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# PHOTONICS & IMAGING TECHNOLOGY

**How Double-Sided Polishing Can  
Revolutionize Optical Manufacturing**

**The Nancy Grace Roman  
Space Telescope**

**A Photonic Processor  
for AI Computations**

**Large Format Windows:  
*From Material to Mission***



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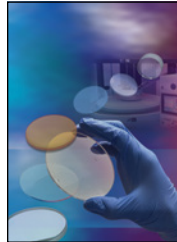
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## ON THE COVER



Leading optical component manufacturers continuously seek innovations that help meet the market's demand for high-performance optics with shorter lead times. Traditionally, single-sided polishing has been the go-to method, particularly for complex components where one-sided control is critical. To understand how double-sided polishing can improve the production process and enable higher standards of quality while improving turnaround times, read the feature article on page 1.

(Image: PG&O)

# How Double-Sided Polishing Can Revolutionize Optical Manufacturing

In an increasingly competitive optics industry, quality, precision, and speed have become essential pillars for success. Leading optical component manufacturers continuously seek innovations that help meet the market's demand for high-performance optics with shorter lead times. To enhance production capabilities and meet these demands, Precision Glass & Optics recently integrated a PR Hoffman double-sided polisher (DSP) into the production lineup. This advanced piece of machinery has transformed the company's ability to manufacture high-precision optical components, particularly those operating across a wide spectral range from 0.2  $\mu\text{m}$  to 15  $\mu\text{m}$ , helping set new benchmarks in precision, efficiency, and higher volume throughput.

## Understanding the Differences Between Single- and Double-Sided Polishing

In optical manufacturing, precision polishing is vital to achieving the required flatness, surface quality, and angular precision that many applications demand. Traditionally, single-sided polishing has been the go-to method, particularly for complex components where one-sided control is critical. It is also used when polishing is only required on one side, or when each side has different polishing specifications. In the latter instance, the part can be flipped for polishing the other side, per specifications.

The single-sided approach offers extensive control over the working surface, especially on larger parts, enabling the manu-

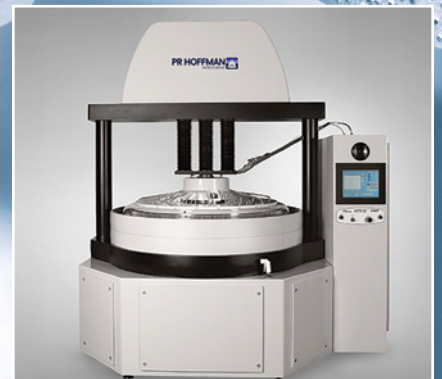


Figure 1 – PR Hoffman 5400 double-sided polishing machine.



# Optical Manufacturing

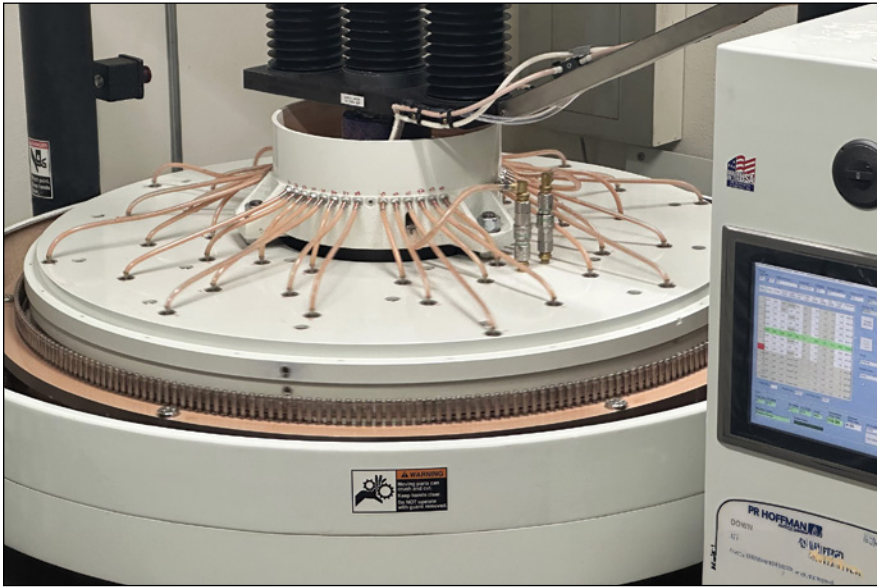


Figure 2 – Shows the abrasive polishing compound being added via pink tubing between the parts and the platens.

factor to achieve high precision on specific areas of the optic. However, working on one side at a time can be a lengthy and arduous process. Given the stringent specifications required for many optics, single-sided polishing can take days, or even weeks, to complete a single component.

