disc wear test with Ti pin grade 5 - r= 10.00 [mm] - Normal load : 2.00 [N] - Lin. Speed : 6.67 [cm/s] - Acquisition rate : 2.0 [Hz] - Rel. humidity: 0%

DLC^2 Thickness Distribution on Valve Shanks for Racing Cars

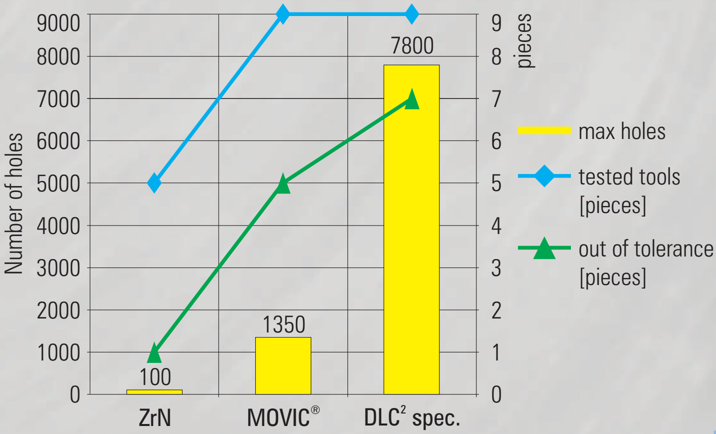
One of the most important applications is the DLC-coating of valves for the racing and normal road cars, trucks and bikes.







Micro Drilling in Titanium Tool Life Comparison



TripleCoatings3®

Cathode Configurations

CrTiN3®: For Forming

CrTiN - Cr/TiN-NL - CrN or TiN
All π machines: 1: Ti – 2: Al – 3: Cr – 4: none – 5: none
π1511 : 1: Ti – 2: Al – 3: Cr – 4: Ti/Cr – 5: Ti/Cr

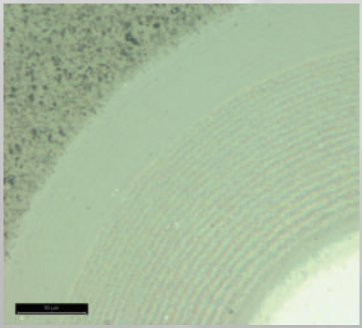
AlTiN3®: For Universal Use

TiN - AlTiN-G - AlTiN-NL
All π machines: 1: Ti – 2: Al – 3: Cr – 4: none – 5: none
π1511 : 1: Ti – 2: Al – 3: Cr – 4: $AlTi_{33}$ – 5: $AlTi_{33}$

AlCrN3®: For Dry Cutting Abrasive Materials

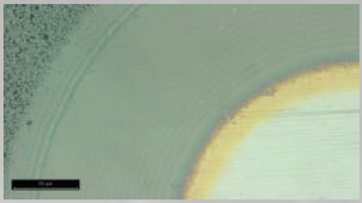
CrN - Al/CrN-NL - AlCrN
π111PLUS : 1: Al – 2: Cr
π311 eco : 1: none – 2: Al – 3: Cr
π311 - π411 : 1: none – 2: Al – 3: Cr – 4: $AlCr_{30}$
π1511 : 1: Ti – 2: Al – 3: Cr – 4: $AlCr_{30}$ – 5: $AlCr_{30}$

AlCrN3®+: AlCrN3® doped by Titan: TiN - AlTiN - Al/CrN-NL
π311 - π411 : 1: Ti – 2: Al – 3: Cr – 4: $AlTi_{33}$



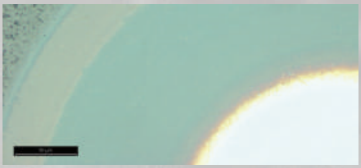
AlTiCrN3®: For Dry and Wet Cutting

Ti(Cr)N - Al/CrN NL - AlTiCrN
π111PLUS : 1: $AlCr_{30}$ – 2: Ti
π311 eco : 1: Ti – 2: Al – 3: Cr
π311 - π411 : 1: Ti – 2: Al – 3: Cr – 4: none



