Designation: E 1862 – 97 (Reapproved 2002)ε1

Standard Test Methods for Measuring and Compensating for Reflected Temperature Using Infrared Imaging Radiometers[1]

This standard is issued under the fixed designation E 1862; 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.

ε[1] NOTE—Removed Footnote 2 in September 2002 since the organization is no longer in business.

1. Scope

1.1 These test methods cover procedures for measuring and compensating for reflected temperature when measuring the surface temperature of a specimen with an infrared imaging radiometer.

1.2 These test methods may involve use of equipment and materials in the presence of heated or electrically energized equipment, or both.

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:*

E 1316 Terminology for Nondestructive Examinations[2]

3. Terminology

3.1 *Definitions:*

3.1.1 *diffuse reflector, n*—a surface that produces a diffuse image of a reflected source.

3.1.2 *infrared thermographer, n*—the person using an infrared imaging radiometer.

3.1.3 *infrared reflector, n*—a material with a reflectance as close as possible to 1.00.

3.1.4 *reflected temperature, n*—the temperature of the energy incident upon and reflected from the measurement surface of a specimen.

3.1.5 *specular reflector, n*—a surface that produces a direct image of a reflected source.

3.2 See also Terminology E 1316.

4. Summary of Test Methods

4.1 Two test methods are given for measuring the reflected temperature of a specimen, the Reflector Method and the Direct Method.

4.2 A test method is also given for compensating for the error produced by reflected temperature using the computer built into an infrared imaging radiometer.

5. Significance and Use

5.1 The infrared energy that is reflected by a specimen can cause measurement errors for an infrared thermographer measuring its surface temperature. Two test methods are provided for measuring and compensating for this reflected temperature error source, the Reflector Method and the Direct Method.

5.2 These test methods can be used in the field or laboratory using commonly available materials.

5.3 These test methods can be used with any infrared radiometers that have the required computer capabilities.

6. Interferences

6.1 *Reflector Method*:

6.1.1 This test method uses an infrared reflector with an assumed reflectance of 1.00, which is an ideal property. Errors can be minimized by using a reflector having a reflectance as close as possible to 1.00.

6.1.2 Specimens vary in that they can be diffuse or spectral reflectors, or both. Use of an infrared reflector with reflectance properties as close as possible to those of the specimen will reduce errors.

6.2 *Direct Method*:

6.2.1 The Direct Method usually does not account for the heat from the infrared thermographer's body as a source of reflected temperature. If this heat source creates a significant error, use the Reflector Method.

[1] These test methods are under the jurisdiction of ASTM Committee E07 on Nondestructive Testing and are the direct responsibility of Subcommittee E07.10 on Emerging NDT Methods.

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[2] *Annual Book of ASTM Standards*, Vol 03.03.

6.3 Reflected temperature errors produced by a point source, such as the sun or a lamp, are difficult to measure accurately. These error sources can often be avoided by moving the infrared imaging radiometer's position and angle relative to the specimen.

6.4 The measured reflected temperature of a specimen may be specific to the waveband of the infrared imaging radiometer used. Therefore, the infrared imaging radiometer's waveband should be noted with the measured value.

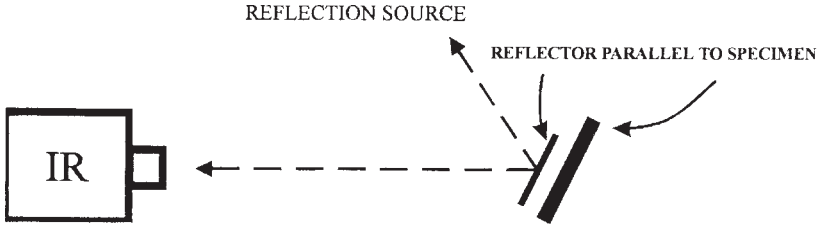


FIG. 1 Reflector Method

6.5 The significance of the error contributed by reflected temperature can be estimated by shielding the specimen from various angles and observing any changes in the thermal image.

6.6 The error caused by reflected temperature can be reduced by shielding the specimen from the source of the reflection.

7. Apparatus

7.1 *Calibrated Infrared Imaging Radiometer*, with a built-in computer with the capability to measure temperatures with the computer's emissivity control set to 1.00.

7.2 *Tripod*, or device to support the infrared imaging radiometer.

7.3 *Infrared Reflector*—The reflector method also requires an infrared reflector made from a piece of metal whose reflectance is as close as possible to 1.00. Examples are a crumpled and re-flattened piece of aluminum foil placed shiny side up on a piece of cardboard, or a flat piece of metal with diffuse or spectral reflection characteristics, or both, similar to those of the specimen.

8. Procedure

8.1 *Reflector Method*:

8.1.1 Set the infrared imaging radiometer's emissivity control to 1.00.

8.1.2 Place the infrared imaging radiometer on the tripod or support device at the desired location and distance from the specimen.

8.1.3 Point the infrared imaging radiometer at the specimen and focus on the portion of the specimen where the reflected temperature is to be measured.