The DSP approach addresses this time constraint by allowing both sides of an optical component to be polished simultaneously. This parallel process offers several advantages, particularly for components that require excellent transmitted wavefront, parallelism, and thickness control. By polishing both sides at once, one can achieve the desired specifications much faster than with single-sided techniques, reducing production times from weeks to mere days. At PG&O, the recently installed PR Hoffman 5400 double-sided polishing machine has greatly improved efficiency and refined our production process, enabling us to meet high standards of quality while significantly improving turnaround times.

## Why the PR Hoffman Double-Sided Polisher Stands Out

The PR Hoffman DSP is specifically designed to handle large volumes of optical components while ensuring consistent quality and precision. Its advanced design enables precise control over polishing pressure, speed, and other critical parameters, making it highly versatile across various applications. For PG&O's manufacturing operations, the addition

of this polisher has been a game-changer. It is a robust solution for producing high-quality optics with unparalleled efficiency, allowing us to reliably meet the industry's stringent requirements.

The double-sided polisher is optimized for optical windows and other components requiring superior transmitted wavefront error, parallelism, and surface quality. Ideal for part sizes in the 25 mm to 250 mm diameter range, and for thicknesses from 0.5 mm to 25 mm, the PR Hoffman machine enables the manufacturer to fabricate a broad array of optical components tailored to different customer needs. The machine's precision and versatility are key, particularly for industries where optical accuracy can directly impact performance, such as in aerospace, telecommunications, and medical devices.

## How the DSP Machine Works

The PR Hoffman DSP machine is designed to polish both sides of a part simultaneously, which makes it highly efficient for optical manufacturing. Here is a breakdown of the process:

- **Setup and Loading:** Parts to be polished are placed between two rotating plates, called platens, within the DSP. These platens typically contain carriers or fixtures to hold the parts in place and apply controlled pressure.
- **Abrasive Slurry Application:** An abrasive slurry or specialized polishing compound is introduced between the parts and the platens. This slurry con-

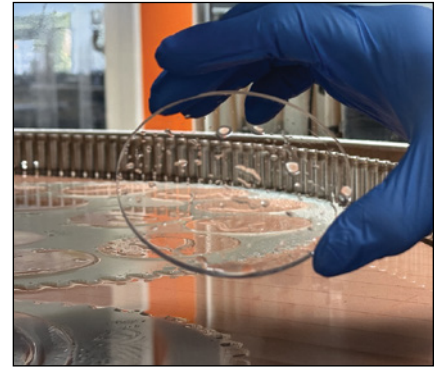


Fig. – 3 The double-polished circular part is carefully removed from the DSP machine to be cleaned and inspected.

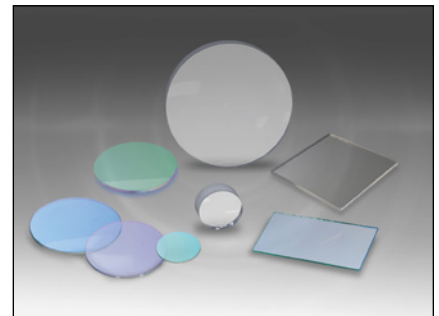


Figure 4 – Circular, square, and rectangular high-precision optical components for critical applications.

tains fine particles designed to gradually wear down the surface of the part, smoothing it to the desired finish.

- **Simultaneous Polishing:** The upper and lower platens rotate in opposite directions, ensuring uniform material removal from both surfaces. This simultaneous action is key to achieving precise thickness control, excellent flatness, and uniform surface quality across the part.
- **Pressure and Speed Control:** The machine allows for precise control over pressure, rotation speed, and slurry flow, which are essential for achieving the desired polish quality. Operators can adjust these settings depending on the material and specific optical requirements of the parts.
- **Final Inspection and Cleaning:** Once the polishing cycle is complete, parts are removed, cleaned to remove any remaining slurry, and inspected for thickness, flatness, and surface finish to ensure they meet the required specifications. This process is efficient for high-precision optical components, as polishing both sides simultaneously minimizes the potential for warping and helps maintain strict tolerances.

## Optics for Demanding Applications

The double-sided polisher's capacity to handle a range of optical materials and dimensions has expanded application areas considerably at PG&O. While the machine is ideal for optical windows, its versatility also extends to mirrors and other round, square, or rectangular components that require high-performance characteristics. The ability to achieve superior wavefront accuracy and surface flatness makes it especially suitable for optics used in high-stakes environments, including laser systems, infrared imaging, and spectroscopic analysis.

For example, in the production of laser optics, ensuring that the component surfaces are impeccably polished and highly parallel is crucial to maintaining beam coherence and minimizing diffraction. With the PR Hoffman double-sided polisher, achieving this level of precision, which is required for highly demanding applications, lends a competitive edge by producing components that meet exacting specifications.

