ramé-hart instrument co. MODEL 50-00 / 100-00 CONTACT ANGLE GONIOMETER



Model 100-00

1. Instrument Assembly

Packing List:

- 1. Contact Angle Goniometer
- 2. Illuminator Power Supply
- 3. Power Cord
- 4. Micro-Syringe Attachment
- 5. Micro-Syringe with one (1) 22 gauge straight needle
- 6. Goniometer Instruction Manual

Remove Goniometer unit, Micro-Syringe Attachment Assembly and Illuminator Power Supply from shipping box.

Connect the Illuminator Lamp Cable to the Illuminator Power Supply and plug the Power Cord into a suitable electrical outlet.

The Micro-Syringe Attachment mounts directly to either the top or bottom mounting plate of the 3-Axis Stage using the two (2) thumbscrews supplied. Mount the Micro-Syringe Attachment on the bottom mounting holes to keep the syringe in a stationary position. Mount it on the top mounting holes to enable the syringe to stay with the stage as it is moved horizontally.

2. Optical Bench Leveling

Level the Optical Bench using the spirit level mounted on the base of the 3-Axis Stage and the two (2) knurled head thumbscrews on the Optical Bench.

3. Microscope Assembly

The Microscope Assembly is equipped with a 2.3X Objective Lens and a 10X Ramsden-type Eyepiece. This optical combination produces an overall system magnification of 23X. At this magnification, the approximate working distance from the end of the Objective Lens Housing to the specimen is 57mm (2.28"). The image viewed through the Microscope is inverted.

Certain applications may require an increase or decrease of image magnification. The Microscope uses a standard objective lens mounting thread to permit the use of other objective lenses. **Note:** A change in overall magnification will increase or decrease working distance. Please refer to page 7 for examples of alternate optical combinations.

Two glass reticles are located within the Microscope optical tube on the focal plane of the Objective Lens. The baseline reticle is located nearest to the eyepiece and contains the **"baseline"**, which will be set to align with the top surface of the substrate. It also contains a short vertical line or **"witness mark"** at the six o'clock position. The measuring reticle is located farthest from the eyepiece and contains a protractor and the **"angle line"**, which will be aligned tangent to the drop profile at the baseline. The contact angle measurement is read directly at the witness mark. (To measure contact angles greater than 105 degrees, use the complementary angle.) Rotate the reticles using the external knurled dials as indicated on page 1.

Reticle focus is independent of image focus. To bring the reticle lines into focus, slowly rotate and simultaneously slide the Eyepiece in or out. Adjust the image focus using the knurled knob on the end of the Microscope base plate (page 1, Image Focus Knob). If the motorized focus feature is incorporated into your system, adjust image focus using the toggle switch on the Focus Control Box.

If the baseline and angle line are not coincidental when set to horizontal, the system is not

calibrated correctly and should be sent to ramé-hart instrument co. for recalibration.

4. Illumination

The Illuminator Power Supply unit controls the Illuminator Lamp. The large knurled knob on the front of the unit switches the lamp on and off and provides fine adjustment of lamp brightness.



Power/Fine Adjustment Knob The illumination level should be kept relatively low to begin, and increased gradually if necessary. Proper adjustment will result in a sharply defined drop, darkly silhouetted against a soft white background.

5. Specimen Stage Assembly

The Specimen Stage Assembly provides the following motions for precise positioning of the drop to accomplish contact angle measurements. The locations of the associated knobs and dials are as indicated on page 1.



5.1 Cross-Travel Adjustment

The graduated knurled dial located on the right side of the 3-Axis Stage Assembly Base Plate controls the left/right movement of the Specimen Stage relative to the optical axis. The graduated dial is a slip-ring arrangement that allows the dial to be set to "0" at any point along the left/right travel. This feature is used when defining drop dimensions. The dial contains 50 graduations of .02mm each, with values marked in 0.1mm increments.

