



TitankoteTM

PVD COATING TECHNOLOGY

*Advanced Coating Technology For
General Manufacturing and Wear Applications*

RICHTER PRECISION INC.

RICHTER PRECISION INC. ● ● ●

Richter Precision Inc. was among the first commercial PVD coating service providers in North America. When the company opened in 1978, our goal of improving tool productivity had a fairly broad scope. Within a few years, we began to focus on thin-film coating technologies. When Richter Precision Inc. first introduced PVD technology to our customers, all of these coatings were offered under the tradename Titankote™.

Titankote™ PVD coatings have nearly four decades of positive field testing in almost every imaginable manufacturing application. These PVD films have helped our customers dramatically improve the efficiency and profitability of their tooling and manufacturing processes. We are confident that our Titankote™ PVD coatings will make your good tools even better.



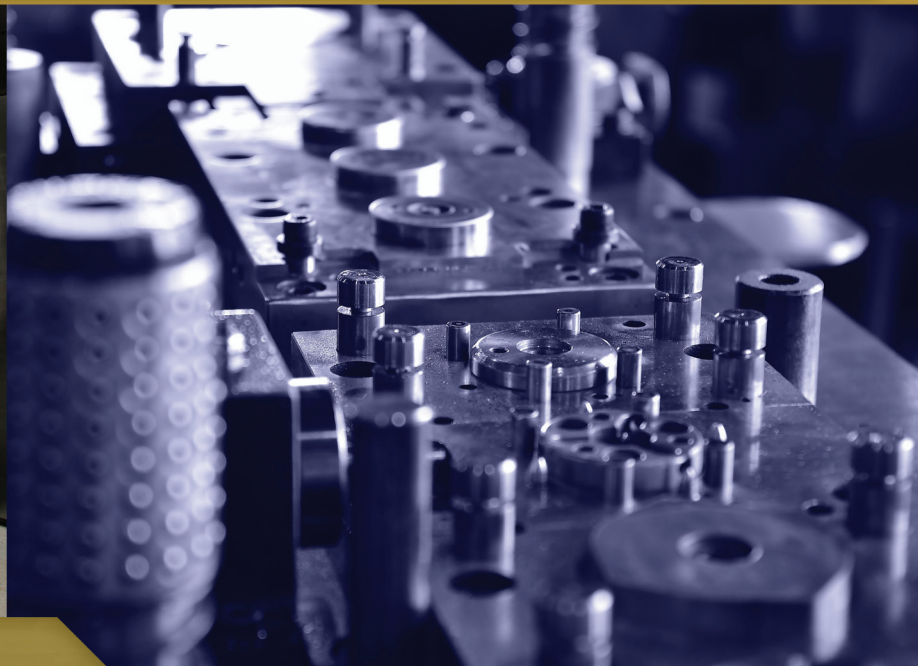
PVD Coating ● ● ●

Titankote™ PVD Coatings ● ● ●

Titankote™ has been developed as our standard line of general purpose PVD coatings. While we started with only titanium nitride (TiN), we have expanded our Titankote™ family to include nearly 20 standard coating compositions. These coatings utilize the latest PVD deposition technologies and coating compositions, and have been engineered for use across a broad spectrum of applications: metal-cutting, metal-forming, injection molding, powder compaction, die casting, and much more. We also employ most major PVD deposition technologies: cathodic arc, pulsed arc, filtered arc, ion beam plating, reactive sputtering, magnetron sputtering, and HIPIMS. With our wide range of technologies and compositions, we can meet just about any tooling challenge.

What Is PVD Coating ● ● ●

Physical Vapor Deposition (PVD) is a term used to describe a family of vacuum coating processes. The most common of these PVD coating processes are evaporation (typically using cathodic arc or electron beam sources), and sputtering (using magnetic enhanced sources or “magnetrons”, cylindrical or hollow cathode sources). All parts are processed in a vacuum chamber at working pressure (typically 10^{-2} to 10^{-4} mbar) and generally involve bombardment of the substrate to be coated with energetic positively charged ions during the coating process to promote high film density. Additionally, reactive gases such as nitrogen, acetylene or oxygen may be introduced into the vacuum chamber during metal deposition to create various compound coating compositions. The result is a very strong bond between the coating and the substrate and tailored physical, structural and tribological properties of the film.



