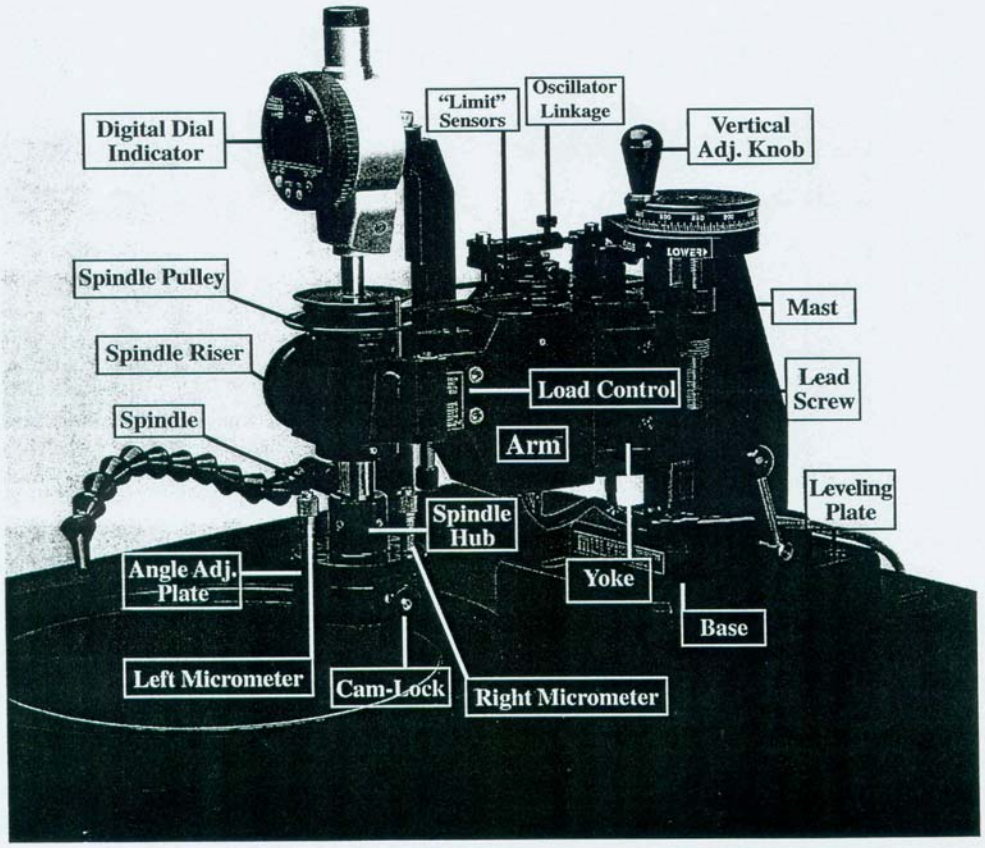


MAIN PHOTO - MULTIPREP™

3) Calibration:

The MultiPrep™ and TechPrep™ are both precision instruments and have been machined to very tight tolerances. Accuracy of calibration is dependent on the cleanliness of certain components. Because the platen and platen base of the TechPrep™ are precision surfaces, it is very important that they be cleaned and dried after every use to ensure accuracy. The MultiPrep™ is calibrated so its **vertical spindle** is perpendicular to the plane of the TechPrep™ platen.

All systems are calibrated and inspected before shipping, but should be checked upon installation by the procedure described on the following pages and be calibrated on an as-needed basis. Many factors contribute to the frequency of calibration, such as number of users, hours used, and number of different applications being performed on the tool.

Note: Prior to performing the following calibration procedures, make sure #15-1040 Load Adjustment Kit or #15-1055 Load Reduction/Spindle Lock Attachment are not contacting the spindle pulley. Also, use a lint-free wipe to clean the bearing inside the pulley and the surface the bearing makes contact with underneath it.

Platen Run-out

Before spindle calibration, it is important to make sure that the overall vertical run-out (movement up and down) of the platen as it rotates is within the tolerance specification of 5 microns.

Locate the **dial indicator kit** (#15-1030), which contains a **dial indicator** (readout in 2μm) and a **black adapter plate** (see photo of accessories on page 20). Attach the dovetail pin to the **black plate** by inserting it into the hole and tightening the set screw with the supplied Allen wrench. The **dial indicator** has a groove on the back that fits into the dovetail pin. Slide the **dial indicator** onto the pin and tighten the collar to secure it.

