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PLATIT®

*Dedicated Coating Systems for Special Applications*



# Dedicated Coating Systems for Special Applications

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Due to the increase of the special demands, PLATIT decided to specialize its team in Riaz, Switzerland to engineer and produce special machines.

Coatings for cutting tools are usually produced in standard equipment. The typical coating chambers offer coating volumes of  $\sim\varnothing 300 \times 300$  to  $\sim\varnothing 700 \times 700$  mm.

PLATIT's main business runs with the standard machines of the series 11 [1], which covers the entire spectrum of coating plants:

- $\pi 111$ : a small system with  $\varnothing 355 \times 440$  coating volume,
- $\pi 411$ : a medium sized unit with  $\varnothing 500 \times 440$  mm coating volume and
- PL1011 and  $\pi 1511$ : large systems with  $\varnothing 700 \times 700$  mm coating volume.

During the last two decades PLATIT successfully grew a large worldwide network of customers, who came to PLATIT with their special demands. Due to the increase of these special demands, PLATIT decided to specialize its team in Riaz, Switzerland to engineer and produce special machines. The engineers and technicians are specialized in:

- concept development
- advice & consultation
- mechanical & electrical equipment design
- customer specific programming
- manufacturing with a local network of Swiss companies
- factory acceptance test and commissioning at customers' facilities
- machine and process support & spare parts.

According to the new concept, PLATIT approaches large companies as well as SMEs worldwide.

Several systems have already been developed, produced and delivered to the following sectors:



Fig. 1: Coated big broaches.

- Cutting Tools: manufacturers of large cutting tools like broaches & saw blades
- Aerospace: anti-abrasion, anti-erosion hard coatings, scratch resistance coatings
- Plastic injection: extra smooth coatings for corrosion and scratch protection & lubricant films for moving elements with minimum lubrication and tight tolerances

- Medical: bio compatible coatings for dental components and medical devices

From our portfolio, the following technologies were already implemented and delivered:

- ARC – in DC & pulsed modes
- Sputtering – in DC, pulsed & HiPIMS (High-power impulse magnetron sputtering) modes and
- PECVD (Plasma Enhanced Chemical Vapor Deposition) mode

This paper introduces interesting and sophisticated special systems, which require special machine designs, holders, handlings and coatings for:

- broaches,
- saw bands,
- saw blades, and
- machine components.

## Inclined system for coating band saws

Saw bands are wound up and coated in coils. In order to avoid overbending, the coils must be wound up with a certain minimum inside diameter and for maximum productivity with a maximum outside diameter. The system was built for the company Wikus (Spangenberg, DE, Fig. 2) in our plant in Sumperk, Czech Republic. It can span saw band coils with an outside diameter of up to 1.4 m, which can be used to coat saw bands up to a length of approx. 400 m in one batch.

The system uses three standard rotating LARC® [1] cathodes covering a coating height of 440 mm. The wound saw band coil spins in front of the cathodes. If both the cathodes and the coil were perpendicular, a non-constant layer thickness distribution would arise depending on the coil radius. Therefore, the carrying turntable of the coil was tilted. The inclination of the coil causes a distance increase between the coil and the cathodes, which equals the dissimilar circumferential speed along the radius of the



**Fig. 2:**  $\pi$ 603 coating machine for saw bands  
User: Wikus, Spangenberg, Germany.



coil. In the meantime, after its commissioning, the plant has nearly coated 7-digit meter numbers of saw bands. By using dedicated coatings, enormous productivity increases have been achieved (Fig. 3).

### Coating plants with a large chamber diameter for coating saw blades

In order to increase productivity when coating saw blades, special substrate carriers are built up, which enable overlapped clamping of the tools. In the plant PL2001 (Fig. 4), which PLATIT built with 1.15 m coatable diameter for the company TRU-CUT (Brunswick, Ohio, USA [4]), more than 1000 saw blades, with a diameter of 160 mm, are coated in one batch. At 450 mm diameter, there's room for 172 tools.

