PR Hoffman

Servo RS™
DOUBLE SIDED PLANETARY LAPPING & POLISHING MACHINES
Industry Leaders
PR Hoffman provides innovative products to the world’s leading high-tech manufacturers of parts which require flat, parallel surfaces. Customers in the semiconductor, electronics, ceramic, optics, quartz, glass, medical, and electro-optics industries rely on our machines for precision control of dimensional tolerances and surface finish.

Precision Control
PR Hoffman’s Servo RS™ Series of double-sided Lapping, and Polishing Machines are ideal for thin and fragile parts.

- Computerized programming offers unlimited 14-step recipes to process any application.
- Precision Removal System allows for Symmetrical or Asymmetrical material removal.
- Three independent velocity servomotor-drives offer quiet, smooth machine operation.
- Accurate lap force controller can run with as low as 15 pounds (6.8 Kg) on fragile parts.
- Automatic plate flattening is achieved by processor-controlled operation modes.
- Soft-start, soft-stop and load ramping control gently handles fragile parts.
- Retractable ring gear eases the “lift-off” of thin, hard to handle parts.
- Multi-step programming “tops off” thicker parts at lighter pressure for less thickness variation between individual parts.
- Touch-Screen-Input through a Windows™ based PC system allows unlimited storage of recipes, access to online information, machine manual, technical information, and more.
- Separate embedded machine controller executes the machine control program from its flash memory independently from the PC for high reliability and safety.

* For details on Asymmetrical Material Removal, contact our Engineering Department

Precise Pressure Control
- Servo drive obsoletes air cylinders for top plate support and lap force control.
- Programmable transition point switches easily from fast down to float down for parts of different thickness.
- At “end of run”, the servo drive adjusts the vertical travel of top plate to zero load WITHOUT lifting off parts, thus keeping parts in their workholes.
- All-electric design eliminates the need for compressed air.
3-Way Motion - Key to Precision

- Bottom lap plate is fixed - providing a zero-runout base.
- Carriers orbit the center sun gear at controlled speeds.
- Top lap plate spins at twice the speed of the planet carrier orbit speed.
- Material removal is equal from top & bottom of parts.
- Contact stresses on the part edge and on carrier teeth are minimized, thus reducing "crashes" and edge chipping, and increasing carrier, ring and center gear life.
- Machines are designed for very thin parts and high loads.

Benefits of 3-Way versus 4-Way Motion

- Solid lap plate base provides higher precision than rotating base.
- Machine complexity is drastically reduced, thereby lowering maintenance and improving isolation of abrasive from critical machine components.
- Processing speed is normally limited by hydroplaning phenomenon, negating higher speeds of the more complex 4-way machines.

Automatic Plate Flattening

- Programmable reversing of carrier axial spin direction keeps plates flat during production. Controlling axial spin constantly corrects any out of flat condition.
- Excessive un-productive conditioning time for out of flat plates is eliminated.

Speed & Load Ramping

- Programmable soft-start speed control prevents jolts to fragile parts, greatly reducing edge chipping.
- Precision load ramping is gentle for fragile parts, and provides a "light touch" to thicker parts in a batch, resulting in lower thickness variation.
- Soft-stop sequencing allows top plate "spin-off" to reduce or eliminate having parts adhere to the top plate.
Retractable Ring Sprocket

- When processing is complete and the top plate raised, the ring sprocket may be lowered ~2" (~50mm), placing it below the level of the bottom plate.
- After first removing the carriers, small or fragile parts may be easily slid off the edge of the plate without damage.

Optional Features
The **Servo RS™ Series** of double-sided Lapping and Polishing machines offers many optional features to provide you with a machine that is fully customized to meet the needs of your lapping and polishing applications. Below are a few popular options; please contact the factory for all current options.

- **Automatic Sizing Control**
  The automatic sizing control (ALC) system measures parts up to .065" (1.65mm) thick. A piezo-electric quartz crystal is loaded in the center of a carrier and processed along with the parts. As the quartz is lapped, its resonant frequency increases and is monitored by an electrode inserted into the bottom plate. When the crystal resonates at the frequency preset on the ALC, the machine is stopped.