Remove the TechPrep™ splash ring and place a bare **platen** (#10-1005) onto the **platen base**.

Manually adjust the tip of the **dial indicator** back so it points at approximately a 25-degree angle toward the **black adapter plate** (as shown in Figure A).

Raise the **arm** using the **vertical adjustment knob** almost to the maximum vertical position. If the **spindle** is raised with the **spindle riser**, lower it.

Activate sample rotation until the **cam-lock lever** is positioned on the right side (Figure B).

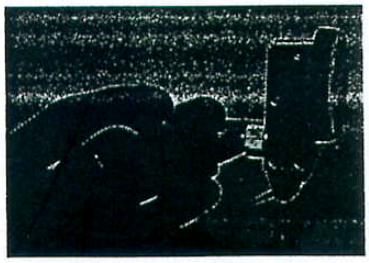


FIGURE A

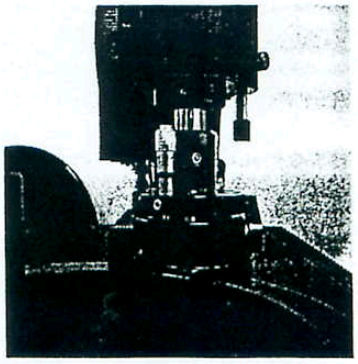


FIGURE B

3) Calibration (cont'd):

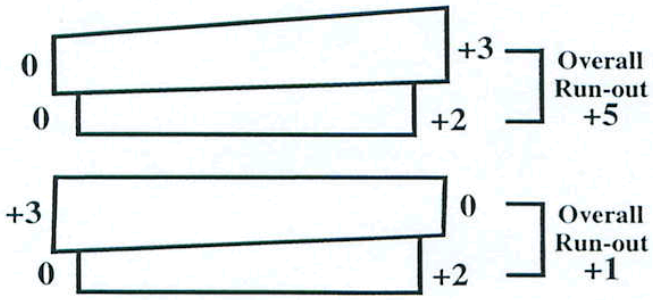
Attach the **dial indicator** adapter plate using the **cam-lock**. **Note**: the **black plate** is directional and can only be attached one way. The upper side is defined as the side that has the smaller U-groove.

Adjust the oscillator drive linkage so the **dial indicator** is 1" from the edge of the platen. Lower the indicator by rotating the **vertical adjustment knob** counterclockwise until contact is made with the platen (deflection of the face needle indicates contact) and the face needle reads "100" (rotate the bezel so "100" is at the 6 o'clock position as shown in Figure C). Set the platen speed to 20 RPM counterclockwise and activate platen rotation. Observe the movement of the needle.

FIGURE C

If there are more than 5 microns of vertical run-out, check the platen and platen base contact surfaces for debris, corrosion, etc., and clean as needed.

Note: Even though the platen and platen base are precision lapped surfaces, they still have machined tolerances of 2-3 microns each, and the platen orientation as it rests on the platen base will affect the overall run-out. If the thicker side of the platen rests on the high side of the base, the run-out can be compounded up to 5-6 microns (see Diagram 1).



Side View
(exaggerated for illustration purposes)

DIAGRAM 1

3) Calibration (cont'd):

There are 4 drive pin holes on the underside of the platen, allowing four *different* platen positions relative to the platen base (as seen in Figure D). To counteract the compounded effect and minimize the overall run-out, observe the needle deflection at each of the 4 platen positions. For example, the run-out may be 5 microns, 4 microns, 2 microns and 2 microns at the four positions. At the minimal position (i.e., 2 microns), remove the platen and mark the platen drive hole and the nylon drive pin with a permanent ink pen (see Figure D). In the future, when placing platens onto the platen base, match the marked drive pin with the marked platen hole to ensure the same run-out conditions.

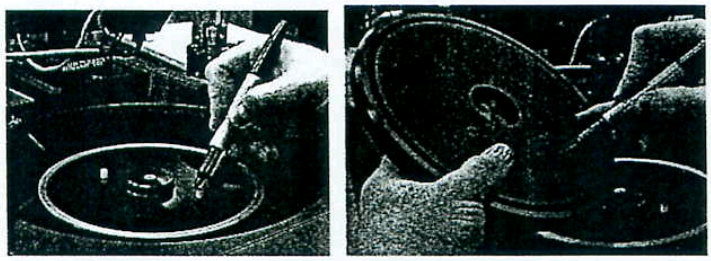


FIGURE D

NOTE: Remove the aluminum platen when not in use! Dry the machined surface on the platen base and platen when changing.

