

Accessories for the Model 920 Lapping and Polishing Machine

Introduction

Lapping and polishing is a common practice in many materials preparation laboratories. Instrumentation for materials processing using lapping and polishing techniques has existed for several decades, with most equipment being dedicated to specific application requirements. South Bay Technology, Inc. has designed a system for a variety of technological applications that include sample preparation for metallography, optical and electron microscopy, substrate preparation, small scale device fabrication and research, electro-optic device fabrication, and many others.

The Model 920 Lapping and Polishing system has been designed to allow for a wide range of applications to be solved utilizing one instrument. This flexibility can be exploited by adapting a single instrument to several different techniques and specific sample cases. In this report a brief introduction to the various accessories and their functions is given to introduce the far reaching abilities of this equipment set.

The Model 920 Lapping and Polishing Machine

The Model 920 is a multi purpose grinding and lapping machine designed for accurately lapping and polishing a wide range of materials. The Model 920 can be used as a standard metallurgical grinder and polisher using abrasive papers, films, polishing cloths, or diamond discs. It can also be used as a high precision, free abrasive lapping machine for flat polishing of optical and semiconductor materials. When used as a free abrasive lapping machine, the Model 920 can accommodate most SBT Lapping and Polishing fixtures to provide accurate specimen orientation and maximum flatness.



Figure 1: The Model 920 Lapping and Polishing Machine.

Model 92001 Polishing Fixture Arm

The Model 92001 is a polishing fixture arm designed for the polishing of a variety of crystals, rods, or other specimen types. Specimens are mounted to a variety of different holders that are, in turn, mounted into the bearing assembly of the Model 92001. This bearing is driven by a pulley extending from the post on the Model 920 casting all the way to the end of the fixture. The speed of the rotation is continuously adjustable using the controls of the lapping machine, variable from 2-25 RPM. The specimen creates the only point of contact on the lapping plate, with nothing else wearing on the lapping plate or abrasive surface.

A variety of assemblies can be installed into the Model 92001 to accommodate varying types of lapping and polishing applications. End polishing of rods can be achieved using a specialized holder as seen in Figure 1. Other assemblies such as square crystal mounts and planar polishing attachments can also be used for varying applications. Custom holders to place inside the Model 92001 can also be implemented for special types of polishing applications. The table below shows some of the currently available accessories.



PART NUMBER	DESCRIPTION
02-02180	Square Crystal Holder Assembly (for holding small, square crystals for end polishing)
02-02182	Crystal Rod Holder Assembly (for holding rod shaped samples for end polishing)
02-02183	Planar Polishing Holder Assembly (for mounting samples for parallel or plan view polishing)

Table 1: Accessories for the Model 92001 Workstation.



Figure 2: The Model 92001 Polishing Fixture Arm is shown as mounted to the Model 920. The crystal rod holder is shown installed on the fixture arm, allowing for six rods to be end polished simultaneously. Special holders can be developed that are inserted into the bearing assembly of the 92001, making a wide range of applications possible.

Model 92002 Workstation

The Model 92002 is the only true multi-purpose workstation that is for virtually all of the SBT Lapping and Polishing Fixtures. The Model 92002 is a workstation which provides a means for rotating lapping fixtures to provide the most efficient grinding and polishing mechanism with little to no operator supervision. It utilizes a drive pulley in constant contact with the base of the lapping fixture and rotates the fixture at a variable speed determined by the user. Positioning of the lapping fixture relative to the workstation is easily accomplished using two adjustments. The height of the workstation drive wheel can also be adjusted to allow for proper positioning using various lapping wheel arrangements. The Model 92002 can be used with virtually all of the SBT Lapping fixtures and a chart showing the various fixtures available is given below.

