

# HAUZER

TRIBOLOGICAL COATINGS



INDUSTRIAL PLASMA SOLUTIONS

IHI GROUP

# INDUSTRIAL PLASMA SOLUTIONS

“Hauzer has been the pioneer in vacuum plasma coatings since 1983. Creative solutions are part of our DNA. Our engineers have used the experience to develop a broad technology portfolio. We supply various deposition and etching technologies to deposit Physical Vapour Deposition (PVD), Plasma Assisted Chemical Vapour Deposition (PACVD) and nitriding layers. We integrate these in our industrial batch and inline equipment. Tailor-made machine concepts for our customers are created continuously. With IHI-Bernex joining the Hauzer group recently, CVD Technology has been added to our product portfolio. Visit [ihi-bernex.com](http://ihi-bernex.com) for more information.”

“The basics for our success are our people, our experience and joint development with our customers. Hauzer has 200 employees. In the future we will continue to expand our expertise, developing our technologies and material properties in line with our customers' sustainable goals. Combining these technologies with application knowledge, we can build the most efficient, highly productive equipment that markets need. Hauzer is your partner for industrial plasma solutions.”

**Dave Doerwald**  
CEO



# PARTNERSHIPS, RECIPE FOR SUCCESS

Cooperation is essential for Hauzer. A broad technology portfolio and mass production equipment are most valuable when combined with our customers' application knowledge. Some customers use our ready-made recipes for coatings that surpass the competition. Other customers use our industrial plasma solutions to develop their own unique products. Their success is our triumph.

## **Global Leader**

Partnerships make Hauzer strong. They give us the position of global leader in tribological coatings for the automotive market, they provide the competitive edge in tool coating technology and they ensure that we build sustainable factories for decorative coatings, such as Cromatipic. Due to its large installed base of hundreds of machines, Hauzer offers an extensive customer support package, including upgrades with new technologies and consumables.

## **Global Presence**

From our competence centres and offices in the Netherlands, Spain, China and Japan, we offer our customers the support necessary to be a real partner. Our engineers will provide local assistance in process development, maintenance, training, trouble shooting and delivery of spare parts and consumables.

## **Research Collaboration**

Due to Hauzer's pioneering position and the consecutive decades of technology development and equipment building, we have built a close relationship with many research departments in industrial companies and scientific institutes. Our research, combined with our engineering experience guarantees excellent industrial plasma solutions.

## **Development for Future**

Plasma technology and robust mass production equipment will be needed in many more markets. Hauzer will be your partner to develop the industrial plasma solutions for the future.

# MACHINE PORTFOLIO BATCH

Hauzer Flexicoat batch machines are built in mature modules that combine a high degree of flexibility with a reliable production output. Multiple plasma technologies can be combined in one machine. The design makes upgrading of existing equipment with new technologies always possible. Mass customization enables the supply of unique equipment with proven plasma concepts. The flexible design gives you to the opportunity to adapt your machine to future needs of the market. By discussing your market, applications and requirements we create an understanding how to match our system configuration with your future success.

## GENERAL ADVANTAGES OF THIS MODULAR APPROACH

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COMPETITIVE  
COST OF OWNERSHIP



