Corning® Semiconductor Glass Wafers
Bow, Warp, and Total Thickness Variation (TTV) Definitions and Method of Measurement

Definitions

Bow A - Reported BOW B - Least Squares Spherical Fit C - Intersecting Plane **BOW = A**	• A least squares spherical fit **(B)** is applied to the shape of the unclamped (free state) wafer. • A second plane **(C)** is applied across the edge of the wafer as an intersecting plane to the spherical fit. • Bow A is the distance between **(B)** and **(C)** at the center point of the wafer. • Bow is reported as either negative (concave shape) or positive (convex shape).
Warp (Flatness) A - Max B - Min C - Least Squares Focal Plane	• A least squares focal plane **(C)** is applied to the shape of an unclamped (free state) wafer. • Warp (Flatness) is the maximum distance between the highest point **(A)** and lowest point **(B)** from the least squares focal plane **(C).** • Measurements are always positive. • Warp uses the entire surface of the wafer instead of just the position at the center point and is a more useful measurement of true wafer shape compared to Bow.
Total Thickness Variation (TTV) **TTV = Tmax-Tmin** A - Maximum Thickness (Tmax) B - Minimum Thickness (Tmin)	• Total Thickness Variation (TTV) is the difference between the highest (Tmax) and lowest (Tmin) elevation on the entire surface of the unclamped (free state) wafer.

Method of Measurement

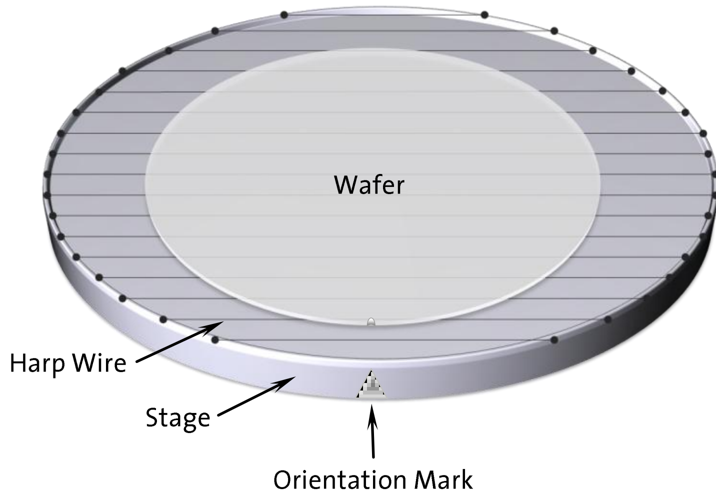
Measurement System and Method

Tropel® Flatmaster® MSP Wafer Analysis System by frequency scanning interferometry

Sample Method

Fixturing

- Wafers are suspended horizontal on a harp wire stage in an unclamped "free state".
- Wafers featuring a notch or flat are orientated facing forward.
- Wafers with additional laser marking have marked side facing up.
- Bare wafers (no notch, flat or laser mark) are random oriented.



Measurement

- Wafers are measured single side.

Performance

- Single measurement provides a full surface scan of wafer form and thickness simultaneously based on 3.1 million data points per measurement.
- Data Analysis can include 3-D, contour, slice and wafer analysis plots.

Warp (Flatness) *TTV - Thickness*