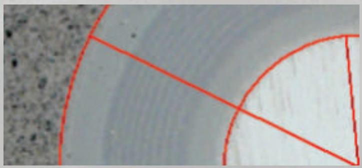
nACo3®: For Universal Use, Turning, Drilling

TiN - AlTiN - nACo
π311 eco : 1: Ti – 2: $AlSi_{18}$ – 3: Al
π311 - π411 : 1: Ti – 2: $AlSi_{18}$ – 3: none – 4: $AlTi_{33}$



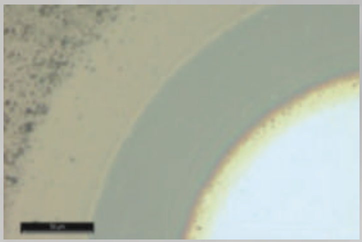
nACRo3®: For Superalloys, Milling, Hobbing

CrN - AlTiCrN-ML - nACRo
π311 : 1: none – 2: $AlSi_{18}$ – 3: Cr – 4: $AlTi_{33}$
π411 : 1: Ti – 2: $AlSi_{18}$ – 3: Cr – 4: $AlTi_{33}$



TiXCo3®: For Superhard Machining, Milling, Drilling

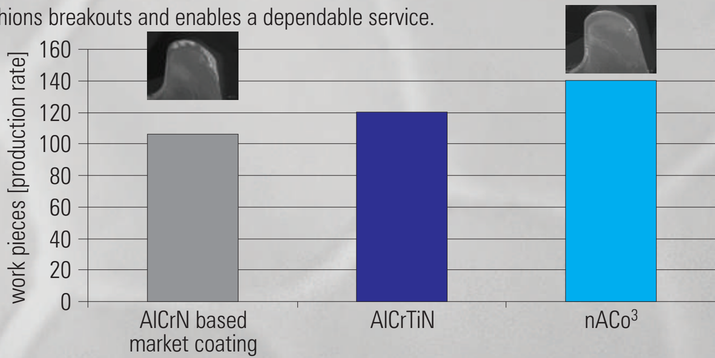
TiN - nACo - TiSiN
π111PLUS : 1: Al – 2: $TiSi_{20}$
π311 eco : 1: Ti – 2: Al – 3: $TiSi_{20}$
π311 : 1: Ti – 2: none – 3: $TiSi_{20}$ – 4: $AlTi_{33}$
π411 : 1: Ti – 2: Al – 3: $TiSi_{20}$ – 4: $AlTi_{33}$



Applications with TripleCoatings3®

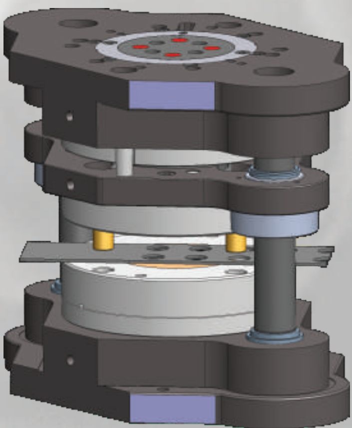
Increasing Tool life at Turning with TripleCoatings3®

The multilayer (triple) coating structure cushions breakouts and enables a dependable service.

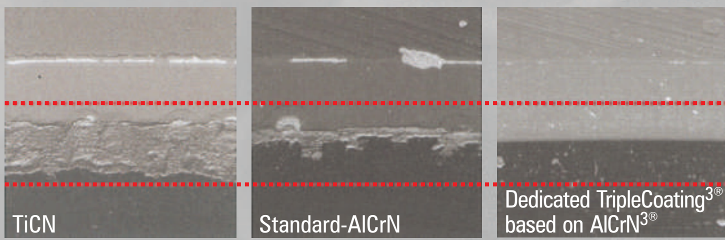


Material: high-alloyed steel with reduced Ni-content
v_c = 63 m/min – f=0.1 mm/rev – Coolant: MMS
Source: Daimler AG, Stuttgart, Germany

Fine Blanking



Comparative Analysis (SEM) after 30'000 Strokes



Coating detached, maintenance urgently needed.

