

## **ET-Measure<sup>TM</sup>**

### **Metrology for Engineering Technology**

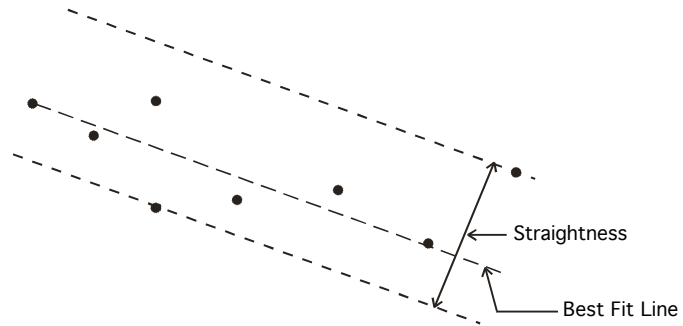
ET-Measure is a combination of software and hardware that can be assembled into a powerful, easy to use metrology system using the customer's trinocular microscope. Included are software, camera, and cabling, and can be used with the customer's computer, or a computer can be furnished.

## Edge Detection Operation:

RDL Equipment's Edge Detection algorithms detect edges a single row of pixels at a time. This operation filters out noise. The edge data points are fit line by line and the individual data points are filtered and fit in terms of X and Y. This computationally intensive operation is the heart of the high level of repeatability that is attained with ET-Measure. It is common for a line width calculation to be both accurate and repeatable to less than 1/20 of a pixel.

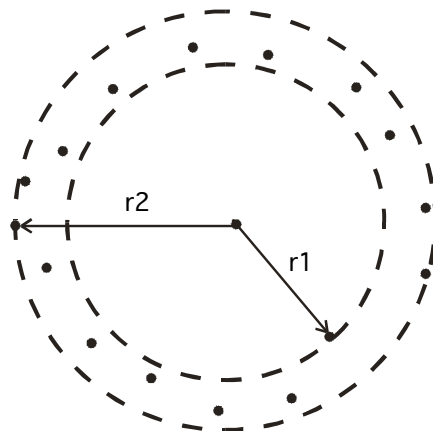
## Straightness:

Straightness is defined as the distance between two lines, parallel with the best fit line, that encloses all the data used to construct the best fit line. If an edge is perfect, the straightness would be 0.



## Roundness:

Roundness is defined as the distance between two circles, concentric with the best fit circle, that encloses all the data used to construct the best fit circle. If the data are all perfectly in a circle, the roundness would be 0.