The diameter of the chamber and thus the number of coatable tools per batch can be increased further. It is thanks to the fact that the coating only matters on the outer edge of the tools (i.e. on the saw teeth) and the carousel (the rotating tool carrier).

The distances between the saw blades determine the layer thickness distribution in the «depth» of the saw blade (Fig. 5), which is only important for HSS saw blades. They are usually only reground and not recoated. After regrounding the layer only remains on the side surfaces of the saw blade, contributing to a small increase of tool life. It speaks in favor of recoating reground saw blades, a perspective for future applications.

### Machines for coating broaches

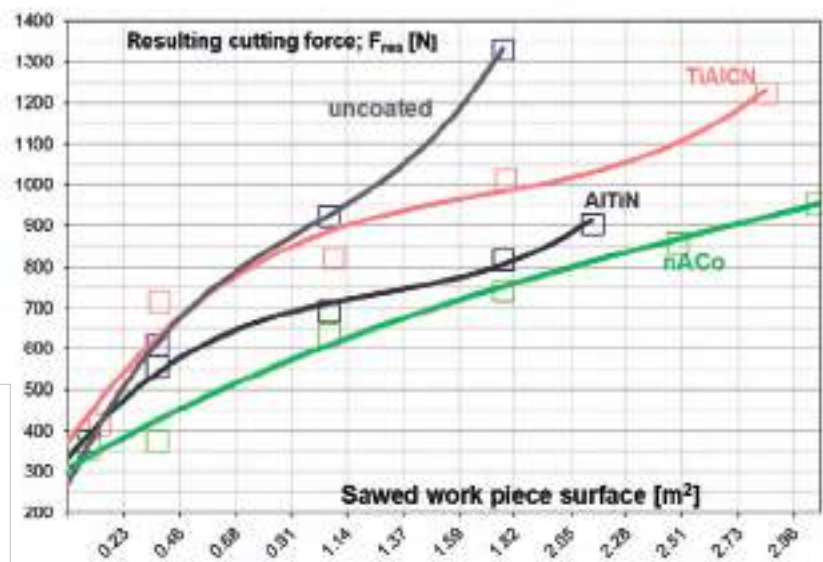
Several projects for broaches were realized by PLATIT with the "hat solution" of the standard machine PL1001

(with coating volume  $\varnothing 700$  mm x 700 mm) (Fig. 6a), [1], [4]. The hat is placed on the top of the standard chamber, a simple tube. This can be used to charge broaches with twice the length (1.4 m). In the first batch half of the broach's length is coated. Thereafter, the broach is turned by 180° to complete the other half in the second batch. Of course, the hat solution is slow because it doubles process time, but it is cost effective.

With the extremely long broaches, we have to break with the principle; "The cathodes must be longer than the coatable height". Extremely long cathodes would be extremely expensive.



**Fig. 3:** Development of dedicated coatings for sawing in stainless, austenitic steel  
Work piece material:  
X6CrNiMoTi17-12-2 – 1.4571  
D-work piece: 300 mm.  
Source: Wikus, Spangenberg, Germany.





**Fig. 4:** PL2001 coating machine for saw blades  
User: TRU-CUT, Brunswick, Ohio, USA.

PLATIT supplied the company Genta (Torino, Italy) with the PL2500 (Fig. 6b). It can pick up broaches up to a length of 2.5 m and coat up to 1.8 m working length. The machine works with four cathodes, two on top of each other on the opposite sides of the chamber. They each coat 700 mm, resulting in 400 mm missing for direct coverage of the total

height of 1.8 m. The coating thickness distribution can be optimized with the help of more cathodes.

This year there is a machine in the project stage, which also receives 2.5 m long broaches and can coat 2 m working length on the tools. We use six vertically and horizontally offset cathodes (see Fig. 6c).

Because of the enormous masses of broaches, the carousel (tool carrier) must be guided on a track that is sunk into the fundament (see Fig. 6b).