MODEL #	SAMPLE Ø	MODEL #	SAMPLE Ø	MODEL #	SAMPLE Ø
145	½" (12.7 MM)	154	2" (50MM); LOW FORCE	130	1" (25mm)
147, 147D, 147E	2.6" (66 MM)	155, 155D	2" (50MM)	135	2" (50mm)
150	1.25" (31.75MM)	156	2" (50MM); LOW FORCE; WIDE BASE	142	½" (12.7mm)
151	1.25" (31.75MM); LOW FORCE	157	2" (50MM); WIDE BASE		
153	2" (50MM); EDGE POLISHING	195	1" (25MM); UP TO 6 SAMPLES		

Table 2: List of various lapping and polishing fixtures compatible with a single Model 92002 Workstation.



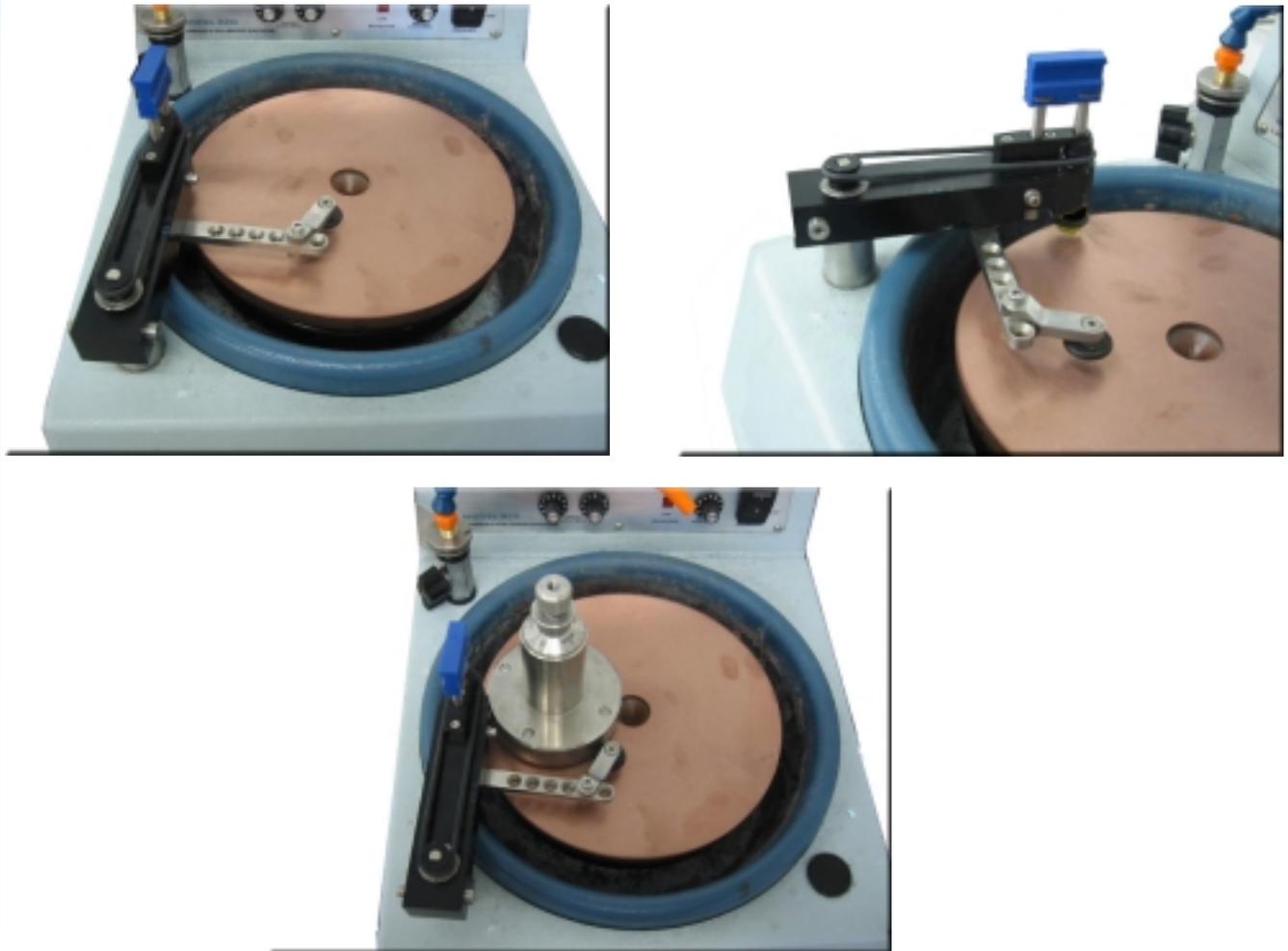


Figure 3: The Model 92002 Workstation is shown as mounted to the Model 920. The holder is attached the post of the Model 920 using a clamping screw arrangement. The position of the wheel extension attached to the arm is adjustable to accommodate various diameter lapping and polishing fixtures. Fixtures are then rotated counter-clockwise to provide a uniform, random polishing motion. The bottom image shows a typical arrangement of the Model 920 combined with the Model 92002 and a Model 155 Lapping and Polishing Fixture.

Model 92003 Non-Contact Polishing Arm

The Model 92003 Non-Contact Polishing Arm is a workstation designed for general lapping and polishing applications. It is a combination lapping fixture and workstation, implementing elements from both products. The Model 92003 is designed to act as a lapping and polishing fixture with only the specimen coming into contact with the lapping wheel surface. Adjusting the level position can be done using horizontal and vertical adjustments. A piston assembly is gravity fed toward the lapping plate and can be loaded with weights to increase the lapping and polishing force. A precision micrometer controls the depth of material to be removed, and specimens up to 4" (100mm) in diameter can be polished when mounted onto the specimen mounting block. A pulley drive system rotates the sample continuously during processing, randomizing the polishing process.

These fixtures are designed for parallel polishing applications or instances where the sample should be the only material touching the lapping wheel surface.





Figure 4: The Model 92003 Non-Contact Polishing Arm is shown as mounted to the Model 920. The holder is attached to the post of the Model 920 using a clamping screw arrangement. Horizontal and vertical alignment is done using adjustment screws with the sample mounting block attached. Samples are removed from the holder using a threaded knob arrangement as with the lapping and polishing fixtures.

