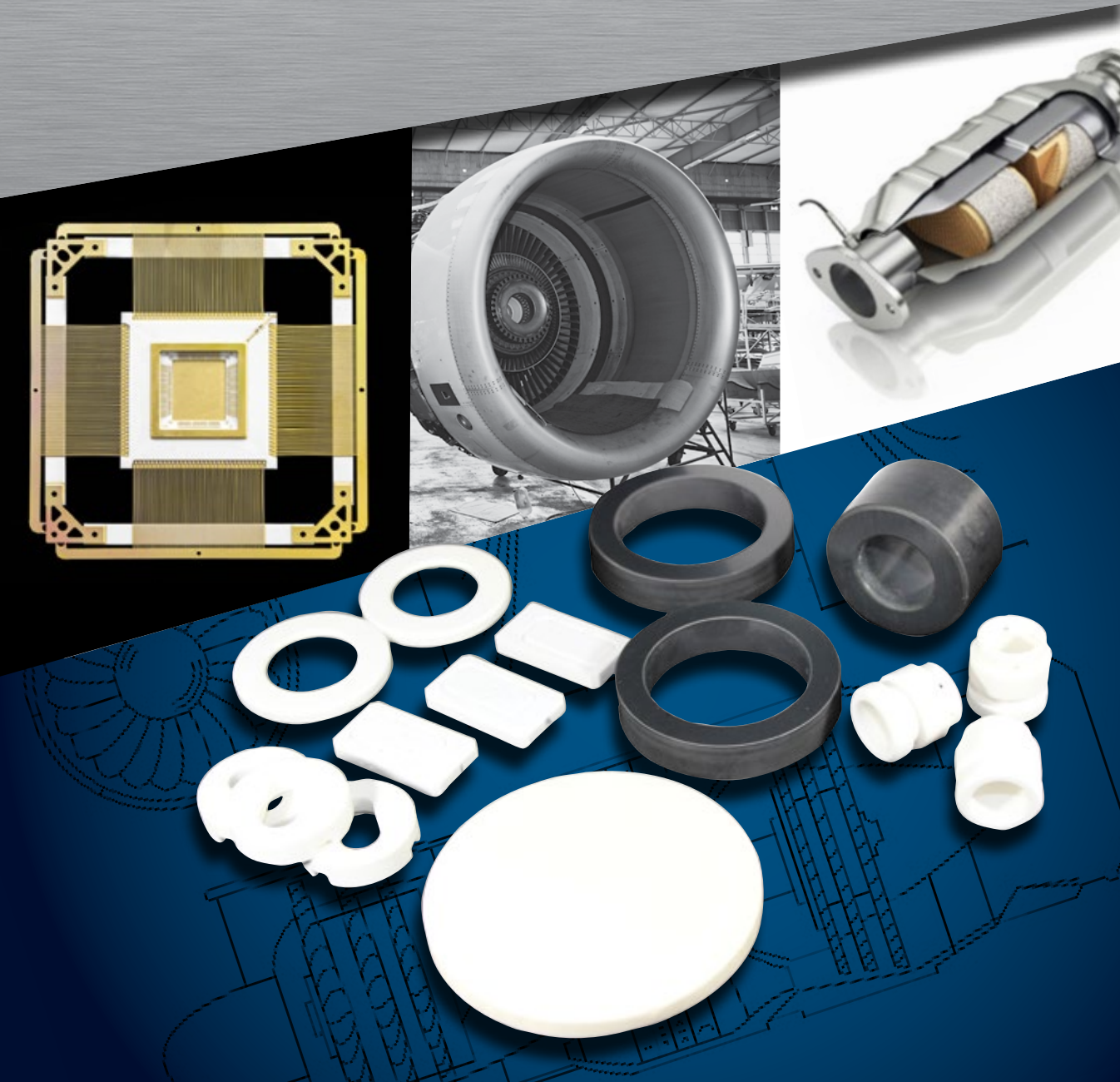


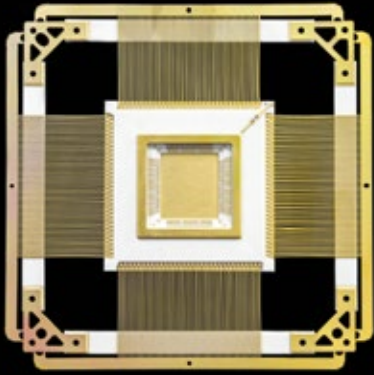
CERAMICS PROCESSING



SURFACE ENGINEERING THROUGH DIAMOND EXPERTISE

Grinding, Lapping and Honing





CASE STUDY

ELIMINATION OF COPPER CONTAMINATION IN SEMICONDUCTOR CERAMICS LAPPING

APPLICATION:

Aluminum oxide component used in semiconductor processing equipment.

