Designation: ~~F733 – 09~~ F733 – 09 (Reapproved 2014)

Standard Practice for Optical Distortion and Deviation of Transparent Parts Using the Double-Exposure Method[1]

This standard is issued under the fixed designation F733; 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 reapproval. A superscript epsilon (ε) indicates an editorial change since the last revision or reapproval.

1. Scope

1.1 This photographic practice determines the optical distortion and deviation of a line of sight through a simple transparent part, such as a commercial aircraft windshield or a cabin window. This practice applies to essentially flat or nearly flat parts and may not be suitable for highly curved materials.

1.2 Test Method F801 addresses optical deviation (angluar deviation) and Test Method F2156 addresses optical distortion using grid line slope. These test methods should be used instead of Practice F733 whenever practical.

1.3 *This standard does not purport to address the safety concerns 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:*

F801 Test Method for Measuring Optical Angular Deviation of Transparent Parts

F2156 Test Method for Measuring Optical Distortion in Transparent Parts Using Grid Line Slope

3. Terminology

3.1 *Definitions:*

3.1.1 *deviation*—the displacement of a line or object when viewed through the transparent part. Expressed as the angular measurement of the displaced line, for example, milliradians of angle.

3.1.2 *distortion*—the rate of change of deviation resulting from an irregularity in a transparent part.

3.1.3 Expressed as the angular bending of the light ray per unit of length of the part, for example, milliradians per centimetre.

3.1.4 May also be expressed as the slope of the angle of localized grid line bending, for example, 1 in 5 (see Fig. 1).

3.1.5 *installed angle*—the part attitude as installed in the aircraft. Defined by the angle between a horizontal line and the plane of the part, and the angle of sweep back from a horizontal line normal to the center line of the aircraft. See Fig. 2 for an example.

4. Summary of Practice

4.1 The transparent part is placed a given distance from a grid line pattern. A camera is placed so as to photograph the grid pattern as viewed through the part. The photograph is then examined and optical distortion or deviation is measured.

5. Significance and Use

5.1 Transparent parts, such as aircraft windshields and windows, can be inspected using this practice, and the amount of optical distortion or deviation can be measured. The measurement can be checked for acceptability against the specification for the part. The photograph (digital file, print or negative) can be maintained as a permanent record of the optical quality of the part.

6. Apparatus

6.1 *Test Room*—The test room must be large enough to properly locate the required testing equipment.

6.1.1 Method A requires a room approximately 12 m (40 ft) long.

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[1] This practice is under the jurisdiction of ASTM Committee F07 on Aerospace and Aircraft and is the direct responsibility of Subcommittee F07.08 on Transparent Enclosures and Materials.

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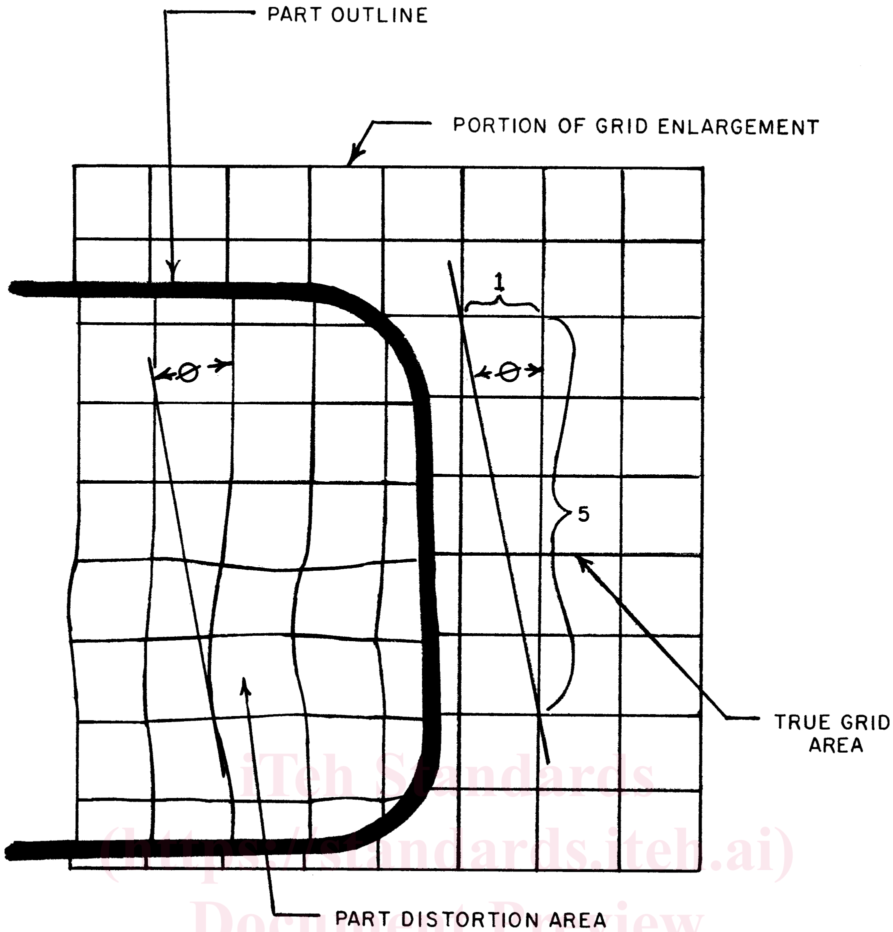

FIG. 1 Optical Distortion Represented by Tangent

6.1.2 Method B requires a room approximately 7 m (23 ft) long.

6.1.3 The walls, ceiling, and floor shall have low reflectance. A flat black paint or coating is preferred.

6.2 *Grid Board*—The grid board provides a defined pattern against which the transparent part is examined. Grid boards are of the following types.

6.2.1 *Type 1*—The grid board is composed of white strings held taut, each spaced at a specific interval, with the strings stretched vertically and horizontally. The grid board frame and background shall have a flat black finish to reduce light reflection. A bank of fluorescent lights at each side provides illumination of the strings.

6.2.2 *Type 2*—The grid board is a transparent sheet having an opaque, flat black outer surface except for the grid lines. The grid lines are left transparent, and when lighted from behind with fluorescent lights, provide a bright grid pattern with excellent photographic characteristics.

TABLE 1 Optical Inspection Distances

Method A	
Camera-to-grid-board distance	1000 cm (32 ft 10 in.)
Camera-to-part distance	550 cm (18 ft 1 in.)
Part-to-grid board distance	450 cm (14 ft 9 in.)
Method B	
Camera-to-grid-board distance	450 cm (14 ft 9 in.)
Camera-to-part distance	150 cm (4 ft 11 in.)
Part-to-grid-board distance	300 cm (9 ft 10 in.)

6.2.3 *Type 3*—The grid board is a rigid sheet of material which has a grid pattern printed on the front surface. Details of the grid lines, pattern, and lighting shall be as specified by the procuring activity.

6.2.4 The grid board shall have a width and height large enough so that the area of the part to be photographed can be superimposed within the perimeter of the grid board. Details of the grid square size shall be as specified by the procuring activity, but grids shall not have a line spacing less than 1.27 cm (½ in.), or more than 2.54 cm (1 in.).