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An American National Standard

Standard Guide for Storage of Radiographs and Unexposed Industrial Radiographic Films[1]

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1. Scope

1.1 This guide may be used for the control and maintenance of industrial radiographs and unexposed films used for industrial radiography.

1.2 The values stated in inch-pound units are to be regarded as the standard. SI units are provided for information only.

NOTE 1—For information purposes, refer to Terminology E 1316. The terms stated therein, however, are not specifically referenced in the text of this document.

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 and health practices and determine the applicability of regulatory limitations prior to use.*

2. Referenced Documents

2.1 *ASTM Standards:*

[1] This guide is under the jurisdiction of ASTM Committee E-7 E07 on Nondestructive Testing and is the direct responsibility of Subcommittee E07.01 on Radiographic Radiology (X and Gamma) Method.

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E 94 Guide for Radiographic ~~Testing~~ Examination[2]
E 746 Test Method for Determining Relative Image Quality Response of Industrial Radiographic Film Systems[2]
E 1316 Terminology for Nondestructive Examinations[2]

2.2 ~~*ANSI Standards:*~~
~~IT9.2 Processed Films, Plates, and Papers—Filing Enclosures and Containers for Storage~~ISO Standards:[3]
~~IT9.1 Radiographic Films, Silver-Gelatin on Polyester Base—Specifications~~
ISO 14523:1999 Processed Photographic Materials—Photographic activity test for ~~Stability~~[3]
~~PH4.8 Residual Thiosulfate~~ enclosure materials
ISO 18901:2002 Imaging Materials—Processed silver-gelatin type black-and-white films - Specifications for stability
ISO 18902:2001 Imaging Materials—Processed photographic films, plates, and ~~Other Chemicals in Films, Plates,~~ papers - Filing enclosures and ~~P~~ storapge containers
ISO 18917:1999 Photography—Determination of residual thiosulfate and ~~M~~ other related chemicals~~u~~ in processed photographic materials - Methods using iodine-amylose, methylene blue and silver sulfide

3. Significance and Use

3.1 The provisions of this guide are intended to control the quality of industrial radiographs and unexposed films only and are not intended for controlling the acceptability of the materials or products radiographed. It is further intended that this guide be used as an adjunct to Guide E 94.

3.2 The necessity for applying specific control procedures such as those described in this guide is dependent to a certain extent, on the degree to which a user adheres to good processing and storage practices as a matter of routine procedure.

4. Unexposed Film Storage

4.1 *Unopened Containers*:

4.1.1 *Storage Recommendations*—Any films in containers sealed by the manufacturer and not opened should be stored with the films on edge, whenever possible, to avoid container damage and possible film damage. Storage temperature should be between 40°F ~~(4.4°C)~~ [4.4°C] and 75°F ~~(24°C)~~ [24°C] at a relative humidity range of 30 to 60 %.

4.1.2 *Higher Storage Temperatures*—When temperatures exceed 90°F ~~(32°C)~~ [32°C] for 30 days, some unexposed films may be processed under normal existing conditions to test for fogging. The outside sheets in a pack of cut films or the ends of rolled films are most affected by heat. If excessive fogging is found on these samples, subsequent sampling may be done on inner sheets or further in on the rolls to avoid unnecessary scrap. A limit of 0.30 density units total for the base density and fog is acceptable (see 4.3) for industrial radiographic films.

4.1.3 *Lower Storage Temperatures*—The temperature can be lower than 40°F ~~(4.4°C)~~ [4.4°C] as lower temperatures reduce the rate of heat and age fogging. However, lower temperatures will have no effect on background radiation fogging. Films stored at these lower temperatures in unopened containers should be allowed to stabilize at room temperature before opening the containers. The stabilization time varies with the bulk of the stored films and the temperature stored at. The lower the temperature and greater the bulk the longer the time required to reach room temperature. If the containers are opened too soon, condensation could cause the films to stick to whatever is touching their surfaces.

4.1.4 *Lower or Higher Storage Humidities*— If the relative humidity is below 30 % and the moisture in the films is reduced sufficiently, film emulsion cracking or damage can occur during handling after opening the sealed containers, and the films may be subjected to static electrical discharges. Storage humidities over 60 % can also cause the films to stick to whatever is touching their surfaces.

4.2 *Opened Containers*—The same considerations described in 4.1 for unopened containers apply. Opened containers are those on which the manufacturers inner bag around the film itself has been opened. This can cause the unexposed film to stick and fog more rapidly when exposed to high humidity and temperature.

4.3 *Time-of-Use Usability*—Tests used to evaluate image quality in accordance with Test Method E 746 showed that equivalent penetrameter sensitivity (EPS) of 1.4 % can be maintained for films with base plus-fog (B + Fog) up to 0.30.

4.3.1 If unexposed sheets or rolls are processed normally through the available processing system, and base plus-fog density exceeds 0.30, the film may still be suitable for use. However, specific agreement should be obtained between the purchaser and supplier if out-dated film or film stored under non-recommended conditions is to be used.

4.4 *Radiation Protection*—Storage facilities for unexposed films should provide adequate protection from penetrating radiation.

