

Thermal spray capabilities Höganäs



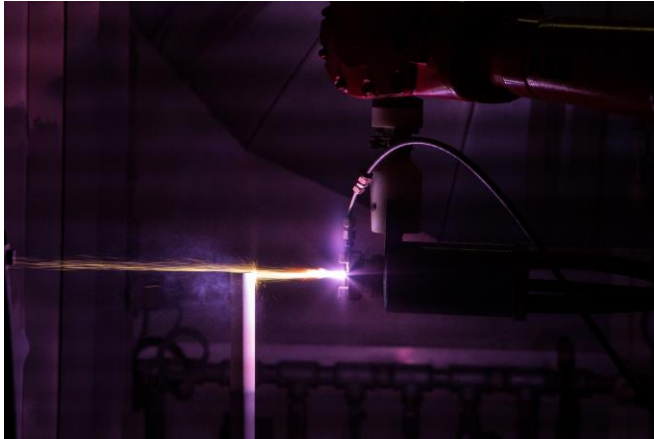
Wellington Goes, May 2023

ArcX Laufenburg

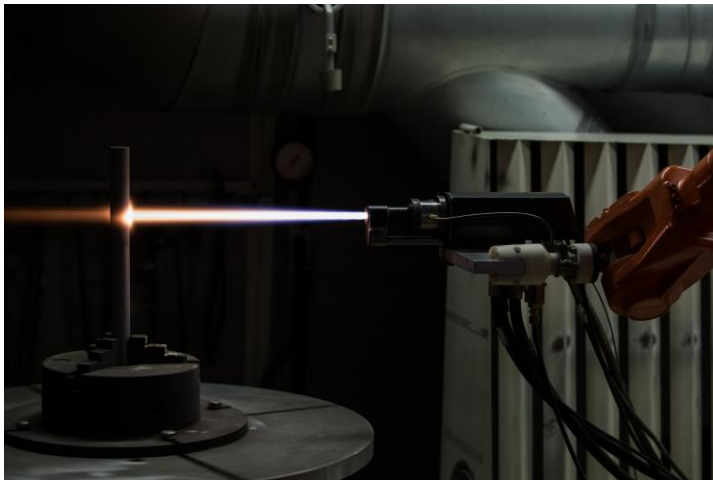
- » Located in South-West-Germany
- » 60 mins from Zurich Airport Switzerland / 45 mins from Basel-Mulhouse-Freiburg Airport
- » Multiple Hotels near by Rebstock, Alte Post (Laufenburg)
- » 4-6 people



Thermal Spray ArcX Laufenburg



F4



JP5000

Capabilities

- » LF-HVOF: JP5000
- » GF-HVOF: DJ 2600
- » Plasma: F4, 3MB, 9MB
- » Cascade: Leap, SinplexPro
- » Spraywatch particle diagnostic

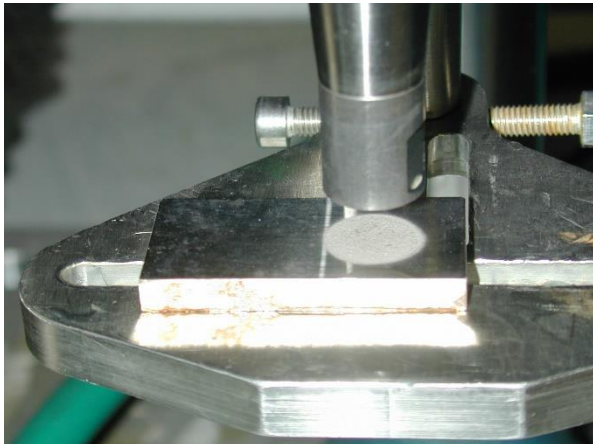


Thermal spray booth

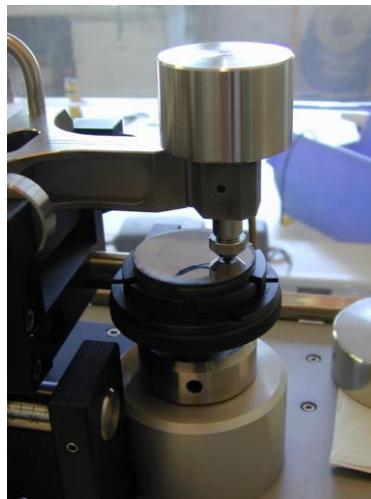
Testing & Analysis ArcX Laufenburg

Capabilities

- » Metallographic inspection (Porosity, Chemistry, etc.)
- » Cavitation test (ASTM G32)
- » Bond strength test (ASTM C633)
- » Wear test (Pin on Disc)
- » Wear test (Abrasion test ASTM G65)
- » Wear test (JIS 8605)



