



Designation: E1311 – 89 (Reapproved 2004)

# Standard Test Method for Minimum Detectable Temperature Difference for Thermal Imaging Systems<sup>1</sup>

This standard is issued under the fixed designation E1311; 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 ( $\epsilon$ ) indicates an editorial change since the last revision or reapproval.

## 1. Scope

1.1 This test method covers the determination of the minimum detectable temperature difference (MDTD) capability of a compound observer-thermal imaging system as a function of the angle subtended by the target.

1.2 *This standard does not purport to address all of the safety problems, 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:*<sup>2</sup>

E1316 Terminology for Nondestructive Examinations

## 3. Terminology

3.1 *Definitions:*

3.1.1 *differential blackbody*—an apparatus for establishing two parallel isothermal planar zones of different temperatures, and with effective emissivities of 1.0.

3.1.2 *field of view (FOV)*—the shape and angular dimensions of the cone or the pyramid that define the object space imaged by the system; for example, rectangular, 4-deg wide by 3-deg high.

3.1.2.1 *Discussion*—The size of the field of view is customarily expressed in units of degrees.

3.1.3 See also Terminology E1316.

## 4. Summary of Test Method

4.1 A standard circular target is used in conjunction with a differential blackbody that can establish one blackbody isothermal temperature for the target and another blackbody isothermal temperature for the background by which the target is

framed. The target, at an undisclosed orientation, is imaged onto the monochrome video monitor of a thermal imaging system whence the image may be viewed by an observer. The temperature difference between the target and the background, initially zero, is increased incrementally until the observer, in a limited duration, can just distinguish the target. This critical temperature difference is the MDTD.

NOTE 1—Observers must have good eyesight and be familiar with viewing thermal imagery.

4.2 The temperature distributions of each target and its background are measured remotely at the critical temperature difference that defines the MDTD.

4.3 The background temperature and the angular subtense for each target are specified together with the measured value of MDTD. The (fixed) field of view included by the background is also specified.

4.4 The probability of detection is specified together with the reported value of MDTD.

## 5. Significance and Use

5.1 This test method gives a measure of a thermal imaging system's effectiveness for detecting a small spot within a large background. Thus, it relates to the detection of small material defects such as voids, pits, cracks, inclusions, and occlusions.

5.2 MDTD values provide estimates of detection capability that may be used to compare one system with another. (Lower MDTD values indicate better detection capability.)

NOTE 2—Test values obtained under idealized laboratory conditions may or may not correlate directly with service performance.

## 6. Apparatus

6.1 The apparatus consists of the following:

6.1.1 *Target Plates*, containing single or multiple circular targets of area(s) not greater than 5 % of the combined areas of target and background (that is, FOV area), and with the distance from the center of the target to the center of the FOV equal to one third of the height or the diameter of the FOV. See Fig. 1.

NOTE 3—A target plate may be fabricated by cutting one or more circular apertures in a metal plate of high thermal conductivity, such as aluminum, and coating with black paint of emissivity greater than 0.95. In

<sup>1</sup> This test method is under the jurisdiction of ASTM Committee E07 on Nondestructive Testing and is the direct responsibility of Subcommittee E07.10 on Emerging NDT Methods.

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<sup>2</sup> For referenced ASTM standards, visit the ASTM website, www.astm.org, or contact ASTM Customer Service at service@astm.org. For *Annual Book of ASTM Standards* volume information, refer to the standard's Document Summary page on the ASTM website.