Model 92005 and 92006 Metallographic Holders

The Model 92005 and 92006 are specimen mounting fixtures designed for automated specimen grinding and polishing of multiple specimens to increase throughput and efficiency. These fixtures are designed for simultaneous processing epoxy or acrylic encapsulated specimens. The Model 92005 is designed for holding three samples of diameters approximately 38 mm (1.5"). The Model 92006 is designed for four samples of diameters ranging from 25-32 mm (0.98-1.25"). Samples are placed into the holder and applied to a flat surface. A planarizing gauge is used to create space between the samples and the grinding surface. Once this distance has been set, each sample is locked into place using a set screw arrangement. Additional weights can be added to the top plate of the Model 92005 to increase the load applied to the mount.

These simple to use holders can be used with the Model 92002 Workstation and used for semi-automatic processing of metallographic mounts.



Figure 5: Model 92005 Tri-Holder Specimen Mount shown used with the Model 92002 Workstation. Metallographic samples can be processed simultaneously using this holder and can be applied to grinding papers, polishing cloths, or lapping techniques.



Model 92022 Left and Right Yoke Sweep Mechanism

The Model 92022 is an oscillating workstation which allows the user to maximize the surface area of the lapping surface as well as to increase uniformity and abrasive life. The Model 92022 achieves this by allowing the user to adjust the amount of sweep, or oscillation, the fixture has. It is a belt driven workstation that incorporates an adjustment cam used to set the amount of sweep desired for the lapping fixture being used. The lapping fixture is placed inside the drive and idler wheels of the workstation and the position of the work arm is adjusted to accommodate various diameter fixtures. Various heights of the lapping plates are easily accommodated using a variable thickness spacer mounted between the lapping plate adapter and the spindle. Selection of various sweep distances is accomplished by applying different cam positions relative to the plate diameter.

