

Flat Lapping Ceramics with Diamond

Precision lapping improves mechanical seal quality and reliability at Morgan Advanced Materials.

By John Smallshaw

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Founded in 1856, Morgan Advanced Materials is a global leader in the production of engineered advanced materi-

Morgan's manufacturing facility in Coudersport, Pa., was established in 1959 as a satellite to the St. Marys-based Pure Carbon, a division of Stackpole International. Acquired by Morgan in 1995, the plant manufactures carbon-based materials, as well as a variety of silicon carbide parts, many in high volume.

corrosive application can lead to expensive repairs or result in various environmental, health and safety consequences up to and including risk to life. The focus on continuous improvement in seal face quality at Morgan has led to a 30-year relationship with Engis Corp. of Wheeling, Ill., which supplies Coudersport with high-precision lapping equipment, application technology and engineered consumables.

"Seals require precision lapping due not only to their material properties, but to their form, fit and function," explains Tom Grossman, Morgan's manufacturing engineering manager, who has worked at the Coudersport facility for 37 years. "We don't need Engis every day, but the support has been there when we do. We spend a lot of weekends here in Coudersport to keep the ball moving on cost and quality, so we need to partner with technically competent vendors."

Lapping Considerations

Multiple factors should be considered when determining the best lapping equipment and materials for a specific application. "When lapping ceramic seals, selection of the lapping plate is critical," says Mike Pisauo, Engis' applications manager. "It is very important that the lap plate material be softer than the parts, so the diamond will charge into the plate and not cross-charge back into the components."

Another important consideration for plate selection is whether or not metals can be tolerated, since copper- or iron-based composite plates are typically the workhorses for many lapping processes. "In some cases, companies can



Lapping machines and precision lap plates are used to lap/polish ceramic parts and other stain-sensitive materials.

als, including ceramics, specialty brazing alloys, composites and carbon. Key end-use markets for Morgan's products include petrochemical, electronics, energy, healthcare, industrial, transportation, and security and defense. From medical instruments, aerospace, power generation and satellite communications to body armor, trains and fire protection systems, Morgan's components have proven to be key for many of the modern world's sophisticated devices and equipment.

Products include mechanical seal faces and sliding axial and radial bearings with sizes ranging from less than 0.035 in. to over 20 in. in diameter. This Morgan location also produces silicon carbide ceramic tiles, which are key components in both personnel and vehicle armor.

Mechanical Seals

Components used for mechanical seals, in particular, require extreme precision in terms of flatness, parallelism and finish. A seal failure in a high-pressure or

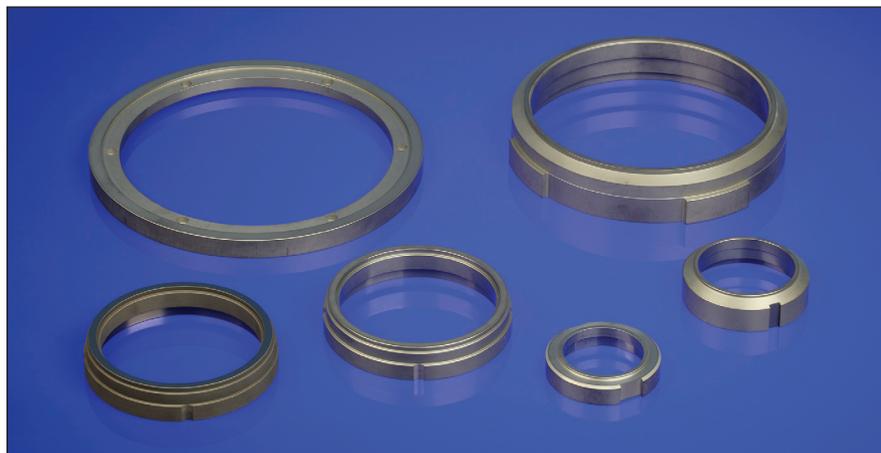


Ceramic mechanical seals are critical to avoiding the leaking of valves in refineries and petrochemical plants.

be concerned about staining or metallic contamination when lapping ceramics,” explains Pisauro. “In these cases, Engis recommends the Hyprez® HY ceramic lapping plate. Grooving the lapping plate will further increase the cut rate of the diamond slurry and also create a channel for the evacuation of abraded material.”

Selecting the right diamond slurry depends on the material removal requirements and final surface finish of the parts. It is important to consider not only the size of the diamond, but also properties such as friability, aspect ratio, and uniformity and consistency of the particle size distribution. Engis engineers select the appropriate slurry and tailor these properties to fit specific needs as necessary.

Plate preparation is a key consideration when it comes to lapping process development. When lapping ceramics, it is important to keep the plate slightly damp. The plate should not be flooded with lubricant, however, because that will cause the parts to hydroplane. The plate conditioning process must also be chosen carefully. When using ceramic-based lapping plates, Engis recommends that the plates be conditioned dry, so they produce a powder during the process. Conditioning a wet ceramic lap plate can produce a “muddy” swarf, which is difficult to clean. In addition, the muddy swarf will eventually load the diamond conditioning ring and prevent it from cutting.



The Morgan facility in Coudersport, Pa., produces high-precision ceramic mechanical seals, as well as seal noses engineered from silicon carbide.

Because Morgan is dedicated to continuous improvement in the quality and fit of its ceramic seals, total thickness variation (TTV) is critical. As a general rule, slowing the lap plate rotational speed toward the end of the process will improve the flatness of the seals. These types of multi-stage processes can be best accomplished with machines that offer programmable process recipes.

“The performance bar has continued to rise over the past few years as the application requirements for mechanical seals continues to increase, sometimes to staggering levels,” says Joe Boylan, manager of sales and marketing for Morgan’s Seals & Bearings business in North America. “These critical face components are being designed to handle higher pressures, speeds and temperatures. Maintaining the integrity of the interface between the seal faces is key. The material technologies of Morgan, coupled with Engis’ machining expertise, creates the ability to tailor the topography of the seal face to precise levels, making these designs a reality.”

Continued Innovation

One of Morgan’s customers recently upped the ante on the surface finish requirements of a critical component. Morgan’s engineers partnered with Engis to meet that challenge, resulting in a number of modifications being made to the current FastLap® lapping machine design. The suggestions from the Morgan

engineering team will improve not only the cosmetics, but also the finish of the parts being processed at Coudersport.

“No two applications are exactly alike,” says Alicia Waters, product manager of Hyprez products. “Therefore, it is critical to approach process development from many angles. Engis is unique in our ability to control the machine design, slurries, plate materials, and accessories combined with our Process Development Labs to develop and deliver a process to the end user. The ability to select from a wide range of available and proven options allows us to quickly achieve the desired results in the majority of cases, and to develop unique solutions when necessary.”

In addition to its lapping systems, Engis also produces specialized electroplated diamond tooling for the ceramics industry and has been supplying products for the abrasive machining of advanced materials at Morgan’s St. Marys facility. “We are working in global markets,” says Grossman. “The only way to remain competitive is to constantly stay ahead of the curve in terms of quality, reliability and costs. Any engineering solution needs not only to be practical, but cost effective.” 

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