PVD Coating Center

PVD Coatings

Guidelines

T.T.N. GROUP

PVD Coatings - Features

Coating	*Name*	*Hardness HV*	*Thickness * µm*	*Coating Temp.*	*Max.Working Temp.*	*Friction Coeff.*	*Color*
TiN	**TiN**	2000 - 2500	2-4	150 – 450° C	600° C	0.45	Gold yellow
TiCN	**TiCN**	3000 - 4000	2-4	150 – 450° C	400° C	0.45	Blue-grey
AlTiN	**AlTiN Performa**	2800 - 3000	2-4	150 - 600° C	900° C	0.60	Violet-grey
AlTiN Multilayer**	**AlTiN Multi MGN ****	2600 - 3200	2-8	480 – 600° C	1000° C	-	Violet-grey
AlTiCN	**Eclipse**	3000 - 3200	2-8	400 – 450° C	600° C	0.3	Red-grey
CrN	**CrN Monolayer**	1800 - 2200	2-4	150 – 450° C	700° C	0.40	Grey
CrN-mod	**CrN Modified**	1800 - 2200	2-4	150 – 450° C	700° C	0.40	Grey
CrN-S	**CrN-S**	2200 - 2800	2-4	150 – 350° C	700° C	-	Dark grey
CrN ox	**CrN Ox**	2000 - 2500	2-4	150 – 450° C	550° C	0.25	Iridescent
ZrN	**ZrN**	2600 - 3200	2-4	450° C	800° C	0.45	Pale yellow
WC/C	**Tribo W**	800 - 1000	2-4	160 – 300° C	300 – 350° C	< 0.2	Antracite
AlCrN	**AlCrN ST**	2500 - 3600	2-8	480 – 600° C	1100° C	-	Violet-grey
AlCrN Multilayer	**AlCrN MGN**	2500 - 3000	2-8	480 – 600° C	1100° C	-	Violet-grey
TiSiN	**TiSi HP**	3400 - 3600	2-4	450° C	1200° C	-	Copper
DLC	**DLC Endurance**	> 2000	2-4	160 – 300° C	350° C	0.05 – 0.15	Rainbow-black
DLC	**HDLC**	> 5000	1-3	90 – 100° C	400° C	0.05 – 0.15	Rainbow-black

* Thickness may vary according to specific customer requests.
** Available also in nanostructured version.

Coating	Friction coefficient (VS steel)
Steel	0.70
TiN	0.45
TiCN	0.45
WC/C	0.1-0.2
AlTiN	0.60
CrN	0.40

Test employed to determine friction coefficient:
disc-sphere tribometer
Sphere: 100Cr6 steel
Load: 5N
Speed: 10cm/s
HR: 50%
Load times: 5000x

Applications

TiN: standard coating employed for plastic moulding, machining and metal cutting tools. It features a good chemical stability.

AlTIN: features high wear resistance and oxidation-resistance at high temperature. Particularly suitable for coating of cutting tools, for the processing of highly abrasive materials (alloy steel, cast iron, super alloys, etc..) and operations at high cutting speed and in the absence or with poor lubrication.

AlTIN performa: has the same characteristics of resistance to oxidation at high temperature. The particular chemical composition allows to obtain a high wear resistance. Particularly suitable for coating cutting tools, in dry machining and milling of hardened materials.

AlTiN multi MGN: characterized by multilayer structure with high hardness, excellent toughness and high point of oxidation. Recommended for coating of die casting moulds, metal deformation moulds, gear steels difficult to machine with creators (using lubrication).

AlCrN the main characteristics are the high oxidation resistance and a good maintenance of the hardness of the coating during high temperature treatments. This allows excellent wear resistance to abrasion, extending the life of the coated particular. Suitable for dry milling in severe condition of hardened high alloy steels hardened, metal stamping, die casting cores.

TiCN: : thanks to its high toughness and hardness, it's suitable for the coating of utensils for iron materials working. Excellent performances in milling operations, interrupted cutting and metal stamping.

