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# CX Series Film Thickness Gauges – Video Script

## Theory of Operation

Thickness Testing is used in product development or quality control to measure the cross-web or down-web thickness profile of plastic film (less than 10 mil or 250 micron) and plastic sheet materials (up to 25 mil or 625 micron). The Oakland Instrument CX Series Film Thickness Gauges are off-line thickness testers, placed on a lab bench, used by an operator who cuts and prepares samples from the production line to run on the system. The CX Series Gauges automatically feed or pull the sample strip through the tester for profiling. The procedure allows calculation and location of minimum thickness, maximum thickness, average thickness, and other statistics such as standard deviation of thickness data for a given sample.

CX Series Film Thickness Gauges utilize proprietary capacitance-sensors and precision contact measurement probes to determine the absolute thickness plus the thickness variation of the material measured when used in our patented AutoCalTM mode. Resolution to 0.001 mil (0.025 micron) and accuracy to 0.01 mil (0.25 micron) are achievable with the systems. Different non-contact sensor configurations, adjustable contact probe pressures, and contact probe tip & anvil styles 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 self-calibration process.

Both self-calibrating CX Series models also come, standard, with flat anvil or with parallelism adjustment mechanisms to achieve parallelism of better than 20 microinches, to ensure measurement accuracy is maintained during the calibration process. Several Cycle Rates, Dwells, Drive Increments, and Measurement Units are available to meet your specific needs.

## The Oakland patented Capacitance Sensor

Oakland currently hold three patents on its proprietary capacitance sensor technology. The first covers its unique Reference Sensor where a second precision capacitance sensor is used to detect change in temperature and humidity in the environment and compensate, “on the fly”, to ensure that the measurements by the primary capacitance sensor are stable and accurate.

## Ultra-High Resolution Sensors

In addition, our capacitance sensor technology offers micro-fine resolution, both thickness and spatial, also unique to Oakland. With thickness and step resolution to 0.001 mil (one micro-inch), the Oakland sensor design stands alone in its ability to detect, and measure, die lines, port lines, layer drop-outs, and score marks.

## Oakland’s Self-Calibrating AutoCalTM

Our second patent covers our unique self-calibration AutoCalTM system. Discovered when measuring nylon films and their tendency to absorb moisture which can affect capacitance sensor accuracy, our AutoCalTM system was designed and patented to include a precision contact probe, alongside the capacitance probe, to measure absolute thickness of a calibration location on the sample, feed this location accurately to the capacitance sensor

probe, and automatically calibrate the capacitance probe with that absolute thickness value. This provides a unique self-calibration or automatic-calibration feature to our instrument.

AutoCalTM is extremely effective for simplifying and minimizing the number of recipes required for different film thicknesses, structures, additives, and the like. If you run a wide range of material types, sizes, and colors, AutoCalTM is for you.

## Oakland's CX-1200 Software – suitable for both day-to-day Quality Control of film thickness + Process Control features

This self-calibration is all done, via. software, in an fully-automatic mode where the sample is loaded and started – the software automatically calibrates, starts the sample drive, runs, and stops the sample, displays data and statistics at sample finish; for true "single button" operation. Fast and easy.

Also unique to Oakland is the range of application-specific features in its software packages for the CX-1000 Series of Film Thickness Gauges:

**Variable Speed Sample Drive** – set anywhere from 10 – 300 cm/min to allow you to run difficult to handle films, and to take advantage of die line and port line detection with our high-resolution sensors.

**Five Operating Techniques in Single-Sample mode** – run in Standard Capacitance mode, AutoCalTM self-calibrating mode, Basis-Weight Mil mode, and Basis-Weight Gram mode. Even run the AutoCalTM probe by itself as a Contact-Profiler! Single Sample mode allows you to create Film Recipes, recall them, and run individual samples quickly and efficiently.

**Automate your Data Collection with Process mode** – run in our unique Process mode to allow you to run samples and automatically store data sorted by your company's Job Number or Order Number system. Automatically names and saves data files with Order Number and Roll Number. Allows data Search & Sort by Order Number, Date, Extrusion Line, Operator, Shift, etc.

**Fourier Analysis for Process evaluations** – Fourier Analysis allows you to mathematically detect and calculate repeating cycles in your data. Use the results to discover and correct extrusion system problems such as poor die-gap settings, port line issues, off-center nip and collapsing frame alignments, drive variations, many others.

**Before & After Data Comparisons** – profile overlays, up to 10 samples, allow you to compare before vs. after changes to measure adjustment effectiveness. Summary Statistics allow you to also compare statistical data from run to run.

**Specialty Software Features** – Thick/Thin Handle Bag control limits, Upper/Lower Control Limits set as absolute or percentage of nominal values, automatic tape detection and removal from data file, moving average filtering to allow on-line gauge comparison to off-line high-resolution profiles.

**Flexible Data File Export Options** – export your data to ASCII or text file formats for direct import into 3rd party statistical software packages such as Excel, Minitab, Zontec Synergy, Access, many others.

## ASTM and International Standards

The Oakland Instrument Models CX-1000, CX-1020 and CX-1025 AutoCalTM Thickness Testers are designed to meet the testing requirements of ASTM D-6988 "Standard Guide for Determination of Thickness of Plastic Film". Testing requirements of ASTM D-374 "Standard Test Methods for Thickness of Solid Electrical Insulation" are also met by the devices.

Our Model CX-1200 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 3.0 inch wide, either in the cross-web (Transverse) or down-web (Machine) directions. 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 25 mil 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 can be filtered with software techniques 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 CX-1000 Film Thickness Gauge, you can run the sample in a loop (tubing) or tape into a loop in the case of slit sheeting or cast film.

You can also mark your film sample and run it from a defined start point to allow tracing your thickness and adjustment issues back to the specific problem location on the die or air ring.

## Running the CX-1000 Gauge as a stand-alone system with Firmware-Driven Console, or as a PC/Software operated system

Place the sample, or sample leader between the drive roller by pressing, and releasing the Up/Down button on the gauge faceplate, or the Up/Down Lever above the drive rollers, depending on model.

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.

Data can be read from the digital display on the faceplate of the CX-1000, or the system can be operated with our Model CX-1200 Quality Control Software.

## Recording Your Data

Your CX-1200 Quality Control Software allows you to display Linear Profiles, Polar Profiles, Statistics Summaries, Multiple Sample Statistics, and Fourier Analysis graphs. The CX-1200 Software also allows you to Export data to any ASCII-format software including Microsoft Excel™, Minitab™, Zontec Synergy, 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 and viewing the test data, print your Reports. 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 CX-1200 Quality Control Software.

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

Oakland Instrument also can provide 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 ExcelTM.