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Non-destructive testing — Industrial radiographic illuminators — Minimum requirements

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Foreword

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This document was prepared by Technical Committee ISO/TC *135*, *Non-destructive testing*, Subcommittee SC 5, *Radiographic testing*, in collaboration with the European Committee for Standardization (CEN) Technical Committee CEN/TC 138, *Non-destructive testing*, in accordance with the Agreement on technical cooperation between ISO and CEN (Vienna Agreement).

This second edition cancels and replaces the first edition (ISO 5580:1985), which has been technically revised.

The main changes are as follows:

— normative references added to Clause 2;

— exact specification for luminance measurement equipment required (4.3);

— statements on luminance control of illuminators added (4.3);

— range of permitted light colours has been added (4.4);

— “Lamps” replaced by “Light sources”, so that LEDs can be used too (7);

— “Film density” was replaced by “optical density” throughout the document;

— minor editorial corrections.

Any feedback or questions on this document should be directed to the user’s national standards body. A complete listing of these bodies can be found at www.iso.org/members.html.

Non-destructive testing — Industrial radiographic illuminators — Minimum requirements

1 Scope

The function of an industrial radiographic illuminator is to provide sufficient diffuse light for viewing of developed radiographic films (radiographs).

This document specifies the minimum requirements for industrial radiographic illuminators used for viewing radiographs.

2 Normative references

The following documents are referred to in the text in such a way that some or all of their content constitutes requirements of this document. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

CIE S 017/E, *International Lighting Vocabulary, 2nd Edition*

ISO/CIE 19476, *Characterization of the performance of illuminance meters and luminance meters*

ISO 5576, *Non-destructive testing — Industrial X-ray and gamma-ray radiology — Vocabulary*

3 Terms and definitions

For the purposes of this document, the terms and definitions given in CIE S 017/E and ISO 5576 apply.

ISO and IEC maintain terminology databases for use in standardization at the following addresses:

— ISO Online browsing platform: available at https://www.iso.org/obp

— IEC Electropedia: available at https://www.electropedia.org/

4 Characteristics of radiographic illuminators

4.1 Mechanical and electrical construction

An illuminator consists of the housing with one of the sides being the viewing screen illuminated from the inside. This screen can itself be the diffusing screen. This housing may also contain a system for thermal protection of the radiographs; this system may or may not be ventilated.

Generally, dry radiographs should be viewed. For possible viewing of wet radiographs in the dark room, the illuminator shall be designed to prevent penetration of the liquid if the radiograph comes into contact with the screen.

The illuminator shall guarantee the same safety of personnel as an electric apparatus with maximum voltage, insulation and earthing which is required by corresponding safety standards of electro technics in each country where these are applied.

4.2 Viewing screen

The screen shall be easy to clean and shall be made of a material which is resistant to scratching during cleaning processes recommended by the manufacturer and during film viewing.

The screen may be a combination of elements, all of which should be resistant to heat in terms of deformation and discoloration.

The size of the screen shall allow the viewing of a radiograph without excessive glare reaching the eyes of the operator. If the illuminator is used for viewing radiographs of different sizes, internal or external covering masks shall be provided.

4.3 Luminance

The screen luminance required depends on the optical density of the radiographs. The luminance shall be measured with a luminance meter in cd/m^2 in accordance with ISO/CIE 19476 using a $V(\lambda)$ spectral responsivity. The following minimum screen luminance $L_{\min}$ should be achieved for the perception of information depending on the optical density D of the illuminated radiograph.

The luminance L (or brightness) of the illuminated radiograph shall be:

— $L \geq 30$ cd/m^2 for optical densities $D \leq 2{,}5$, i.e. $L_{min} \geq 3 * 10^{D+1}$ cd/m^2;

— $L \geq 10$ cd/m^2 for optical densities $D > 2{,}5$, i.e. $L_{min} \geq 1 * 10^{D+1}$ cd/m^2;

and, wherever possible, approximately 100 cd/m^2 or higher. These minimum values require the following screen luminance $L_{\min}$ according to Table 1:

Table 1 — Minimum screen luminance $L_{\min}$ depending on the optical density D of the radiograph

optical density D	Minimum screen luminance $L_{\min}$ cd/m^2
1,0	300
1,5	1 000
2,0	3 000
2,5	10 000
3,0	10 000
3,5	30 000
4,0	100 000
4,5	300 000
5,0	1 000 000

At screen luminances $L_{\min} > 300\,000$ cd/m^2, the viewed radiograph will absorb so much light, that it heats up itself and will curl as a result of this single side heating by the illumination light. Viewing at such high luminance should be limited to seconds only.

The illuminator shall be equipped with a variable and continuous control of the screen luminance.

The illumination control should be realized using constant current. A pulsed current through the light source will irritate standard, non-integrating densitometer circuits resulting in wrong density measures. Pulsed current illumination control requires the application of integrating densitometers over several pulses. In this case, correct density readings at various illumination levels should be verified before usage.

