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StandardPractices for Verification and Calibration of Polarimeters[1]

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1. Scope

1.1 Polarimeters and polariscopes used for measuring stress in glass are described in Test Methods F218, C148, and C978. These instruments include a light source and several optical elements (polarizers, optical retarders, filters, and so forth) that require occasional cleaning, realigning, and calibration. The objective of these practices is to describe the calibration and verification procedures required to maintain these instruments in calibration and ensure that the optical setup is within specification for satisfactory measurements.

1.2 It is mandatory throughout these practices that both verification and calibration are carried out by qualified personnel who fully understand the concepts used in measurements of stress retardation and are experienced in the practices of measuring procedures described in Test Methods F218, C148, and C978.

1.3 The values stated in SI units are to be regarded as standard. No other units of measurement are included in this standard.

2. Referenced Documents

2.1 *ASTM Standards:*[2]

C148 Test Methods for Polariscopic Examination of Glass Containers

C162 Terminology of Glass and Glass Products

C770 Test Method for Measurement of Glass Stress—Optical Coefficient

C978 Test Method for Photoelastic Determination of Residual Stress in a Transparent Glass Matrix Using a Polarizing Microscope and Optical Retardation Compensation Procedures

F218 Test Method for Measuring Optical Retardation and Analyzing Stress in Glass

3. Terminology

3.1 For definitions of terms used in these practices, see Terminology C162.

4. Principles of Verification and Calibration Procedures

4.1 Verification and calibration of polarimeters are accomplished using the following procedures:

4.1.1 *Procedure A: (Verification)*—Measure individual components and their orientation to ensure that the requirements of Test Methods F218, C148, and C978 are satisfied.

4.1.2 *Procedure B: (Calibration)*—Determine the accuracy of the polarimeter using a calibrated gage or retarder.

5. Auxiliary Component Requirements

5.1 The following are required to verify and calibrate a polarimeter:

5.1.1 *Verification of Components (Procedure A):*

5.1.1.1 *Verification of Polarization Efficiency,* a light-intensity meter, linear over the range of measured values.

5.1.1.2 *Verification of Quarter-Wave Plate,* a Babinet compensator equipped polarimeter, with a monochromatic light source of traceable wavelength.

5.1.1.3 *Reference Polarizer with Known Axis.*

5.1.2 *Calibration of Polarimeter (Procedure B):*

5.1.2.1 Procedure B requires a gage with a calibrated, known retardation. The calibrated gage must have sufficient retardation to calibrate the instrument within its intended use range. For example, a polariscope/polarimeter used in Test Methods C148 should be calibrated using a gage exhibiting a retardation range of from 0 to 227 nm (0 to 10 temper grade).

5.1.2.2 Alternately, a rectangular cross-section specimen prepared from an SRM glass having a known stress-optical constant, subjected to uniaxial compression in a calibrated testing machine, may be used instead of a calibrated gage with known retardation.

6. Verification and Calibration Procedures

6.1 *Procedure A—Verification and Aligning of Components:*

6.1.1 *Verification of Polarization Efficiency*—Using a light-intensity meter, measure the light intensity, with polarizers crossed, I_c (dark field) and then with polarizers parallel, I_p. Calculate the polarization efficiency, E, as follows:

$$E = \frac{(I_p - I_c)}{I_p} \quad (1)$$

[1] These practices are under the jurisdiction of ASTM Committee C14 on Glass and Glass Productsand are the direct responsibility of Subcommittee C14.04 on Physical and Mechanical Properties.

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[2] For referenced ASTM standards, visit the ASTM website, www.astm.org, or contact ASTM Customer Service at service@astm.org. For *Annual Book of ASTM Standards* volume information, refer to the standard's Document Summary page on the ASTM website.