5.2 Vertical Coarse Adjustment

The Specimen Stage has a support post mounted in the center of the 3-Axis Stage Assembly that is secured by a knurled thumbscrew. Care must be taken to avoid damage when adjusting the height of the Specimen Stage. Grasp the Specimen Stage firmly by hand and then loosen the thumbscrew. Move the Specimen Stage to the desired height and tighten the thumbscrew to lock the Specimen Stage in place.

5.3 Vertical Fine Adjustment

The vertical movement of the Specimen Stage, relative to the optical axis, is by means of the graduated dial just below the Specimen Stage. The dial contains 100 divisions of .02mm each, with values marked in 0.1mm increments. The dial graduations are used when defining drop dimensions. To take measurements by this dial, add/subtract the initial reading at the starting position from the final reading.

Note: If the instrument is not used for an extended period of time, the motions of the 3-Axis Stage may not operate freely. Work the knobs and dials back and forth several times to restore smooth travel.

6. Specimen Stage Leveling



The Specimen Stage has a central ball joint connection and three (3) thumbnut jacking screws supporting its underside. Use the two stainless steel jacking screws (front side and right side) to level the Specimen Stage and use the black cap thumbnut at the front right corner to lock the stage in position.

The Specimen Stage is leveled prior to shipment but should be checked before use to ensure proper leveling. To check leveling, a glass microscope slide is used as a target.

6.1 Optical Axis Leveling







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Summary: First, reference the center of the Specimen Stage. Then compare the position of the front of the stage to the baseline. If necessary, adjust the position of the front of the stage to align with the baseline.

Step-by-step procedure:

- 1. Place a standard microscope slide on the Specimen Stage. Align the front edge of the slide with the center of the stage (Figure A). The back edge of the slide will be aligned with the back edge of the stage.
- 2. Focus on the front edge of the slide.
- 3. Using the vertical fine adjustment graduated dial, raise or lower the stage to align the edge of the microscope slide with the baseline.
- 4. Reposition the microscope slide to align with the front edge of the stage (Figure B).
- 5. Refocus on the front edge of the slide.

- 6. If the microscope slide aligns with the baseline, the stage is level. Go to procedure 6.2, Left to Right Leveling.
- 7. If the microscope slide does not align with the baseline, the stage is NOT level.
- 8. Adjust the level of the stage using the X-axis leveling screw (the thumbscrew located under the front of the stage) to bring the slide into alignment with the baseline.
- Check the level of the stage by focusing on the slide as it is placed at various positions on the stage. When the slide consistently aligns with the baseline, the optical axis of the stage is level.

6.2 Left to Right Leveling

Summary: First, reference the center, front of the Specimen Stage. Then compare the position at the far right or left of the stage to this "point" of reference. If necessary, adjust the position of the stage to align with the reference point.

Step-by-step procedure:

- 1. Position the baseline and angle line so that they intersect to form a "point" of reference.
- Place a microscope slide on the stage and align the front edge of the slide with the front of the stage (Figure B). Position the stage to view the center of the stage. Focus on the front edge of the slide.
- 3. Using the vertical fine adjustment graduated dial just below the stage, raise or lower the stage to align the edge of the microscope slide with the reference "point".
- 4. Move the stage to view either the far right or left edge of the slide.
- 5. If the far right or left edge of the slide does not align with the reference point, the stage is NOT level.
- 6. Using the Y-axis leveling screw (the thumbscrew located under the right side of the stage), adjust the level of the stage to bring the slide into alignment with the reference point.
- 7. Check the level of the stage by observing the slide while moving the stage right and left. If any divergence from the reference point occurs, repeat this procedure.

6.3 Baseline Alignment



Once the stage is level, you can align the baseline to the stage using the baseline reticle dial on the Microscope. It is very important that the baseline is coincidental with the front edge of the stage (and subsequently, the top surface of the substrate). The contact angle reading will not be accurate unless the witness mark on the baseline reticle is perpendicular to the substrate surface.

7. Contact Angle Measurements

Prior to making measurements, the user should be familiar with the instrument's features and the pre-measurement requirements of Sections 1 to 6.