<u>Vertical Spindle Calibration</u>

With the **dial indicator** installed as it is for vertical run-out verification, adjust the oscillator drive linkage (see page 15) so that the **dial indicator** is at the center of the platen. Activate sample rotation at the slowest speed and make sure the tip of the dial indicator stays on the platen for a complete rotation. Observe the movement of the face needle as it rotates the entire 360 degrees. If the needle stays within 2 graduations (4 microns) during a full rotation, the **spindle** is within perpendicular specification to the platen and calibration is not necessary. If the needle deflects more than 4 microns, spindle calibration is necessary. Calibration is accomplished by adjusting the screws on the leveling plate (Figure E and Diagram 2).

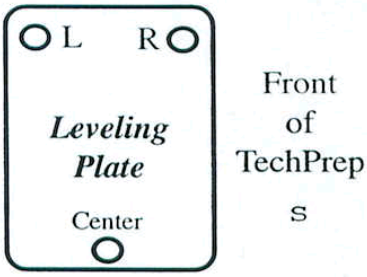


DIAGRAM 2

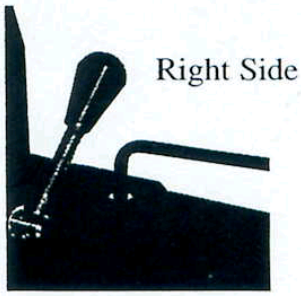


FIGURE E

3) Calibration (cont'd):

Calibration begins by adjusting the right screw of the leveling plate so the **dial indicator** shows exact readings as it contacts the platen at the 3 and 9 o'clock positions. Once the readings on both sides are equal, only the front-to-back (6 and 12 o'clock) alignment needs to be performed. This will require an adjustment to be made to the center screw of the **leveling plate** (Diagram 2).

1) Activate sample rotation to advance the **dial indicator** to the 3 o'clock position on the platen and stop (Figure F).
2) Adjust the **vertical adjustment knob** to position the needle at "100" on the **indicator** (Figure G). This defines the calibration reference point.
3) Activate sample rotation and stop at the 9 o'clock position (180 degrees). Note the position of the needle. If it moved 2 microns or less in either direction, no left to right adjustment is necessary at this time. If the needle deflected more than 2 microns, adjustment of the **leveling plate** is necessary.
4) If the needle rotates clockwise, tighten the right screw until it reads "100." If the needle rotates counterclockwise, loosen the right screw until it reads "100."
5) Activate sample rotation and stop when the **dial indicator** is at the 3 o'clock position. Using the **vertical adjustment knob**, adjust until the needle reads "100." Activate sample rotation and stop at the 9 o'clock position.
6) Repeat steps 1 through 5 until less than 2 microns of deflection (1 graduation on the dial indicator) is observed between 9 o'clock and 3 o'clock.
7) Activate sample rotation and stop when the **dial indicator** is at the 12 o'clock position. Using the **vertical adjustment knob**, adjust until the needle reads "100."
8) Activate sample rotation and stop when the **dial indicator** is at the 6 o'clock position. If the needle moved 2 microns or less, no adjustment is necessary. If it moved more than 2 microns, adjustment of the **leveling plate** is necessary.
9) If the needle rotates clockwise, loosen the **center screw** until it reads "100." If the needle rotates counterclockwise, tighten the **center screw** until it reads "100."
10) Repeat steps 7 through 9 until less than 2 microns of deflection is observed.
11) Observe one full rotation to verify needle movement on the dial indicator is 4 microns or less.
12) If more than 4 microns is observed, repeat steps 1 through 11.

