



Designation: E 115 – 97

Standard Practice for Photographic Processing in Optical Emission Spectrographic Analysis¹

This standard is issued under the fixed designation E 115; 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 the photographic processing of plates and films used in optical emission spectrographic analysis to obtain a permanent image of the analytical spectrum.

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.* Specific precautionary statements are given in Section 8 and Note 10.

2. Referenced Documents

2.1 ASTM Standards:

E 116 Practice for Photographic Photometry in Spectrochemical Analysis²

E 135 Terminology Relating to Analytical Chemistry for Metals, Ores, and Related Materials²

3. Terminology

3.1 For definitions of terms used in this practice, refer to Terminology E 135.

4. Summary of Practice

4.1 The invisible latent image present after exposure of a plate or film is converted to a visible image by developing the emulsion, removing the unexposed sensitized material, washing to remove processing chemicals, and drying.

5. Significance and Use

5.1 Controlled photographic processing of the exposed emulsion is necessary to develop a spectral line opacity that is consistent with the degree to which the latent image was formed.

5.2 The inclusion of the following paragraphs, or suitable equivalents, in any ASTM optical emission spectrographic method (preferably in the sections on Apparatus, Reagents and

Materials, and Photographic Processing) shall constitute due notification that this practice shall be followed:

Photographic Processing Equipment—Refer to Practice E 116.

Photographic Processing Solutions—Refer to Practice E 116.

Photographic Processing—Develop the emulsion in accordance with Practice E 116.

6. Apparatus

6.1 *Developing Machine*, for processing the photographic emulsion at a constant temperature between 18 and 21°C within $\pm 0.3^\circ\text{C}$ and with continuous agitation of the processing solutions over the surface of the emulsion (Note 1 and Note 2). It shall have separate compartments for the developer, stop bath, and fixer. The trays, tanks, or any hardware contacting processing solutions shall be made of glass, hard rubber, plastic, stainless steel, enameled iron, or glazed earthenware. Not all plastics can be used. When using a plastic for the first time, test it by having it remain in contact with the processing solution for one day. Tin, copper, brass, and metallic-coated iron containers are to be avoided as they will react with the processing solutions.

NOTE 1—Most commercial developing machines have either trays that rock or deep narrow tanks in which the plates or films move up and down. Automatic processing machines produce a quality of development superior to random manual agitation. The volume of solution in a tray will affect the agitation, and experimentation with different volumes will determine the proper volume for uniform agitation. A visual check may be performed by observing the clearing of an undeveloped plate or film placed in a fixer solution: Improper agitation will cause some areas to clear before others. A test may be made by exposing an emulsion to a source of short-wavelength radiant energy, such as a “black light” lamp, positioned far enough away from the emulsion to ensure uniform exposure. (Short wavelength radiation is preferable because it shows less effect to variations in emulsion thickness than does visible light.) Process the emulsion and measure the uniformity of opacity across the plate or film on a microphotometer. With an exposure that produced an opacity ranging from 30 to 70 % transmittance (densities from 0.15 to 0.52), an appropriate test would be as follows: Scan across near both ends of the plate or the exposed area of the film. Make additional scans about one third of the way in from the original scans. Make two more scans along the length of the plate or film, close to the edge. None of these scans should come closer than 6 to 10 mm from an edge. The variation in measured opacity should be less than 1.5 % for a Type SA-1 emulsion or less than 3 % for more coarse-grained emulsions such as a Type 103-0.

¹ This practice is under the jurisdiction of ASTM Committee E-1 on Analytical Chemistry for Metals, Ores and Related Materials and is the direct responsibility of Subcommittee E01.20 on Fundamental Practices.

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² *Annual Book of ASTM Standards*, Vol 03.05.

NOTE 2—Nitrogen burst agitation of developing solutions has proved satisfactory for the processing of photographic material in deep narrow tanks.^{3,4}

6.2 *Washer*, for washing the emulsion after processing. It shall provide for washing by either agitating a plate or film in a continuous stream of fresh water or by directing a stream of water on the plate or film so that the emulsion is uniformly bathed in water. The action of the washing process should not rupture the gelatin of the emulsion. Water flow shall be sufficient to give at least one complete change of water in 5 min.

6.3 *Dryer*, capable of providing a stream of warm air for drying the emulsion without blistering or softening. In addition to warming the air, the dryer may use an infrared lamp or resistance heater to warm the film or plate directly while the air is flowing. The dryer shall contain controls for regulating the degree of heating or permitting air to flow without heating. A timer for controlling the entire drying cycle may also be included. The film or plate shall be held in such a way that no useful area of emulsion is in contact with the holder.

6.4 *Timer*, easily read to within 3 s, with a bell or buzzer alarm and automatic reset mechanism.

6.5 *Safelights*, as recommended by the manufacturer of the spectroscopic emulsion used.

