



Oakland Instrument Corporation

7405 Bush Lake Road
Minneapolis, MN 55439 USA
Tel & Fax (952) 835-4935
E-mail: info@oaklandinstrument.com

Theory of Operation

Caliper or Thickness Testing is used in product development or quality control to measure the cross-web or down-web thickness profile of plastic film, paper, tissue, and sheeting materials. The Oakland Instrument MX Series MicroGauges are off-line thickness testers, placed on a work bench or lab bench, where the operator cuts and prepares samples from the production line to run on the system. Models are available that can automatically feed or pull the sample strip through the tester for profiling, or manual models where the strip is hand-fed under the measurement foot for single readings, or hand-fed for cross-web readings at multiple locations. Both procedures allow calculation and location of minimum thickness, maximum thickness, average thickness, and other statistics such as standard deviation of thickness data for a given sample.

The MX MicroGauge series utilize precision LVDT-sensors and contact measurement heads to determine the absolute thickness of the material measured. Resolution to 0.01 mil (0.25 micron) and accuracy to 0.02 mil (0.50 micron) are achievable with the systems. Different contact foot configurations, pressures, and weights are available to match the specific requirements of the materials you are trying to measure. Low foot pressures are utilized if there is a possibility of material compression during the measurement process.

All three MicroGauge models also come, standard, with parallelism adjustment mechanisms to achieve parallelism of better than 40 microinches, to ensure measurement accuracy is maintained. Several Cycle Rates, Dwells, Drive Increments, and Measurement Units are available to meet your specific needs.

ASTM and International Standards

The Oakland Instrument Series MX-1210, MX-1200 and MX-1100 MicroGauge Thickness Testers are designed to meet the testing requirements of ASTM D-6988 "Standard Guide for Determination of Thickness of Plastic Film" and TAPPI T-411 "Thickness (caliper) of paper, paperboard, and combined board". Testing requirements of ASTM D-374 "Standard Test Methods for Thickness of Solid Electrical Insulation" are also met by the devices.

Oakland Instrument manufactures several thickness tester models that meet the various testing methods specified by ASTM standards. The Model MX-1100 is a discrete point tester (or point-to-point testing) with an RS-232 Port to allow data collection by leading 3rd party statistical software packages. The Model MX-1200 includes on-board Statistics which can be displayed on the unit console, and can also operate with our Oakland Quality Control Software. The Model MX-1210 adds a drive mechanism for automatically pulling sheet samples for thickness profiling. Our Model MX-1300 Quality Control Software records, graphs data, calculates Statistics values, and provides reports for quality control record keeping.

Preparing Film or Material Samples

Film samples are cut to approximately 125 mm (5.0 inch) wide. Film is defined as sheeting have a thickness of not greater than 0.254 mm (10 mil) as indicated by ASTM Standard D-6988. A sheeting specimen (greater than 0.254 mm thickness) up to approximately 300 mil (7620 micron) can be measured with the system, depending upon hardware configuration.

Sheeting specimens should be flat and free of creases and defects, to assure optimum accuracy. Material creases could be hand fed around (to avoid) the sensor during the measurement cycle.

Record the direction in which the readings are taken – cross-web (transverse direction or "TD") or down-web (machine direction or "MD") One specimen is typically prepared and run per roll of material produced.

Loading Film or Material Samples

Care must be exercised when handling sample specimens. The test surface must be kept free from external damage, or any foreign matter that may change the surface characteristics of the specimens and be measured in error.

Plastic films and sheeting may exhibit different thickness properties in their respective principal directions due to anisotropy or extrusion effects. Specimens may be tested with their long dimension in either the machine or transverse direction, but it is common practice to test specimens with its long dimension perpendicular to the machine direction.

To measure samples from the leading edge with the MX-1210 Profiling MicroGauge, you can tape a “leader” to the beginning of the sample and place the leader under the drive wheel to begin the sample measurements at the sample edge. Tape the approximately 5 inch (125 mm) long leader to the leading edge of the sample strip.

Running the Caliper or Thickness Test with Firmware-Driven Console

Place the sample, or sample leader under the drive wheel by pressing, and releasing the lower spring-loaded idler wheel.

Start the drive mechanism to start the test and begin data collection. Stop the drive mechanism at the end of the sample to stop data collection.

Depress the red push-button labeled “Average” at the end of the test to display thickness profile statistics including Average, Standard Deviation, High Thickness, Low Thickness, and Count (or number of data points taken during the test).

(while demonstrating pushbuttons) “Average”, “Standard Deviation”, “High Thickness”, “Low Thickness”, “Count”.

Depress the white push-button labeled “Clear” after recording or printing your data to clear the firmware memory for the next test. Or, if you prefer to run more than one sample segment and combine the data into a single data file, simply re-start the drive mechanism and the new data will be added to the resident file data.

Running the Caliper or Thickness Test with Optional Serial Ticket Printer

A serial Ticket Printer can be connected to your MX Series MicroGauge for ticket-data reporting of thickness points and summary statistics. Simply connect the configured serial ticket printer to your MicroGauge. All data that is transmitted to the digital display on the gauge console is also transmitted serially from the RS-232 connection on the back panel of your MicroGauge.

Running the Caliper or Thickness Test with Oakland MX-1300 Quality Control Software

Place the sample, or sample leader under the drive wheel by pressing, and releasing the lower spring-loaded idler wheel.

Open your Oakland MX-1300 Quality Control Software and press the “Start Sample” button (labeled “SPC” on the Main Screen). Start the drive mechanism to start the test and begin data collection. Stop the drive mechanism at the end of the sample to stop data collection. Depress the “Stop Sample” button on your MX-1300 Quality Control Software to display the thickness profile on the Main Screen.

The MX-1300 Quality Control Software allows you to view thickness profiles in either Linear Graph or Polar Graph styles (for blown film annular extrusion dies), plus a variety of Statistical Screens including Fourier Analysis.

Recording Your Data

During the test, record your data on a standard data form as shown, or collect data to Ticket Printers, 3rd Party Statistical Software or Oakland's MX-1300 Quality Control Software package.

Your MX-1300 Quality Control Software also allows you to Export data to any ASCII-format software including Microsoft Excel™, Minitab™, and Hertzler Systems.

If following ASTM or other standards, you are typically required to record: product (specimen) description, sample conditioning procedure followed, instrument configuration and setup, testing technique used, specimen nominal thickness, principal directions tested, approximate age of sample after manufacture, date and operator name, average thickness and thickness range, together with the standard deviation, and number of specimens tested for each Caliper.

Reporting Your Data

After recording the test data, determine and report the calculated High and Low Thickness values, Range, Average, together with the standard deviation. Other useful reported values include Range as a Percentage of Average and Deviation as a Percentage of Average or Target. Comparisons to pre-set Upper and Lower Control Limits are also useful for keeping your process within control. All of these are automatically calculated and reported by your MX-1300 Quality Control Software.

The thickness and length values stated in SI units are regarded as the standard. Units can be reported in Metric, English, or SI values.

Oakland Instrument provides standard Data Forms with its testers, which can either be filled out manually, or used in a computer-assisted manner with 3rd party Statistical Software packages such as Microsoft Excel™.

Oakland Instrument also offers Quality Control Software packages for Caliper or Thickness data collection and reporting that meets the Standards.