CUSTOMIZED  
EQUIPMENT SOLUTIONS



MULTIPLE PLASMA  
TECHNOLOGIES IN ONE MACHINE



QUICK TROUBLE  
SHOOTING

## HAUZER FLEXICOAT® 850

### Technical Specifications:

#### Effective coating volume

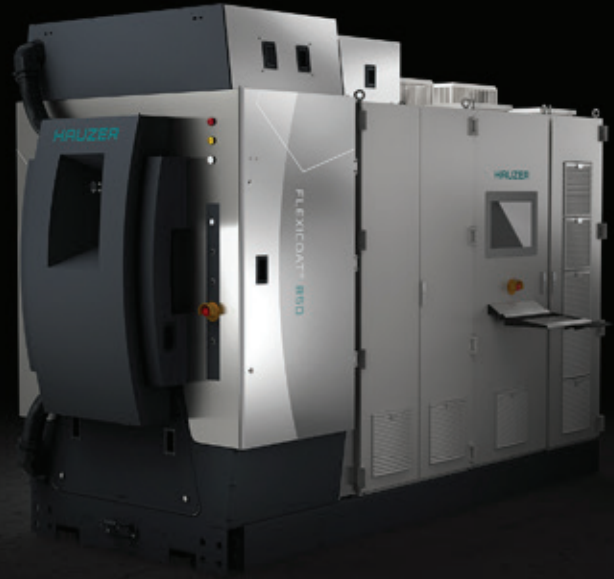
ø 500 mm x 500 mm height

#### Number of cathode positions

4

#### Maximum load mass

400 kg



## HAUZER FLEXICOAT® 1000

### Technical Specifications:

#### Effective coating volume

ø 650 mm x 650 mm height

#### Number of cathode positions

6

#### Maximum load mass

1000 kg



## HAUZER FLEXICOAT® 1250

### Technical Specifications:

#### Effective coating volume

ø 810 mm x 850 mm height

#### Number of cathode positions

7

#### Maximum load mass

1000 kg



## HAUZER FLEXICOAT® 1500

### Technical Specifications:

#### Effective coating volume

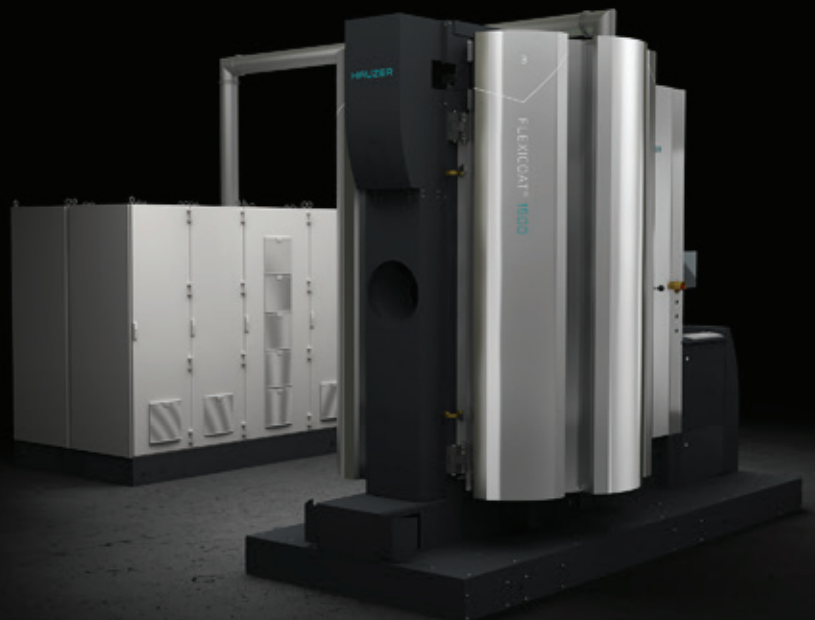
ø 900 mm x 1500 mm height

#### Number of cathode positions

6

#### Maximum load mass

3000 kg



# MACHINE PORTFOLIO INLINE

Hauzer inline machines coat millions of components every day. They are built for 24/7 mass production of three dimensional components and can easily be integrated in highly automated factories. Modular design enables the equipment to be expanded whenever production growth is needed.





# GENERAL ADVANTAGES



LOW COST OF OWNERSHIP



INTEGRATION IN HIGHLY AUTOMATED FACTORY



HIGH UPTIME, HIGH YIELD



TRACEABILITY OF PRODUCTS

### HAUZER Inline Concepts

The inline solutions can be built with or without rotating vertical or horizontal fixturing concepts passing the cathodes. Some of them are supplied with fixtures on a rack with dimensions of 1.5 m height, 1.2 m width, 0.2 m depth. Some of the inline platforms are built for coating bulk products. We challenge