General Characteristics of Titankote™ PVD Coatings

- Metal ceramic films exhibit a high micro-hardness (1500-8000 HV), typically in excess of 80 HRc, depending on film composition
- PVD coatings will typically exhibit a low coefficient of friction (0.1 – 0.35) depending on composition
- PVD is an additive process, with an average film thickness of 2-5 µm, or .00008-.0002"
- Relatively low processing temperatures (320°-800°F)
- Performed in relatively high vacuum (10^{-2} – 10^{-4} mbar)
- Line of sight coating deposition
- Coating exhibits a strong physical bond to the substrate
- Suitable for a wide range of common tool/component substrates: alloy steels, tool steels, HSS, HSCo, stainless steel, carbide and more!
- Ideal for components with close tolerances (+/- .00005" is appropriate)
- No post-coating heat-treating is required in order to maintain core hardness
- Excellent for sharp edges: no excessive coating build-up
- PVD will generally replicate existing surface finishes

General Benefits of Titankote™ PVD Coating

The benefits noted below are, by necessity, fairly generic in nature. We cannot account for all possible variations in these applications for which there might be additional coating benefits. Please contact your Richter Precision Inc. technical sales representative for more information about your particular application.

Metal-Cutting

- Better cutting edge retention for longer tool life
- Improved chip evacuation reduces heat in the tool
- Higher speeds and feeds for increased production
- Thermal barrier protects against edge breakdown

Powder Compaction

- Abrasion protection from hard particles
- Reduced pick-up of material onto tools
- Better part release/ejection
- Decreased downtime for tool maintenance

Die-Casting & MIM

- Improved wear resistance on mold surfaces
- Reduced erosion in gate and high flow areas
- Reduced tendency for soldering
- Improved part release characteristics

Metal-Forming

- Abrasion protection from hard particles
- Reduced pick-up/galling on tool surfaces
- Improved finishes on formed parts
- Decreased downtime for tool maintenance

Plastic & Rubber Molding

- Protects the mold surface finish from degradation
- Low friction improves performance of moving parts
- Low surface energy improves flow and release
- Reduced downtime for cleaning & maintenance

Components

- High micro-hardness improves wear resistance
- Decreased friction between moving parts
- Reduce or eliminate lubrication
- Increased service life and overall improved efficiency



Typical Applications for Titankote™ PVD Coatings ● ● ●

The potential applications for our Titankote™ PVD coatings are broad and constantly expanding. The categories listed below illustrate some of the common applications in which these coatings are used.



Metal-Cutting

- Drills
- End Mills
- Broaches
- Hobs
- Reamers
- Saws
- Inserts
- Taps



Metal-Forming

- Punches
- Dies
- Draw Forms
- Coining Tools
- Trims
- Bend Dies
- Extrusion Tools
- Form Rolls



Powder Compaction

- Upper Punches
- Lower Punches
- Dies
- Cores



Plastic & Rubber Molding

- Cavities
- Cores
- Slides
- Ejector Pins
- Guide Rings
- Feed Screws
- Gate Inserts
- Injection Nozzles



Die-Casting & MIM

- Cavities
- Cores
- Ejector Pins
- Gate Inserts



Components

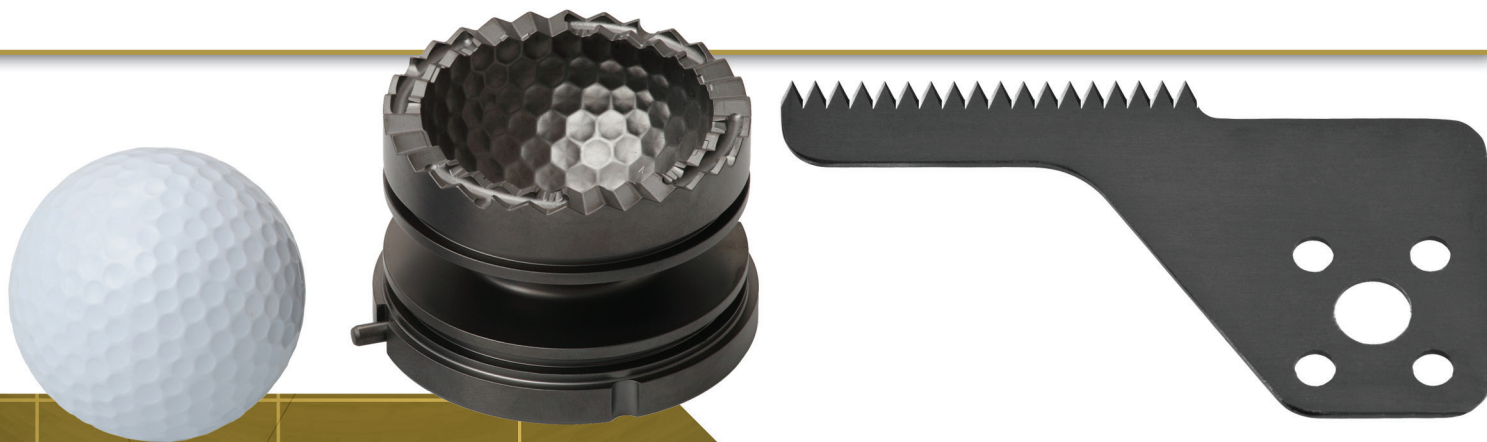
- General Industrial
- Automotive
- Aerospace
- Oil & Gas / Power Generation