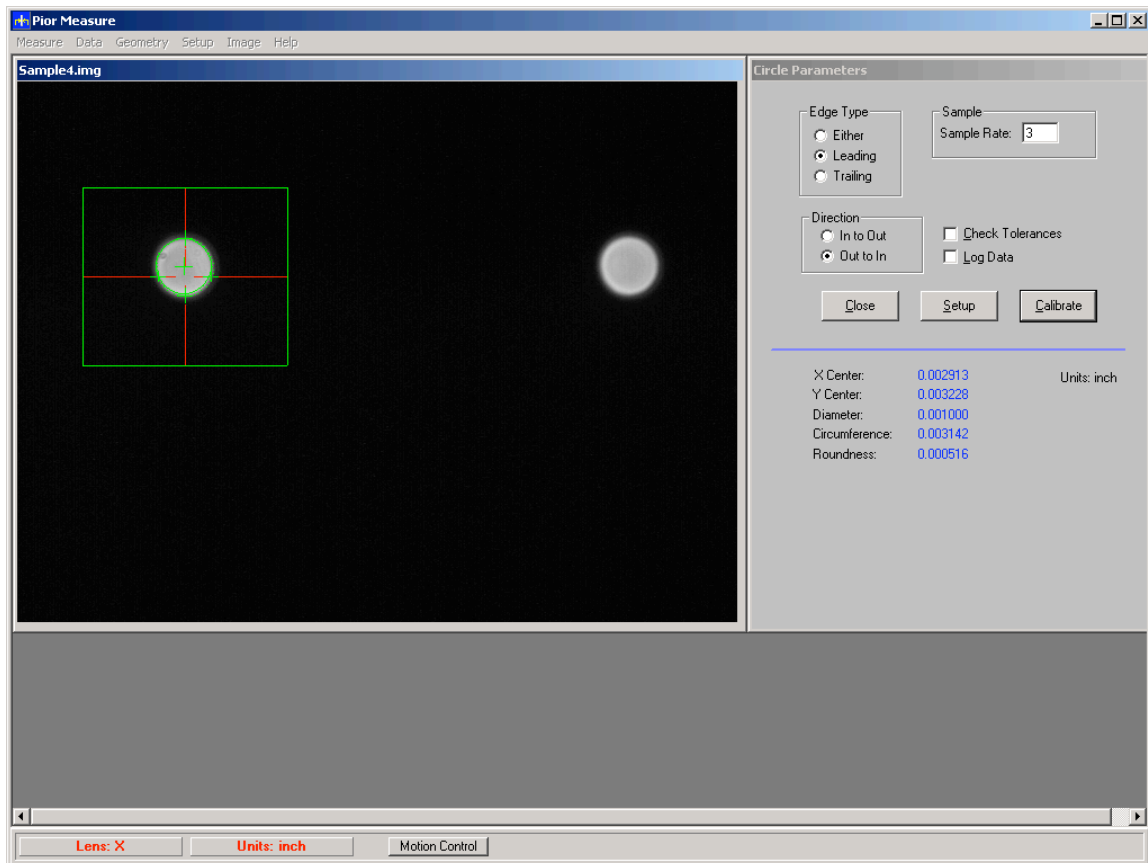
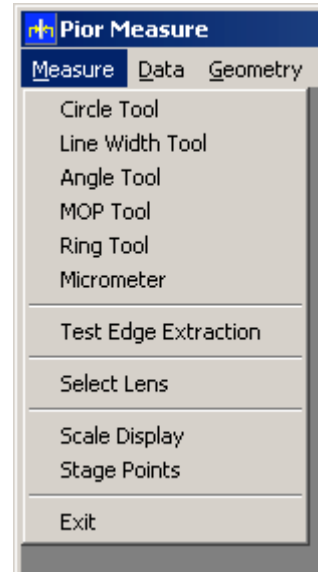


**Measure Menu:**

The measure menu is where all measurement functions start. Click on Measure to show the drop down menu of measurement options.

**Circle Tool:**

The circle tool is used to measure circles and uses a square region. If an annular region is required, then the Ring Tool should be used. When the circle tool is selected, the tool is displayed along with the available measurement options. As shown below, the circle tool is green and can be moved and sized as required. Place the square region of the tool around the circle to be measured and double click on the image.



As shown, after positioning the tool over the circle of interest, double clicking provides an automatic measurement. The results are shown in blue at the right and the preset system units are displayed. The results displayed are X Position in the field of view, Y Position in the field of view, Diameter, Circumference, and Roundness.

If the Check Tolerances box is checked then the calculated results will be checked against user supplied values. The measurement results that are within tolerance will be indicated by **PASS** in green; and out of tolerance measurements will be indicated by **FAIL** in red. Close the Circle Tool window and return to the main menu by selecting the Close button.