Cavitation test



Pin on Disc



Abrasion test

Capabilities

- » Surface roughness test
- » Hardness tests (Micro-, Macrohardness)
- » Young's modulus (Lawave®)
- » Salt spray test (ASTM B117)
- » Chemical Analysis
- » Gas permeability test



Lawave®

Powder Analysis ArcX Laufenburg



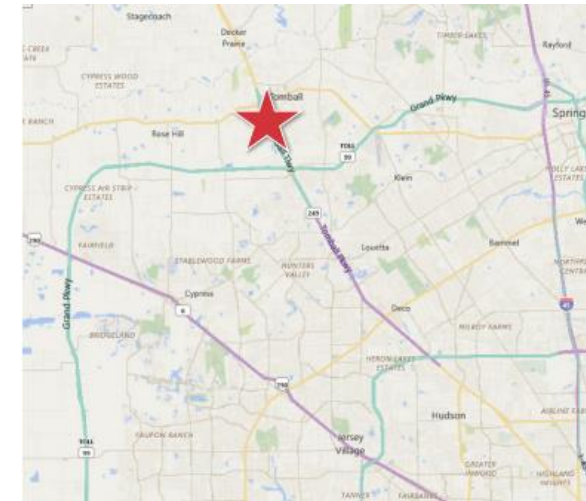
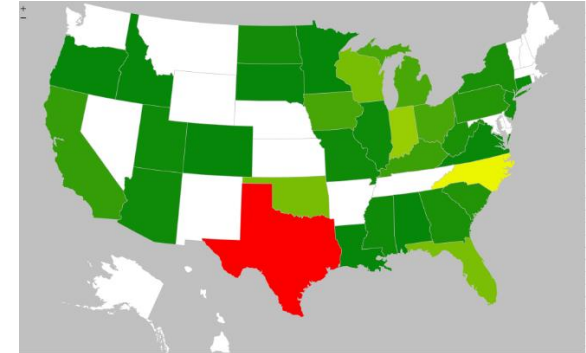
Capabilities

- » PSD Check – Lab milled (ASTM B430), Rotap (ASTM B 214), Microtrac (ASTM B 822)
- » Apparent density (ASTM B 212/ B 417/ B329)
- » BET (ISO 9277)
- » Hall Flow (ASTM B 330)
- » Tap density (ASTM B 527)
- » Sample Blending
- » Sample Creation
- » Powder Screening
- » Sample Storage



ArcX North America

- » Building area is 12,000sq ft (1115m2).
- » Located in North-West Houston (35 mins from Bush Airport).
- » Vicinity of Highway 249 and 99, easy access.
- » Multiple Hotels nearby (inc Hampton Inn, Marriot etc).
- » 4-6 people

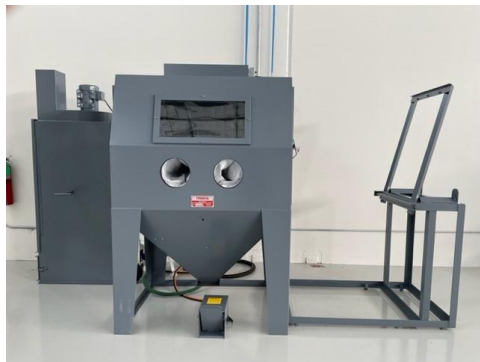


2019 data

Thermal Spray ArcX North America



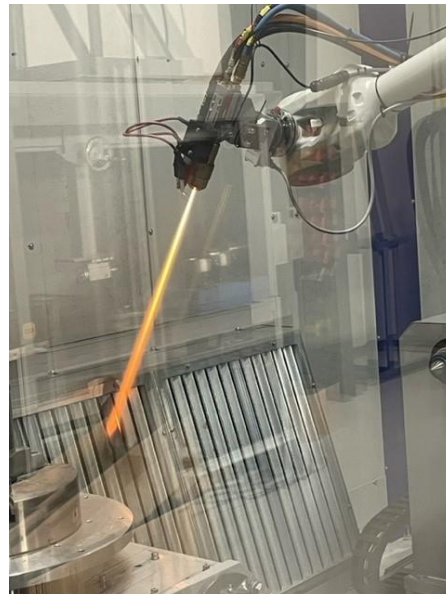
Thermal spray booth



Grit blaster

Capabilities

- » LF-HVOF: JP5000
- » GF-HVOF: DJ2700
- » HVAF: Kermetico AK6
- » HVAF-ID: Kermetico AK4
- » Flame spray: Colmonoy J3, Terodyn 3000
- » Plasma: F4
- » Cascade: SinplexPro