4.4 Colour of light

The colour of the light used to illuminate the radiograph is normally white. The correlated colour temperature (CCT), in accordance to CIE S 017/E, shall be in the range between 2 500 K to 7 000 K. However, in the case of a film with an emulsion type yielding a non-white image, light with adapted colours may be used if they have been recommended by the film manufacturer.

4.5 Diffusion of light

If the illuminator has a diffusing screen, the light shall be sufficiently divergent so that the eyes of the observer receive rays from all parts of the screen. The diffusion factor σ' shall exceed 0,7 (see 5.2).

4.6 Uniformity of illumination

The screen shall be uniformly illuminated, the uniformity factor g being higher than 0,5 (see 5.3).

4.7 Disturbing light

The housing, blinds and covering masks shall be constructed in such a manner that no disturbing light hinders the viewing of the radiographs (see 5.1).

4.8 Anti-glare device

Each illuminator shall be fitted with an anti-glare device, which, by manual or automatic operation, prevents the operator from being subjected to excessive light brightness when the radiograph is removed.

4.9 Heating

Precautions shall be taken to ensure that the temperature of the housing does not exceed 60 °C at the usual contact surfaces after 1 h of intermittent operation (50 % switched on with maximum of 15 s duration at an ambient temperature of 20 °C). Further precautions shall be taken to ensure that a radiograph of optical density of 3 does not warp after a continuous viewing time of 1 min and 1 h of intermittent operation of the illuminator.

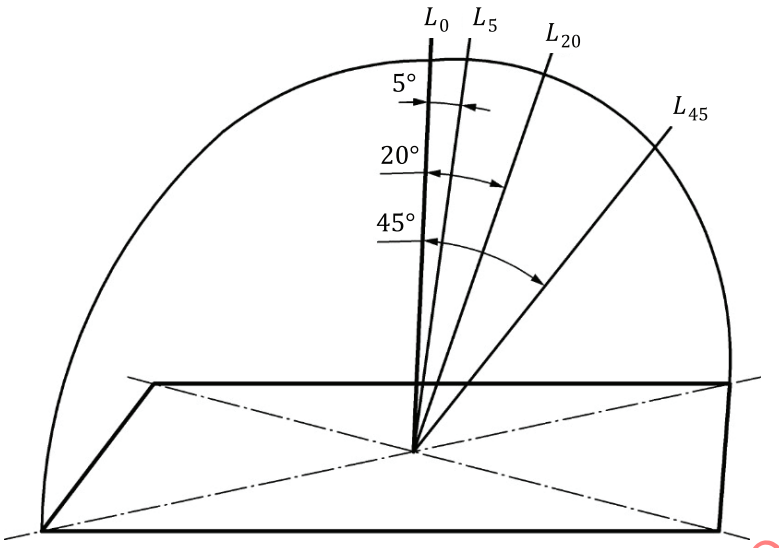
5 Determination of certain characteristics

5.1 General

All photometric measurements shall be carried out in a darkened room. The luminance meter shall be used only in its specified measuring range. Further, light escaping from the illuminator, even when the viewing screen is completely masked, shall not affect the measurements.

5.2 Divergence and dispersion of light of diffusing screens

The luminance shall be measured on a semi-circle, the centre of which is the centre of the screen and the diameter of which is approximately the same as the maximum dimension of the screen, but at least 50 cm. The luminance shall be measured with the aid of an appropriate luminance meter, the sensitive surface of which is a tangent to the curve of the circle (see Figure 1).



Key

L_0	luminance measured in a perpendicular direction to the screen	L_{20}	luminance measured at a 20° inclination from the perpendicular direction to the screen
L_5	luminance measured at a 5° inclination from the perpendicular direction to the screen	L_{45}	luminance measured at a 45° inclination from the perpendicular direction to the screen

Figure 1 — Screen luminance measurement

These measurements shall be made at angles of 45° (L_{45}), 20° (L_{20}) and 5° (L_5) related to the perpendicular direction to the screen. The diffusion factor σ' shall be calculated according to the Formula (1).

$$\sigma' = \frac{L_{45} + L_{20}}{2L_5} \tag{1}$$

where

σ' is the diffusion factor;

L_5 is the screen luminance measured at an angle of 5°;

L_{20} is the screen luminance measured at an angle of 20°;

L_{45} is the screen luminance measured at an angle of 45°.

The measurements shall be made successively in both senses of rotation.

5.3 Uniformity of screen luminance

The measurements shall be made with the aid of a luminance meter or other suitable instrument. If the screen is rectangular, it shall be divided into squares, each side of the squares measuring 3,5 cm, the luminance of each being measured separately. If the screen is circular, the same basic procedure shall be followed. In both cases, the network of the squares shall be so arranged that the middle square is centred in the middle of the screen.