VLC 450 DG

DOUBLE-SIDED SURFACE GRINDER FOR HARD-COATED BRAKE DISCS

Series production of hard-coated brake discs

EMAG

EURO 7

The EURO 7 standard sets limits for the emission of brake particles for passenger cars and light commercial vehicles for the first time. Irrespective of the drive system used, a changeover to a new braking technology is required. An effective approach to reducing particulate matter in the braking system is the use of hard-coated brake discs.

Hard-coated brake discs place high demands on both the coating technology and the grinding process. Optimum coordination of both technologies is therefore essential for good and economical results.

CONTENT

BACKGROUND
Why the technological requirements are high

The further development and optimization of brake system components is a constant process in the automotive industry, which has been given a new dynamic with the entry into force of the EURO 7 standard.

A key component here is the brake disc, whose effectiveness and service life depend not only on the material properties, but also to a large extent on the surface treatment. In this context, hard machining technologies, especially grinding, play a central role. The aim is to apply a coating to the brake disc that shows as little material loss as possible during the braking process. This makes machining a major challenge, as a lot of material needs to be removed in as short a time as possible with minimal tool wear.

THERMAL DEFORMATIONS CAUSED BY THE COATING PROCESS

Another challenge is the possible deformation of the brake disc due to the thermal influences of the coating process.

1 ADAPTATION TO THE VARIETY OF SHIFTS

Challenges and solutions

The variety of coating materials requires specific machining strategies. Multi-layer coatings place high demands on the grinding process. Their cutting behavior is similar to the carbide machining known from tool grinding. This type of coating requires low cutting speeds, but all the higher torque. Before machining, these coatings have a roughness of up to 100 micrometers. After the grinding process, both the matrix and the carbides are machined. The machining behavior is due to the dual properties of the coatings: brittle-hard carbides on the one hand and a ductile matrix on the other.

2 MULTI-LAYER COATINGS

after laser metal deposition

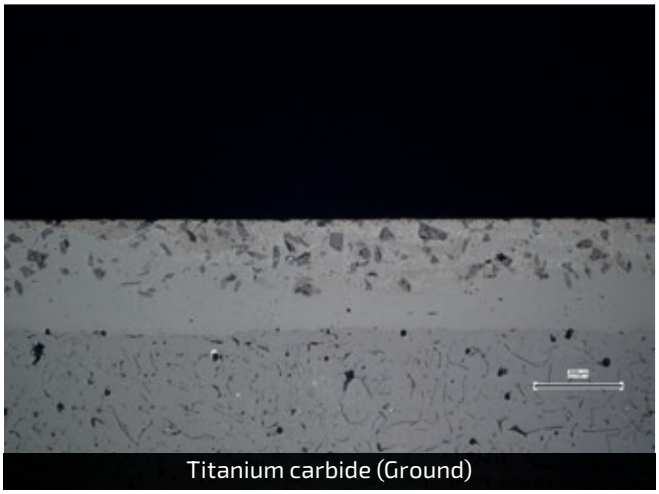
"Soft" matrix and "hard" carbides must be machined.

Titanium carbide

3 MULTI-LAYER COATINGS

after grinding

Ductile and brittle materials generally require individual grinding strategies. In the case of the coating, the brake disc combines both. The material properties and cutting behavior are influenced not only by the volumetric composition of the materials, but also by the process parameters during laser metal deposition.



Titanium carbide (Ground)

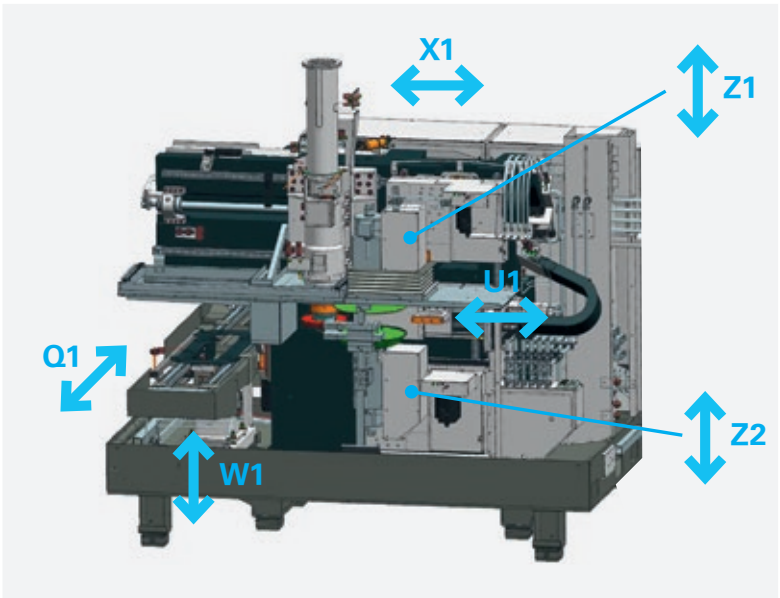
THE GRINDING MACHINE
Grinding machine and technology are decisive for prec

The VLC 450 DG is designed for rigidity and durability to meet the high demands of batch production. The machine shuttle forms the interfaces to the downstream automation outside the machine's work area. The machine concept is based on decades of experience in the construction of vertical turning and grinding machines. An intelligent sensor concept enables adaptive process control.