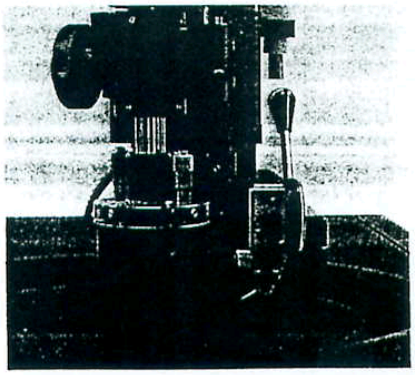


FIGURE F

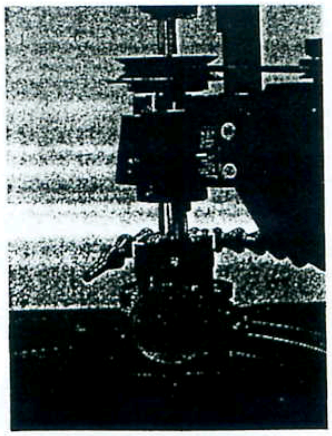


FIGURE G

B) Parallel Polishing Calibration

For microhub assembly calibration and precision parallel polishing, follow the calibration procedure below:

1) Attach a Parallel Polishing Fixture (#15-1020) to the MultiPrep™.

2) Manually adjust the tip of the **dial indicator** so it is at approximately a 25-degree upward angle, as shown in Figure H.

3) Secure the **dial indicator** onto the **platen** using the supplied double-sided tape. Be sure the needle is positioned near the inside edge of the fixture on its underside.

4) Rotate the dial indicator bezel until the "zero" on the dial points towards the back of the machine.

5) Activate **sample** rotation until the **fixed pivot pin** is located over the tip of the **dial indicator** as shown in Figure I.

6) Lower the MultiPrep™ **arm** using the **vertical adjustment knob** until the bottom of the fixture makes contact with the indicator tip and the **dial indicator** reads "zero."

7) Activate **sample** rotation until the **right micrometer** (nearest the **cam-lock lever**) is over the indicator tip, and stop rotation (Figure J).

8) Adjust the micrometer so the **dial indicator** needle moves back to "zero" (Figure J).

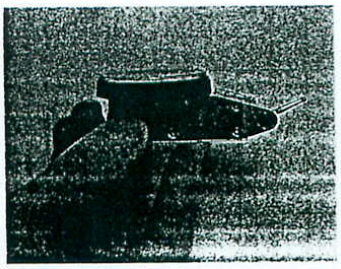


FIGURE H

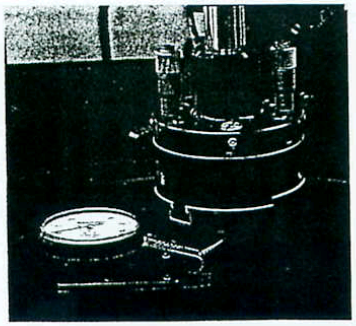


FIGURE I

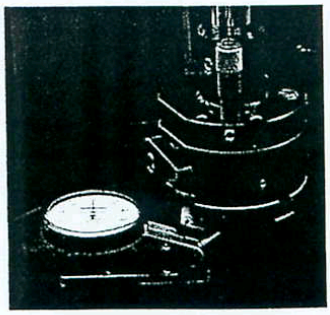


FIGURE J

Parallel Polishing Calibration (cont'd):

9) Activate **sample** rotation until the **left micrometer** is over the indicator tip, and stop rotation (Figure K).

10) Adjust the micrometer so the **dial indicator** needle moves back to "zero" (Figure K).

11) Repeat steps 6-10 until less than 4 microns of deviation from "zero" is noted on the dial indicator over the 360-degree rotation.

12) Note the **left and right micrometer** settings to assist with future calibration.

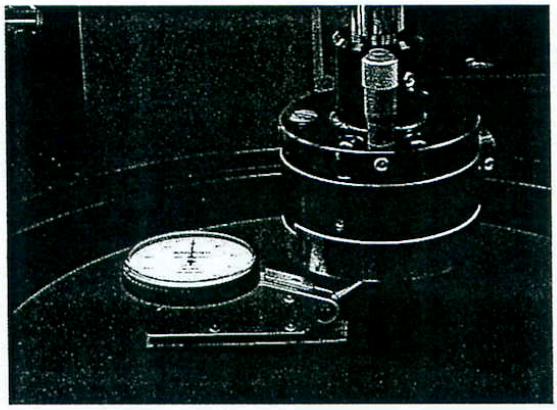


FIGURE K

4) Operation:

A) Vertical Adjustment

The MultiPrep™ is designed to accommodate samples of variable thickness, and has two methods of vertical adjustment. Method A is with the **vertical adjustment knob** (Figure L). Method B is with the **spindle riser** (Figure M).