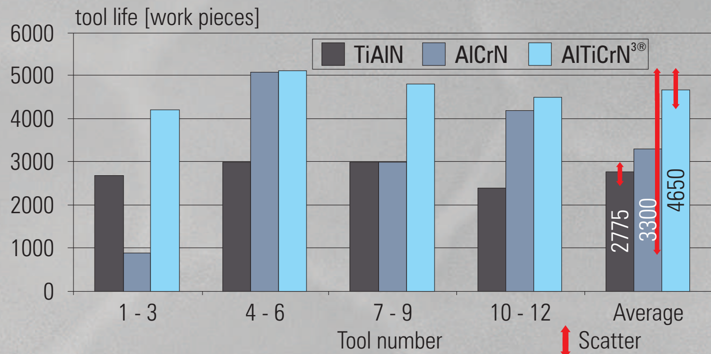
Element requires preventive maintenance.

Element can continue in service.

Source: Feintool, Lyss, Switzerland

Hobbing

Tool Life Comparison



Work piece material: 34CrNiMo6 (1.6582)
v_c=45m/min, f_n=0.12 mm/rev, RPM=500
Coolant with oil - Source: Unimerco, Sund, DK

QUAD Coatings4®

Cathode Configurations

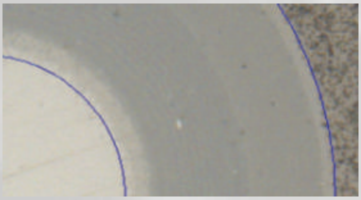
ALL4®: AlCrTiN4®: For Wet and Dry Machining

CrTiN - AlCrTiN-G - Al/CrN Multilayer - AlCrTiN - (CrCN optional)

π^{411} : 1: Ti – 2: Al – 3: Cr – 4: $AlCr_{30}$

π^{1511}: 1: Ti – 2: Al – 3: Cr – 4: $AlCr_{30}$ – 5: $AlCr_{30}$

ALL4® eco : Dedicated for Big Hobs



CrTiN - AlCrTiN-G - Al/CrN Multilayer - AlCrTiN - (CrCN optional)

π^{311} : 1: $CrTi_{15}$ – 2: Al – 3: Cr – 4: none

π^{411} : 1: $CrTi_{15}$ – 2: Al – 3: Cr – 4: none

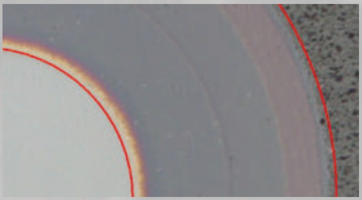
AlTiCrN4®: For Tapping and Forming

CrTiN - AlTiCrN-G - Al/CrN Multilayer - AlTiCrN - (CrCN optional)

π^{411} : 1: Ti – 2: Al – 3: Cr – 4: $AlCr_{30}$

π^{1511}: 1: Ti – 2: Al – 3: Cr – 4: $AlCr_{30}$ – 5:$AlCr_{30}$

nACo4®: For Universal Use, Turning, Drilling



TiN - AlTiN-G - AlTiN-NL - nACo

π^{411} : 1: Ti – 2: Al – 3: $AlSi_{18}$ – 4: $AlTi_{33}$

π^{1511}: 1: Ti – 2: Al – 3: $TiSi_{20}$ – 4: $AlTi_{33}$ – 5: $AlTi_{33}$

nACRo4®: For Superalloys, Milling, Hobbing

CrN - AlCrN-G - AlCrN-NL - nACRo

π^{311} eco : 1: $AlSi_{06}$ – 2: Al – 3: Cr (nACRo4®-eco)