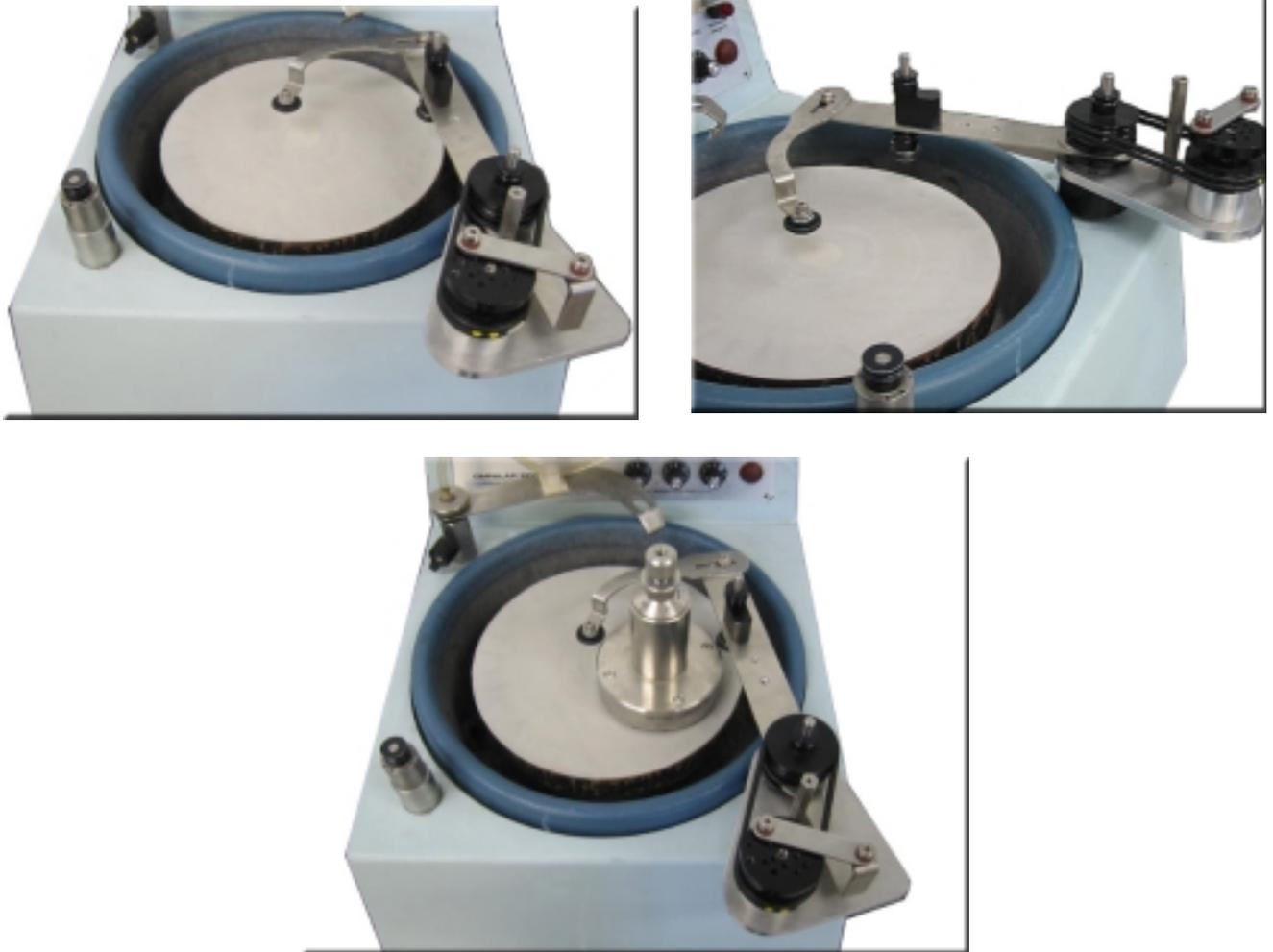


Figure 6: The Model 92022 R Yoke Sweep Mechanism shown mounted to the Model 920. The lapping fixture is placed between the idler wheel (mounted to the arm extension) and the drive wheel running from the cam assembly. The entire assembly is used to rotate the lapping fixture and 'sweep' the fixture laterally to increase the polishing uniformity. For abrasive papers and polishing cloths the lifetime is extended as the wear rate is normalized across the radius of the plate. The bottom image shows the Model 155 Lapping Fixture with the 92022.



