



Designation: E 671 – 98

Standard Specification for Maximum Permissible Thermal Residual Stress in Annealed Glass Laboratory Apparatus¹

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1. Scope

1.1 This specification establishes a limit for thermal residual stress in reusable annealed glass laboratory apparatus as determined by prescribed photoelastic measurement procedures.

1.2 In broad classification, the laboratory glassware items covered by this specification, but not limited to, are:

beakers	Imhoff cones
bottles, aspirator	impingers
bottles, dropping	jars, battery
bottles, gas washing	jars, bell
bottles, infusion	jars, chromatography
bottles, milk test	jars, cylindrical
bottles, reagent	joints, ball and socket or standard taper
bottles, weighing	manometers
bulbs, absorption	percolators
bulbs, leveling	pycnometers
bulbs, sampling	stopcocks
burets	tubes, centrifuge
condensers	tubes, chromatography
crystallizing dishes	tubes, color comparison (turbidity)
culture dishes	tubes, combustion (ignition)
custom apparatus	tubes, connecting and adapter
cylinders, graduated	tubes, digestion
and plain	tubes, drying
desiccators	tubes, fermentation
extraction tubes	tubes, thistle (spray traps)
flasks	vapor traps
fritted ware	viscometers
funnels	watch glasses
generators, Kipp	
grinder, tissue	

1.3 This specification recognizes that photoelastic measurements are proportional to the difference of the principal stresses. The limit imposed represents a safety factor to cover a situation in which one of the principal stresses may be larger than the apparent stress.

1.4 This specification applies only to annealed glassware that is intended for sale as such. It excludes glassware that has been thermally tempered, ion-exchanged, or laminated with glass layers of differing expansion. The intent of this specification is to limit the residual stresses for safe consumer use in annealed glass, as it leaves the manufacturer.

1.5 Stresses introduced by thermal expansion differences within the glassware are covered by this specification. Graded and glass-to-metal seals are excluded.

2. Referenced Document

2.1 *ASTM Standards:*

E 1157 Specification for Sampling and Testing of Reusable Laboratory Glassware²

E 1273 Specification for Color Coding of Reusable Laboratory Pipets²

F 218 Method for Analyzing Stress in Glass³

3. Stress Limit

3.1 The stress as measured by the procedure in Section 4 and calculated by Eq 2 shall not exceed 5.2 MPa (750 psi), except for combustion, centrifuge, and chromatography tubes, for which a limit of 4.5 MPa (650 psi) applies. Ware exceeding these limits shall be rejected or reannealed to meet the specification.

4. Measurement Procedure

4.1 Using a Friedel (Senarmont) polarimeter as described in Method F 218, place the glass article to be measured in the viewing field in air. Examine every part of the article with a definable light path (glass dimension) by rotating the analyzer to compensate for local stress birefringence. Document those zones showing the higher values for the retardation or thickness ratios by recording analyzer angle, glass thickness (light path), and position in ware.

4.2 In some orientations, such as sighting perpendicular to the axis of a thin-walled cylinder, two glass paths must be included in the measurement. If by rotating the cylinder, the retardation appears to be relatively constant, the measurement is straightforward and the two walls define the light path. If the retardation is variable, the scheme shown in Fig. 1 is recommended. If an adjacent region is found with low or constant retardation, or both, measure this retardation at normal incidence. Then use the recommended (slant) path shown which includes one wall of the adjacent region and one wall of the region in question. The retardation that applies in this case is

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² *Annual Book of ASTM Standards*, Vol 14.04.

³ *Annual Book of ASTM Standards*, Vol 15.02.