+ Reduction of the risk of damage or wear to critical components, critical components (guides, measuring systems, ...) are located outside the work area.
+ Simple link-up and line integration, automation of the loading and unloading process thanks to vertical arrangement and feed shuttle.
+ Good thermal stability of the machine thanks to integrated cooling concept.
+ Good vibration damping thanks to mineralite machine base.

AXIS STRUCTURE OF THE VLC 450 DG

+ X1-axis main spindle with workpiece chuck
+ Z1/Z2 axis with grinding spindle
+ U1 Sharpening
+ Q1 Shuttle
+ W1 Workpiece lift



ision and process reliability

LARGE WORK AREA, VERTICAL DESIGN

- Direct removal of sanding sludge thanks to vertical spindle arrangement
- Minimization of the accumulation of sanding residue on the workpiece and in the machine
- Excellent accessibility for set-up and set-up and maintenance work

The brake discs are lifted through the the lifting station to the main spindle are transferred.

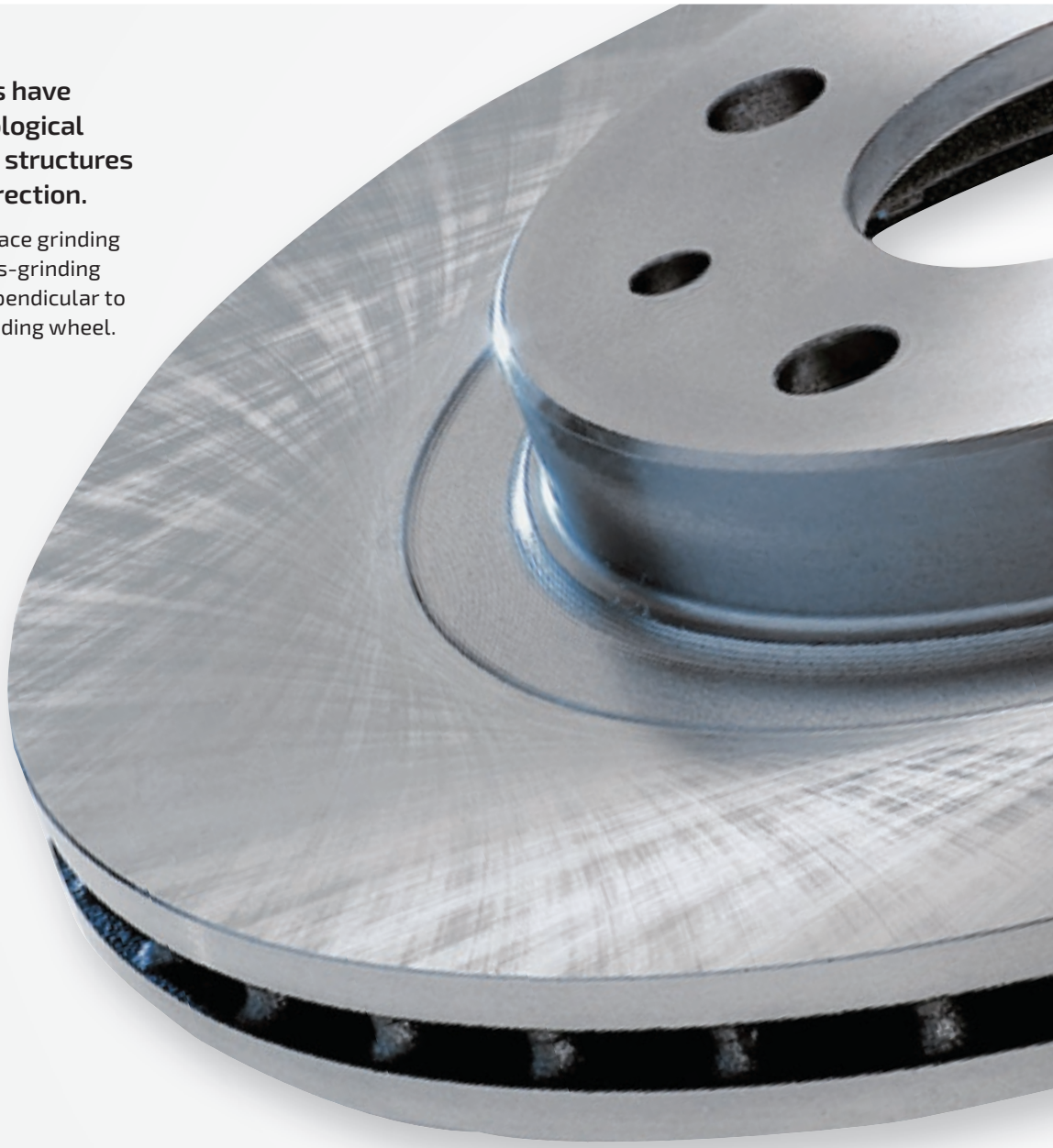
TECHNICAL DATA

		VLC 450 DG
Outer diameter of friction ring max.	mm in	450 18
Diameter friction ring inside max.	mm in	250 10
Friction ring thickness	mm in	10–45 0.4–1.8
Hub bore diameter	mm in	60–100 2–4
Outer diameter of hat	mm in	140–250 5.5–10
Installation height	mm in	< 100 < 4
Workpiece weight max.	kg lb	25 55

THE TECHNOLOGY
Focus on quality with double-sided surface grinding

Cross-ground structures have significantly better tribological running-in behavior than structures in the circumferential direction.

