International Standard 8374

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Photography — Determination of ISO safelight conditions

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Foreword

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Draft International Standards adopted by the technical committees are circulated to the member bodies for approval before their acceptance as International Standards by the ISO Council. They are approved in accordance with ISO procedures requiring at least 75 % approval by the member bodies voting.

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Users should note that all International Standards undergo revision from time to time and that any reference made herein to any other International Standard implies its latest edition, unless otherwise stated.

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Photography — Determination of ISO safelight conditions

0 Introduction

The term "safelight" in photography is used to describe lighting conditions that will not affect the photographic characteristics of a sensitized material under conditions of normal use. Since most sensitized materials are handled under safelight conditions by the manufacturers and/or users, it was considered desirable to prepare an International Standard specifying a traceable method for determining safe working conditions.

It is often believed, incorrectly, that a lighting condition is safe if it does not change the density of an area not previously exposed. This is untrue for most materials; generally an exposed image area is more sensitive. Therefore, an unsafe lighting condition may go undetected if one looks only for changes in unexposed areas. The greater effect in image density areas is caused by the combination of their higher inherent sensitometric contrast and the percentage of the total exposure provided by the safelight. The effect is greatest in low exposure areas of the image. The effect may also depend on whether the material is subjected to a "safe-light condition" before or after the image has been exposed.

This International Standard establishes the term "ISO safelight condition" to define the lighting conditions for a specific sensitized material which has been evaluated using the procedures and meeting the requirements specified in this International Standard. This term should be used only when these conditions are met.

Generally, the spectral quality for a safelight is selected to provide the maximum ratio of the visual response to the photographic response of the product involved. This International Standard is not concerned with this selection, but in defining when the exposure (illuminance × time) from a safelight has an effect on the image-forming characteristics of a sensitized material. It should be noted that a sensitized material generally has a spectral distribution of sensitivity very different from the human eye. This makes it possible for two safelights to give the same illumination (visual appearance), but to affect a material quite differently.

As exposures may be additive i.e. exposure of sensitized materials to safelight conditions during manufacturing, inspection, camera loading, splicing, processing, etc., may have a cumulative effect, exposure of a material to safelight conditions should be kept to a minimum at all stages of handling. This International Standard is, however, concerned only with evaluating a sensitized material to the safelight exposure under test and not the effect of cumulative conditions over a long period of time.

1 Scope and field of application

This International Standard specifies the method of test for determining the "ISO safelight condition", for handling a sensitizing material. This is defined as that condition which provides less than half the maximum safelight exposure which can be given to a sensitized material without producing a detectable change in the final image.

The method for evaluating the ISO safelight conditions is applicable to all wet or dry photographic films, plates and papers.

2 Definitions

For the purpose of this International Standard, the following definitions shall apply.

2.1 safelight : An illuminant having a specified relative spectral power distribution recommended for use during the handling of sensitized material. Generally, it is emitted from a fixture containing a specific light source and an appropriate filter.

2.2 safelight filter : A spectrally selective absorbing material recommended for use with a specified light source to produce an illuminant with the required relative spectral power distribution.

2.3 safelight fixture : An enclosure for a light source which generally includes a safelight filter through which radiant flux is transmitted.

2.4 safelight illumination : Illumination from a safelight which is incident on a sensitized material.

2.5 safelight exposure : The time integral of the illuminance from a safelight on a sensitized material.

2.6 **detectable change** : Any significant difference in image density or hue that can be seen in a side-by-side visual examination or that can be measured with a densitometer using appropriate filters. For visual examination, it is desirable to compare the images on a single piece of material.

2.7 **pre-exposure** : An overall safelight exposure before a sensitized material receives a normal image-forming exposure.

2.8 **post-exposure** : An overall safelight exposure after a sensitized material receives a normal image-forming exposure.

2.9 **ISO safelight condition** : Lighting conditions that provide less than one-half the exposure required to produce a photographic effect when evaluated by use of the methods described in this International Standard.

3 Method of test

3.1 Principle

Separate samples are subjected to a series of exposures to safelight illumination before the image exposure and after the image exposure. The maximum safelight exposure which does not affect the image is determined and used to define the ISO safelight condition.

3.2 Apparatus

3.2.1 Step tablet

The use of a transmission step tablet is recommended to create a series of stepped exposures which will provide the range of densities expected in the normal use of the material to be evaluated. For products normally exposed with direct X-rays, the exposure series shall be obtained in a manner appropriate for radiographic films.