π^{311} : 1: $AlSi_{06}$ – 2: Al – 3: Cr – 4: none (nACRo4®-eco)

π^{411} : 1: Cr – 2: $AlSi_{18}$ – 3: Cr – 4: $AlCr_{30}$

π^{1511} : 1: none – 2: $AlSi_{18}$ – 3: Cr – 4: $AlCr_{30}$ – 5: $AlCr_{30}$

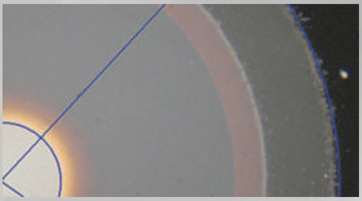
TiXCo4®: For Superhard Machining

TiN - nACo-G - nATCRo-ML - TiSiN

π^{411} : 1: Ti – 2: Al – 3: $TiSi_{20}$ – 4: $AlCr_{30}$

π^{1511}: 1: Ti – 2: Al – 3: $TiSi_{20}$ – 4: $AlTi_{33}$ – 5: $AlTi_{33}$

nACoX4®: For HSC Dry Turning and Milling



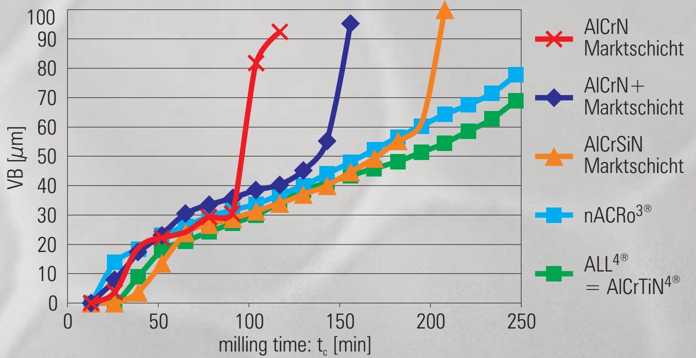
TiN - AlTiN - nACo - AlCrON

π^{311}-π^{411}: 1: Ti – 2: $AlSi_{18}$ – 3: $AlCr_{45}$ – 4: $AlTi_{33}$

π^{1511} : 1: Ti – 2: $AlSi_{18}$ – 3: $AlCr_{45}$ – 4: $AlTi_{33}$ – 5: $AlTi_{33}$

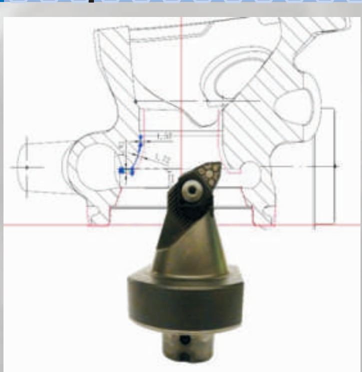
Applications with QUAD Coatings4®

Wear Comparison at Milling with QuadCoatings4®

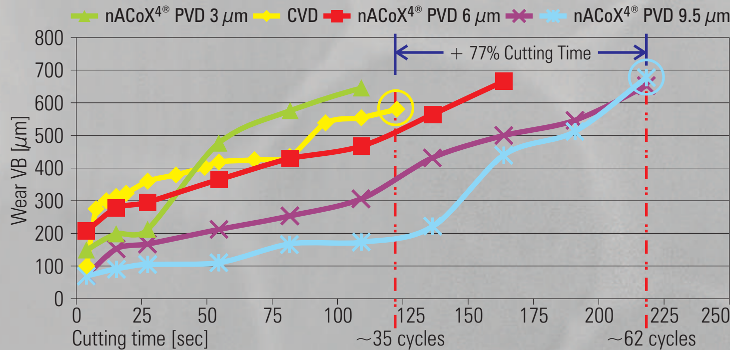


Tools: Solid carbide end mills – d=8 mm – z=4 - a_p=5 mm – a=3.5 mm – v_c=110 m/min – f=0.24 mm/rev – Work piece material: DIN 1.2085 – X33CrS16 – R_m=1000 N/mm² – 26.3 HRC – External minimum lubrication