- **Digital Sizing Control**
  The digital gauge sizing device approximates the thickness of the parts being processed by direct measurement of the distance between the plates. The digital gauge probe is mounted inside the top plate assembly, and makes contact with a tungsten-carbide anvil mounted on the machine center shaft. By presetting the digital gauge sizing device at the instant the machine ramps up to speed, this device accounts for the slurry fluid boundary thickness and for plate wear.

- **Plate Cooling / Heating**
  Special bottom (and on model 5400, top and bottom) subplates are supplied with passages for re-circulating cooled or heated coolant. This option aids in maintaining consistent process temperature (which is especially important for precision polishing applications). A self-contained chiller / heater system can also be supplied to control the coolant temperature with the plate cooling / heating option.
**PR-1 & PR-2 Series**

*For Precision Double-Sided Polishing & Lapping Applications*

**PR-1 Series - Simple, Reliable, Economical**

- PR-1 series double-sided lapping and polishing machines have been the Industry Standard for over 60 years.
- Four carrier configurations cover nearly all small part sizes.
- Soft-start, variable speed DC drive handles fragile parts gently.
- Simple two-way action with a fixed, zero-runout bottom plate is standard and used for most applications.
- Multiple machines are excellent for rough lapping, fine lapping and polishing processes. The PR-1 series of machines may be "paired" with Servo_RS series machines with the same capacity.
- Simple, rugged design is well-suited for moderately thin parts using fixed loads.
- Popular plate lifter option eliminates manual lifting, reduces operator’s lifting requirements, and is available for both fixed and driven top plates. (This is standard on the BST version).
- Optional three-way top plate drive version is ideally suited for thin and fragile lapping and polishing applications, converting machines to three-way action with a driven top plate.

**2-Way Motion - Simple, Rugged & Affordable**

- Bottom lap plate is fixed — providing a zero-runout base.
- Carriers orbit the center (sun) gear at controlled speeds.
- Top lap plate is non-rotating on standard configurations and is ideal for high aspect ration parts.
- Material is equally removed from top and bottom of parts.
- Simple, rugged design is well suited for moderately thin parts and loads.

**PR-2 Series - for Very Small, Thin Parts**

- The PR-2 series is designed specifically for very small and very thin parts.
- Table-top design is suited for research & development operations where only a few parts are processed at a time.
- The PR-2 series is built with the proven, heavy duty production design of the PR-1 series.
- With its standard, stationary top plate, the PR-2 is an excellent choice for small, high aspect ratio parts.
- PR Hoffman’s smallest lapping and polishing machines, the PR-2 series, feature a soft-start, variable speed drive for gentle part handling.
### PR-2 Specifications

<table>
<thead>
<tr>
<th>Carrier Type</th>
<th>Standard Lap Plate Diameter</th>
<th>Number of Carriers</th>
<th>Carrier Root Diameter</th>
<th>Maximum Part Circle</th>
<th>Recommended Min. Work Thickness</th>
<th>Lap Down Force Nominal</th>
<th>Drive Power</th>
<th>Standard Voltage</th>
<th>Req’d Service</th>
<th>Dimensions</th>
<th>Approx. Weight</th>
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<tr>
<td>32T Gear</td>
<td>3.5&quot; x 6.9&quot; (90 x 172mm)</td>
<td>5</td>
<td>2.5&quot; (64mm)</td>
<td>2.1&quot; (53mm)</td>
<td>.003&quot; (.076mm)</td>
<td>3.5 Lb. (1.6 Kg.)</td>
<td>1/17 HP (.04 KW) DC VARIABLE SPEED</td>
<td>115 VAC 1a</td>
<td>15 AMP</td>
<td>~135 Lbs (~60 Kg)</td>
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<td>32T Gear</td>
<td>11&quot; x 14.4&quot; (279 x 366mm)</td>
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<td>2.5&quot; (64mm)</td>
<td>2.1&quot; (53mm)</td>
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<td>19-27 Lbs (8-12 Kg.)</td>
<td>32T, 50T, 66T 1.0 HP (.79 KW) DC VARIABLE SPEED</td>
<td>208/230 VAC 1a</td>
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<td>46&quot; x 26&quot; x 50&quot; (117 x 66 x 127cm) (~1,200 Lbs (~550 Kg)</td>
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<td>4&quot; (102mm)</td>
<td>3.6&quot; (91mm)</td>
<td>.005&quot; (.127mm)</td>
<td>24-36 Lbs (11-16 Kg.)</td>
<td>DC VARIABLE SPEED</td>
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<td>28-44 Lbs (13-20 Kg.)</td>
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<td>6.9&quot; (175mm)</td>
<td>6.6&quot; (168mm)</td>
<td>.010&quot; (.254mm)</td>
<td>40-58 Lbs (22-27 Kg.)</td>
<td>50/60 Hz (750 VAC) DC VARIABLE SPEED</td>
<td>208/230 VAC 3a</td>
<td>25 AMP</td>
<td>54&quot; x 37&quot; x 82&quot; (~1.4 x .95 x 2.1 m) 2,300 Lbs. (1,050 Kg)</td>
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### PR-1 Specifications

