



Designation: E3235 – 21

Standard Practice for Latent Print Evidence Imaging Resolution¹

This standard is issued under the fixed designation E3235; 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 provides recommendations on the resolving power that enables recording of Level 3 details of latent print evidence that are suitable for comparison purposes using a digital camera, a flatbed scanner, or other image capture device. These recommendations take into consideration the minimum resolution requirements for utilizing the photographs for comparison.

1.2 This practice describes procedures that can be used to verify the resolving power of such imaging systems and recommends equipment to be used.

1.3 Certain commercial equipment, instruments, or materials are used in this document as representative examples to more clearly explain the procedures. Such use does not imply a recommendation or endorsement.

1.4 *This standard is intended for use by competent forensic science practitioners with the requisite formal education, discipline-specific training (see Practice E2917), and demonstrated proficiency to perform forensic casework.*

1.5 *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.*

1.6 *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:²

E1732 Terminology Relating to Forensic Science

E2916 Terminology for Digital and Multimedia Evidence Examination

E2917 Practice for Forensic Science Practitioner Training, Continuing Education, and Professional Development Programs

2.2 Other Documents:

ISO-16067-1 Reflective Scanner Test Chart³

ISO/IEC 17020 Conformity assessment — Requirements for the operation of various types of bodies performing inspection³

ISO/IEC 17025 Testing and calibration laboratories³

T-90-N-CG Ultra High Resolution Target⁴

3. Terminology

3.1 *Definitions*—Refer to Terminologies E1732 and E2916 for terms not defined in this practice.

3.1.1 *achievable resolution, resolving power, n*—the measure of imaging system's practical limit to distinguish between separate adjacent elements, typically by imaging a known reference standard. **E2916**

3.1.2 *bit depth, n*—the number of bits (binary digits) used to specify the brightness or color range of each pixel in an image sensor.

Photo Review Magazine Digital Imaging Glossary (1)⁵

3.1.3 *Dmax, n*—an abbreviation for maximum density. The abbreviation is used in describing both the characteristics of an image and/or an imaging device such as a scanner.

Federal Agencies Digital Guidelines Initiative Glossary (2)

3.1.4 *dynamic range, n*—the difference between the brightest highlight and darkest value that a sensor can detect and record in a single image. **E2916**

3.1.5 *focal length, n*—the distance from the optical center of a lens to its point of focus at the sensor or image plane when focused at infinity. **E2916**

¹ This practice is under the jurisdiction of ASTM Committee E30 on Forensic Sciences and is the direct responsibility of Subcommittee E30.12 on Digital and Multimedia Evidence.

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² 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.

³ Available from International Organization for Standardization (ISO), ISO Central Secretariat, Chemin de Blandonnet 8, CP 401, 1214 Vernier, Geneva, Switzerland, https://www.iso.org.

⁴ Available from Applied Image, Inc., Rochester, NY, https://www.appliedimage.com.

⁵ The boldface numbers in parentheses refer to a list of references at the end of this standard.

3.1.6 *lossless compression, n*—a data reduction process that is completely reversible, such that all of the original data can be retrieved in its original form. **E2916**

3.1.7 *lossy compression, n*—a data reduction process that is not completely reversible, and some original data is irretrievably lost. **E2916**

3.1.8 *machine resolution, optical resolution, n*—a nominal resolution specification for a flatbed scanner based on the actual number of pixels per inch in the sensor array and the number of individual steps per inch that the stepper motor can move the sensor array. This is to be distinguished from the maximum resolution specification that is based on resampling. This is also called optical resolution.

I Digital Photo Dictionary (3)

3.1.9 *nominal resolution, n*—the number of horizontal and vertical pixels an imaging system or sensor is capable of capturing. **E2916**

3.1.10 *normal lens, n*—a lens designed to approximate the field of view of the human eye without magnification or reduction. **E2916**

3.1.11 *quadripod, n*—a generic term for a four-legged camera support.

