



Standard Test Method for Determining Low-Level X-Radiation Sensitivity of Photographic Films¹

This standard is issued under the fixed designation F 947; 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 test method determines the maximum x-ray sensitivity coefficient (slope of diffuse visual density versus x-ray exposure) of film/processing combinations for low quantities of x-ray exposure to silver halide photographic film. This coefficient can be used to assess the relative susceptibility of films to damage from x-ray exposure, such as that encountered in airport and similar security screening systems.

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.*

2. Referenced Documents

2.1 ANSI Standard²

PH2.19 (1976) American National Standard Conditions for Diffuse and Doubly-Diffuse Transmission Measurements (Transmission Density)

3. Significance and Use

3.1 The x-ray sensitivity coefficient is used to estimate the amount of x-ray exposure that would produce a visually significant effect on a film. This value may be useful in establishing maximum allowable x-ray doses for classes of film products, for example, consumer color films, scientific and x-ray films, etc.

4. Calibration and Standardization

4.1 Radiant Energy Quality:

4.1.1 Tungsten target x-ray tubes shall be used to expose test films. Inherent filtration of the tube plus an additional aluminum³ filter located as close to the x-ray tube as possible shall provide a total filtration equivalent to 3.7 ± 0.5 mm of aluminum.

4.1.2 The kilovoltage applied to the x-ray tube shall be adjusted to yield a half-value layer (HVL) of 3.4 ± 0.5 mm of aluminum as determined with a radiation measuring device having a quantum energy response flat within $\pm 5\%$ over the effective energy range from 30 to 100 keV. That is, with the measuring device at or adjacent to the film exposing position, the tube kilovoltage shall be adjusted⁴ such that the introduction of 3.4 mm of aluminum³ into the x-ray beam close to the tube, in addition to the filtration specified in 4.1.1, will reduce the measured x-ray intensity to $50 \pm 1\%$ of its value without this HVL aluminum in the beam. The HVL aluminum must of course be removed for subsequent film exposure and exposure measurement.

4.2 Secondary X-Rays:

4.2.1 To minimize secondary radiation during dosimetry and exposure of test films, x-ray beams shall be diaphragmed to as small a size as will properly include the exposure area for the films (and exposure measuring device, if included). Except for a 1 mm minimum thickness sheet of lead for backing the film container, the lightest supports possible of low-atomic-number material shall be used for supporting the film and exposure measuring device. Other materials in the x-ray beam shall be kept at least 50 cm distant from the film. The amount of secondary radiation reaching the film and measuring device shall be less than 3 % of the primary x-rays.

4.2.2 The presence of secondary (scattered) radiation shall be tested by plotting the inverse square root of the exposure rate as a function of distance from the source. Absence of significant secondary radiation is indicated when the resulting plot is a straight line passing through the origin. Such radiation is excessive if the point corresponding to the observed exposure rate at the distance used for film exposures is more than 3 % below the best straight line from the origin among the plotted points. Measurements shall be made at enough distances to provide a reliable indication of secondary radiation reaching the exposure plane and shall include distances approximately equally spaced from one-half that between the

¹ This test method is under the jurisdiction of ASTM Committee F-12 on Security Systems and Equipment and is the direct responsibility of Subcommittee F12.60 on Controlled Access Security, Search and Screening Equipment.

Current edition approved July 26, 1985. Published October 1985.

² Available from American National Standards Institute, 11 W. 42nd St., 13th Floor, New York, NY 10036.

³ Aluminum Association Alloy 1100, or the equivalent.

⁴ The HVL specification should be satisfied with approximately 80 kV constant potential, approximately 80 kVp 3-phase, or approximately 95 kVp single phase applied to the x-ray tube.