If a step tablet is not available, the following procedure may be substituted for the exposure. Cover one end of the piece of sensitized material being tested with a black card or other opaque material and uniformly flash expose the uncovered area, moving the card to produce a series of exposure times such as 1 s, 2 s, 4 s, 8 s, 16 s, etc. The spectral quality of the illuminant shall be similar to that normally used for the material. The exposures should produce the full range of densities expected in actual use. A less satisfactory alternative is to give the entire piece of sensitized material, except for a protected border, a uniform exposure through a transparent picture image providing the picture produces a good distribution of light, medium and dark tones. It is important to remember that for most negative-working materials, low image densities are particularly vulnerable to the effects of low level exposures as might occur under safelight conditions. In direct-positive materials, high densities generally are most affected.

3.2.2 Opaque cover

A black opaque card is needed to limit the area exposed to the safelight illumination. Additional pieces of card and masking tape may be used in the construction of a guide for positioning the sensitized material and the opaque card in the dark (see annex).

3.2.3 Timer

A means of timing the exposure from the safelight for a few seconds to 8 min or longer is required. If a visual timer is used, any light provided for the timer shall be prevented from reaching the sensitized material unless such light constitutes part of the normal dark-room safelight illumination being tested.

3.2.4 Data recording

A record should be made of all pertinent data, including the safelight filter designation, size, approximate age, lamp type, wattage and voltage, distance from the safelight fixture to the sensitized material, sensitized material designation, safelight exposure times, and processing data. Once established the safelight condition shall be maintained by ensuring that proper replacement lamps are used, checking the filter for fading, maintaining the correct distance from the safelight fixture to the sensitized material, not changing the environment (i.e., painting walls, etc.). Any change to the elements described above should be evaluated for its effect on the material. It is also very important to control darkroom procedures for handling material such as process time, latent image time, orientation of product, etc.

3.3 Test conditions

Samples should be handled in total darkness except when intended exposures are made.

3.4 Procedure (see figure 1)

3.4.1 Pre-exposure test

Cut the sensitized material to be tested into several strips, preferably at least 2,5 cm wide.

Cover one-half of each strip longitudinally with an opaque card and expose the other half to the safelight illumination for the shortest time considered practical.

Repeat this procedure for each successive strip, increasing, however, the safelight exposure time for example, one strip for 15 s, the next one for 30 s, etc. doubling the time for each successive strip.

In total darkness, make a step tablet exposure on each strip; it is important that the exposures produce the full range of densities normally expected in actual use.

Process the strips together in total darkness within 2 h of exposure in order to minimize latent image keeping effects. The process should be the same as normally used for the sensitized material.

3.4.2 Post-exposure test

Cut the sensitized material to be tested into several strips, preferably at least 2,5 cm wide.

In total darkness, make a step-tablet exposure on several strips of the sensitized material. It is important that the exposures be capable of producing the full range of densities normally expected in actual use.

Cover one-half of a strip longitudinally with an opaque card.

Expose the other half to the safelight illumination for the shortest practical time. Repeat this procedure for each successive strip doubling the exposure time.

Process the strips together in total darkness within 2 h of exposure in order to minimize latent image keeping effects. The process should be the same as normally used for the sensitized material.

3.4.3 Test — During processing

3.4.3.1 First decide when safelight illumination is necessary or desirable during the process cycle. The sensitivity of a wet sensitized material may be greater or less than that of the same material in a dry condition. For example, safelight inspection during development of panchromatic film is recommended only briefly towards the end of the normal developing time. The relatively short developing time following the safelight exposure reduces the effect on the image. However, soaking sensitized material in water or other liquids that dissolve soluble bromides or otherwise alter chemical composition of the emulsion or the bromide concentration in the gelatin before development can increase the effect of a safelight exposure on the image.

The preferred way to evaluate safelight conditions used during processing is to vary the illuminance on the sensitized material. This may be done by

a) using a series of area masks, made from a black opaque material, over the safelight fixture;

or

b) varying the distance of the safelight fixture from the sensitized material;

or

c) introducing non-selective absorbers over the safelight fixture.