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AlTiCN: particularly suitable for milling and drilling under severe working conditions, at temperatures higher than 500° C.
It is designed for a wide range of processes under different conditions for prolonged times.

TiSi HP: nano-composite coating that maintains high hardness values at high temperatures in oxidant environments. It is especially suitable for metal removal in the presence of materials with high hardness and low cooling rates.

CrN: thanks to its versatility, this coating is used for different applications. Cutting of non-metallic materials, stainless steel forming, die casting moulds for light metals, polymers.

CrN-Ox: coating with ceramic properties developed for aggressive environments. Thank to its high hardness it is suitable for applications characterized by abrasion, corrosion, erosion, cavitation and sticking problems. It is successfully employed during loaded polymers production.

CrN-S: evolution of CrN coating. While maintaining excellent adhesion properties and high chemical inertness, it is characterized by improved mechanical and anti-corrosion characteristics and higher hardness.

ZrN: highly chemical-inert coating, suitable for applications that faces sticking and metallization problems caused by high temperature. It is specifically used for zama processing.

WC/C: coating with low friction coefficient, it is used for the coating of high precision mechanical components, details of sliding moulds for plastic materials (telescopes, males, fork-shaped figure and parts manufactured with beryllium-copper). It is suitable for large moulds and resists to high mechanical loads.

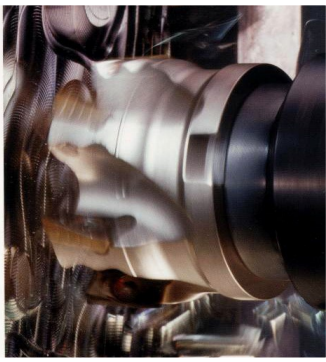
DLC/HDLC: Specifically developed for high precison mechanical components, every time a very low friction coefficient s necessary.
It is also employed in case of milling of glass-loaded polymers and shearing of low-thickness non-ferrous materials.

The most suitable coating for every kind of application

Cutting tools

Application	Turning	Milling cutters			Drilling		Tapping	Reaming	
	H.M. inserts	HSS	HM	Inserts	HSS	HM		HSS	HM
Non-alloy steel	AlTiN AlTiCN	AlTiN	AlTiN	AlTiN	TiSiN AlTiN	TiSiN AlTiN	TiCN + WC/C	TiCN	AlTiN
Alloy steel	TiCN AlTiN AlTiCN	AlTiN	ALTiN TiSiN	AlTiN TiCN	AlTiN TiSi	TiSi	TiCN + WC/C	TiCN	TICN
Hardened steel HRC 45>60	AlTiN TiSiN	-- --	AlTiN TiSi	-- --	-- --	-- --	-- --	-- --	-- --
Stainless steel	AlTiN	TiCN	AlTiN	AlTiN	AlTiN+WC/C TiSi	AlTiN+WC/C TiSi	TiCN+WC/C AlTiN+WC/C	TiCN	TiCN
Aluminum alloys	TiCN DLC	TiCN	AlTiN ST DLC		TiCN AlTiN ST	TiCN AlTiN ST	WC/C	TiCN	TiCN
Titanium alloys	AlTiN Performa	AlTiN DLC	AlTiN DLC	AlTiN DLC	TiSi	TiSi	WC/C	DLC	DLC
Copper	CrN	CrN	CrN	CrN	CrN	CrN	CrN	CrN	CrN
Brass - Bronze	TiCN	TiCN	TiCN	TiCN	TiCN	TiCN	TiCN	TiCN	TiCN
Grafite Greens	DLC	DLC	DLC	DLC	DLC	DLC	DLC	DLC	DLC
Composites – Al-Si alloys	DLC	DLC	DLC	DLC	DLC	DLC	DLC	DLC	DLC