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<td>15-200 Lbs (6-8.9 Kg)</td>
<td>208/230 VAC 3a</td>
<td>25 AMP</td>
<td>56&quot; x 37&quot; x 86&quot; (~1.4 x .95 x 2.2 m) 2,500 Lbs. (~1,150 Kg)</td>
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<td>15-275 Lbs (6.8-125 Kg)</td>
<td>208/230 VAC 3a</td>
<td>25 AMP</td>
<td>56&quot; x 37&quot; x 86&quot; (~1.4 x .95 x 2.2 m) 2,500 Lbs. (~1,150 Kg)</td>
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### 3100 Specifications

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<th>Approx. Weight</th>
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<td>3100</td>
<td>10.5&quot; x 31.4&quot; (267 x 798mm)</td>
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<td>11.6&quot; (295mm)</td>
<td>10.9&quot; (277mm)</td>
<td>.010&quot; (.254mm)</td>
<td>15-530 Lbs (6.8-240 Kg)</td>
<td>230 VAC 3a</td>
<td>30 AMP</td>
<td>74&quot; x 44&quot; x 94.5&quot; (~1.9 x 1.1 x 2.4 m) 4,800 Lbs. (~2,000 Kg)</td>
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### 5400 Specifications

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<td>5400</td>
<td>17&quot; x 53.5&quot; (432 x 1,359mm)</td>
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<td>19.7&quot; (500mm)</td>
<td>19.2&quot; (488mm)</td>
<td>.010&quot; (.254mm)</td>
<td>50-2,200 Lbs (13-1,000 Kg)</td>
<td>480 VAC 50/60 Hz - 3 a</td>
<td>50 AMP</td>
<td>106&quot; x 73&quot; x 117&quot; (~2.7 x 1.9 x 3 m) 15,400 Lbs. (~7,000 Kg)</td>
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### Mark-IV Specifications

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<th>Standard Lap Plate Diameter</th>
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<th>Lap Down Force Nominal</th>
<th>Drive Power</th>
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<th>Req’d Service</th>
<th>Dimensions</th>
<th>Approx. Weight</th>
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<tbody>
<tr>
<td>120ST Sprocket (Pin Drive)</td>
<td>10.8&quot; x 66&quot; (478mm x 1,676mm)</td>
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<td>27.6&quot; (701mm)</td>
<td>26.3&quot; (667mm)</td>
<td>.079&quot; (2.0mm)</td>
<td>150-2,000 Lbs (~70-910 Kg)</td>
<td>480 VAC 50/60 Hz - 3 a</td>
<td>50 AMP</td>
<td>106&quot; x 73&quot; x 117&quot; (~2.7 x 1.9 x 3 m) 16,300 Lbs. (~7,400 Kg)</td>
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<tr>
<td>180ST Sprocket</td>
<td>18.8&quot; x 66&quot; (478mm x 1,676mm)</td>
<td>4</td>
<td>31.4&quot; (797mm)</td>
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<td>.108&quot; (2.75mm)</td>
<td>150-2,000 Lbs (~70-910 Kg)</td>
<td>480 VAC 50/60 Hz - 3 a</td>
<td>50 AMP</td>
<td>106&quot; x 73&quot; x 117&quot; (~2.7 x 1.9 x 3 m) 16,300 Lbs. (~7,400 Kg)</td>
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Specifications subject to change without notice.
54” Plate Double-Side Lapping & Polishing Machines
for Large, High Volume, Precision Manufacturing

PR Hoffman’s *ServoRS™ 5400 Series* of double-side Lapping and Polishing Machines are ideal for thin and fragile parts. These machines are the number one choice in silicon, semiconductor, optics, and electro-optics manufacturing.