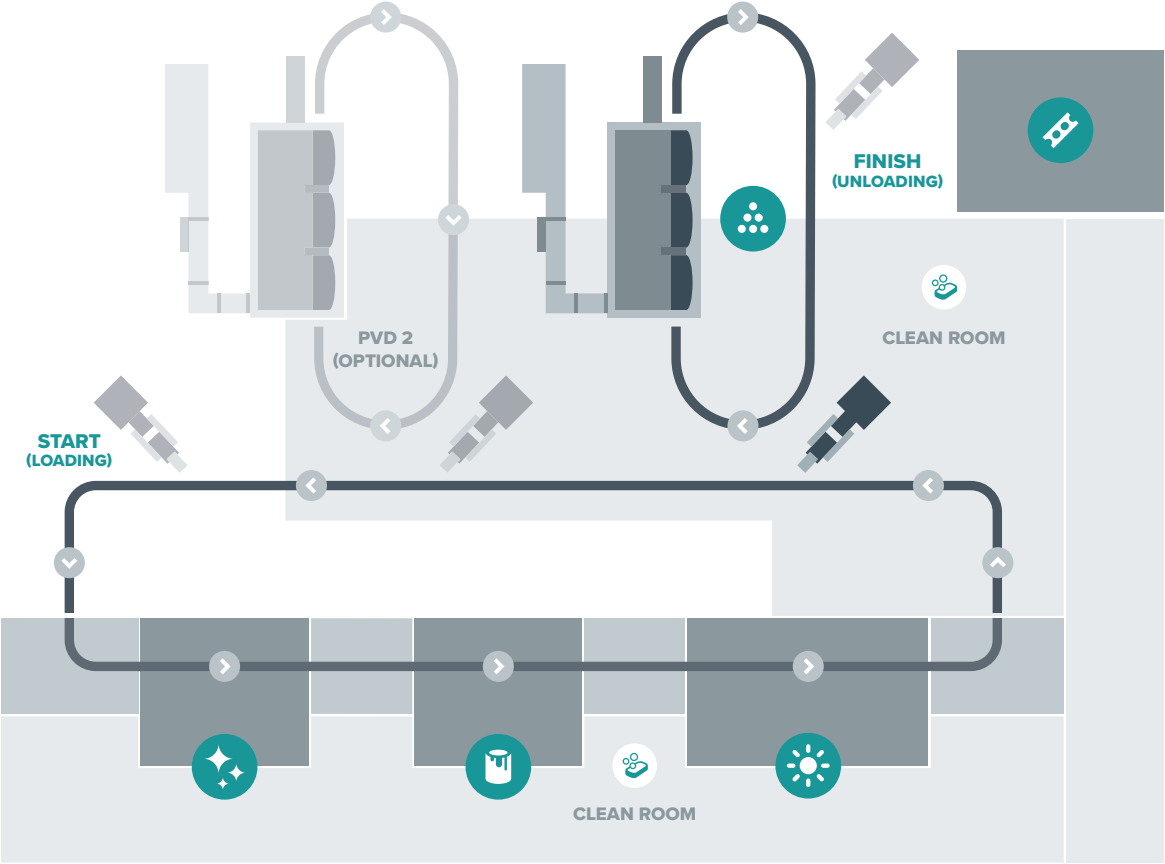
you to tell us about your products and coating issues, so we can produce tailor-made, highly productive inline machines for your specific requirements.

### Cromatipic® Factory

The alternative for electroplating in the automotive industry is called Cromatipic. Beautiful, high performance

Cromatipic coatings can be made safely and environmentally-friendly in a cost-effective way. The state-of-the-art plant and competence centre is located in Barcelona. Hauser supplies the complete factories for this technology.

More information can be found in the separate Cromatipic brochure.



# PLASMA COATING TECHNOLOGIES

Technologies are the foundation of every effective coating, whether it is on a tool, a component or a decorative product. Hauzer offers a broad range of technologies, which can all be combined.

## **CARC<sup>+</sup>**

CARC<sup>+</sup> is a circular arc evaporation, PVD technology. It produces very smooth coatings, including TiAlN, AlCrN and Si-containing nanocomposite coatings and state-of-the-art hydrogen-free carbon coatings at very high deposition speeds and low cost of ownership.

## **CARC<sup>+</sup> Flex**

CARC<sup>+</sup> Flex gives increased flexibility in magnetic field design. This gives more control over ionization and coating properties. It also offers uniform target erosion, thicker coatings for special applications and the possibility to program parameters during the coating process, so you will have adequate parameters for different steps in your coating design.

## **Advanced Controlled Arc**

Advanced controlled arc evaporation technology uses rectangular arc cathodes to produce metal nitride, carbonitride and oxide coatings. It is used for coating temperature sensitive products and when a range of attractive colours is required.

## **Focussed Ion Rapid Etch (FIR Etch)**

FIR Etch is based on Hauzer's plasma source etching technology. The ion beam is enhanced and steered in the chamber, resulting in higher etch rates, perfect adhesion and an increased productivity.

## **Magnetron Sputtering**

Magnetron sputtering technology is used to produce smooth and well-adhering coatings for applications where friction needs to be reduced. It can also be used for materials with poor electrical conductivity or for special colour requirements. It is often used in combination with PACVD technology for diamond like carbon (DLC) coatings.