## Significant Reductions in Lead Times and Production Costs

Since the installation of the PR Hoffman double-sided polisher at PG&O, we have also observed substantial improvements in production efficiency and lead time reductions. Projects that previously took months to complete can now be finished within days, allowing us to deliver on short notice while still upholding the high standards our clients expect. This efficiency has enabled us to take on a larger volume of orders without compromising quality, making our company a more agile and responsive player in the optics market.

The polisher has also contributed to a notable reduction in manufacturing costs. By polishing both sides of a component simultaneously, labor and material expenses are reduced, resulting in cost savings that we can pass on to clients. The dual-sided approach allows us to optimize production times without the need for extensive rework or additional materials, making our production process not only faster but also more economical.

## Synergy with the New Diamond Wire Saw

To fully maximize the potential of the PR Hoffman machine, PG&O recently

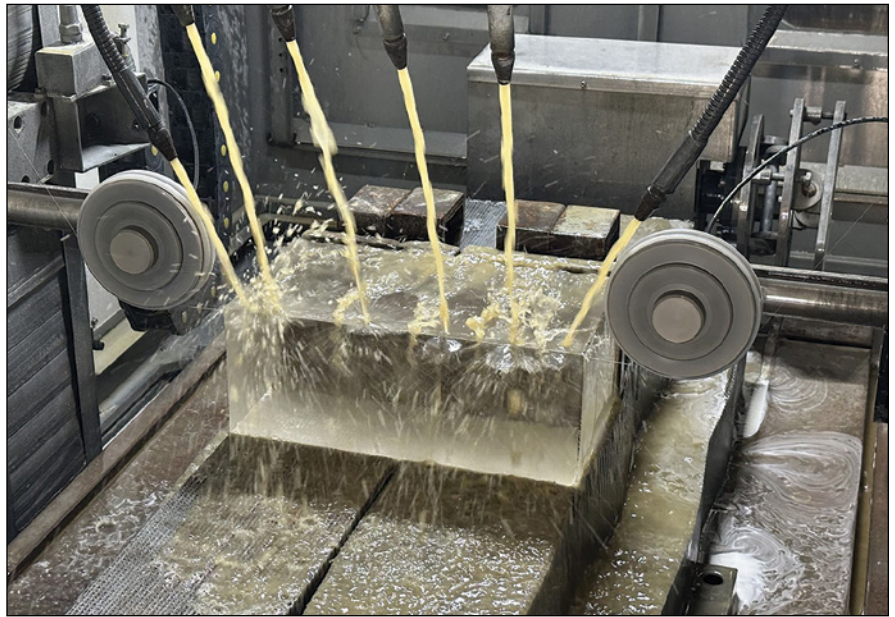


Figure 5 – Shows the diamond wire saw cutting blanks to precise thicknesses before loading into the DSP machine.

invested in a state-of-the-art diamond wire saw. This machine is capable of cutting blanks to precise thicknesses that can go directly into the double-sided polisher, eliminating intermediate steps that previously required additional time and resources. By providing perfectly dimensioned blanks, the diamond wire saw streamlines the overall manufacturing process, allowing us to move seamlessly from material preparation to final polishing.

The synergy between the diamond wire saw and the double-sided polisher has brought production capabilities to new heights. Together, these machines reduce material waste, improve dimensional accuracy, and cut down on processing times. This integrated approach is both time- and cost-effective, helping to maintain a competitive advantage in the optics market while delivering a product that meets the stringent requirements of our customers.

## Advanced Machinery Enhances Production Versatility

The recent machinery additions complement our company's extensive lineup of advanced optical manufacturing equipment, which includes CNC machines, edging systems, scribing tools, and thin-film coating technology. Each piece of equipment plays a crucial role in the production pipeline, enabling delivery of high-quality optics across a wide range of specifications. The addition of

the PR Hoffman double-sided polisher and diamond wire saw has further diversified our fabrication capabilities.

Each stage of the production process is performed in-house, from raw material preparation to final finishing and coating. This ensures that control is maintained over the end-to-end manufacturing process to meet strict quality standards and customer specifications for each optical component.

## Innovation and the Future of Optical Manufacturing

The optics industry is continually evolving, with new advancements in technology pushing the boundaries of what is possible.

With the addition of the PR Hoffman DSP machine, faster lead times, reduced costs, and the ability to produce higher volumes and a wider range of high-precision components with improved performance is achievable. Ongoing assessment of the manufacturing process and implementing advanced solutions for optical component manufacturing is the key to meeting ever increasing high thresholds of precision and optical performance. The industry's commitment to innovation will shape a brighter future in optics for years to come.

This article was written by Dan Bukaty, Jr., President, Precision Glass & Optics (Santa Ana, CA). For more information, visit [www.pgo.com](http://www.pgo.com).