They are designed with full subplates to increase the available pressure needed for lapping or polishing of hard materials such as sapphire wafers and heat-treated metals. This additional down-force allows the processing of up to two times as many parts as can be processed with a competitor's machine.

The combination of a DC servo motor and a load-cell provides a highly accurate pressure control, allowing the 5400 to run with loads as light as 50 pounds (23kg) of down-force for thin and fragile parts.

- High production requirements are the norm for the 5400 series double side planetary lapping and polishing machines.
- Industry proven design incorporates mechanical design features from prior series, combined with state-of-the art touch screen computer control and variable speed brushless DC servo drives.
- Sprocket tooth pin drive system reduces carrier wear and helps to keep operating and maintenance costs low.
- Robust design & construction provide years of production life.
- Highly efficient drives and controllers reduce operating power consumption, and combined with low standby power between cycles, results in greatly reduced energy costs.
- Overall design results in lower consumable costs than major competitors machines.
- Automatic lubrication system and independently operated plate-leveling jacks are included as standard design features.
- Unbeatable value in large lapping and polishing machines.

5400 Series Double-Side Machines
State of the Art

Our technologically advanced 5400 series machines offer the highest precision possible in large double-sided planetary lapping and polishing machines, and are especially suited to thin and fragile substrates. The Servo RS™ Series of machines use servomotors to precisely control the smooth, quiet, three-way planetary motions as well as precise, continuously variable control of down force ranging from as little as 50 pounds to as much as 2,200 pounds. These design features, combined with a new friendly user interface Windows™ Touch-screen editor linked to a multi-step machine controller, allow for flexible programming of speeds and pressure, optional thickness control, and crash protection.

These machines are ideal for double-sided lapping and polishing of 76mm - 300mm silicon and semiconductor wafer materials as well as for double-side lapping and polishing of other components up to ~19 inches in diameter. Temperature control of both plates is an option for temperature sensitive materials and precision process control on the 5400 series.

All of PR Hoffman’s Servo RS™ Series of machines also include breakthrough asymmetric removal technology, which allows for the removal of material from one side of a part while minimally affecting the opposite side of the product with removal ratios as great as 50:1.

Touch-Screen Editing

The Servo RS™ Series offer real-time monitoring of machine operation as well as easy editing of control programs with up to 14 individual steps. Three independent computer controlled brushless DC velocity servo motors allow gentle speed ramping, and a servo driven ball screw with constant feedback load cell provides for precise control of down-force on parts from 11 lbs to 2,200 lbs (5-1,000kg) depending on machine model.

An end of cycle rinse shut-down sequence reduces probability of parts sticking to the top plate, and a retractable ring gear allows parts to be slid off the edge of the plate. These features help to break cohesion between the parts and the plate to allow easy unloading of thin, fragile parts. Automatic speed ratio changes during processing result in continuous self-flattening of lapping-plates, and greatly reduces conditioning time.

Features / Options

- Unequaled Precision
- Energy Efficient
- Low Maintenance Design
- Built for 24-7-365 Operation
- Quality Management Systems to ISO-9001
- Best Wafer TTV / TIR
- Precision Thickness Control Options
- Worldwide Representation
- Worldwide Recognition
- Premium Manufacturer

PR Hoffman Machine Products, Inc.
66” Plate Double-Side Lapping & Polishing Machines for Very Large Precision Part Manufacturing

PR Hoffman’s Servo™ RS Mark-IV Series of double-side Polishing, Lapping and Grinding machines are based on the Servo™ RS 5400 model. The Mark-IV Series of machines offer a small footprint for machines capable of processing very large parts, and can be adapted to finish many different materials.