OBJECTIVE:

Achieve finish, flatness, and throughput requirements without introducing copper contamination, which is detrimental to semiconductor device performance.

SOLUTION:

Replace copper lap plate with Engis X100 lap plate to achieve final surface finish and cleanliness objectives in a single step.

BENEFITS:

- **Reduces the burden** on final cleaning steps normally required to remove residual copper
- When paired with Engis diamond slurry, X100 plate maintains high throughput, final **surface finish improved** 10-20% vs Copper
- **Scratch free**, visually reflective surface can be achieved in a single step
- X100 Plate compatible with Engis facing option for **superior flatness control**

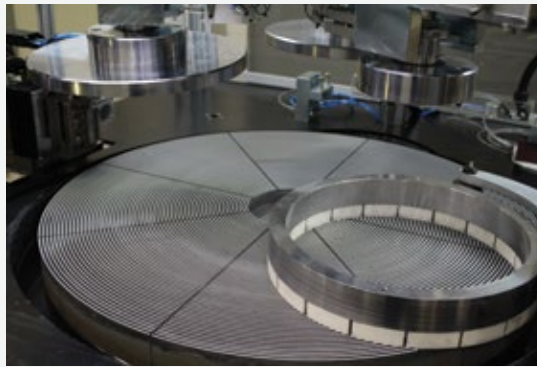
SURFACE ENGINEERING THROUGH DIAMOND EXPERTISE

Designed to maximize the advantages of diamond superabrasives.

Engis designs and manufactures complete, end-to-end solutions capable of achieving ultraprecise tolerances and finishes. We're more than just a supplier of products and machines. Through our Process Development Laboratories, we can offer you efficient turnkey systems custom-tailored to achieve your manufacturing goals and objectives.

Each system consists of the following:

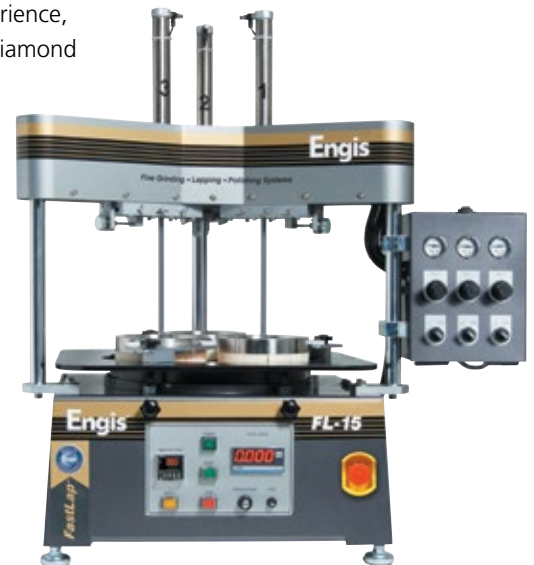
- Diamond and CBN superabrasives characterized and micronized by Engis' proprietary processes
- Machines, tooling, part holders, automation and accessories
- Process development and application consultation to maximize productivity, consistency and versatility



SURFACE ENGINEERING SOLUTIONS FOR FLAT LAPPING POLISHING

Flat lapping/polishing solutions that set new standards for versatility, consistency and precision – without sacrificing speed and throughput. Hyprez® systems from Engis come with decades of application experience, process development know-how and diamond expertise built-in:

- Bench-top and free-standing machines – standard & custom-build
- Standard and customized diamond slurries and compounds for ceramic materials
- Lapping plates – vast range of materials, machined features and diameters
- Fixtures, workpiece holders, slurry dispensers and accessories
- Three specialized Process Development Laboratories





SURFACE ENGINEERING SOLUTIONS FOR GRINDING

Electrogrip® diamond and CBN plated grinding products that earn respect and confidence through superior, consistent cutting precision and long wheel life.

- Diamond and CBN plated form wheels
- Diamond dressing blocks and tools
- Diamond pins and mandrels
- Diamond saw blades and specialized tools
- Best application assistance in the industry

SURFACE ENGINEERING SOLUTIONS FOR SINGLE-PASS HONING FOR FLUID DISPENSING VALVES FOR FOOD AND PHARMA

Boost throughput and generate precise geometric inside and outside diameters while consistently creating optimal surface conditions – all with a single pass through the part. Engis designs, manufactures and integrates all key components:

- Single & multi-spindle machines – standard & custom-build
- Diamond and CBN plated tools
- Fixtures, workpiece holders, gauging systems
- Automation, robotics, material handling systems
- Process development with experienced bore finishing engineers



FLAT LAPPING CERAMICS WITH DIAMOND

Precision lapping improves mechanical seal quality and reliability for a technical ceramics manufacturer.

