



Standard Test Method for Measuring Optical Distortion in Flat Glass Products Using Digital Photography of Grids¹

This standard is issued under the fixed designation C1652/C1652M; the number immediately following the designation indicates the year of original adoption or, in the case of revision, the year of last revision. A number in parentheses indicates the year of last reappraisal. A superscript epsilon (ϵ) indicates an editorial change since the last revision or reappraisal.

INTRODUCTION

Transmitted and reflected distortion in annealed, heat strengthened, and tempered glass can be measured by several methods. **(1, 2, 3, 4)**² Qualitative methods are based on the observation of waviness in the glass as viewed in of reflected or transmitted images in a set of equidistant lines, called Zebra Lines. Quantitative measuring techniques are based on several methods, some of which are:

- (1) Measuring local curvature using mechanical radius gages (**(1, 5, 6, and Test Method C1651)**)
- (2) Moiré Fringe analysis **(7, 8)**
- (3) Double exposure of transmitted grid images (Practice **F733**)
- (4) Projection of an array of round dots **(9)**
- (5) Dual laser beams **(10)**

The user should be familiar with techniques that are available so as to select the most suitable after considering the precision, speed, and test specification requirements. The test method described in this document uses a digital camera to capture a transmitted or reflected image of a set of equidistant lines. Changes in the spacing of lines are used to quantifying the distortion.

1. Scope

1.1 This test method covers the determination of optical distortion of heat-strengthened and fully tempered architectural glass substrates which have been processed in a heat controlled continuous or oscillating conveyance oven. See Specifications **C1036** and **C1048** for discussion of the characteristics of glass so processed. In this test method the reflected image of processed glass is photographed and the photographic image analyzed to quantify the distortion due to surface waviness. The test method is also useful to quantify optical distortion observed in transmitted light in laminated glass assemblies.

1.2 The values stated in either SI units or inch-pound units are regarded separately as standard. The values stated in each system may not be exact equivalents; therefore, each system shall be used independently of the other. Combining values from the two systems may result in nonconformance with the standard.

¹ This test method is under the jurisdiction of ASTM Committee **C14** on Glass and Glass Products and is the direct responsibility of Subcommittee **C14.11** on Optical Properties.

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² The boldface numbers in parentheses refer to a list of references at the end of this standard.

1.3 There is no known ISO equivalent to this standard.

1.4 *This standard does not purport to address all of the safety concerns, if any, associated with its use. It is the responsibility of the user of this standard to establish appropriate safety and health practices and determine the applicability of regulatory limitations prior to use.*

2. Referenced Documents

2.1 *ASTM Standards:*³

C162 Terminology of Glass and Glass Products

C1036 Specification for Flat Glass

C1048 Specification for Heat-Strengthened and Fully Tempered Flat Glass

C1651 Test Method for Measurement of Roll Wave Optical Distortion in Heat-Treated Flat Glass

F733 Practice for Optical Distortion and Deviation of Transparent Parts Using the Double-Exposure Method

2.2 *Other Standards:*

U.S. Patent 7 345 698 Optical System for Imaging Distortions in Moving Reflective Sheets (2003)

³ 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.