Method A: Vertical Adjustment Knob

The **vertical adjustment knob** (Figure L) is used to control the vertical position of the sample as defined by the **yoke/arm** assembly. It is also used to establish the downward travel stopping point for the sample, which occurs when the **spindle pulley** makes contact with the **arm**. The readout on the scale around the **knob** is in 2-micron increments. When rotated clockwise, the **arm** travels upward. When rotated counterclockwise, the **arm** travels downward.

Method B: Spindle Riser

The **spindle riser** (Figure M), located on the left side of the **arm**, is used to raise the **spindle/** sample without changing the vertical position of the arm. It will be used when it is necessary to replace platens, abrasives or cloths, or for sample inspection. To use, rotate the **knob** toward the front of the arm until the flat spot on the plastic fin is in full contact with the bottom of the **spindle pulley** (Figure N). At this point, the sample can be removed for inspection (see mounting information, page 14) and/or the **arm** can be swung away to allow platen/abrasive changes. When completed, lower the sample with the **spindle riser** to continue grinding/ polishing. This process returns the sample to its original vertical position, as no adjustments were made to the **vertical adjustment knob**.

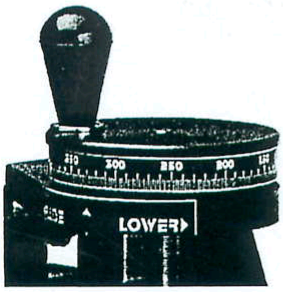


FIGURE L
Vertical Adjustment Knob

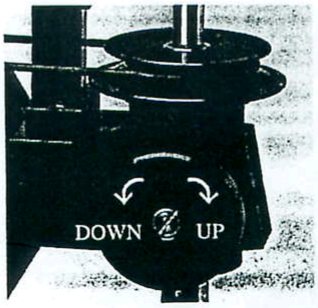


FIGURE M
Spindle Riser

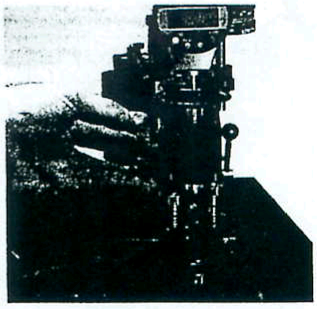


FIGURE N

Note: When replacing platens/abrasives having different thicknesses, a change may be noticed on the **digital dial indicator** readout. Use the **vertical adjustment knob** to reestablish the previous setting if necessary.

The **digital dial indicator** may be operated in either metric (1μm resolution) or standard (0.00005-inch resolution) as defined by the operator. Please see instructions enclosed with the **digital dial indicator** for more information.

B) Mounting

The sample-holding fixtures are mounted to the bottom of the **angle adjustment plate** at the base of the **spindle**. Each sample fixture has a common U-shaped cutout. The flat edge of the fixture is referenced against the machined edge (lip) of the **angle adjustment plate**, which is located behind the **cam-lock plunger** (Figure O). Raise the **spindle** by rotating the **vertical adjustment knob** clockwise until the sample and fixture fit without contacting the abrasive.

To attach a fixture, slide it onto the plate until it makes full contact with the edge. Make sure it has engaged the **cam-lock plunger**. Rotate the **cam-lock lever** clockwise until tight. Mounting of the sample onto the fixture is usually done with wax, double-sided tape, glue or set screws as required by the type of sample and desired sample orientation.