NOTE 3—A safelight can be checked by finding how long it takes a plate or film to show perceptible fog when exposed to its illumination. A safe time would be at least four times the length of time it takes for normal processing. Fog may be considered to be absent if a thin, opaque object placed on the emulsion during the test shows no shadow image. A safelight may be made satisfactory by using it at a greater distance from the emulsion or by reducing the intensity of its lamp.

6.6 *Refrigerator*, for the storage of plates or films at a temperature not to exceed 10°C and at a relative humidity not to exceed 60 %.

NOTE 4—Sensitive emulsions for use in the infrared and extreme ultraviolet, such as Kodak SWR plates or films and Z sensitizings or equivalent, must be stored at −19 to −23°C. If these deep-freeze conditions are not available, refrigerator storage may be adequate for short periods of time when accompanied by spot checks for photographic quality. Type 649 material, however, should never be frozen.

6.7 *Water Cooler*—If tap water is not sufficiently cold all year long, it may be necessary to cool water to maintain temperature control. An adequate cooler should be capable of providing water at or below 18°C at a minimum rate of 19 L/h.

7. Reagents and Materials

7.1 *Processing Solutions*—A variety of photographic processing chemicals are commercially available for making up the solutions needed for processing emulsions. Adequate and consistent processing solutions will be obtained if they are prepared according to the manufacturer's instructions.

7.1.1 General High-Contrast Developer for All

³ *Gaseous Burst Agitation in Processing*, Kodak Publication No. E-57, Eastman Kodak Company, Rochester, NY 14650.

⁴ The Kodak Intermittent Gaseous Burst Valve, Model 90B, has been found satisfactory for this application; however, a properly designed multi-holed gas distribution tube, such as the Kodak Gas Distributor, must be installed to fit the individual processing tank.

Emulsions—Commercially available high-contrast developers⁵ typically have keeping properties as follows: 6 months in a full, sealed bottle; 2 months in a half-full, sealed bottle; 24 h in a tray; and 1 month in a 3.78-L tank. All containers should be shielded from light. In a tray, the useful capacity of the developer is 3000 cm² of emulsion per litre. In a deep narrow tank, the useful capacity is 4000 cm² of emulsion per litre. Life of the developer in a tank can be extended by the addition of a replenisher.⁶

7.1.2 *Rapid Developer for Thin Emulsions*—Commercially available rapid developers⁷ typically have keeping properties as follows: 2 months in a full, sealed bottle; 2 weeks in a half-full, sealed bottle; and 2 h in a tray. All containers should be shielded from light. In a tray, the useful capacity of the developer is 1000 cm² of emulsion per litre. This developer is not recommended for tank use. A replenisher shall not be used to extend the life of this developer.

7.1.3 *Fixer Solutions with Hardener*—Commercially available fixers⁸ typically have keeping properties as follows: 3 months in a sealed bottle at 18°C; 1 week in a tray; and 1 month in a 3.78-L tank. In a tray or tank, the useful capacity of the fixing solution is 6600 cm² of emulsion per litre. The active ingredient in a fixer, sodium thiosulfate pentahydrate, is commonly called “hypo.”

7.1.4 *Stop-Bath Solution*—Commercially available stop baths⁹ typically have keeping properties as follows: approximately 3 days in a tray and 1 month in a 3.78-L tank. They can be kept indefinitely in sealed bottles. In a tray or tank, the useful capacity of the solution is 3300 cm² of emulsion per litre.

7.2 Optional Solutions:

7.2.1 *Wetting-Agent Solutions*—Commercially available wetting agents¹⁰ may be used to assist in removing surface water prior to drying an emulsion.

7.2.2 *Tank or Tray Cleaning Solutions*—Appropriate solutions¹¹ may be used to remove stains caused by oxidation, silver, silver sulfide, or dyes.

7.2.3 *Hypo Test Solution*—A commercially available solution¹² may be used to check the effectiveness of the fixer.

8. Hazards

8.1 *Ventilation*—The dark room used for processing plates or films should be adequately ventilated to remove all fumes and to keep the air free of dust.

9. Procedure

9.1 Development:

9.1.1 *Type of Developer*—To be satisfactory for spectrographic analysis a developer must produce good contrast,

⁵ Kodak D-19 and Ilford ID2 developers have been found satisfactory.

⁶ Kodak D-19K replenisher has been found satisfactory.

⁷ Kodak D-8 developer has been found satisfactory.

⁸ Kodafix and Kodak Rapid Fixer have been found satisfactory.

⁹ Kodak Indicator Stop and Kodak Stop Bath SB-5 have been found satisfactory.

¹⁰ Kodak Photo-Flo has been found satisfactory.

¹¹ Appropriate solutions can be made up in accordance with Kodak Formulation TC-1 or TC-3, available in Kodak publications or from Eastman Kodak Company, Rochester, NY 14650.

¹² Kodak Hypo Test Solution HT-1a has been found satisfactory.