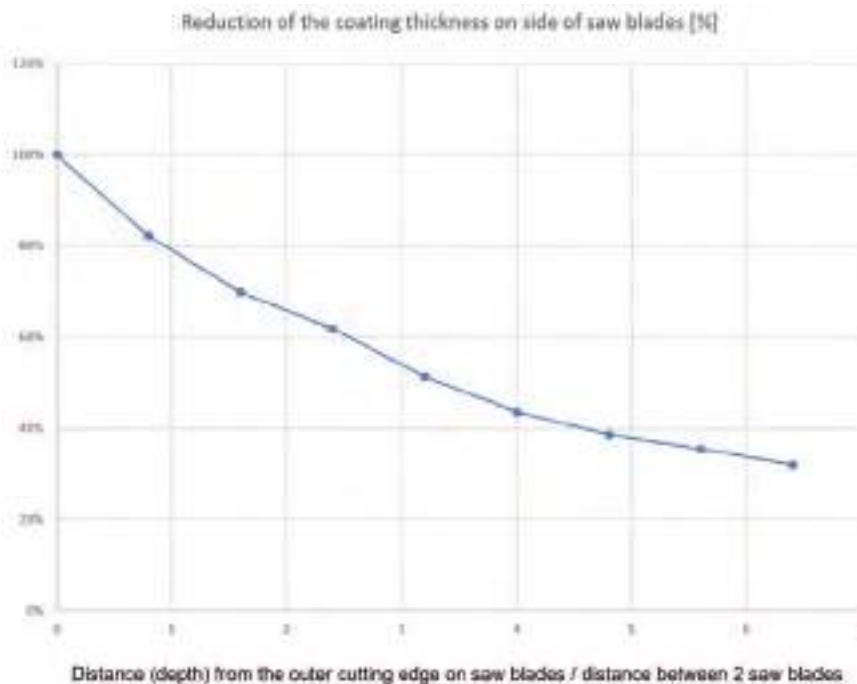
According to the principle of the turnkey solutions from PLATIT, the system will be supplied with an adapted single-chamber cleaning system [1].

### Machine for Coating Components

Many moving parts in the machinery and automotive industries do not need extra hard coatings. But they must be extremely smooth and have to show very low coefficients of friction.

For a smooth adhesion layer, the HIPIMS sputtering method is suitable [6]. In the plant PL1011-Hybrid (Fig. 7), a very thin (~200 nm) CrN layer is sputtered pulsed, as a ground layer.

After deposition of the adhesive layer, the shutters of the cathodes will be closed and a DLC (Diamond Like Coating) layer will be formed by a PECVD



**Fig. 5:** Reduction of the layer thickness when coating saw blades  
Measured by saw blades D = 280 mm at d = 25mm distance between two saw blades.



**Fig. 6:** Coating equipment for broaches  
A: PL1400 with hat at Metallestalki, Bilbao, Spain  
B: PL2500 at Genta, Torino, Italy  
C: PL2511 project with 6 cathodes

process. The extremely smooth DLC<sup>2</sup> (Sa<20 nm) layer is deposited as silicon doped amorphous carbon with hydrogen; a-C: H: Si [1].

This combination of PVD and DLC coatings offers very good adhesion, smoothest surface finish with good hardness. Their main applications for this process are

- high quality machine components, medical devices, aerospace components, as well as
- cutting tools for composite materials with affinity for built up edges, and
- stamps, dies, and cutting tools.

### Outlook

Especially for large tools, the standard coating systems are limited. Even the coating of components in large quantities requires special machines.

PLATIT set up an independent production facility for special equipment. The production unit, managed by extremely experienced specialists, plans and manufactures these special systems in coordination with users, according to the specific requirements, including design, planning, production and commissioning.

The focus is on special equipment for:

- broaches,
- saw blades,
- hobs, and
- machine components with special requirements,
- embossing rolls, and punches.

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- [4] Coating unit for broaches with "hat"  
[www.metallestalki.com](http://www.metallestalki.com)
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[www.nano4energy.eu](http://www.nano4energy.eu)



**Fig. 7:** PL1011-Hybrid coating plant for components in the automotive industry  
User: Fullandi, Shenzhen, China