Designation: F 1181 – 96

Standard Test Method for Measuring Binocular Disparity in Transparent Parts[1]

This standard is issued under the fixed designation F 1181; 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 test method determines the amount of binocular disparity that is induced by transparent parts such as aircraft windscreens, canopies, HUD combining glasses, visors or goggles. This test method may be applied to parts of any size, shape or thickness, individually or in combination, so as to determine the contribution of each transparent part to the overall binocular disparity present in the total "viewing system" being used by a human operator.

1.2 This test method represents one of several techniques that are available for measuring binocular disparity, but is the only technique that yields a quantitative figure of merit that can be related to operator visual performance.

1.3 This test method employs apparatus currently being used in the measurement of optical angular deviation under Method F 801.

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.*

1.5 The values stated in *inch-pound* units are the preferred units. The values in parentheses are for information only.

2. Referenced Documents

2.1 *ASTM Standards:*

F 801 Test Method for Measuring Optical Angular Deviation of Transparent Parts[2]

3. Terminology

3.1 *Definitions:*

3.1.1 *angular deviation*—the angular displacement of a light ray as it passes through a transparent part, expressed as an angular measurement, for example, degree, minutes of arc, milliradians. Since it is an angular measurement, the amount of displacement increases with distance.

3.1.2 *binocular disparity*—the difference between the two images on the retina resulting from the lateral separation between the two eyes when viewing an object at a fixation point or due to the fact that an object is either nearer or farther than the fixation point. A certain amount of disparity is beneficial and natural, leading to the perception of depth. However, when the disparity exceeds the limits for binocular fusion, doubling of vision, eye fatigue, and headaches occur as the eyes strain to merge the disparate images.

3.1.3 *diplopia*—the doubling of images of an object due to the fact that the object is either nearer or farther than the point of fixation or due to the fact that the lines of regard of the eyes do not intersect at the point of fixation.

3.1.4 *Panum's area*—the area on the retina in which the eyes are able to fuse disparate images so that single vision occurs.

4. Summary of Test Method

4.1 Using an optoelectronic system (consisting of a transmitter and a receiver) and with the part held in its installed angle, two sets of angular deviation measurements are made at several intervals (for example, 2°) in both azimuth and elevation. The extent of the area to be measured is dependent on the type of part being measured, for example, windscreen, visor, etc. The first set of measures is taken from the left eye position, the second from the right eye position. The separation between the two eye positions is 2.5 in. (6.35 cm), a distance equivalent to the interpupillary distance between the human eyes. The measurements taken from the left eye position are subtracted from that taken from the right eye position to determine binocular disparity.

5. Significance of Use

5.1 Diplopia or doubling of vision occurs when there is sufficient binocular disparity present so that the bounds of Panum's area (the area of single vision) is exceeded. This condition arises whenever one object is significantly closer (or farther) than another so that looking at one will cause the image of the other to appear double. This can be easily demonstrated: Close one eye and look at a clock (or other object) on a distant wall. Now place your thumb to one side of the image of the clock. Now open both eyes. If you look at the clock, you should see two thumbs. If you look at your thumb, you should see two clocks.

5.2 Complaints from pilots flying aircraft equipped with wide field of view HUDs such as the LANTIRN HUD indicated that they were experiencing discomfort (eye fatigue,

[1] This test method is under the jurisdiction of ASTM Committee F-7 on Aerospace and Aircraft and is the direct responsibility of Subcommittee F07.08 on Transparent Enclosures and Materials.

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[2] *Annual Book of ASTM Standards*, Vol 15.03.