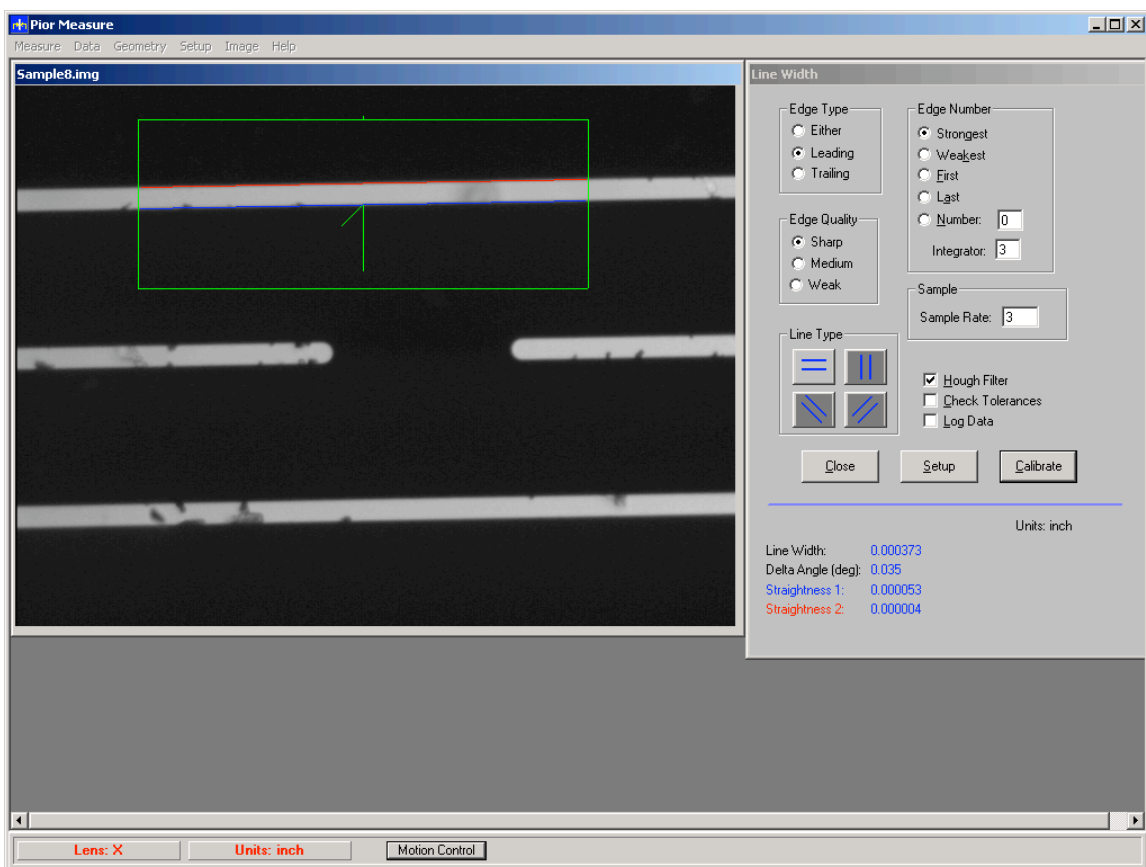
The screenshot shows a software window titled "Circle Parameters". It contains several control groups: "Edge Type" with radio buttons for "Either", "Leading" (selected), and "Trailing"; "Sample" with a "Sample Rate" input field set to "3"; "Direction" with radio buttons for "In to Out" and "Out to In" (selected); and checkboxes for "Check Tolerances" and "Log Data". At the bottom are "Close", "Setup", and "Calibrate" buttons. Below a horizontal line, the following measurement results are displayed in blue text: X Center: 0.002913, Y Center: 0.003228, Diameter: 0.001000, Circumference: 0.003142, and Roundness: 0.000516. The units are specified as "Units: inch".

X Center:	0.002913	Units: inch
Y Center:	0.003228	
Diameter:	0.001000	
Circumference:	0.003142	
Roundness:	0.000516	

## Line Width Tool:

The line width tool is used for measuring line widths within the field of view. The line width tool can measure lines at any orientation and does not have cosine or repeatability problems from lines that are angled within the field of view. The line width calculation is an integrated line width over the entire length of the line within the tool.

The two lines that are calculated are displayed in red and blue and correspond to the red and blue results displayed. If the Check Tolerances box is selected, then the results will