OXI-Option: Oxide Quad-Coatings versus CVD at Turning of High Alloyed Steel

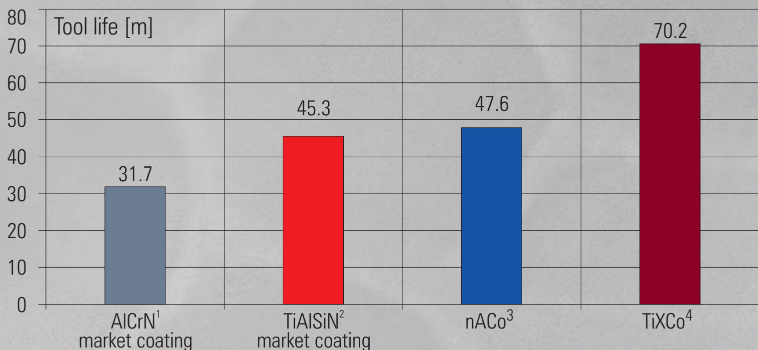


SME can more than compete with CVD using their own, thick PVD-OXI-coatings!



Inserts: WNMG – v_c=110 m/min – f=0.4mm – Cutting length/cycle: 6.42m
Material Ni-steel – R_m=620 N/mm² – Coolant: MQS
Source: Daimler AG, Stuttgart, Germany

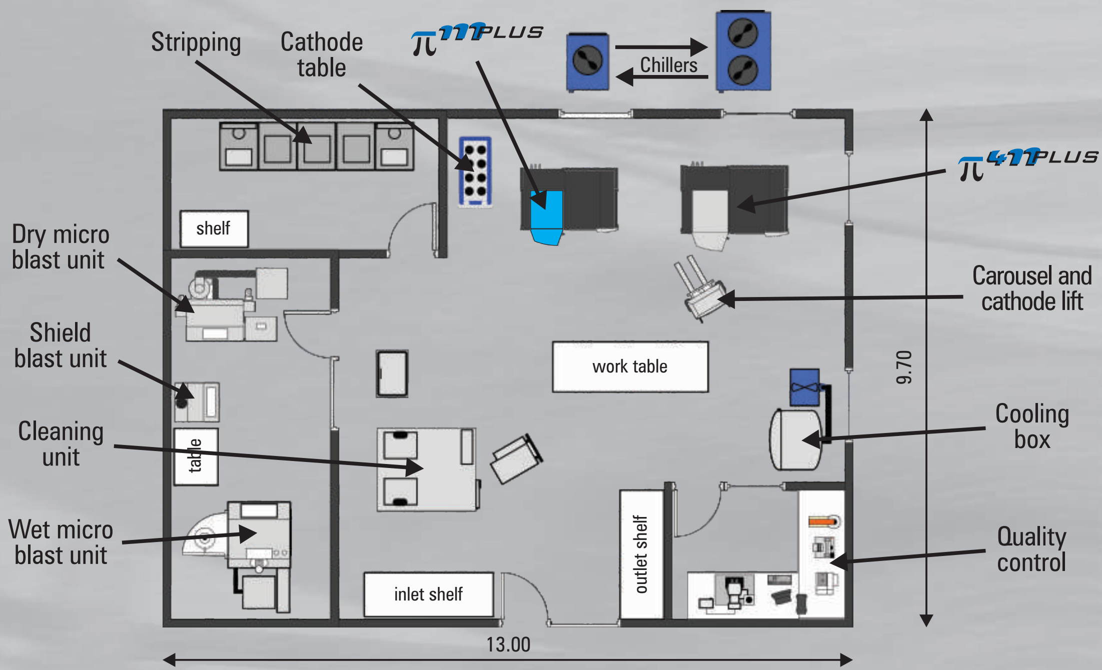
Drilling in High Strength Steel with 4 Generations of Coatings