5. Radiograph Storage

5.1 *Introduction*—Radiographs are normally stored in some form of enclosures to exclude dirt and protect them against physical deterioration and damage. Storage conditions can be designed for archival preservation, normally considered to be for more than

[2] *Annual Book of ASTM Standards*, Vol 03.03.
[3] Available from American National Standards ~~Institute, 11 West 42nd Street, 13th~~ Institute (ANSI), 25 W. 43rd St., 4th Floor, New York, NY- 10036, or http://www.iso.ch.

100 years or for moderate time periods by using the guidelines in this standard; however, the radiographs must have been sufficiently fixed and washed and stored in suitable enclosures to ensure preservation.

5.2 *Residual Thiosulfate*—If radiographs are not fully fixed and washed, they can retain some fixer, or thiosulfate, and some residual silver in the lower density areas. During storage, these residual chemicals can generate permanent, brownish stain super-imposed on the radiographic image. Since the rate at which a stain is generated depends on both the amount of residual thiosulfate and radiograph storage conditions, factors such as the temperature, humidity, and air flow in the storage facility must be considered as they affect this rate (see ~~ANSI IT9.1).~~ ISO 18901:2002). If radiographs are stored at or below the upper limits of the temperature and relative humidity ranges described in 4.1.1, stain generation will be minimized and lowered as these two parameters are lowered. Again, be aware of possible film emulsion cracking at very low humidities.

5.2.1 *Testing for Residual Thiosulfate*— The procedure described in ~~ANSI PH4.8~~ ISO 18917:1999 as the silver densitometric method for measuring residual thiosulfate details a silver nitrate-acetic acid reagent. A solution that can be used as a spot test for residual thiosulfate is as follows: Dissolve 10 g silver nitrate in a solution of 30 mL glacial acetic acid in 750 mL water. Dilute to 1 L and store in brown, glass-stoppered bottle. Discard if darkened. Two minutes after a drop of this solution has been placed on the lowest density area of a radiograph, a stain will appear if any residual thiosulfate is present. The intensity of the stain will approximate the maximum amount of discoloration that one side of the radiograph will ever reach during any kind of storage conditions of temperature and humidity. For a visual reference to the approximate maximum discoloration of both sides of a radiograph, both sides must be tested with superimposed drops. This spot test not usually considered adequate where critical work or work to a strict code or specification is involved and the methylene blue method or the complete silver densitometric method described in ~~ANSI PH4.8~~ ISO 18917:1999 is preferred.

5.2.2 *Natural Aging Stain*—Practical long-time storage tests indicate that under normal "office" conditions of controlled, moderate temperature and humidity, approximately one third of the maximum stain indicated by such a spot test was actually generated over a 10-year period.

5.2.3 *Rewashing Radiographs*—If the spot test does generate a stain, the radiograph can be rewashed to lower the residual level and then retested to confirm the lower level. Immersion in a fixer neutralizer such as 2 to 6 % solution of sodium sulfite can drastically reduce rewashing times.

5.3 *Enclosure Materials for Radiographs* :

5.3.1 *General*—Packaging enclosure materials, including corrugated boxes and interleaving paper, shall be chemically stable and have a slightly rough or matted surface. Guidelines for enclosure ~~materials, including a photographic~~ materials are described in ISO 18902:2001. A photo activity test for suitability ~~are~~ is described in ~~ANSI IT9.2.~~ ISO 14523:1999.

5.4 *Storage Area Conditions*:

5.4.1 *Air Impurities*—Inert or inactive solid particles can be deposited on radiographs and interfere with readability and produce scratches. Reactive types of solids may cause fading or staining and gaseous impurities may cause base or image deterioration. Impurities such as peroxides, ammonia, paint fumes, sulfur dioxides, or compounds of sulfur, such as hydrogen sulfide, can be particularly harmful.

5.4.2 *Temperature*—Continuous temperatures above 100°F ~~(38°C)~~ [38°C] will accelerate staining caused by residual thiosulfate and temperatures below the dew point of the air may produce condensed moisture on the radiographs and cause sticking. In general, a moderate temperature range, as described in 4.1, is recommended.

5.4.3 *Humidity*—The extremes must be avoided as prolonged exposures to relative humidities over 60 % will tend to damage the emulsion because of fungus growth and could cause sticking. Under conditions of low or changing humidity, emulsion adhesion defects such as edge peeling, flaking, or emulsion cracking can develop. Low humidities will also increase the potential of static charges on the radiographs attracting solids that could harm them. In general, a relative humidity range of 30 to 60 % is recommended.

5.5 *Fire Resistance*—Radiographs can withstand temperatures as high as 302°F ~~(150°C)~~ [150°C] without significant loss of image quality, provided they are free of residual thiosulfate; however, they may become distorted or stick to each other or to the enclosure material.

6. Precision and Bias

6.1 No statement is made about either the precision or bias of this guide for measuring residual thiosulfate and the activity test for enclosure materials since the results merely state whether there is conformance to the criteria for success specified in the procedure.

7. Keywords

7.1 industrial radiographic films; radiograph storage; unexposed film