DJ2700

Laboratory ArcX North America



Capabilities

- » Sample Sectioning
- » Sample Mounting: Hot and Cold Mounts
- » Sample Polishing
- » Sample Etching
- » Vacuum Cure
- » Roughness measurement
- » Hardness & Microhardness
- » Porosity Measurement
- » Coating Thickness



Applications

- » Parameter Development
- » Customer Investigations
- » Powder Analysis
- » Microstructure Determination
- » Coating Quality



Testing & Analysis ArcX North America

Capabilities

- » Salt Spray Tester
- » XRF
- » Electrode Discharge Machine
- » Air Furnace
- » TIG Welder
- » G65 Wear test



Salt Spray



EDM Machine

Capabilities

- » Bond Strength (ASTM C633)
- » Scanning Electron Microscopy (SEM)
- » EDS
- » X-Ray Diffraction
- » Vacuum Heat treatment
- » DTA
- » Impact Testing
- » Chemical Analysis

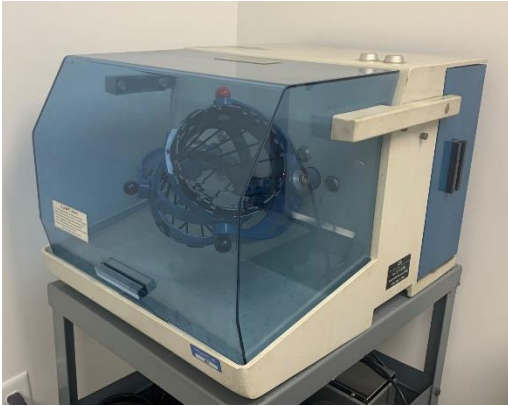


Vacuum Furnace



G65 Wear Tester

Powder Analysis ArcX North America



Capabilities

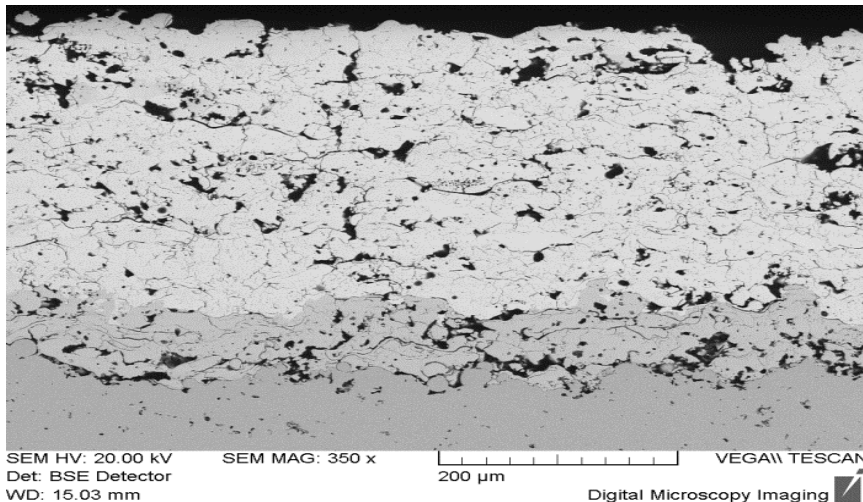
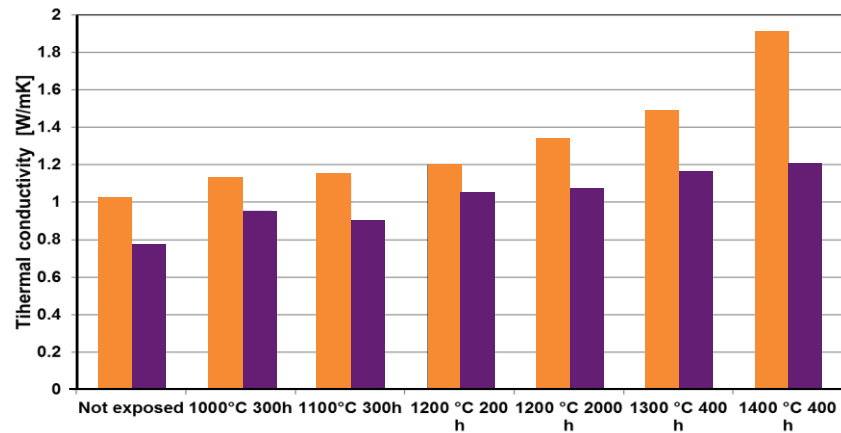
- » PSD – Rotap (ASTM B 214)
- » Sample Blending
- » Sample Creation
- » Powder Screening
- » Sample Storage