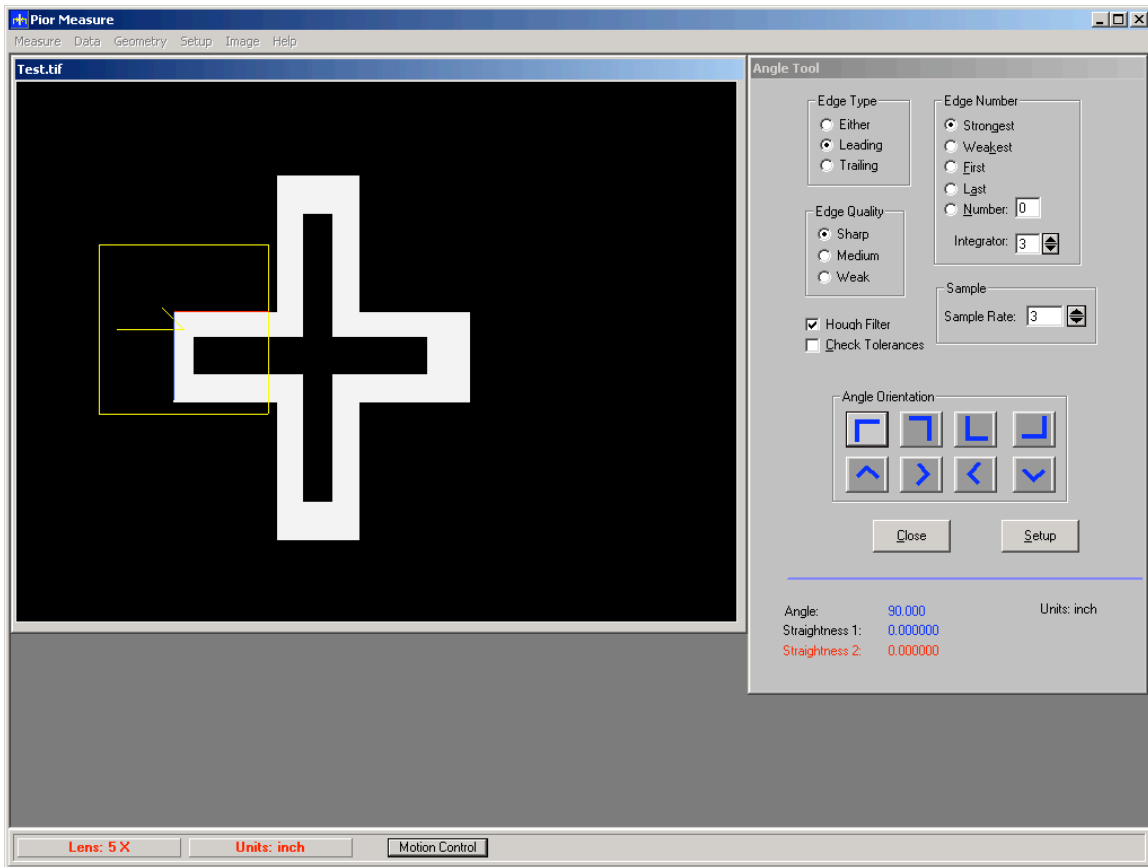


be compared the to the tolerances entered by the user.

Measurement results will be saved to the line log. They will also be displayed in the Live Log window that will appear at the bottom of the main menu.

### Angle Tool:

The angle tool is used to measure the angle of two connected edges. This is a common requirement in masks, various reticles and MEMS, among numerous other applications. The image shown below is a generated image that simulates an alignment target on a reticle. The corners must be very close to 90.