3.1.12 *resizing, n*—changing the size of an image by changing the number of pixels per unit of measurement without adding or subtracting any pixels from the image.

3.1.13 *resampling, n*—changing the size and/or resolution of the image by adding or subtracting pixels through interpolation.

Crime Scene Photography, 3rd ed. (4)

3.1.14 *resolution, n*—the act, process, or capability of distinguishing between two separate but adjacent parts or stimuli, such as elements of detail in an image, or similar colors.

Encyclopedia of Photography, 3rd Edition (5)

3.1.15 *resolving power, n*—see *achievable resolution*. **E2916**

3.1.16 *tri-linear array, n*—the sensor in a flatbed scanner, or digital scanning back, which is made up of three rows of pixels with a red filter covering one row, a green filter covering the second row and a blue filter covering the third row.

Federal Agencies Digital Guidelines Initiative Glossary (2)

4. Summary of Practice

- 4.1 Select photographic equipment.
- 4.2 Create a photographic procedure manual.
- 4.3 Verify the resolving power of digital cameras used to photograph latent print evidence.
- 4.4 Verify the resolving power of scanners used to scan latent print evidence.

5. Significance and Use

5.1 The procedure described in this document is in accordance with current SWGFAST guidelines (6), as well as National Institute of Standards and Technology (NIST) standard (7), which specify 1000 pixels per inch (ppi) at 1:1 as the

minimum scanning resolution for latent print evidence. This standard appears primarily to be historical and directed towards scanners, rather than cameras, though recent studies suggest that it is suitable for capturing Level 3 detail (8).

5.2 While the 1000 ppi resolution standard permits the capture of level three detail in latent prints, it does not mean that any image recorded at a lower resolution would necessarily be of no value for comparison purposes. Such an image could have captured level two details sufficiently for comparison. However, there are some latent print impressions that are so degraded or contain such limited quantity of information that at least 1000 ppi resolution is required to conduct an accurate examination. Some automated fingerprint identification systems require 1000 ppi for submission purposes. The relationship between machine (optical) resolution and achievable resolution (sometimes called *resolving power*) can vary greatly by manufacturer (8).

6. Recommended Photographic Equipment

6.1 A digital camera system with the following specifications:

6.1.1 A full frame, or larger, sensor is suggested because it will usually have less image noise as compared to smaller sensors.

6.1.2 *Interchangeable Lenses:*

6.1.2.1 A normal fixed focal length, or longer, macro lens is preferred. Listed below are two common examples of normal focal length lenses for different size camera sensors.

(1) For a full frame sensor, the normal focal lens is 40 mm to 60 mm.

(2) For an APS-C/H sensor, the normal focal lens is 35 mm to 45 mm.

6.1.2.2 A macro zoom lens set to approximately the normal focal length, or longer, based on the size of the camera sensor is acceptable.

6.1.2.3 *Optional*—A normal, or longer, focal length perspective control (PC) macro lens.

6.1.2.4 *Additional Lens Considerations:*

(1) When capturing images for comparative analysis, it is important to minimize distortion and obtain the correct perspective. In general, normal focal length prime lenses have less optical distortion as compared to zoom lenses.

(2) The photographs of the bottom of a shoe illustrate the problems of using a wide angle lens as compared to using a normal focal length lens and filling the frame. The photographs were taken with a 20 mm and 50 mm lens on a DSLR with a full frame sensor (see Figs. 1-4).

6.1.3 Manual and aperture priority exposure modes.

6.1.4 Automatic and manual focus.

6.1.5 Remote shutter release port or self-timer.

6.1.5.1 Choice of file format in order of preference

6.1.5.2 RAW file format at a maximum bit depth or RAW+JPEG.

6.1.5.3 Uncompressed or lossless compressed image file format such as TIFF.

6.1.5.4 If RAW and TIFF are not available, use the highest quality JPEG settings.