## **Plasma Assisted Chemical Vapour Deposition (PACVD)**

Different from PVD, PACVD does not use metallic targets. With PACVD, a plasma is used to crack pre-cursor gasses at relatively low temperatures. The technology is mainly used in combination with hydrocarbon gasses to produce highly wear resistant carbon coatings. DLC coatings can be doped with Si or other elements to tune the coating properties.

## **High Power Impulse Magnetron Sputtering (HiPIMS)**

HiPIMS is a specific kind of sputtering that combines the advantages of high ionization like arc evaporation with the smoothness of magnetron sputtering. This technology opens up extra possibilities to fine-tune the coating properties, such as internal stress and coating structure, of layers that cannot be produced with other existing technologies.

#### Dual Magnetron Sputtering (DMS) and T-mode

DMS technology is used for the deposition of materials that show very low electrical conductivity. Together with Hauzer's T-mode technology for fast control of reactive gas flow, this enables the deposition of metal oxide coatings like  $Al_2O_3$ .

#### Microwave Technology

PACVD can be further enhanced by using a microwave plasma source for more tuneable properties, higher deposition rates and therefore lower coating cost.

#### Hybrid Technologies

Because the Hauzer Flexicoat equipment can combine many technologies in one machine, highly effective combination layers can be produced. An example of a hybrid technology is Nitrocoat, a combination of plasma nitriding and coating. Because the technology can be combined in one batch, the typical white layer can be avoided and a strong adhesion is the result. Other examples are CARC<sup>®</sup> and DMS or nitride coatings and DLC. Please discuss with us the best combination for your application!

#### CROSS-OVER DEVELOPMENT

Hauzer is developing its technologies and coatings for several markets, in which we are recognized as technology leaders. This provides advantages for our customers. For example in the tool and decorative markets our customers can benefit from the fact that we have developed our DLC and ta-C coatings for years for tribological applications. Using effective technologies and building deep knowledge about the coating characteristics makes tuning for new applications much easier.

Another example is the development of CARC<sup>®</sup> technology for the tool market. Now that we have become supplier of benchmark coatings in this field, other markets can benefit and find the coatings that fit their needs, developed and produced with our broad technology portfolio.

A strong focus on technology development gives our customers their competitive edge!

Photo in courtesy of Dörrenberg

# TRIBOLOGICAL APPLICATIONS

Hauzer is a technology leader for tribological coatings. In the 1990s automotive suppliers started to use plasma coatings to reduce wear and friction in their engines. From the beginning, Hauzer cooperated with the leaders in the market to develop the most productive coatings concepts with the best coating performance. Nowadays Hauzer Flexicoat equipment produces the best diamond like carbon (DLC) and nitride coatings to satisfy this critical market and many other markets that need tribology. Every year millions of coated parts leave a Hauzer machine somewhere in the world to start their lives as low friction components.

## **Automotive Components**

Examples of automotive engine components that are being coated are fuel injection parts like injection needles, high pressure plungers and orifices valves. Piston rings, valve train components like rockerarms and tappets, piston pins, roller and sliding bearings, gears and many others. Lately, in order to reduce emissions even further, industry is investigating other engine parts as well, like dynamic seals (friction reduction) and bi-polar plates (electrification of powertrains).

## **Non-automotive Markets**

Tribology expertise is of use in many markets, such as medical, off-road, oil and gas, aerospace and general machine components. With our broad technology portfolio, Hauzer is of value in all of these markets.

## **Batch Versus Inline**

Cost of ownership is an important deciding factor and inline platforms have a lot to offer because of their productivity increase. Hauzer's inline platforms come with a high degree of automation. And they gather more and more interest from component manufacturers. Our inline equipment choices come in many different forms and sizes, although they have one thing in common: they all combine high productivity with the broad technology portfolio that we built up over the years and are still improving upon.



# TRIBOLOGICAL COATINGS

Hauzer offers a full range of tribological coatings. Because the equipment is flexible, many tribological coatings can be combined in one machine, ensuring efficient batches and low cost of ownership.

The most commonly used coatings are listed below.

## **CrN**

Chrome nitride, produced by either arc evaporation or magnetron sputtering, is heavily used for its wear resistance properties, coating toughness and high temperature resistance.

