Designation: E1862 – 14 (Reapproved 2022)

# Standard Practice for Measuring and Compensating for Reflected Temperature Using Infrared Imaging Radiometers[1]

This standard is issued under the fixed designation E1862; 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 practice covers procedures for measuring and compensating for reflected temperature when measuring the surface temperature of a specimen with an infrared imaging radiometer.[2]

1.2 These procedures 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, health, and environmental practices and determine the applicability of regulatory limitations prior to use.*

1.4 *This international standard was developed in accordance with internationally recognized principles on standardization established in the Decision on Principles for the Development of International Standards, Guides and Recommendations issued by the World Trade Organization Technical Barriers to Trade (TBT) Committee.*

## 2. Referenced Documents

2.1 *ASTM Standards:*[3]

E1316 Terminology for Nondestructive Examinations

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

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

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 E1316.

## 4. Summary of Procedure

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

4.2 A procedure 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 procedures are provided for measuring and compensating for this reflected temperature error source, the Reflector Method and the Direct Method.

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

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

5.4 Due to the nature of the specimens, the repeatability and reproducibility are subjective. However, a measure of the precision of the procedures can be inferred from the results of the replicate procedures specified in 8.1.6 and 8.2.7.

## 6. Interferences

6.1 *Reflector Method:*

6.1.1 This procedure 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.



[1] This practice is under the jurisdiction of ASTM Committee E07 on Nondestructive Testing and is the direct responsibility of Subcommittee E07.10 on Specialized NDT Methods.

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[2] This practice was originally adapted in 1997, by agreement, from the *Guideline for Measuring and Compensating for Reflected Temperature, Emittance and Transmittance* developed by Infraspection Institute, 425 Ellis Street, Burlington, NJ 08016.

[3] 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.

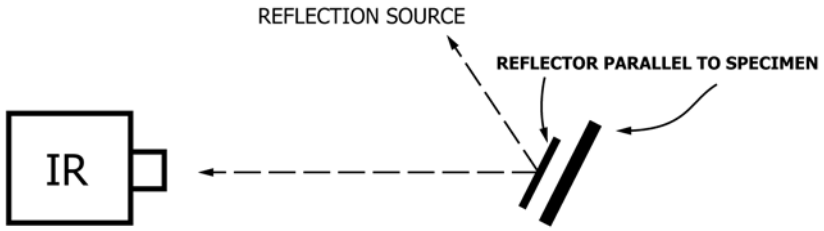


FIG. 1 Reflector Method

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.

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.

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.

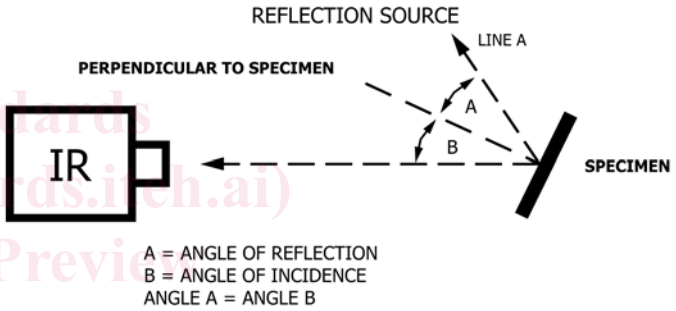


FIG. 2 Estimating the Angle of Reflection and Incidence

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).