As a result, double-sided surface grinding is of central importance. Cross-grinding structures are generated perpendicular to the axis of rotation of the grinding wheel.

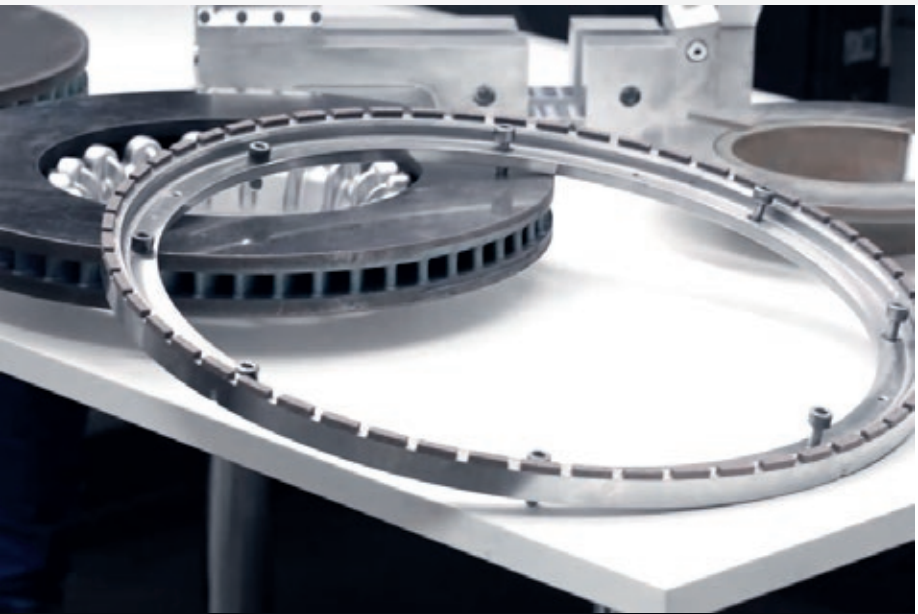


KEY POINTS

+ Both grinding spindles are arranged in parallel, the brake disc is machined in cross-grinding mode
+ The grinding wheels are self-sharpening
+ A mineral oil-free solution is used as the process cutting fluids

DIRECT QUALITY CONTROL

by cross-grinding and, therefore, simple checking of the machine settings. The progression of the incoming and outgoing grain confirms that all axis angles are set correctly and that the machine can deliver geometrically perfect results.



THE GRINDING TOOL

The grinding tool of the VLC 450 DG sets new standards in the machining of brake discs. Designed as an interchangeable ring, it is characterized by its low weight of less than five kilograms, which makes it easy to handle. Tool change times are remarkably short at under ten minutes. The tools are self-sharpening.

THE KEY TO OPTIMIZATION
Looking at coating and grinding together and optimally

The effective coordination of laser metal deposition and grinding processes is crucial for the production of high-quality brake discs. This coordination goes beyond pure island optimization, in which individual parameters such as laser power, beam geometry or kinematic parameters are considered in isolation. Such optimizations can achieve short-term improvements in sub-areas, but the real success lies in the holistic view of the process chain: turning-laser metal deposition-grinding.

Laser-coated brake disc

Ground brake disc

Being able to offer both processes under one roof - laser metal deposition and grinding and turning - is a decisive advantage. This allows us to work closely together and organize the processes in a complimentary manner, resulting in manufacturing solutions for brake discs that not only impress with their function in the brake system, but they also set new standards in terms of manufacturing efficiency and material usage. This integrated approach is the key to optimally meeting our customers' requirements while minimizing production costs.

LASER METAL DEPOSITION OF BRAKE DISCS

Special metal powder (often with carbides) is applied to the brake discs at a high feed rate and high laser power.

coordinate them

GRINDING OF THE HARD COATING OF BRAKE DISCS

The VLC 450 DG is specially designed for the series machining of hard coating of brake discs. The production system meets the highest productivity levels and workpiece quality requirements and is, therefore, predestined for finishing hard-coated brake discs.

LASER METAL DEPOSITION AND GRINDING IN THE LAC (LASER APPLICATION CENTER)

The EMAG LaserTec laser application center in Heubach is the development center for laser processes within the EMAG Group. A special development and testing area has been set up as part of the process development for the coating of brake discs. Both laser coating machines and grinding machines from the VLC 450 DG series are available here for prototype manufacture.

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