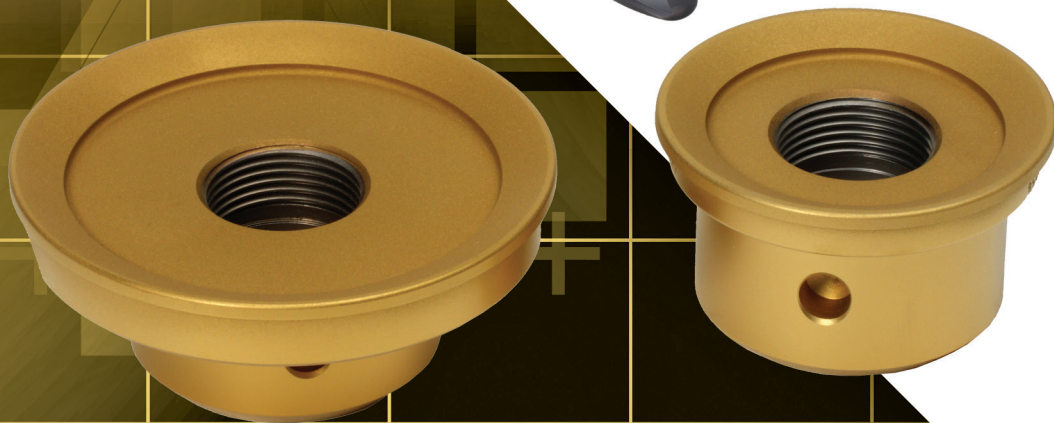
Standard Titankote™ PVD Coating Processes

Proprietary Name	Type	Composition	Color	Thickness (microns)*	Micro-Hardness*	Coefficient of Friction	Max. Working Temp.	Coating Process Temp.
Titankote™ C	PVD	TiN	Gold	1-5	2300-2500	0.35	600°C/ 1112°F	375°C/ 707°F
Titankote™ C+	PVD	TiC	Gray	1-5	2800-3200	0.3	600°C/ 1112°F	375°C/ 707°F
Titankote™ C2-SL	PVD	AlTiN - CrN	Gray	3-7	3200-3500	0.35	1000°C/ 1832°F	375°C/ 707°F
Titankote™ C2-SL+S	PVD	AlTiN-CrN/(Mo, W)S ₂	Gray	3-7	3200-3500	0.15	1000°C/ 1832°F	375°C/ 707°F
Titankote™ C3	PVD	CrN/CrC	Silver	1-5	2000-2200	0.35	700°C/ 1292°F	375°C/ 707°F
Titankote™ C3+S	PVD	CrN/CrC/(Mo, W)S ₂	Gray	3-7	2000-2200	0.15	700°C/ 1292°F	375°C/ 707°F
Titankote™ C5	PVD	TiCN	Bronze	1-5	2800-3200	0.3	400°C/ 752°F	375°C/ 707°F
Titankote™ C5B	PVD	TiCN	Blue/Gray	1-5	2800-3200	0.3	400°C/ 752°F	375°C/ 707°F
Titankote™ C6	PVD	AlTiN	Violet/Black	1-5	3000-3400	0.35	900°C/ 1652°F	375°C/ 707°F
Titankote™ C6+S	PVD	AlTiN/(Mo,W)S ₂	Charcoal	3-7	3000-3400	0.15	900°C/ 1652°F	375°C/ 707°F
Titankote™ C6B	PVD	TiAlN	Copper	1-5	3000-3200	0.35	850°C/ 1562°F	375°C/ 707°F
Titankote™ C7	PVD	TiAlSiCN	Charcoal	2-10	3200-3500	0.3	1050°C/ 1922°F	375°C/ 707°F
Titankote™ C8	PVD	ZrN	Pale Gold	1-5	2300-2500	0.35	600°C/ 1112°F	375°C/ 707°F
Titankote™ C10	PVD	DLC (ta-C)	Charcoal	0.5-2.5	5000-9000	0.1	400°C/ 752°F	220°C/ 428°F
Titankote™ C11	PaCVD	DLC (a-C:H)	Black	1-4	2000-3000	0.1	350°C/ 662°F	220°C/ 428°F
Titankote™ C12	PVD	Me-DLC	Black	1-5	1000-2000	0.1	350°C/ 662°F	160°C/ 320°F
Titankote™ C14	PVD	C-DLC	Black	1-3	2200-4000	0.06 - 0.15	350°C/ 662°F	180°C/ 356°F

Data generated from lab samples. Characteristics may vary depending customer's material, surface condition and part geometry. Additional coating compositions, thicknesses, and processing temperatures are available upon request.

* - The coating thicknesses and micro-hardnesses are listed as ranges: we do not guarantee a specific number within this range on standard processing. Requests for a specific thickness or micro-hardness, if feasible, will be quoted as a special process.





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with any coating questions

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