- **TiN** = titanium nitride
- **TiCN =** titanium carbonitride
- **AlTiN ST =** aluminum-titanium nitride
- **AlTiN performa =** aluminum-titanium nitride
- **AlTiN Multi =** multilayered titanium-aluminum nitride
- **AlCrN =** chromium-aluminum nitride
- **ZrN =** zirconium nitride
- **CrN =** chromium nitride



Hobbing

Dry hobbing with HM solid hobbs	AlTiN performa- TiSi
Dry hobbing with PM-HSS solid hobbs	AlTiN performa+ WC/C -TiSi
Alloy steel hobbing with refrigerant	AlTiN ST- TiCN- AlCrN
Standard hobbing	TiN- TiCN
Knives hobbing	TiN- TiCN

Metal moulding

Substrate	Shearing	Forming	Cold moulding	Medium-temperature molding
Non-alloy steel	TiN	TiN - TiCN	TiN	CrN - AlCrN
Alloy steel	TiCN - AlTiCN	TiCN - AlTiN Multi - AlTiCN	TiN AlTiN Multi	CrN - AlCrN
Stainless steel	TiCN	CrN – TiCN - ZrN	TiCN AlTiN Multi	CrN - AlCrN
Aluminum	CrN	CrN + WC/C	CrN - TiCN	CrN - AlCrN
Aluminum alloys	CrN	CrN + WC/C – DLC Endurance	TiCN - AlTiCN	CrN - AlCrN
Brass - bronze	TiCN	TiCN	..	CrN - AlCrN
Copper	CrN	CrN	CrN	CrN - AlCrN
Titanium	CrN DLC Endurance	--	--	CrN - AlCrN
Plated sheet metal	TiCN - AlTiN	CrN - TiCN		

Plastic moulding

Issue	Coating	Remarks
Adhesion and sticking	TiN, CrN + WC/C, CrN-Ox, CrN-S	With releasing fluid Without releasing fluid
Parts release	CrN, CrN mod, WC/C	
Mold filling	TiN, CrN	
Abrasion	TiN , AlTiN, Multibak	Considering % of fiberglass loading
Deposits	TiN, CrN, CrN mod.	
Corrosion	CrN Mod, CrN, CrN-S, CrN-Ox	Contact CRT technical assistance
Optical mirror surfaces	TiN – CrN	Contact CRT technical assistance

All the informations reported above are indicative.
Please contact CRT technical service for the best employment of PVD coatings.

Substrate

Metallic materials that will be coated must be able to resist to coating temperatures without modification of mechanical characteristics and dimensional variations.

Material	Standard temperature coating < 500°C	Low temperature coating	Necessity of particular treatment conditions
High speed steel: HS-HSS-AISI M2-M35-M42-W. Nr. 1.3343-3344- ecc…	🟢		
Powder steel (PM) for utensils: ASP- VANADIS-S390-S690 ecc..	🟢		
Hot working steel:			
W. Nr. 1.2343 AISI H11 W. Nr.1.2344 AISI H13 W. Nr.1.2365 AISI H10 W. Nr. 1.2367 ----	🟢		
Cold working steel:			
W. Nr. 1.2379 AISI D2			🟡
W. Nr. 1.2601			🟡
W. Nr. 1.2363 AISI A2			🟡
W. Nr. 1.2080 AISI D3	🔴	🟢	
W. Nr. 1.2436 AISI D6	🔴	🟢	
W. Nr. 1.2842 AISI 02	🔴	🟢	
Stainless steel for utensils:			
W. Nr. 1.2083 AISI 420			🟡
W. Nr. 1.4125 AISI 440C			🟡
Copper alloys:			
Ampco 940	🟡	🟢	
Baryllium-copper alloys:			
CuBe1- Ampco93	🟡	🟢	
CuBe2- Ampco83	🔴	🟢	
Bronze-aluminum:			
Ampco 18-21-22-25	🔴	🟢	
Nitriding steels:	🟢		
Stainless steel	🟡	🟢	
Carburizing steel	🔴	🟢	
Titanium	🟢	🟢	

🟢 *idoneo* 🟡 *necessità di pre-trattamento* 🔴 *non idoneo*

Technical guidelines for parts to be coated with P.V.D.