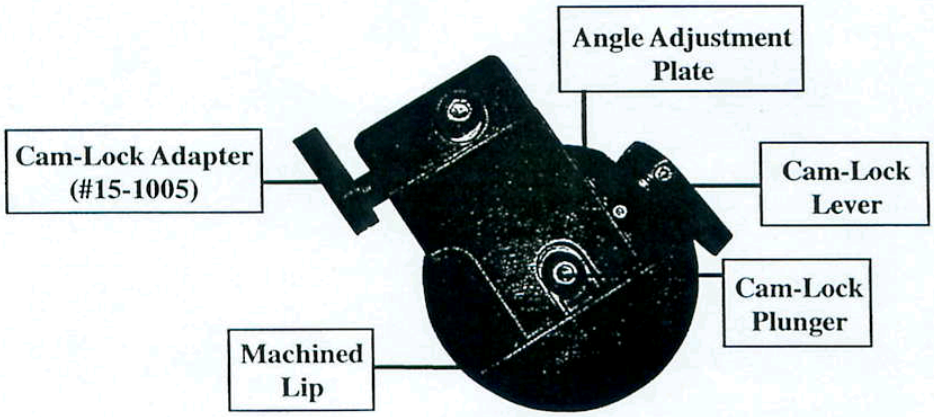


FIGURE O
Bottom View of Angle Adjustment Plate/microhub assembly

C) Rotation

1. Full Rotation: Sample rotation is activated by pressing the "Full" key located above the connected "Rotation" keys in the "MultiPrep Controls" box of the TechPrep™ panel. The "Full" key is a toggle type switch which activates the rotation motor when pressed and turns the LED green. The rotation speed is variable with 8 speed settings. To program the desired speed of rotation, press the "Full" key once and then press it again and hold it until the LED turns orange and a double beep is heard. Release the key and select the desired speed using the up/down arrows. Once that speed is achieved, press the "Full" key again and the LED will turn green. The selected speed will remain as the default speed until reprogrammed.

2. Limit Rotation: Limit rotation allows the sample to be rotated in an alternating direction between two points. At the top of the rotation motor pulley, where the O-ring is connected from the motor to the spindle, there is a knurled screw. When loosened, this screw allows adjustment of the two sensors that define the range of travel. After the sensors are adjusted, tighten the screw. The maximum range of travel is 300 degrees.

Limit rotation is activated by pressing the "Limit" key in the "MultiPrep Controls" panel on the TechPrep™. When activated, the LED turns green. To program the desired limit rotation speed, press the "Limit" key once and then press it again and hold it until the LED turns orange and a double beep is heard. Release the key and select the desired speed using the up/down arrows. Once that speed is achieved, press the "Limit" key again and the LED will turn green. The selected speed will remain as the default speed until reprogrammed.

D) Oscillation

The oscillation function is used to sweep a sample across the abrasive on an arc that is parallel to the plane of the platen. This provides random grinding/polishing of the sample, and enables uniform wear of the abrasive by utilizing its entire surface. The sample can be oscillated with a sweep range that is defined by the operator.

1. Sweep Range: To set the range of the sweep, loosen the thumb screw that is located on the **oscillation motor** (Figure P). This thumb screw is horizontally oriented (see "range" thumb screw, on Figure P). Slide the dovetail bar so the drive pin moves closer to or farther from the center of the hub. Moving the pin closer to the center will provide a smaller sweep (range), and moving it farther from the center will create a larger sweep.

2. Sweep Position: After choosing the range of sweep, you can choose the position the sample will sweep over a particular area of the abrasive. The area is defined by the overall length of the drive linkage. The linkage consists of a drive bar that is engaged into a hollow cylinder. It is adjusted by loosening the thumb screw that is vertically oriented on the cylinder (see "position" thumb screw on Figure P). Adjusting the bar's engagement will position the sample over the desired part of the abrasive. Less engagement of the bar will position the sample toward the

outer edge of the platen/abrasive, and more engagement will position it toward the center of the platen/abrasive. Be sure the sample does not extend over the edge of the platen after adjustments have been made. After adjustments have been made, observe the sweep position and range before lowering the sample onto the abrasive.

3. Sweep Speed: The "OSC" key located on the TechPrep™ control panel in the box labeled "MultiPrep Controls" is a toggle key. Every time the key is pressed, it either activates or deactivates the power for the oscillator motor. When the motor is activated, the LED is green. The speed for the oscillator is adjustable with 6 speed settings and is programmed using the TechPrep™ keypad. To program the oscillator speed, press the "OSC" key, activating the oscillator motor, then press the "OSC" key again and hold it until the LED turns orange and a double beep is heard. Release the key and select the desired speed using the up/down arrows. Once that speed is achieved, press the "OSC" key again and the LED will turn green. The selected speed will remain as the default speed until reprogrammed.

NOTE: When changing platens/abrasives, it will be necessary to swing the **arm** away to the right of the TechPrep™ to gain access to the platen area. To do this, loosen the **"position" thumb screw** at the top of the oscillator bar, which will disengage contact between the drive bar and the hollow cylinder (magnets will hold the arm to the side at its farthest position). To reconnect, simply move the **arm** left until the bar slides into the cylinder and tighten the screw at the desired engagement.