Applications

- » Sample Blending
- » Sample Creation
- » Sieve Size Modification



Thermal conductivity of Höganäs' low-k TBC
on as-sprayed and sintered samples



Aerospace Advanced TBCs



Customer challenges:

- New gas turbine types with an inlet gas temperature of up to 1500 °C request new TBC solutions for efficiency improvements
- APS TBC system based on high Ytria Stabilised Zirconia (YSZ) and on rare earths containing Zr-based compounds are currently available to address the above challenge



Examples of Höganäs' solution:

- Höganäs developed and patented its own advanced TBC - rare earths containing Zr-based compound (Amperit® 808.006)
 - Reduced thermal conductivity of the TBC system
 - Improved sintering behaviour of the ceramic layer
 - Enhanced performance of gas turbine components

Aerospace Landing gears



Customer challenges:

- Improvement of ductility for landing gear coatings

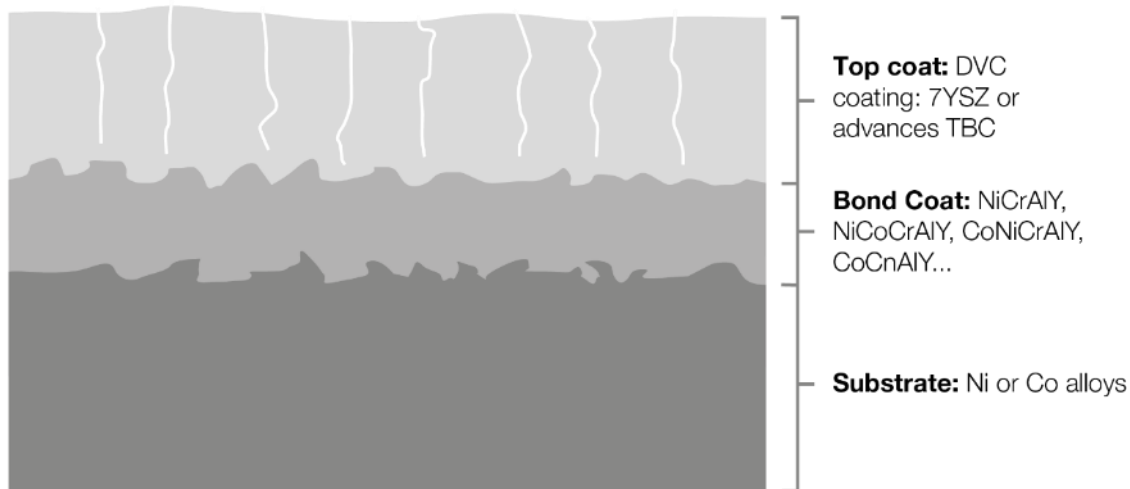


Examples of Höganäs' solution:

- Amperit® 557 for HVOF – new WC-based coating material with excellent carbide-binder distribution and optimized particle morphology
- Coatings combine excellent toughness and impact resistance with good wear and corrosion resistance

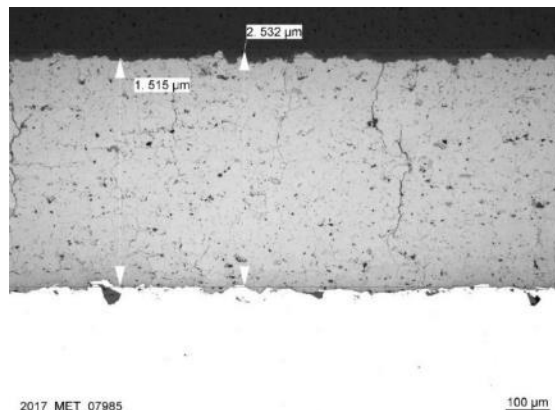
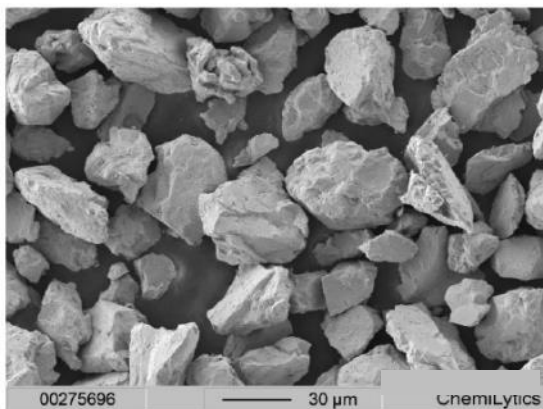