Material Features:

- For good results it is necessary that the choice of materials, heat treatment and final machining are suitable for coating. Thus is necessary a close collaboration between the user and the liner, supported by good metallurgical knowledge.
- Parts must be electrically conductive.
- Parts must be able to withstand at a temperature of about 500° C without damage (deformation, loss of hardness). (250 ° C in case of coating at low temperature). Suitable materials are: tool steels for cold working that have been hardened and tempered to at least 500° C; tool steels for hot working, high-speed steel, carbide, stainless steels and some alloys of copper, aluminium, titanium.
- Parts must be demagnetized before shipping to avoid removal of metal residues.
- It's also possible to coat braised materials but the brazing material must be resistant to the vacuum and temperature (parts should not contain cadmium or zinc, the brazing temperature should be above 600 ° C., the braze must not show shrinkage, blowholes or contain residues of flux). Low melting point and extremely volatile elements (zinc, magnesium, tin, lead, etc.) at theirs elementary state or as alloying elements in insoluble form, are harmful because are characterized by strong tendency to "degassing", "liquefy" etc. in the presence of high temperature and vacuum

Surface Features:

- The surfaces of the parts have to be polished and not treated (surface finishes suitable are, for example, grinding, polishing, electro-erosion with thin finishing, lapping).
- Should not be used mole with worn disc (due to seizure of the surface). Grinding with blunt mole or inadequate lubrication creates cracks, overheating, changes in microstructure, internal stresses and surface that can cause poor adhesion of the coating.
- The mirror polish must be made for removal of material and not for "tracing", because in this way residues of the polishing paste would be trapped, causing damages to the coating. The polishing agents must be removed with a suitable solvent, preferably ultrasonically cleaned and oiled immediately.
- The electro-erosion finishing must be made in order to have a thickness of "white coat" as small as possible (preferably none).
- Parts should be oiled (thin layer) to protect them from rust (use oil hydrophobic).
- For best results the surface roughness Ra of work must be <0.4 microns for tools to form and Ra <0.2 microns for cutting tools.
- There must be no sharp burrs on the edges.
- Parts must be free from chips and particulate pollutants (e.g. curing salts) especially in blind holes.
- Parts must be free of surface treatments such cadmium-treating, galvanizing, tinning, burnishing, phosphatation. Nickel plating, chrome plating and nitriding are usually tolerated . The parts also must be free of rust, waste paint and colored identification markings.
- Nitrided parts (especially extruding screws) must be free of white layer.
- The best choice is to use new moulds than those who have already worked.
- Residua of packaging material (eg waxes, glues, PVC, etc.) must be avoided.
- The photoengraved surfaces can be coated immediately after the process of "photoengraving" without pre-treatments. The surface to be coated must be free of residues of acids or oxidation.
- Parts need not be assembled (send separate parts); locked mould dies: on request.
- The cooling caps must be disassembled to optimize the cleaning inside holes of parts to be coated
- Internal surfaces can be coated with a width / depth ratio of 1:1.
- This technology can increase the degree of surface roughness of the particular that in many cases can be corrected with a polishing after coating.

Fixing:

- Should be made available a way for fixing them (hole, thread, stem, etc.).

Packaging:

- Inner packing: parts shall be wrapped in paper impregnated with oil or in oil-tight plastic containers. The filler material must avoid any collision between the pieces.

Data to add:

- Designation of kind of tool or its use (only for parts of machines)
- Kind of material, Werkstoff number.
- Sizes (scale drawings, sketches), the identification of areas to be treated (in red) and any surface that mustn't be treated (in green), the customer must provide protection for steel.
- Last quenching temperature.
- Hardness (indicate the measurement points).

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