3.4.3.2 In total darkness, make step-tablet exposures on several strips of the sensitized material. Process one strip in total darkness. Process a second strip, with the safelight turned on for a specified interval in the process cycle. Decrease the illuminance from the safelight by 50 % and process another strip, with the safelight turned on only during the same interval of the process as was used for the second strip. Process additional strips reducing the illuminance on the material by 50 % for each successive test.

3.5 Evaluation

Measure the density of all steps of all strips (see figure 1). The type of density measured shall be appropriate for the type of material being evaluated. For example, ISO visual reflection density for reflection black-and-white print material; ISO Status M transmission densities for colour negative film.

Density	Density
0,10	0,10
0,20	0,25
0,41	0,47
0,85	0,88
1,19	1,21
1,69	1,69

Side covered — Side exposed to safelight

Figure 1 — Typical strip (unsafe condition)

Compare the density of the area of a step which was exposed to a safelight illumination with the density of the area of the same step which was not exposed to the safelight illumination. Make this comparison for all steps of all strips and then determine the strip that received the most safelight exposure without producing a detectable change in density of any step.

The exposure associated with this step, when divided by a factor of 2, is called the "ISO Safelight Condition".

It is also valid to visually compare spectrally non-selective images or images that are viewed in normal use. However, precautions have to be taken to use viewing conditions appropriate for the material. The spectral conditions, geometric conditions, and illuminance levels should be similar to those normally encountered in product use. This procedure is not recommended for colour negative films because the spectral sensitivity of the material on which it is to be printed is normally quite different from that of the human eye.

If a more precise determination of the "ISO Safelight Condition" is required, additional tests may be performed where the ratio of safelight exposures between successive test strips is less than 2.

4 Designation

4.1 General

The designation, "ISO Safelight Condition", or "ISO Maximum Safelight Condition" should be used to describe safelight conditions for a material that has been evaluated using the procedures and meeting the requirements specified in this International Standard.

It is also necessary to specify the magnitude and spectral quality of the incident safelight illumination on the material and the maximum exposure time permitted.

The safelight condition is often described as

a) a certain type and size of light bulb or tube;

b) a filter to obtain a specific spectral energy distribution;

c) a distance between the source and the material to limit the energy incident to the material.

4.2 ISO Maximum Safelight Condition

Any condition which produces an exposure equal to one-half that required to produce the smallest detectable change on the final image when evaluated according to the procedures described in this International Standard shall be referred to as the "ISO Maximum Safelight Condition".

4.3 ISO Safelight Condition

Any condition which produces less than one-half the exposure required to produce the smallest detectable change on an image on a material when evaluated according to the procedures described in this International Standard shall be referred to as the "ISO Safelight Condition".

5 Bibliography

ISO 5, *Photography — Density measurements*

— *Part 2 : Geometric conditions for transmission density.*

— *Part 3 : Spectral conditions.*

— *Part 4 : Geometric conditions for reflection density.*

ISO 3664, *Photography — Illumination conditions for viewing colour transparencies and their reproductions.*

ISO 7589, *Photography — Illuminants for sensitometry — Specifications for daylight and incandescent tungsten.*

Annex

Additional data

(This annex does not form part of the standard.)

A.1 Factors that may affect the response of a material to a low safelight exposure on a photographic image :

a) Spectral quality of the illuminant.

b) Illuminance (or irradiance) level.

c) Exposure time.

d) Characteristics of the image exposure (densities produced).

e) Extent of process development of the material.

f) Reciprocity characteristics.

g) Latent image formation mechanism of the material.

h) Latent image keeping characteristics of the material for low exposure levels.

i) Sequence of image and safelight exposure (whichever occurs first).

As can be seen from the above list, which is not complete, the effect produced by a safelight exposure is dependent on many variables. This generally makes it necessary to run a test to verify that a safelight condition is actually "safe".

Typical effects are shown in figure 2 for three levels of overall safelight exposure for a particular product.

A.2 Important safelight factors

a) No safelight is considered safe for an indefinite period of time.

b) Specific safelight filters are designed for specific types of papers, plates and films.

c) Some photographic materials must be handled in total darkness.

d) Filters fade with use.

e) Poor safelight conditions can result in a loss in photographic image quality before actual fog appears.

f) Photographic materials are often sensitive to radiation outside of the visual (400-700 nm) region (i.e. Ultraviolet, Infra red γ-rays, X-rays).

g) Remember that exposure is additive. Previous exposures to safelighting will reduce the tolerance to later exposures.