Dense Vertical Cracked TBC system



» SEM micrograph of Amperit® 825

» Plasma Sprayed DVC coating obtained with Amperit® 825



Industrial Gas Turbines

TBC DVC coatings



Customer challenges:

- IGTs face new challenges due to shift to renewable energies and need to adopt new operating models with a higher number of cycles (switch on/off) to act as peak provider and not as base load
- Parts and related coatings need to have an increased resistance to thermal cycling fatigue
- Dense Vertical Cracked (DVC) TBCs respond to this requirement



Examples of Höganäs' solution:

- Höganäs has developed fused and crushed YSZ (Amperit® 825) which is particularly suitable to obtain DVC coatings
- Amperit® 825 is qualified by main turbine OEMs
- Process parameters development has been carried out to provide customers with full technological solutions
- Same approach has been adopted to advanced TBCs

HVOF



» Salt spray test after >1000h of exposure time (Amperit® 508.072)



Coating thickness 280 µm

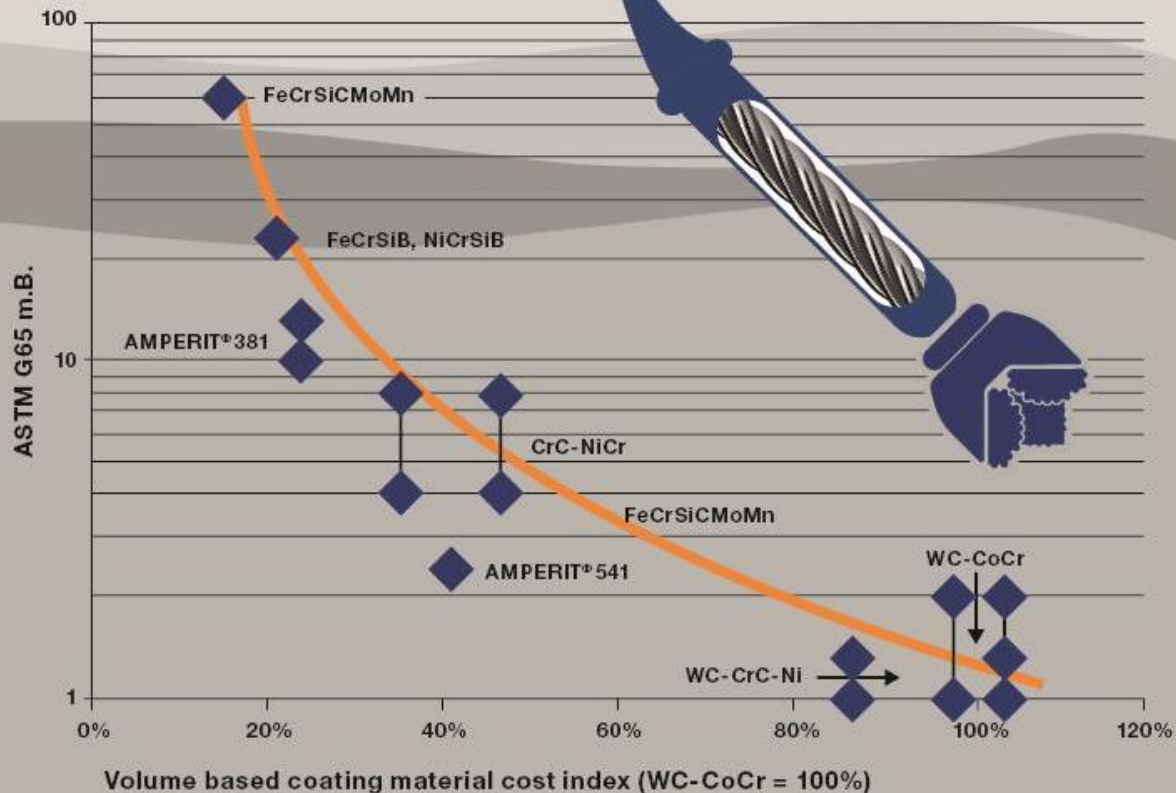
Power generation Hydropower

⚠ Customer challenges:

- Highly resistant coatings needed to protect components against (hydro) abrasion and cavitation

💡 Examples of Höganäs' solution:

- Amperit® 508.072 for dense and cavitation resistant coatings produced by HVOF
 - Tailored carbide size and distribution improve cavitation and impact resistance without compromising wear resistance
 - Suitable parameters have been developed to deposit this material with high density to also grant corrosion resistance
- Performance proven by main hydro operators and OEMs



Oil & Gas

Mud motor rotor

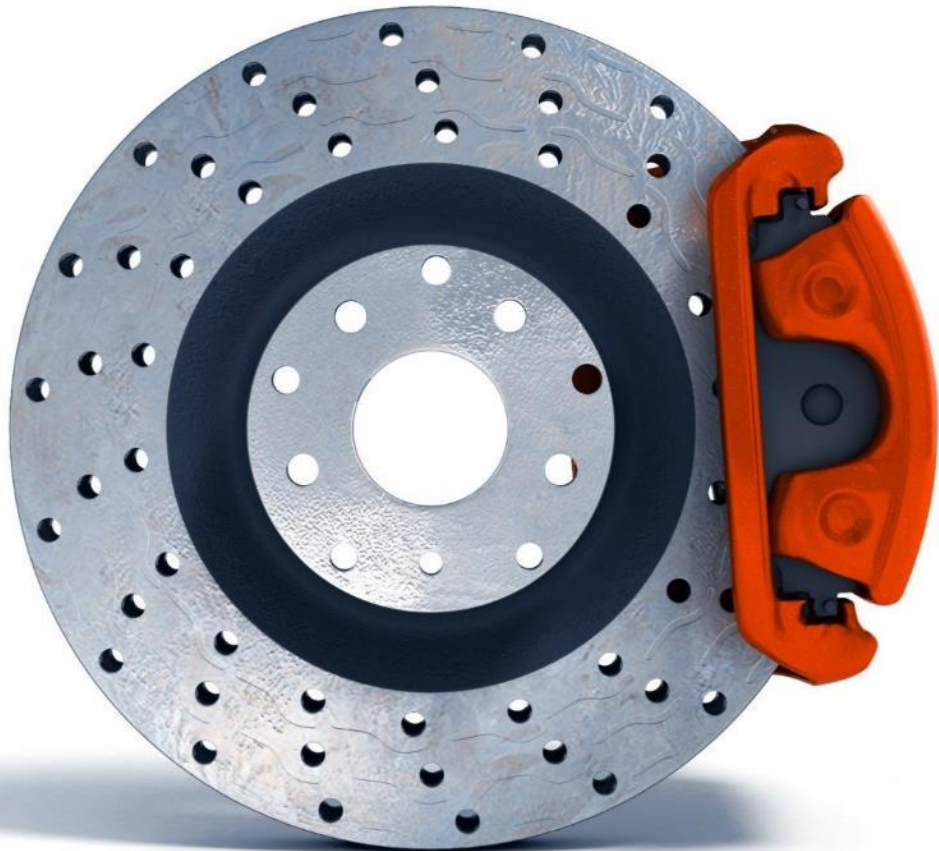
⚠ Customer challenges:

- The common issues with Cr plating:
 - Combination of mechanical stresses, impingement and erosion by solid particles supported by corrosion initiate cracking, cutting and finally spalling of the coating
 - Cutting and spalling of the Cr plating may also lead to severe damages of the stator



Höganäs' solution:

- HVOF / HVOF sprayed Amperit® 543/558 achieves dense and ductile coatings with excellent resistance against erosion, impact and corrosion
- The service life of both rotor and stator is significantly increased over standard chrome platings reducing downtime and maintenance costs



Automotive Brake discs

⚠ Customer challenges:

- Functional issues
 - Emission reduction of fine dust
 - Follow the ongoing performance developments with regards to the electrification of cars
- Aesthetic issues

💡 Höganäs' solution:

- Full range of coating solutions for HVOF, HVOF and laser cladding
 - Amperit® carbides as well as Surfit® Fe- and Ni-based alloys to develop a complete coating system which grants corrosion protection and enhanced brake performance
 - Tailored solutions for your specific requirement

Thank you!



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