HELLER CBC: a mature coating technology

In recent years, HELLER has established itself as a reliable development partner to the industry. Our process expertise is as much in demand as our know-how in the field of innovative technologies. A successful example of a close technology partnership is the CylinderBoreCoating technology (HELLER CBC). In 2011, Daimler AG and HELLER started a cooperation to jointly further develop the coating process, bringing it to technological maturity. Today, the technology has become well-established internationally. By 2016, 32 machines had already been delivered to customers worldwide. Until the end of 2018, there will be a total of 76 machines with a production capacity of approx. 27 million coated bores per year. Considering the enormous advantages of the process, a further increase is to be expected in the coming years.

Cylinder bores coated using the CBC technology minimise the friction between the piston and the cylinder, thus reducing fuel consumption and also CO₂ emissions. Moreover, the oil consumption as well as the weight and dimensions of the engine block are reduced, whilst thermal conductivity of the cylinder walls is improved.

CylinderBoreCoating – a next-generation technology made by HELLER.

For more information go to: www.heller.biz/en/cbc
The facts

- **thermal coating technology** for cylinder bores based on twin-wire arc spraying
- a process comprising four **process steps**: roughening, coating, fine boring hard, honing
- coating using the **HELLER CBC 200 coating module**
- as a **bypass solution** or as a **complete process** provided by **HELLER**
Step 1: Roughening

The mechanical foundation of the CBC coating process is the adequate preparation of the cylinder bore. A number of different roughing technologies are available for producing different surface conditions. To achieve the quality required for the coating process carried out in the second step, it is vital to create a structured surface quality whilst guaranteeing a precisely defined bore centre. To achieve this, HELLER decided to activate the surface using a machining process with a geometrically defined cutting edge to machine the cylinder bore to the required dimensions, whilst creating a precise helical roughened structure according to the requirements. High-precision work in large-scale production. At the CBC TechnologyCenter in Nürtingen the roughing process is performed by an MC 20. The generated surface provides the pre-requisites for adhesive tensile strengths of up to 50 MPa.

Advantages of the roughening operation
- geometrically defined surface quality
- bore centre is defined by the machining centre
- adjustable roughening profile
- bore diameter and roughening profile are in a single operation
- flexibly adaptable process for various types of cast aluminium
- precise and cost-efficient solution with a short machining time

Step 2: Coating

Currently, there are three different technologies available in the market for the coating of cylinder bores: the single-wire technology known as PTWA, the powder-based APS technology and twin-wire arc spraying or LDS. We have optimised the twin-wire process in terms of process and control technology, turning HELLER CBC into today’s leading coating technology for use in high-volume series production.

In the HELLER CBC 200 coating module a pair of steel wires, forming the anode and cathode, are melted by means of an electric arc. Using nitrogen as a process gas, the molten steel is applied onto the roughened cylinder bore structure in the form of droplets. This creates a 0.3 mm steel layer with the characteristic porosity the technology provides. The pores, which are adjustable in number and size, create the cavities for the oil retention volume and thus ensure the lubrication of the cylinder bore.

Advantages of coating using HELLER CBC
Robust process due to fully controlled process parameters:
- high spray rate due to the use of two wires
- spray efficiency above 80 %
- continual layer build-up
- pores adjustable in terms of droplet size and number

Safe and economically competitive process:
- short coating time due to high spray rate
- nitrogen as process gas is inexpensive and safe
- practically no oxides in the layer – ensures efficient fine machining
- powerful extraction system for a clean work environment
- no special wires required, but available on request

Guaranteed dimensional accuracy:
- low heat input into the workpiece due to low temperature of the molten particles

Optionally, the engine block can be heated following the roughening operation. As a result, the bore diameter and the roughened structure are enlarged. This provides optimal conditions for step 2: the coating operation.
Step 3: Fine boring hard

Prior to the final finishing operation, the CBC process comprises a so-called ‘fine boring hard’ operation. In this step, the precise shape and position of the cylinder bore are determined, creating the prerequisites for the honing operation. Contrary to alternative rough honing and position honing processes offered in the market, the fine boring hard operation included in the HELLER CBC process is the only method guaranteeing a minimal layer thickness, whilst maintaining manufacturing tolerances.

Advantages of the fine boring hard process
- very short process time of approx. 12 sec. per bore
- highly precise cylinder geometries are created, whilst maintaining the geometric tolerances of the bores, resulting in an optimal utilisation of the friction advantages provided by the CBC coating process
- precise and cost-effective solution on standard machining centres

Step 4: Honing

The CBC layer is finalised in a mirror honing operation of the cylinder liners. As perfect as the surface may look, the special advantage of the CBC process is retained: a layer uniformly interspersed with pores, providing minimal friction and ideally suited for oil retention.
## Technical data

<table>
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<th>CBC 200</th>
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<td>Positioning range X/Y/A</td>
<td>750 mm / 610 mm / +/- 47°</td>
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<td>Workpiece management</td>
<td></td>
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<tr>
<td>Clamping surface</td>
<td>800 mm x 460 mm</td>
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<tr>
<td>Workpiece length</td>
<td>max. 600 mm</td>
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<tr>
<td>Clamping mass</td>
<td>max. 150 kg (incl. fixture)</td>
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<tr>
<td>Speeds</td>
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<tr>
<td>Acceleration [X/Z]</td>
<td>5 m/s²</td>
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<tr>
<td>Rapid traverse rate [X/Z]</td>
<td>40 m/min</td>
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<tr>
<td>Burner speed</td>
<td>max. 300 rpm</td>
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<tr>
<td>Coating time</td>
<td>approx. 30 sec. per bore</td>
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<td>Workpiece change time</td>
<td>approx. 20 sec.</td>
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<tr>
<td>Burner and wire change time</td>
<td>approx. 180 sec.</td>
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<tr>
<td>Engine types</td>
<td>I3 to V12</td>
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