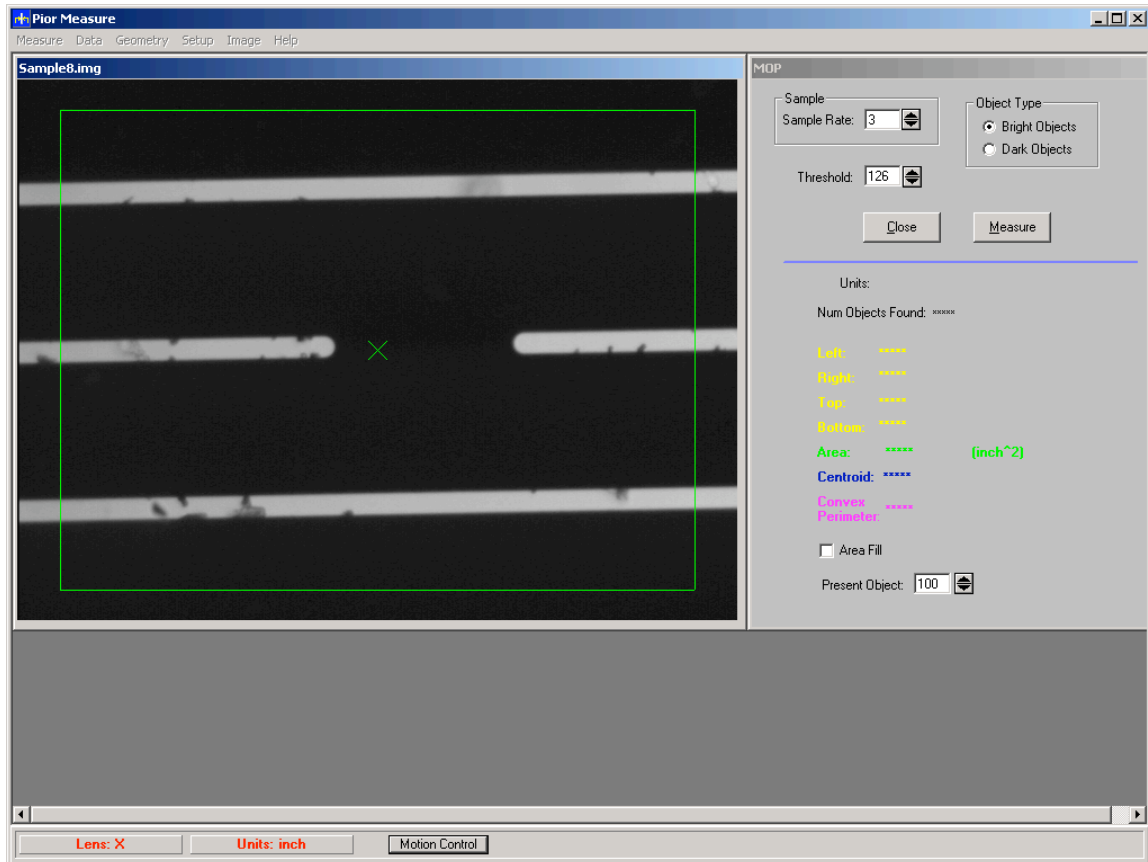


The measurement is made by selecting one of the corner buttons that will indicate the orientation of the corner to be measured. The tool icon will rotate to indicate the first measurement direction. The second measurement direction is rotated 90 degrees clockwise from the first edge.

The results calculated for the Angle Tool are Angle between edges, and Straightness of each edge. The calculated edges are displayed in Red or Blue and correspond to the results display.

## MOP Tool:

MOP stands for Multiple Object Processor and is used to count, size, and sort objects of various sizes. The MOP tool can quickly count a large number of small objects, give the size of an irregular shaped object, and numerous other calculations.