Servo™ RS Mark-IV Polishing, Lapping and Grinding machines are ideal for very large parts; up to 30” diameter or 21” square, and as thin as ~0.080”. Each machine is designed based on the end user’s specific needs to insure optimum performance.

Precision Control

- Computerized programming offers unlimited 14-step recipes to process any application.
- Precision Removal System allows Symmetrical or Asymmetrical material removal.
- Three independent velocity servomotor-drives offer quiet, smooth machine operation.
- Accurate lap force controller can run with as low as ~150 pounds (65 Kg) on thin parts.
- Soft-start, soft-stop, and load ramping control gently handle fragile parts.
- Multi-step programming "tops off" thicker parts at lighter pressure for less thickness variation between individual parts.
- Touch-Screen Input through a WindowsXP™ PC system allows unlimited storage of recipes, access to online information, machine manual, technical information, maintenance videos, and more.
- A separate embedded machine controller transfers control program to its flash memory, leaving the PC free to monitor process or review online information.
- The digital sizing control option for lapping allows process control of parts to ±0.0005” (12.5µm) tolerance.
- “Crash” protection option for the polishing detects improper loading of parts or a crash during operation, and prevents startup, or will shut-down the polishing process if sensed.

Patented Technology

PR Hoffman’s Servo™ RS Mark-IV Series of machines designs and features are protected under US Patents.
Very Large Part Sizes
These machines are ideal for double-sided polishing, lapping and grinding of large size glass, ceramic, and metal parts as well as for double-side lapping, polishing, and grinding of other components up to 30 inches in diameter.

Typical part thickness is a minimum of about 0.080” (2mm). To see if your part is suitable for processing on the Mark-IV, please contact PR Hoffman’s engineering department. Machine highlights:

- 30”Ø / 21” square is the maximum part size.
- Factory adjustable for either of two carrier sizes.
- Small machine footprint for large work-piece size.
- Carrier size can be customized without machine modification.
- Counter-rotating top and bottom plates for fastest material removal.
- Top and bottom plates are supported by full thickness sub-plates for maximum rigidity precision, and load capacity.
- Built with proven ‘rugged’ industrial drives and brushless-DC servo-motors for continuous 24/7 operation.

Touch-Screen Editing
Standard features of the Servo RS™ Mark-IV machine series include real-time monitoring of machine operation as well as easy editing of control programs with up to 14 individual steps. Three independent computer controlled brushless DC velocity servo motors allow gentle speed ramping, and a servo driven ball screw with constant feedback load cell provides precise down-force control on parts from as low as 150 lbs to 2,000 lbs (68-910kg).

End of cycle rinse shut-down sequence reduces probability of parts sticking to the top plate.

Automatic carrier speed ratio changes during processing and reversing of plate rotations can result in continuous self-flattening of plates / pads, and greatly reduces conditioning time.

Features / Options
- Unequalled Precision
- Energy Efficient
- Low Maintenance Design
- Built for 24/7-365 Operation
- Quality Management
- Systems to ISO-9001
- Very Large Parts to 30” Dia.
- Precision Thickness Control Options
- Worldwide Representation
- Worldwide Recognition
- Premium Manufacturer
**CAPACITIES — Number of Parts per Load**

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<th>MODEL</th>
<th>0.5 (12.7)</th>
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</table>

* Quantities based on single row standard carrier layout (with edge breakout). Call PR Hoffman engineering for details.

**OPTIONS**

- **DIGITAL SIZING CONTROL** - Measures distance between plates and stops machine at predetermined set point. Can provide "crash detection" feature.
- **ALC FREQUENCY SYSTEM** - Measures frequency change of quartz disc to gage part thickness independent of slurry viscosity, plate wear or pressure variation.
- **SERRATED LAP PLATES** - Provide higher cutting rates and reduced hydroplaning, especially important for parts larger than 4" diameter.
- **WATER COOLING** - Reduces process variations due to frictional heat build-up caused by high pressures in lapping and polishing applications.
- **STAINLESS STEEL** - Polishing plates, ring and center gears for corrosion protection needed on sensitive parts.
- **CLAD PLATES** - More temperature stability for polishing than stainless steel, at a lower cost.