## **Me-DLC (WC-C:H)**

Upon market introduction in the early nineties, the kind of Diamond Like Carbon (DLC) coating mostly used was metal DLC coating (Me-DLC). Metal DLC coating is applied on the engine component by magnetron sputtering technology. The coating has excellent features with regard to rolling contact fatigue. Typical applications for metal DLC coating are gears, bearings and turbo diesel injection parts.

## **Amorphous hydrogenated DLC (a-C:H)**

Amorphous hydrogenated DLC coating (a-C:H) is applied by Plasma Assisted Chemical Vapour Deposition (PACVD) coating technology, optionally enhanced by microwave technology. With these technologies no expensive target materials are needed.

A typical friction coefficient of DLC coating applied by PACVD technology is in the range of 0.05 to 0.15. Typical applications for this DLC coating are turbo diesel injection parts, piston rings, piston pins and valve train components. Since early 2000, this type of coating is dominating for automotive applications. Hauzer also offers silicon-doped DLC coating (a-C:H-Si) for niche applications where friction reduction is the main driver.

## **Hydrogen-free DLC (a-C and ta-C)**

More and more DLC coatings and other low friction coatings will be used in different applications, because of varied functional requirements. The combination of the specific component together with the coating and the lubricant is most important to achieve an optimum reduction in friction. To this extend Hauzer offers several solutions, such as a-C and ta-C coatings, both hydrogen-free carbon coatings. The ta-C coating can be produced by arc and HiPIMS technology. A typical friction coefficient of ta-C is in the range of 0.02 and 0.1. Apart from ta-C, Hauzer also offers a less hard a-C coating, either produced by CARC or traditional magnetron sputtering.

## DETAILS OF TRIBOLOGICAL COATINGS

Coating	NITRIDE BASED		CARBON BASED			
	CrN , Cr <sub>2</sub> N	Metal doped DLC (WC-C:H)	Amorphous hydrogenated DLC (a-C:H)	Silicon doped DLC (a-C:H-Si)	Hydrogen free DLC (a-C)	Hydrogen free DLC (ta-C)
Technology	<ul style="list-style-type: none"> <li>• CARC+</li> <li>• Magnetron sputtering</li> </ul>	<ul style="list-style-type: none"> <li>• Magnetron sputtering</li> </ul>	<ul style="list-style-type: none"> <li>• PACVD</li> <li>• Microwave assisted PACVD</li> <li>• Magnetron sputtering</li> </ul>	<ul style="list-style-type: none"> <li>• PACVD</li> </ul>	<ul style="list-style-type: none"> <li>• CARC+</li> </ul>	<ul style="list-style-type: none"> <li>• CARC+</li> <li>• HIPIMS</li> </ul>
Thickness range $\mu\text{m}$	1 - 40	1 - 10	1 - 10	1 - 10	1 - 20	1 - 10 (CARC+) 1 - 3 (HiPIMS)
Microhardness (HV0.05)	2000 - 2200	800 - 2200	1500 - 3500	1500 - 2500	2000 - 4000	4000 - 7000
Coefficient of dry friction	0.4	0.1 - 0.2	0.05 - 0.15	0.05 - 0.1	0.05 - 0.1	0.02 - 0.1
Max Temperature resistance °C	700	350	300	300	450	450
Deposition temperature °C	150 - 500	160 - 250	160 - 250	160 - 250	150 - 220	100 - 220
Typical applications	<ul style="list-style-type: none"> <li>• Tappets</li> <li>• Piston rings</li> <li>• Fuel injection components</li> </ul>	<ul style="list-style-type: none"> <li>• Gears</li> <li>• Roller bearings</li> </ul>	<ul style="list-style-type: none"> <li>• Tappets</li> <li>• Plungers</li> <li>• Fuel injection components</li> <li>• Piston pins</li> <li>• Camshafts</li> <li>• Bushes</li> <li>• Actuators</li> <li>• Textile parts</li> </ul>	<ul style="list-style-type: none"> <li>• Tappets</li> <li>• Piston rings</li> </ul>	<ul style="list-style-type: none"> <li>• Piston rings</li> </ul>	<ul style="list-style-type: none"> <li>• Tappets</li> <li>• Piston pins</li> <li>• Fuel injection components</li> </ul>

# HAUZER



**IHI HAUZER TECHNO COATING B.V.**

Van Heemskerckweg 22, 5928 LL Venlo, The Netherlands

T +31 77 355 97 77 | [info@hauzer.nl](mailto:info@hauzer.nl)

[HAUZER.NL](https://www.hauzer.nl)

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