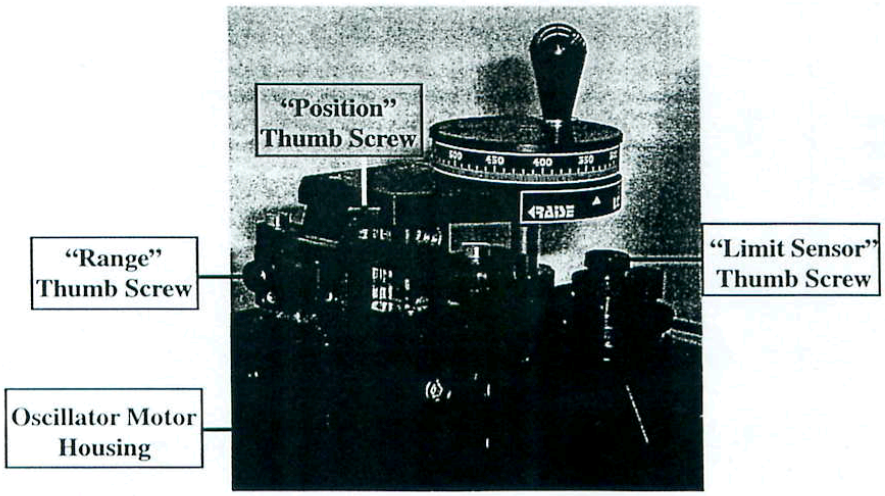


FIGURE P

E) Angular Adjustments

Angular adjustments are necessary for certain polishing procedures or to correct misalignment of samples due to fluctuations in glue, wax or other sample mounting mediums. The adjustments are made by rotating either of the micrometers located on the **spindle hub** (Figure Q). Both micrometers are oriented 90 degrees from the fixed pivot pin. The **spindle hub** and **angle adjustment plate** are spring-loaded. The micrometers and pivot pin are fixed in the **spindle hub** and apply constant pressure to the **angle adjustment plate**. The pivot pin creates a known distance between the two plates. The micrometers are identified as the **left front micrometer** and **right rear micrometer**. To identify these micrometers correctly, the orientation of the hub must be correct. The starting orientation is with the **cam-lock lever** on the right side of the **spindle** (shown in Figure Q) and the pivot pin in the back.

As described in section B, page 14, there is a machined lip under the **angle adjustment plate** (Figure O). This machined surface is the reference for all the sample fixtures and must be kept clean. It is parallel with the pivot pin and the right micrometer. It is perpendicular with the pivot pin and the left micrometer. The right micrometer is used to make radial angle adjustments (left to right). The left micrometer is used to make axial angle adjustments (front to back).

- **Radial -** left to right adjustments are made using the micrometer located at the right rear. The left to right adjustment is also known as **Roll**.

- **Axial -** front to back adjustments are made using the micrometer located at the left front. The front to back adjustment is also known as **Pitch**.

  NOTE: Each incremental adjustment on either micrometer creates a .02-degree angle on the sample.

- **Pivot Pin -** creates a gap between the **spindle hub** and the spring-loaded **angle adjustment plate**. The gap is factory set at 2032μm (.080 inches) allowing axial and radial adjustments of ±2.5 degrees. If more angular adjustment is necessary, the gap can be increased. However, a larger gap between the plates will decrease spring life.

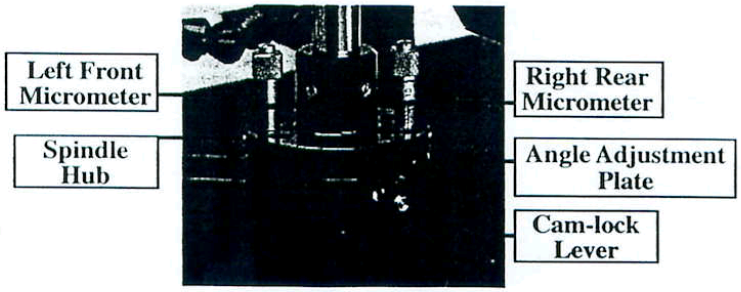


FIGURE Q

F) Sample Load

The load applied to a sample when cross-sectioning is approximately 600 grams, assuming the #15-1005 Cam-Lock Adapter and #15-1010 Cross-Sectioning Paddle are used. For certain polishing applications (i.e. fragile specimens, TEM thinning) it may be desirable to reduce the amount of load on the sample. The load adjustment feature (Figure R) allows load reduction from 0-600 grams in 100 gram increments.