Work piece material: X155CrVMo12 - 1.2379 – R_m=1150 N/mm² – Coolant emulsion 7%
Tool: solid carbide drill: Ø 6.8 mm; Edge preparation: 50 µm – Coating thickness: 3 µm
v_c=70 m/min – f=0.16mm/rev – a_p=15 mm – Tested at GFE, Schmalkalden, Germany

Equipment Layout

In-House Coating Center



Source: PV-Tech, Pforzheim, Germany

Specifications

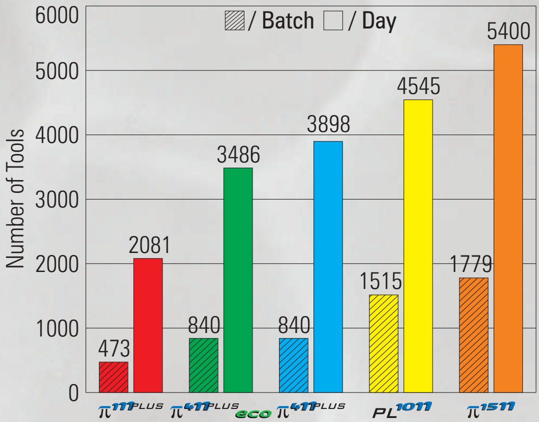
Name	Description	Dimension WxDxHxRH [mm]	Weight [kg]	Power supply [V / Hz]	Electrical connection [kVA]	Fuse [A]	Water [bar]	Air [bar]	Gas
π^{1511}	Coating unit	4882 x 2181 x 3354 x 4200	5000	3x400 / 50 - 60	100	200	2 - 4	8	N_2, Ar, C_2H_2, He
PL^{1011}	Coating unit	3880 x 1950 x 2220 x 4200	4500	3x400 / 50 - 60	90	200	2 - 4	8	N_2, Ar, C_2H_2, He
C1511/1001	Chiller π^{1511}/PL^{1011}	1000 x 1000 x 2055	370	3x400 / 50 - 60	20.7	40	3 - 6	-	-
$\pi^{411PLUS}$	Coating unit	2730 x 1776 x 2215 x 3200	2650	3x400 / 50 - 60	110	160	2 - 4	-	N_2, Ar, C_2H_2, He
C411	Chiller for π^{411}	1000 x 1000 x 2055	350	3x400 / 50 - 60	19.2	35	3 - 6	-	-
$\pi^{111PLUS}$	Coating unit	1881 x 1185 x 2213 x 3200	1400	3x400 / 50 - 60	42	100	2 - 4	-	N_2, Ar, C_2H_2, He
C111	Chiller for π^{111}	1000 x 1000 x 2055	320	3x400 / 50 - 60	9.0	20	3 - 6	-	-
MET6	CNC brushing unit	1885 x 1275 x 1690	500	3x400 / 50 - 60	1.6	16	-	3 - 6	-
DF4	Drag finish unit	1150 x 970 x 2260	370	3x400 / 50 - 60	2	16	-	-	-
115N	Dry sand blasting unit	1250 x 1245 x 1885	360	230 / 50 - 60	0.8	16	-	0.5 - 8	-
TR110	Dry micro blast unit	2100 x 1450 x 2430	480	3x400 / 50 - 60	2	16	-	3 - 10	-
C-II	Wet micro blast unit	2100 x 2050 x 2950	1200	3x400 / 50 - 60	7	32	2 - 4	6	-
ST-40	Stripping unit	625 x 825 x 1200	127	230 / 50 - 60	1.8	16	2 - 6	3	-
CT-40	Stripping unit	1820 x 820 x 1380	400	3x400 / 50 - 60	6.4	16	2 - 6	3 - 6	-
V111	Cleaning unit	1620 x 1420 x 2220	1800	3x400 / 50 - 60	10	16	1.5 - 3	6 - 8	N2
V311	Cleaning unit	1800 x 1650 x 2320	1830	3x400 / 50 - 60	41	32	1.5 - 3	6 - 8	N2
V411	Cleaning unit	3700 x 2210 x 2250	4500	3x400 / 50 - 60	40	80	1.5 - 3	6 - 8	N2
V1511	Cleaning unit	4200 x 1800 x 2450	4500	3x400 / 50 - 60	58	100	1.5 - 3	6 - 8	N2
PQCS	Microscope + PC	1500 x 650 x 800	40	230 / 50 - 60	0.4	10	-	-	-
CB380	Cooling box	1140 x 990 x 1450	150	3x400 / 50 - 60	0.75	10	-	-	-
CB411	Cooling box	1200 x 1342 x 2020	350	230 / 50 - 60	0.4	10	-	-	-
FL380	Fork lift	841 x 1330 x 1947	400	230 / 50 - 60	0.75	10	-	-	-
DE411	Outgas oven	1950 x 1500 x 2250	1400	3x400 / 50 - 60	28	40	2 - 3	6 - 8	Ar, He