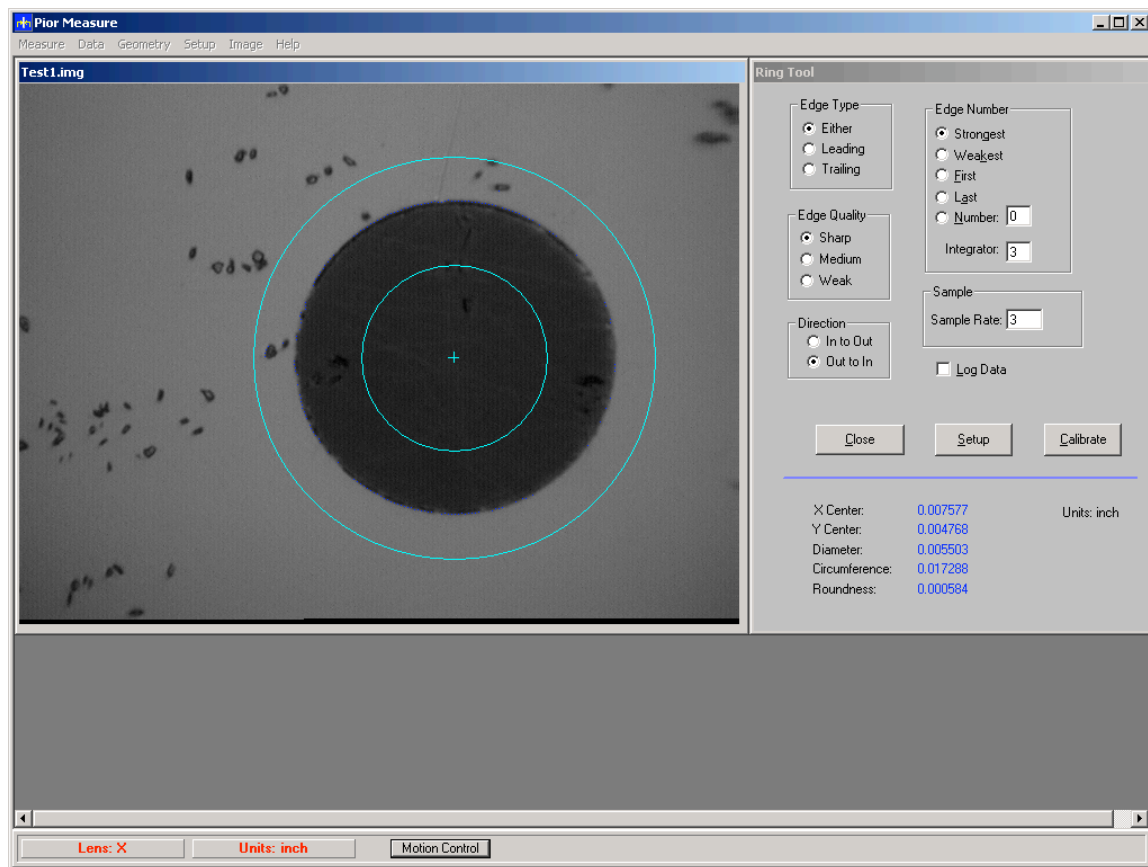


The MOP tool is executed by double clicking on the image. MOP can look for bright objects or dark objects but the objects must be separable from the background by proper threshold settings.

After the MOP processing is complete, the number of objects found will be indicated and the first object will be displayed. The other objects found can be isolated individually by either clicking on an object or by changing the value in the Present Object box.

## Ring Tool:

The ring tool is used to measure circles, similar to the circle tool except that the ring tool has an annular region of interest. This can be useful if the circle of interest has concentric circles that need to be ignored or there are features close by that interfere with the circle measurement tool.



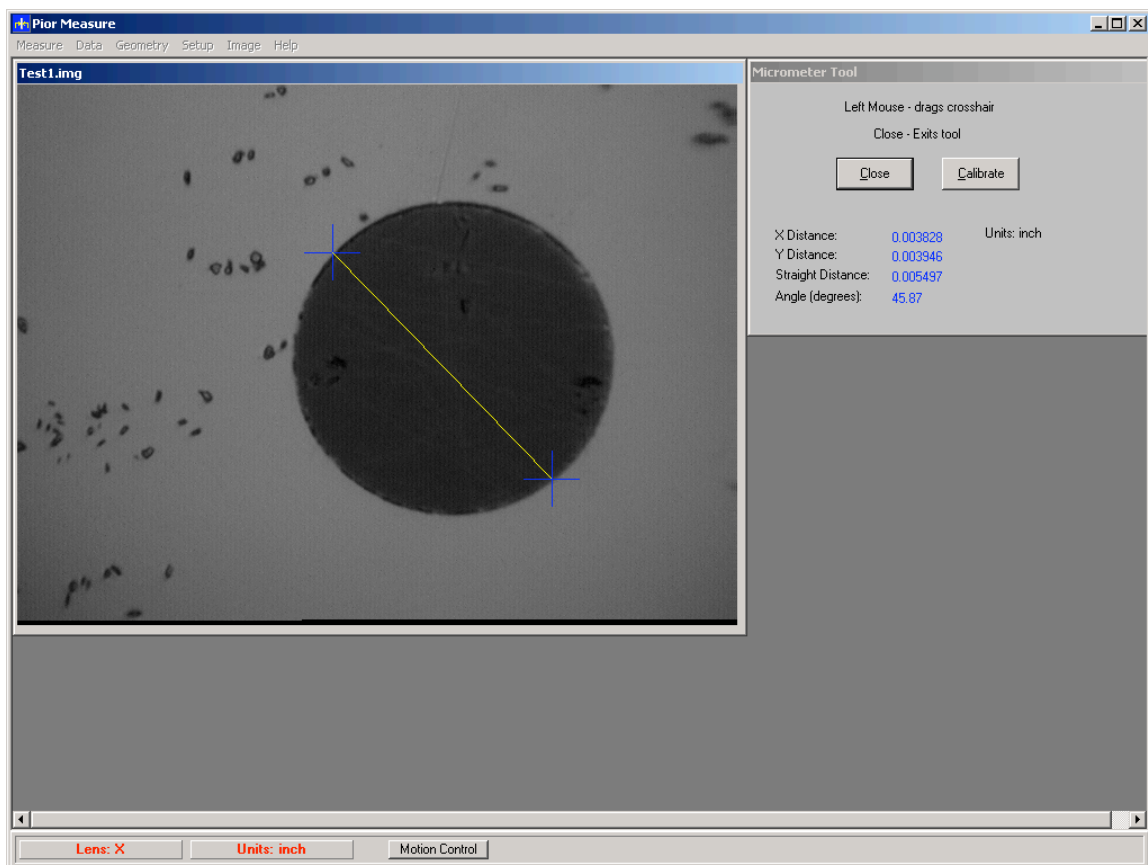
The ring tool is shown above and is moved by dragging from the center of the tool.