1. Focus on the top surface of the substrate at the edge nearest the Microscope. Using the baseline reticle dial and the Specimen Stage vertical fine adjustment dial, bring the substrate and baseline into coincidence. **Note:** *This setting should not be disturbed during the course of acquiring the reading.*

2. Bring the micro-syringe needle into the viewing area and focus on it. Deposit a small volume of liquid onto the substrate to form a sessile drop approximately 2.5mm in diameter. The drop size may vary to suit certain studies.

3. Verify the focus on the drop and, if necessary, refocus the Microscope. Adjust the position of the Specimen Stage to view the extreme right or left side of the sessile drop

4. Adjust the angle line to form a line tangent to the base of the drop, creating a wedge of light bounded by the two crosslines and the drop profile.

5. Slowly rotate the angle line while at the same time adjusting the cross-travel of the Specimen Stage Assembly so that the wedge of light is gradually extinguished and the crossline attains tangency with the drop profile at the base of the drop.

The contact angle value is now read directly from the measuring reticle at the six o'clock position. **Note:** The measuring reticle is limited in travel to approximately 105 degrees on either side of the drop. For contact angles above this limit the reading is for the complementary angle.

8. Pendant Drop Measurements

- 1. Form a pendant drop using the Model 100-10 Micro-Syringe Attachment, mounted on the top mounting plate of the 3-Axis Stage.
- Using the graduated dials on the cross-travel adjustment and on the vertical fine adjustment, measure de and ds.
- 3. Due to the 'pendulum' nature of a pendant drop, the recommended measuring technique is to photograph the drop, at a fast shutter speed, using a camera equipped with a flat field photographic eyepiece. The resultant photograph can then be measured as shown.

References: Pertinent technical data concerning pendant drops and contact angle principles may be found in:

Surface & Colloid Science – Volume 2 Edited by R.J. Good & R.R. Stromberg Available from: Plenum Publishing Corp. 227 West 17th Street New York, NY 10011

9. Advancing and Receding Contact Angles

A sessile drop on an inclined substrate is deformed by gravity. The lower side of the drop forms the advancing contact angle, and the opposite side forms the receding contact angle.

To readily measure advancing and receding contact angles, it is necessary to maintain coincidence between the top surface of the substrate and the Microscope baseline during cross-travel. To meet this requirement and provide inclination to the top surface of the substrate, an angular-displacement mounting base is available for use with the Model 100-10 Contact Angle Goniometer. This option is the Model 100-06 Tilting Base Assembly. An adapter (p/n 100-06-KIT) is required for use with the Model 50-00 Goniometer.

While the gravitational deformation method of measuring advancing and receding contact angles described above is a more convenient method, it is also possible to determine this information using only the Goniometer with the Model 100-10 Micro-Syringe Attachment. Advancing angles are produced as fluid is added to the drop; receding angles are produced as fluid is withdrawn.





PENDANT DROP MEASUREMENT

References: Pertinent technical data regarding advancing and receding contact angles may be found in:

Surface & Colloid Science – Volume 2 Pages: 93-95 Published by: Wiley Interscience New York, NY

10. Alternate Optical Combinations

The following are examples of Microscope Objective Lenses that may be substituted for the Objective Lens supplied with the Goniometer. This table is intended as a guide to assist the user in determining the approximate working distance if the overall system magnification is changed.

Record Number	Magnification	Working Distance	Effective Focal Length
1	1.0 X	150mm	76mm
2	1.5 X	100mm	60mm
3	2.0 X	75mm	51mm
4	4.0 X	35mm	38mm
5	6.0 X	20mm	32mm
6	10.0 X	15mm	14mm

The overall system magnification is obtained by multiplying the Objective Lens magnification by 10X (Eyepiece magnification).

IMPORTANT NOTICE: When lenses are removed from the Goniometer, they should be stored in a plastic bag. Exposure to the elements allows dust and dirt to collect on the lenses, which may cause visual obstructions when in use.