The above data are approximate values only. For detailed data see PLATIT's periphery handbook.

In - House coating center of eft-Pannon, Budaors, Hungary

Cost Comparison and Payback Calculation

Capacity (#Tools) / Day



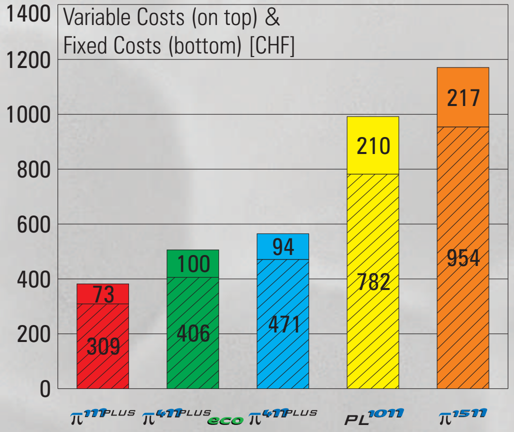
Considered costs:

Fix costs:
- loan (credit) costs
- labour costs
- social costs
- room rental costs
- depreciation

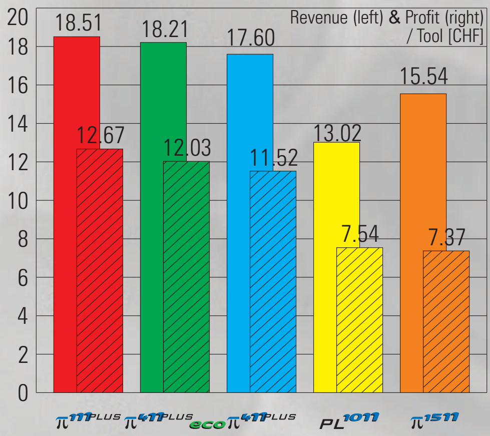
Variable costs:
- energy costs
- target costs
- gas costs
- cleaning costs
- stripping costs

The costs are calculated for typical mixed tools, like drills, end mills, inserts and hobs with the sizes Ø3-120mm – L46-200mm (see pages 40-41) Dedicated Excel calculation is available by request.