The results calculated by the ring tool are the same as the circle tool. The results displayed are X Position in the field of view, Y Position in the field of view, Diameter, Circumference, and Roundness



## Micrometer Tool:

The Micrometer Tool is used for more manual measurements. It provides pixel level resolution and gives X, Y, and straight line distance information.

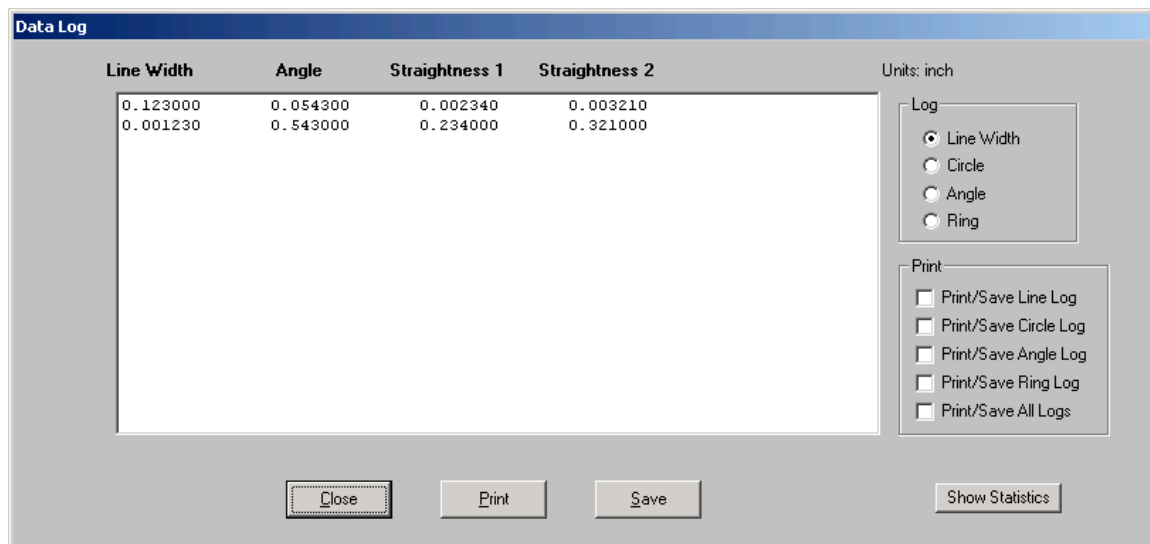


## Data Menu:

The Data menu is where the user will display logged data and clear logged data.

## Display Log:

The Display Menu option is used to display the logged data. When a Circle, Line Width, Angle or Ring Tool are used, the user has the option of turning on the log by clicking the Log Data check box. Two things happen when this box is checked. First the Live log is displayed which shows a running list of the measurement results. The second is that the data are stored in the data logs and can be displayed and/or printed.



Clicking the Show Statistics button will cause the window to expand slightly and display the statistics of the measurements in the log. The caption will then read Hide Statistics, which turns the statistics display off.