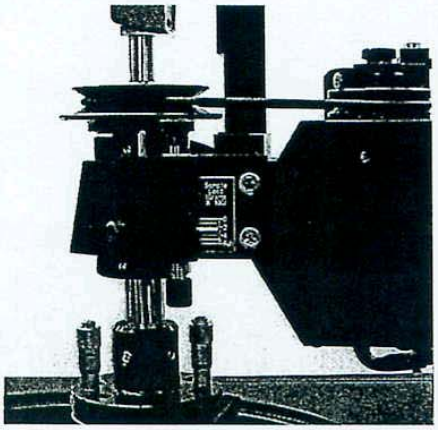


Figure R

G) Spindle Lock

It may be desirable to lock the spindle, so that the sample is oriented in a certain position relative to the abrasive, as well as eliminate swiveling due to O-ring movement (stretching) when grinding larger samples. The **spindle pulley** has 8 holes machined around the edge. To lock the spindle, loosen the red knurled knob attached to the lock pin, raise the pin through the desired hole and tighten (See Figure S). The pin should be at its lower position when not in use.

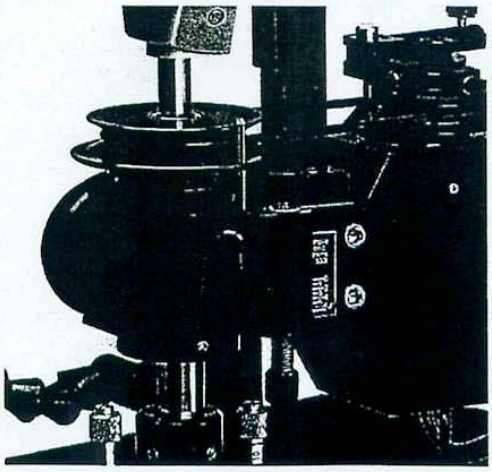


Figure S

H) Specific Material Removal

There are two methods for removing a specific amount of material from a sample. Using Method A, the operator observes the **digital dial indicator** and monitors how much material is removed. For Method B, the operator uses the scale located on the **vertical adjustment knob** to pre-set the amount of material to be removed.

Method A: Digital Dial Indicator Observation

1. Place desired abrasive onto the platen.
2. Adjust sample load.
3. Activate platen rotation set at 10 RPM.
4. Push the "zero" button on the **digital dial indicator** so the display reads 0.000mm.
5. Lower the arm using the **vertical adjustment knob** until the sample makes contact with the abrasive and the display scrolls to at least 0.050mm over the desired amount to be removed.
6. Push the "zero" button on the **digital dial indicator** so the display reads 0.000mm.
7. Increase platen speed to desired RPM.
8. Use the **spindle riser** to raise the sample off of the abrasive when the display reads desired amount removed.

Method B: Scale Adjustment

1. Place desired abrasive onto the platen.
2. Adjust sample load.
3. Activate platen rotation set at 50 RPM.
3. Lower the **arm** using the **vertical adjustment knob** until the sample makes contact with the abrasive, usually signaled either by sound or when a trail of debris is observed on the abrasive.
4. Allow the abrasive enough time to remove the material from the sample until the sample is brushing/hovering over the abrasive.
5. The scale on the **vertical adjustment knob** is in 2-micron increments. Adjust counterclockwise until the desired amount of material to be removed is set.
6. Allow the abrasive enough time to again remove the material from the sample and hover over the abrasive.

Note: When using this method, the value displayed on the **digital dial indicator** will not always correlate to the pre-set measurement on the **vertical adjustment knob**. This is due to compression that occurs when the sample makes contact with paper, plastic or cloth-backed abrasives. There is a distance the sample travels after making contact with the abrasive until the **spindle pulley** separates from its resting point (compression). The only time the two values would correlate is when the abrasive surface is "non-compressible" (i.e., metal-bonded discs, lapping plates, etc.).