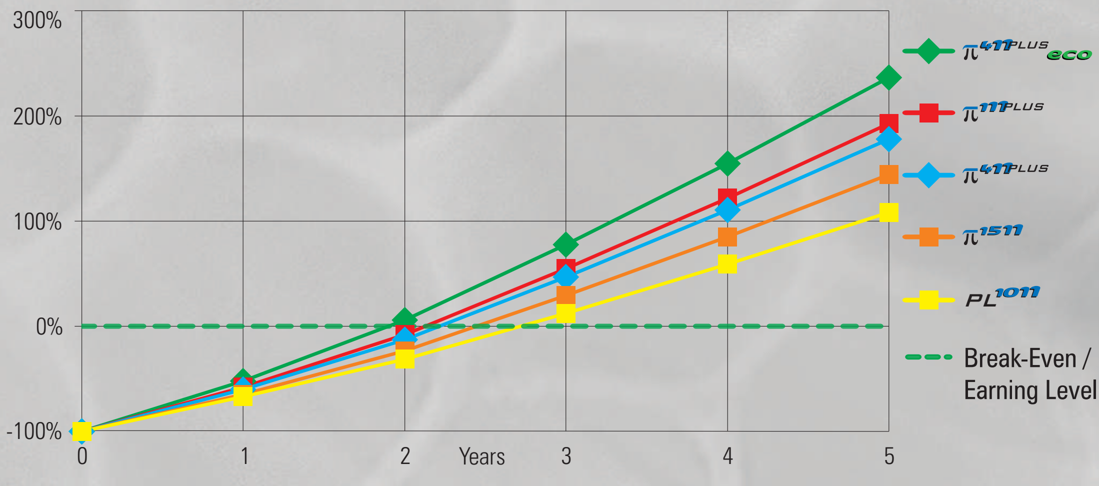
Total Costs / Batch



Revenue & Profit / Tool



Profit / Investment



Cathode Exchange Centers

Customer with PLATIT equipment
π80, π111, π111PLUS, π211, π300, π311 eco, π311, π411 eco, π411, π411PLUS & π1511

1. Customer requests for a refurbished cathode to CEC by email or fax

PLATIT's Cathode Exchange Centers (CEC):

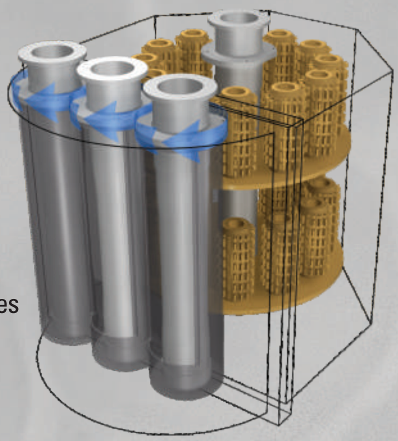
- Sumperk, Czech Republic (EU)
- Selzach, Switzerland
- Libertyville, IL, USA
- Seoul, South Korea
- Curitiba, Brazil
- Shanghai, China
- Tokyo, Japan
- Moscow, Russia

2. CEC dispatches cathode within 24 hours from stock

3. Customer ships used cathode back to CEC within 8 days

CEC-System= Lifetime Warranty for Cathodes

CERC® Cathode



LARC® Cathodes

Stock of cathodes:

LARC®:

- Ti
- Al
- $AlSi_{06}$
- $AlSi_{12}$
- $AlSi_{18}$
- Cr
- Zr
- $TiAl_{50}$
- $AlTi_{33}$
- $AlCr_{30}$
- $AlCr_{45}$
- $TiSi_{20}$
- $CrTi_{15}$

CERC®:

- $AlTi_{33}$
- $AlCr_{30}$

Type of cathodes depending on the machines types:

π80 / π300 / π311 :	short	e.g. Ti-short
π111 / π411 :	long	e.g. Ti-long
π111PLUS / π411PLUS :	plus	e.g. Ti-plus

SCiL®-Cathodes:

- Ti-SCiL®
- B_x-SCiL®
- $TiAl_{50}$-SCiL®
- TiB_2-SCiL®
- $AlCr_{30}$-SCiL®

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World Wide Service
Available through website
www.platit.com

Design: Idea-Lab
Editor: Dr. Tibor Cselle