8.1.4 Place the infrared reflector in front of, and parallel to, the specimen (see Fig. 1). Maintain a safe working distance from any heated, electrically energized or otherwise potentially dangerous targets.

8.1.5 Without moving the imager and using an appropriate measurement function (such as spot temperature, cross hairs or isotherms), measure and record the apparent surface temperature of the reflector reported by the radiometer's computer. This is the reflected temperature of this specimen when viewed from the position indicated in 8.1.2.

8.1.6 Repeat 8.1.1-8.1.5 a minimum of three times and average the temperatures to yield an average reflected temperature.

8.2 *Direct Method*:

8.2.1 Set the infrared imaging radiometer's emissivity control to 1.00.

8.2.2 Place the infrared imaging radiometer on the tripod or support device at the desired location and distance from the specimen.

8.2.3 Point the infrared imaging radiometer at the specimen and focus on the portion where the reflected temperature is to be measured.

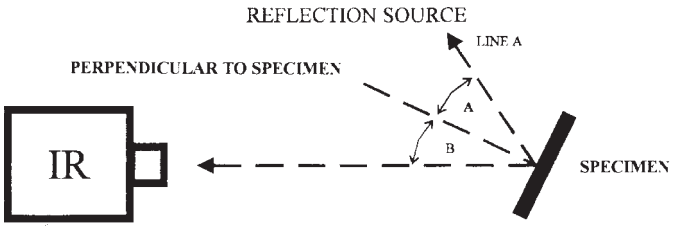
8.2.4 Estimate or measure the angle of reflection and the angle of incidence when viewing the specimen with the infrared imaging radiometer from this location (see Fig. 2).

8.2.5 Remove the infrared imaging radiometer from the tripod and position it so that it is pointing away from the specimen and in the same direction as the angle of reflection (see Fig. 3, Line A). Using an appropriate measurement function (such as spot temperature, cross hairs or isotherms), measure and record the apparent temperature reported by the radiometer's computer. This is the reflected temperature of this specimen when viewed from the position indicated in 8.2.2.

8.2.6 If the specimen surface is a diffuse reflector, point the radiometer at a variety of locations within 45° of both sides of the angle of incidence and average the reported temperatures. This average is the reflected temperature of the specimen when viewing the specimen from the position indicated in 8.2.2.

8.2.7 Repeat 8.2.1-8.2.6 a minimum of three times and average the temperatures to yield an average reflected temperature.

8.3 Compensate for the reflected temperature by entering the average reflected temperature in the reflected temperature



A = ANGLE OF REFLECTION
B = ANGLE OF INCIDENCE
ANGLE A = ANGLE B

FIG. 2 Estimating the Angle of Reflection and Incidence

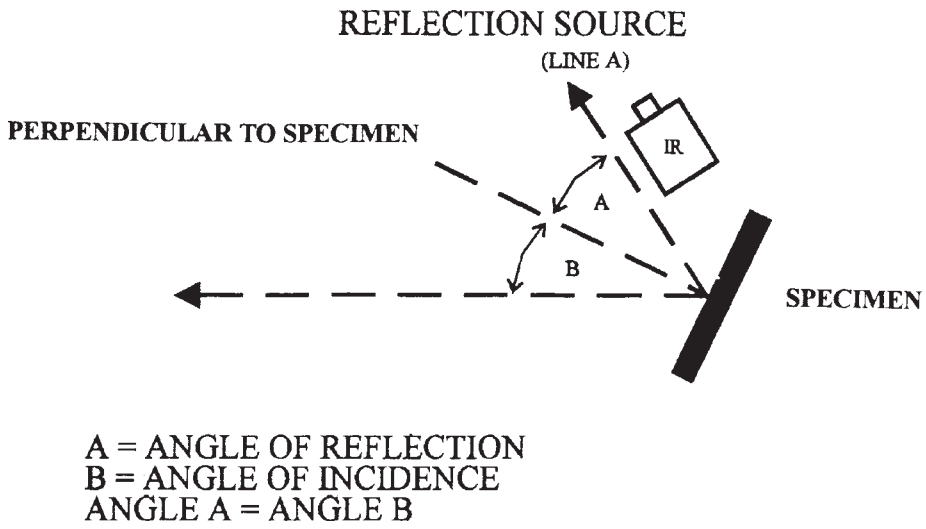


FIG. 3 Direct Method

input of the radiometer's computer, commonly referred to as "TAM," "Ambient Temperature," "Amb Temp" or "Reflected Background."

9. Precision and Bias

9.1 *Precision*—An interlaboratory test program is not practical here because of the nature of the specimens. However, a measure of the precision of the test methods can be inferred from the results of the replicate tests specified in 8.1.6 and 8.2.7.

9.2 *Bias*—These test methods for measuring reflected temperature have no bias because the values of reflected temperature are defined only in terms of the test methods.

10. Keywords

10.1 imaging; infrared; infrared examination; infrared reflector; infrared testing; infrared thermography; nondestructive testing; radiometry; reflected temperature; temperature compensation; temperature measurement