A.3 Precautions to take with darkroom safelighting

a) Use the correct safelight filters and replace them when necessary.

b) Use the correct wattage lamp.

c) Maintain the distance between the safelight and where the material is handled.

d) Consider the effect of darkroom changes on the safelight condition (ie. painting, clothing, location).

e) Test safelighting conditions periodically.

f) Minimize the length of the time material is exposed to safelighting.

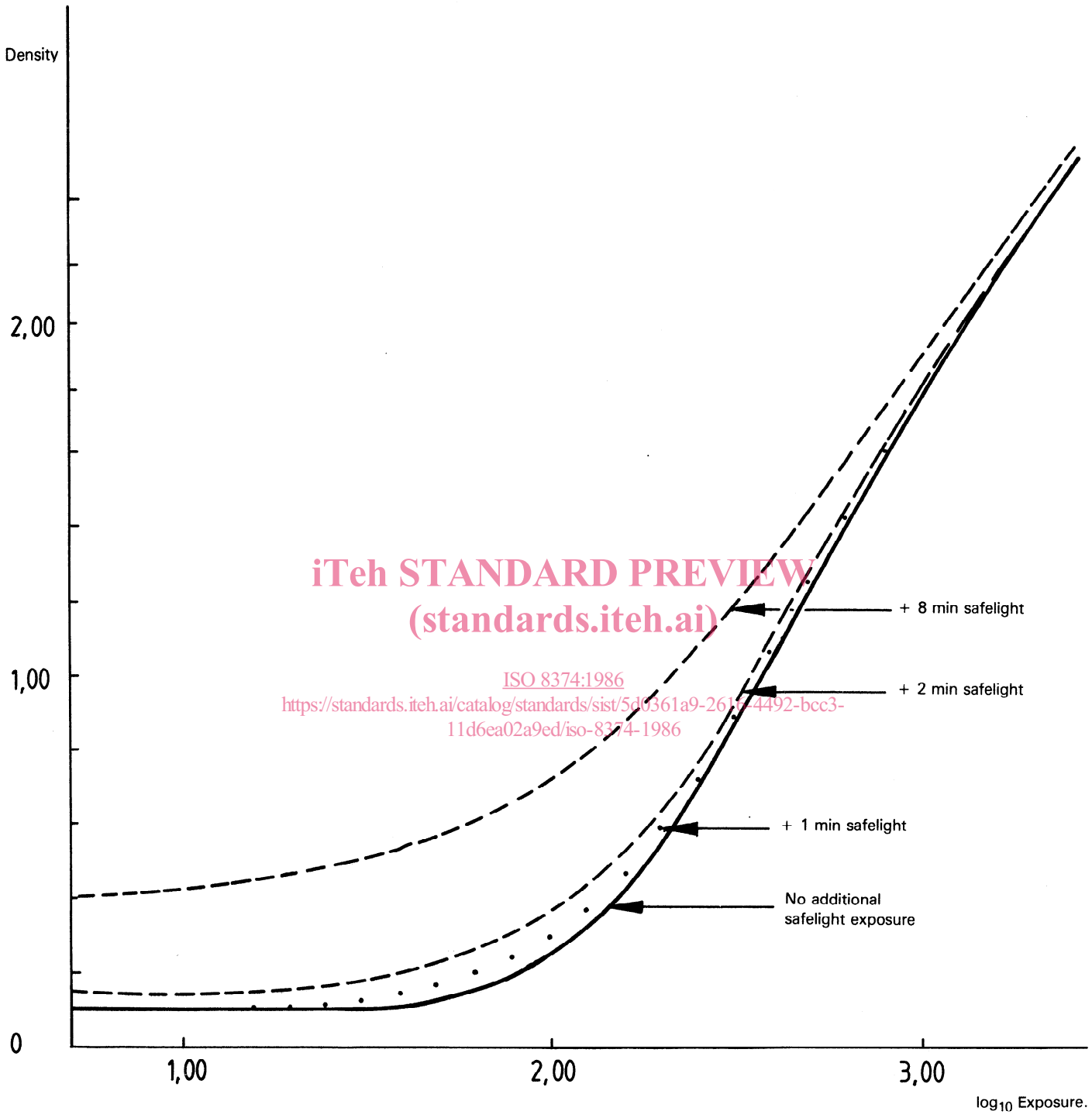

Figure 2 — Example of overall safelight exposure effects