Designation: F 1863 – 98

Standard Test Method for Measuring the Night Vision Goggle-Weighted Transmissivity of Transparent Parts[1]

This standard is issued under the fixed designation F 1863; 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.

INTRODUCTION

Test Methods D 1003 and F 1316 apply to the transmissivity measurement of transparent materials, the former being for small flat samples, and the latter for larger, curved pieces such as aircraft transparencies. Additionally, in D 1003, the transmissivity is measured perpendicular to the surface of test sample and both test methods measure only in the visible light spectral region. Night vision goggles (NVGs) are being used in aircraft and other applications (for example, marine navigation, driving) with increasing frequency. These devices amplify both visible and near-infrared (NIR) spectral energy. Overall visual performance can be degraded if the observer uses the NVGs while looking through a transparency that has poor transmissivity in the visible and NIR spectral regions. This test method describes both direct and analytical measurement techniques that determine the NVG-weighted transmissivity of transparent pieces including ones that are large, curved, or held at the installed position.

1. Scope

1.1 This test method covers apparatuses and procedures that are suitable for measuring the NVG-weighted transmissivity of transparent parts including those that are large, thick, curved, or already installed. This test method is sensitive to transparencies that vary in transmissivity as a function of wavelength.

1.2 Since the transmissivity (or transmission coefficient) is a ratio of two radiance values, it has no units. The units of radiance recorded in the intermediate steps of this test method are not critical; any recognized units of radiance (for example, watts/m^2-str) may be used, as long as it is consistent.[2]

1.3 *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:*

D 1003 Test Method for Haze and Luminous Transmittance of Transparent Plastics[3]

E 177 Practice for Use of the Terms Precision and Bias in ASTM Test Methods[4]

E 691 Practice for Conducting an Interlaboratory Study to Determine the Precision of a Test Method[4]

F 1316 Test Method for Measuring the Transmissivity of Transparent Parts[5]

3. Terminology

3.1 *Definitions:*

3.1.1 *analytical test method*, *n*—the test method that uses spectral transmissivity data of a transparent part collected by the use of either spectraphotometric or spectraradiometric instrumentation. The data are then examined using analytic methods to determine the NVG-weighted transmissivity of the part.

3.1.2 *direct test method*, *n*—the test method that uses the actual luminous output, as measured by a photometer, properly coupled to the eyepiece of the test NVG. The NVG-weighted transmissivity of the part is then determined by forming the

[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] *RCA Electro-Optics Handbook*, RCA/Solid State Division/Electro Optics and Devices. Technical Series EOH-11. Lancaster, PA; 1974.

[3] *Annual Book of ASTM Standards*, Vol 08.01.

[4] *Annual Book of ASTM Standards*, Vol 14.02.

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

ratio of the NVG output luminance with the transparent part in place to the luminance output without the part.

3.1.3 *NVG-weighted spectral transmissivity*, *n*—the spectral transmissivity of a transparent part multiplied by the spectral sensitivity of a given NVG (see Fig. 1).

3.1.4 *NVG-weighted transmissivity* (T_{NVG}), *n*—the spectral transmissivity of a transparent part multiplied by the spectral sensitivity of a given NVG integrated with respect to wavelength (see Fig. 1, Eq 1 and Eq 2).

3.1.5 *NVG spectral sensitivity*, *n*—the sensitivity of an NVG as a function of input wavelength.

3.1.6 *photometer*, *n*—a device that measures luminous intensity or brightness by converting (weighting) the radiant intensity of an object using the relative sensitivity of the human visual system as defined by the photopic curve.[2,5]

3.1.7 *photopic curve*, *n*—the photopic curve is the spectral sensitivity of the human eye for daytime conditions as defined by the *Commission Internationale d'Eclairage* (CIE) 1931 standard observer.[2,6]

3.1.8 *transmission coefficient*, *n*—see *transmissivity*.

3.1.9 *transmissivity*, *n*—the transmissivity of a transparent medium is the ratio of the luminance of an object measured through the medium to the luminance of the same object measured directly.

