Designation: E1079 – 16

Standard Practice for Calibration of Transmission Densitometers[1]

This standard is issued under the fixed designation E1079; 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[2] covers the calibration of transmission densitometers used to perform radiographic film density measurements (see Note 1).

1.2 *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.*

NOTE 1—For further information on the design and use of densitometers, the following literature is suggested as additional background information: ISO 5–1:2009, ISO 5–2:2009, ISO 5–3:2009, and ISO 14807:2001.

2. Referenced Documents

2.1 *ASTM Standards:*[3]

E1316 Terminology for Nondestructive Examinations

2.2 *ISO Standards:*[4]

ISO 5–3:2009 Photography and Graphic Technology - Density Measurements - Part 3: Spectral Conditions

ISO 14807:2001 Photography - Transmission and Reflection Densitometers - Method for Determining Performance

3. Terminology

3.1 *Definitions*—For definitions of terms used in this practice, see Terminology E1316.

4. Significance and Use

4.1 This practice provides a means for calibrating transmission densitometers used for the measurement of radiographic film density. A transmission densitometer calibrated in accordance with this practice provides the assurance that accurate density values of radiographs are obtained.

5. Apparatus

5.1 Apparatus should consist of the following:

5.1.1 A calibrated step tablet covering the density range used in production radiographs shall be used. The step tablet may be a NIST X-ray Step Tablet (X-Ray Film Step Tablet Transmission Density Standard 38100C)[5], or alternately a step tablet from another supplier that is traceable to the NIST step tablet in the range provided by NIST certification. The step tablet shall have at least five step densities, which cover the density range that is used for production radiographs. A calibration certificate shall be provided with the step tablet indicating the tablet ID and recorded values for each step density. For suppliers of step tablets other than NIST, the certificate shall indicate conformance of traceability to NIST, applicable ISO or ANSI standards (for example, ISO 5–3) used, verification of measurement on a NIST step tablet, the ID number of the step tablet, and calibration date of the step tablet. Precautions should be taken in the storage, handling, and use of the step tablet. In the event it becomes scratched, blemished, or exhibits other signs of deleterious wear, it should be replaced immediately. The NIST (or alternate, if used) step tablet shall be replaced four years from the date of first use.[6]

5.1.2 *Transmission Densitometers,* with either direct-scale readout or digital readout displays specifically manufactured for the purpose of measuring the range of film densities described in 5.1.1 may be used.

5.1.3 *Manufacturer's Operating Instructions for Appropriate Transmission Densitometer.*

6. Calibration

6.1 Full-scale linearity calibration should be performed at least every 90 days during use as follows:

6.1.1 Use the manufacturer's recommended warm-up time to stabilize circuitry before starting the calibration procedure or the periodic verification checks described in Section 7. Adjust the "0" reading of the densitometer after the warm-up period.

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[1] This practice is under the jurisdiction of ASTM Committee E07 on Nondestructive Testing and is the direct responsibility of Subcommittee E07.01 on Radiology (X and Gamma) Method.

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[2] For ASME Boiler and Pressure Vessel Code applications see related Practice SE-1079 in Section II of that Code.

[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.

[4] Available from American National Standards Institute (ANSI), 25 W. 43rd St., 4th Floor, New York, NY 10036.

[5] Available from National Institute of Standards and Technology (NIST), 100 Bureau Dr., Stop 1070, Gaithersburg, MD 20899-1070, http://www.nist.gov.

[6] Expiration interval of the NIST or alternate step tablet may be different than the requirements of this practice. Unless otherwise specified, requirements of this practice shall apply.

6.1.2 Select and measure three steps on the calibrated step tablet densities below, above, and near the midpoint of the range that is used for production radiographs.

6.1.3 Compare the measured densities with the actual density values on the calibrated step tablet or the density values listed on the calibration certificate. Calibrate the densitometer, in accordance with manufacturer recommendations, in order to achieve measured densities which are as close as possible to the actual density values on the step tablet. If the densitometer has been calibrated properly, the measured densities at the three steps should not vary more than ±0.05 density units from the actual step tablet density values. If any of the measured density values vary more than ±0.05 density units from the density values on the step tablet, the linearity of the densitometer is out of tolerance and should be taken out of service until corrected and recalibrated.

6.2 Any densitometer that is dropped, repaired, or has had critical parts replaced should be recalibrated prior to use.

7. Periodic Verification

7.1 Periodic calibration verification checks using the procedure described in Section 6 should be performed at the beginning of each shift, after 8 h of continuous operation, or change of apertures, whichever occurs first.

7.1.1 If the verification reading is within ±0.05 of the density values listed on the calibration step tablet or calibration certificate, the densitometer is ready for continued use. If the density values are not within the tolerance, recalibration is required and it shall be performed in accordance with Section 6.

7.1.2 If the verification check shows a variation greater than ±0.05, then all radiographs examined since the last acceptable density check shall be subject to a re-verification for density after the densitometer has been recalibrated.

7.2 Consult the Manufacturer's Technical Manual for troubleshooting information.

8. Records and Associated Documentation

8.1 Note the densitometer calibration and periodic verification acceptance condition in an appropriate log. This log shall also indicate the date the calibration/verification was performed and the identification of the individual who performed the calibration/verification and shall be traceable to the applicable densitometer. The retention period for calibration/verification documentation should be agreed upon by the purchaser and supplier.

8.2 An alternative calibration/verification documentation system may be used provided the calibration/verification traceability requirements identified in 8.1 can be satisfied and documented properly. A pressure sensitive label or tag that indicates the date the calibration/verification was performed, and the identification of the individual performing the calibration/verification, may be applied to the densitometer for verification of the calibration reference check recorded in the calibration/verification log.

8.3 Note and record the date of first use of the calibration/verification step tablet so that the requirements of 5.1.1 can be satisfied.

9. Keywords

9.1 calibration; densitometer; density; periodic verification; radiographic film