Model 92031 Flatness Gauge Kit

When lapping processes are implemented using a free abrasive, the surface of the lapping plate is in constant change. During this process material is being removed from the sample and the lapping plate material simultaneously. Therefore the overall plate shape will begin to be affected and will ultimately become out of flatness. The Model 92031 Flatness Gauge Kit is designed to help maintain the plate flatness by periodically taking measurements of the plate shape following processing. The gauge utilizes digital micrometer that is initially zeroed on a granite leveling plate. The gauge is then placed onto the lapping plate and a measurement taken. This provides a direct measurement of how much the plate has deviated from the zero position. Measuring various points along the lapping plate surface a picture of the overall shape of the lapping plate can be established. Using the information is important to conditioning the lapping plate back into it's flatness specification.



Figure 7: Model 92031 Flatness Gauge Kit showing the flatness gauge and granite leveling plate.

02-02261 Manual Specimen Yoke

The manual specimen yoke is a simple y-shaped yoke designed for use on the Model 910 or Model 920 for holding Lapping and Polishing Fixtures during processing. The manual specimen yoke is used on either the right side or left side of the instrument and holds fixtures when lapping, grinding, or polishing is done. This workstation allows the user to perform semi-automatic lapping operations without the need for holding fixtures by hand or for using motorized arrangements. Although the Model 920 is designed for motorized capabilities, this workstation can be used in place of these as a cost savings. However, rotation of the fixtures is not guaranteed as this workstation relies on the rotational inertia of the fixture to provide the movement of the fixture.



Figure 8: Various setups using the manual specimen yoke. At left is the yoke without any fixtures, while the center and far right images show the yoke with a Model 155 Lapping Fixture and the Model 92005, respectively.



Lapping Plates

The Model 920 is designed for precision lapping and polishing operations, and a common method for precision finishing of materials is free abrasive lapping techniques. Lapping is the removal of material to produce a smooth, flat surface. Lapping processes are used to produce dimensionally accurate specimens to high tolerances and can be used to remove subsurface damage caused by sawing or grinding. Free abrasive lapping is when abrasive slurry is applied directly to a lapping plate and used for material removal. This method is used with a variety of lapping plates of varying composition. There are primarily three types of lapping plates available for use with the Model 920:

**Cast Iron (Fe):**

Cast iron lapping plates are used for rough lapping and stock removal of materials. Specimens around 8-10 on the Mohs Hardness Scale can be lapped using cast iron plates. Cast iron produces a gray surface finish and provides high removal rates.

**Composites:**

Composite plates are used for rough lapping and stock removal of materials. Specimens of 7-10 on Mohs Hardness Scale can be lapped on composite plates. These plates produce medium quality surface finishes with very high removal rates.

**Aluminum:**

Aluminum plates are generally used as a substrate plate for attaching glass plates for lapping, abrasive papers, or lapping films.

Conditioning Rings

When utilizing free abrasive techniques the lapping plate surface will change over time. During lapping processes material is removed from both the sample and the lapping plate surface and will eventually cause the lapping plate to become concave or convex in shape. Conditioning rings are designed to allow the user to resurface the lapping plate and to bring the lapping plate back into flatness. Using simple techniques the plate surface can be brought back into specification and further processing can commence.



Figure 9: Image showing the Model 92002 Workstation with a diamond conditioning ring. The ring is used for removing material from the lapping plate surface to create a flat surface for lapping processes.



Conclusion

The Model 920 Lapping and Polishing Machine has been designed for versatility, precision, and flexibility all into a single system. Implementing any number of different accessories available for this system will allow for high quality materials preparation in a myriad of applications. From grinding applications to precision materials processing, the Model 920 is an excellent system for solving numerous types of materials processing challenges.