4. Summary of Test Method

4.1 *General Test Conditions*—The test method can be performed in any light-controlled area (for example, light-tight room, darkened hangar, or outside at night away from strong light sources). The ambient illumination must be very low because of the extreme sensitivity of the NVGs. A fixture holds the NVG and its objective lens is aimed at and focused on a target. The target can be either an evenly illuminated white, diffusely reflecting surface or a transilluminated screen (lightbox). The illumination is provided by a white, incandescent light source. Handle the samples carefully as not to cause any damage. Do not clean them with any solvents. Use part-specific, prescribed cleaning materials and methods.

4.1.1 *Direct Test Method*—Attached directly to the eyepiece of the NVG is a photodetector. It has been found that the measured field of view (FOV) should be smaller than the uniformly illuminated portion of the target. The target illumination is adjusted so that the output of the NVGs is about 1.7 cd/m^2 (0.5 fL). This ensures that the NVG input is not saturated; the automatic gain control (AGC) is not active. The luminance output of the NVG is measured and then repeated with the transparent material in place. The transmissivity is equal to the NVG output luminance with the transparent material in place divided by the NVG output luminance without the material (see Eq 1). The result is the NVG-weighted transmissivity (T_{NVG}) of the transparent material.

4.1.2 *Analytical Test Method*—Without the sample in place, measure the light source's spectral energy distribution from 450 through 950 nm in 5-nm incremental steps. Place the sample into the spectrophotometer or spectraradiometer fixture. Perform spectral measurements, also from 450 through 950 nm in 5-nm incremental steps. Obtain from the NVG manufacturer the spectral sensitivity of the goggle that will be used in conjunction with the part. Perform the analytic method as defined in Eq 2 to derive the T_{NVG}.

[6] Wyszecki, Gunter, and Stiles, WS, *Color Science: Concepts and Methods, Quantitative Data and Formulae,* 2nd ed., New York, John Wiley and Sons, 1982.

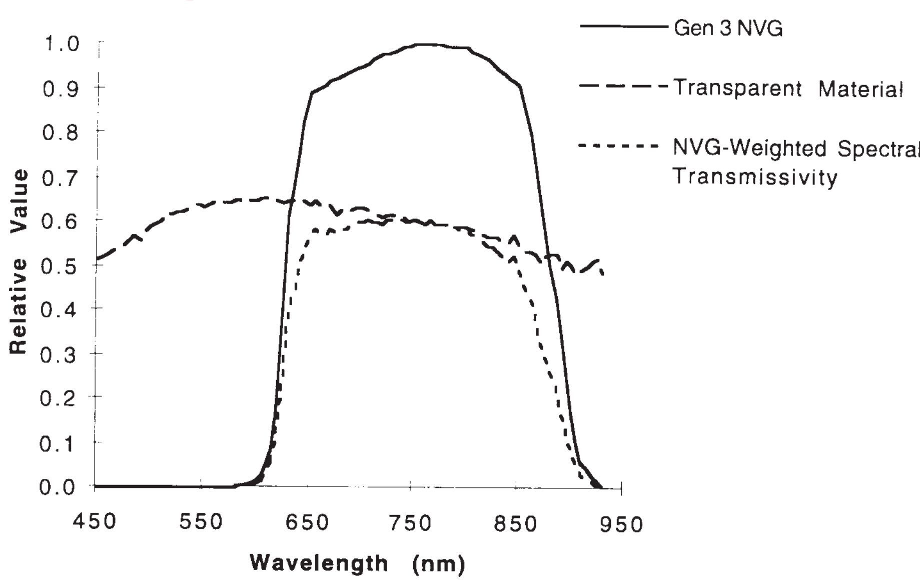

FIG. 1 An Example of How the Spectral Sensitivity of a Generation 3 NVG Multiplied by the Spectral Transmissivity of a Transparent Part Equals the NVG-Weighted Spectral Transmissivity of That Part. Integrating the Curve with Respect to Wavelength Yields the Part's NVG-Weighted Transmissivity (T_{NVG}) Value