



Designation: **F1252 – 10 F1252 – 16**

Standard Test Method for Measuring Optical Reflectivity of Transparent Materials¹

This standard is issued under the fixed designation F1252; 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.

1. Scope

1.1 This test method covers a procedure for measuring the reflectivity of transparent materials, hereafter known as specimens. The results are repeatable without specifying a particular brand name of instrumentation.

1.2 This test method applies to substantially flat parts. Errors in measurement can occur if the parts being measured are not substantially flat.

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

2.1 Definitions:

2.1.1 *angle of incidence* (Θ_i), *n*—in the plane of the light source, specimen, and photometer, the angle of incidence is the angle between the incident light ray and the normal to the surface (see Fig. 1).

2.1.2 *angle of reflection* (Θ_r), *n*—in the plane of the light source, specimen, and photometer, the angle of reflection is the angle between the reflected light ray and the normal to the surface (see Fig. 1).

2.1.3 *light source*—*source, n*—unless otherwise specified, the National Institute of Standards and Technology (NIST) diffused nonpolarized Standard Illuminance A or C light source shall be used. The light source size ~~will~~shall be such that there ~~will~~shall be sufficient overlap of the front and rear images on the specimen to overfill the measurement field size of the photometer. This ~~overlap is measurement field size, and front and back reflected image overlap, are illustrated in Fig. 2.~~ (As angle of incidence and specimen thickness increase, the two images will diverge.) The light source used ~~should~~shall be specified and reported as part of the test results.

2.1.4 *measurement field size*—*size, n*—the angular extent, in degrees, ~~degrees~~ or arc minutes, of the measurement aperture of the photometer.

2.1.5 *photometer*—*photometer, n*—any commercial photometer or photopic filtered radiometer with a suitable measurement field size (1° or smaller is recommended). A model with a viewfinder is recommended.

2.1.6 *pivot point*—*point, n*—the point in space at which the incident light ray and reflected light ray are to intersect (see Fig. 1).

2.1.7 *reflectivity*—*reflectivity, adj*—the reflectivity of a transparent specimen is defined as the ratio of the luminance of the reflected image of a light source to the luminance of the light source. The reflectivity will depend upon several factors: the angle at which the reflected light is measured, the thickness, surface quality, and type of material of the specimen, whether the specimen is coated, the spectral distribution of the light source, and the spectral sensitivity of the measurement device. The reflectivity, as defined here, includes the small amount of scattered light that contributes to the luminance of the reflected image.

3. Summary of Test Method

3.1 The luminance of the standard source is determined by measuring it directly with the photometer. The luminance of the reflection of the ~~source~~source, from both the front and back surfaces of the specimen, is then measured off the specimen at a specified geometry. The luminance of the reflection is divided by the luminance of the source to obtain the reflectivity of the specimen.

¹ This test method 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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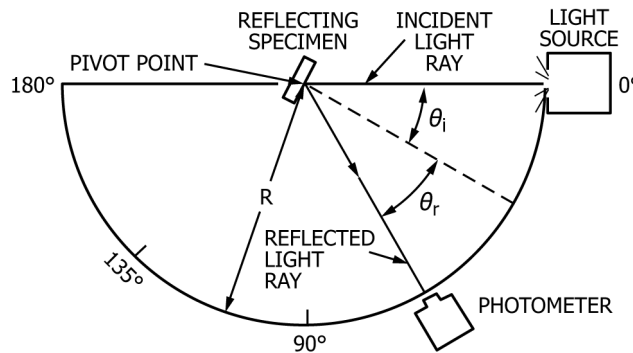


FIG. 1 Apparatus Set-Up

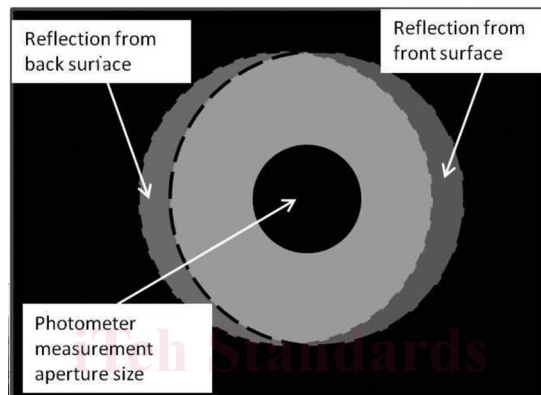


FIG. 2 Photometer Field-of-View Measurement Field Size (Aperture) Compared to Specimen Front and Back Surface Reflections

4. Significance and Use

4.1 Reflections from aircraft transparencies of instrument lights and other cockpit objects have been a concern to many pilots. Attempts to reduce these reflections have been hampered by the lack of a repeatable measurement method and variances in reflection measuring instrumentation. ~~The problem with measuring instrumentation is that different brands will often give significant value differences using the same specimen surface.~~

4.2 This test method reduces the instrument variations by standardizing the light source, calculation method, and area of specimen surface being measured; a brand of instrumentation is not specified. Since the reflectivity is defined as the ratio of two luminance measurements and does not depend on an absolute measurement, dependence upon the accuracy of the calibration of the measuring instrument is reduced.

4.3 The test method may be used to objectively compare the reflection characteristics of various transparent materials. Furthermore, the test method may be used to evaluate reflections of a specified spectral source-distribution light source (for example, a monochromatic light-emitting diode) by using that source in place of the standard light source.

4.4 Provisions are made to check for polarization effects of the sample and to record the reflectivity of a standard specimen. These provisions are offered as an option to the tester; it is up to the user or the requiring agency to determine the significance and use of these data.

4.5 Since the reflections are measured photopically, the results are representative of what the pilot would visually perceive.

5. Apparatus and Setup

5.1 The apparatus shall be set up as shown in Fig. 1.

5.2 The angle of incidence θ_i shall be determined by the user or requiring agency. Since $\theta_i = \theta_r$, the total angle of reflection $\Theta = 2\theta_i = 2\theta_r$. θ_i and θ_r shall be accurate to within $\pm 0.5^\circ$, hence Θ shall be accurate to within $\pm 1^\circ$.

5.3 The distance from the light source to the specimen and from the specimen to the photometer is not critical. However, it is desirable to position the light source relatively far from the sample (for example, 50 cm or more) to minimize the effects of scattered light from the specimen contaminating the reflectivity measurement. The light source to specimen distance must be such that the reflected image viewed through the photometer is sufficiently large to overfill the photometer measurement field (see 2.1.3 and Fig. 2). The distance from the specimen to the photometer must be short enough to ensure the reflected images overfill the measurement aperture but long enough to ensure the photometer can focus on the image.