OBJECTIVE:

Mechanical seal faces and sliding axial and radial bearings. Sizes Ranging from less than 0.035 inches to over 20 inches in diameter for silicon carbide ceramic tile in both personnel and vehicle armor. Objective: Mechanical seals require extreme precision in terms of flatness, parallelism and finish. Seal failures in high-pressure or corrosive applications can lead to expensive repairs or result in various environmental, health and safety consequences up to and including risk to life.

SOLUTION: The advanced materials technologies customer, coupled with Engis' machining expertise, creates the ability to tailor the topography of the seal face to precise levels, making these designs a reality.

RESULTS:

- Customer's engineers partnered with Engis to meet the challenge, resulting in several modifications being made to the current Fastlap® lapping machine design
- Improving not only the cosmetics, but also the finish of the parts being processed

Did You Know



THE 5 KEYS TO DIAMOND CHARACTERIZATION

Five areas of focus, all inter-related

- Close monitoring of incoming raw diamond
- Enhanced PSD grading to create standard and custom grades
- Shape of the diamond is closely monitored
- Dynamic analysis of mechanical strength

Consistency of Diamond Materials

Assess size, shape, purity, residual crystal growth defects

Shape

Dynamic analysis of particle shape characteristics

Particle Size Distribution

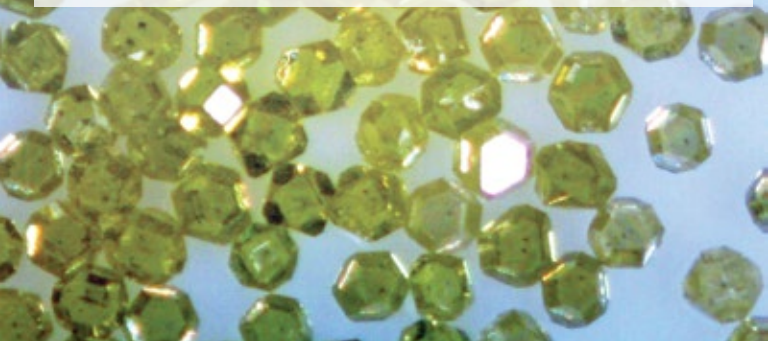
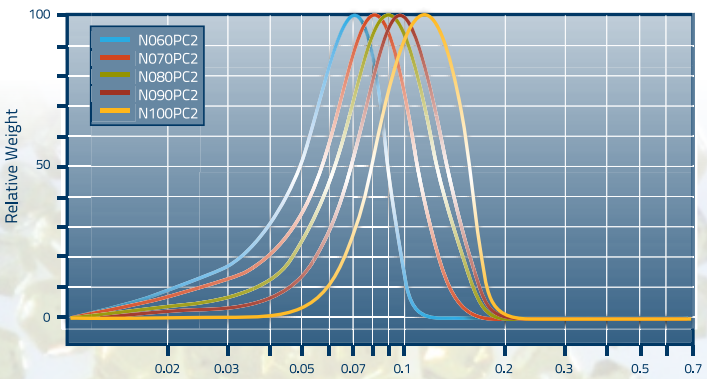
Ensure consistent PSD from 25 nm to 60 microns

Mechanical Strength

Monitor crushing strength and fracture characteristics

Surface Cleanliness

Remove surface contaminants via proprietary process



Call 800.99.ENGIS

Advantages of Applied Diamond Expertise – Diamond Characterization Drives Innovation

Diamond-based surface engineering systems from Engis are enabling global technology and manufacturing firms to expand the frontiers of innovation by applying our diamond expertise to each application through our Diamond Characterization Laboratory.

At the focal point of this process is classifying and characterizing diamond particles especially suited to each material and application. Consistent results require a precise understanding of diamond's intrinsic and extrinsic attributes – such as particle size, shape, cleanliness, friability and thermal properties. Each variable affects performance, so each system must be engineered to generate specific surface features, geometries and finishes.

Engis is an innovator and renowned for our superior reliability, quality and consistency of diamond grit. This is made possible by our ISO9001:2008 quality certified facilities where we micronize our own diamond.

Most important, Engis understands how to repeatedly create new breakthroughs for our customers. We have worked with the world's leading data storage companies for decades, engineering surface finishing processes that enable continuous improvements in the speed, accuracy and integrity of the hard disc drives.

Engis also revolutionized the honing process – across all applications and materials. Our precision single-pass bore finishing technology arose out of our experts' intrinsic understanding of diamond superabrasives and how they apply them in customer applications.



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