

Evaluation and routine testing in medical imaging departments —

Part 2: Constancy tests —

Section 2.5 Method for image display devices

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- British Institute of Radiology
- College of Radiographers
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- Royal College of Radiologists
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National foreword

This British Standard has been prepared by Technical Committee HCC/73, Interchangeable X-ray components, and is the English language version of EN 61223-2-5:1994 *Evaluation and routine testing in medical imaging departments — Part 2-5: Constancy tests — Image display devices*, published by the European Committee for Electrotechnical Standardization (CENELEC). It is identical with IEC 1223-2-5:1994 published by the International Electrotechnical Commission (IEC).

Cross-references

Publication referred to	Corresponding British Standard
IEC 788:1984	BS 6641:1985 <i>Glossary of medical radiology terms</i> BS 7725 <i>Evaluation and routine testing in medical imaging departments</i>
IEC 1223-1:1993	Part 1:1994 <i>General</i> Part 2 <i>Constancy tests</i>
IEC 1223-2-1:1993	Section 2.1:1994 <i>Method for film processors</i>
IEC 1223-2-2:1993	Section 2.2:1994 <i>Method for radiographic cassettes and film changers and film-screen contact and relative sensitivity of the screen-cassette assembly</i>
IEC 1223-2-3:1993	Section 2.3:1994 <i>Method for darkroom safelight conditions</i>
IEC 1223-2-4:1994	Section 2.4:1994 <i>Method for hard copy cameras</i>

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Summary of pages

This document comprises a front cover, an inside front cover, pages i and ii, the EN title page, pages 2 to 22, an inside back cover and a back cover.

This standard has been updated (see copyright date) and may have had amendments incorporated. This will be indicated in the amendment table on the inside front cover.

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Descriptors: Electromedical equipment, computed tomography, medical imaging, constancy test, evaluation testing, routine testing

English version

Evaluation and routine testing in medical imaging
departments
Part 2-5: Constancy tests — Image display devices
(IEC 1223-2-5:1994)

Essais d'évaluation et de routine dans les
services d'imagerie médicale
Partie 2-5: Essais de constance
Dispositifs de visualisation des images
(CEI 1223-2-5:1994)

Bewertung und routinemäßige Prüfung in
Abteilungen für medizinische Bildgebung
Teil 2-5: Konstanzprüfungen
Bildwiedergabegeräte
(Monitore)
(IEC 1223-2-5:1994)

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European Committee for Electrotechnical Standardization
Comité Européen de Normalisation Electrotechnique
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Foreword

The text of document 62B(CO)106, as prepared by Sub-Committee 62B, Diagnostic imaging equipment, of IEC Technical Committee 62, Electrical equipment in medical practice, was submitted to the IEC-CENELEC parallel vote in May 1993.

The reference document was approved by CENELEC as EN 61223-2-5 on 8 March 1994.

The following dates were fixed:

- latest date of publication of an identical national standard (dop) 1995-03-01
- latest date of withdrawal of conflicting national standards (dow) 2000-03-01

Annexes designated “normative” are part of the body of the standard. Annexes designated “informative” are given only for information. In this standard, Annex A and Annex ZA are normative and Annex B, Annex C, Annex D, Annex E and Annex F are informative.

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Introduction

Some provisions or statements in the body of this part of IEC 1223 require additional information. Such information is presented in Annex D, Rationale. An asterisk in the left margin of a clause or subclause indicates the presence of such additional information.

1 Scope and object

1.1 Scope

This part of IEC 1223 applies to IMAGE DISPLAY DEVICES as used in diagnostic imaging systems such as:

- digital radiography;
- digital subtraction angiography;
- COMPUTED TOMOGRAPHY;
- magnetic resonance imaging;
- ultrasonic diagnostic equipment;
- NUCLEAR MEDICINE.

*The test methods are based on the use of test patterns.

*This standard does not apply to video monitors used in INDIRECT RADIOSCOPY systems.

This standard is a part of a series of Particular Publications (standards and technical reports) which give methods of tests for the constancy of properties of diagnostic imaging systems as described in IEC 1223-1 (see clause 2).

1.2 Object*

This part of IEC 1223 defines:

- a) the functional parameters which describe or affect the performance of the above components of diagnostic imaging systems; and
- b) methods of checking that variations in measured quantities related to those parameters are within acceptable limits, in order to maintain adequate standards of imaging whilst, in the case of X-RAY EQUIPMENT, avoiding unnecessary IRRADIATION of the PATIENT.

The methods are based upon assessments of representations of appropriate test pattern.

The aims are:

- to establish a reference level of performance when equipment is accepted;
- to detect and verify any significant variation in performance which may require corrective action.

In some cases, reference is made to procedures, described in other related publications, which for practical reasons are carried out prior to the application of the procedures described in this standard (see clause 2).

Because RADIOLOGICAL INSTALLATIONS differ widely from each other, this standard does not specify values and tolerances for the parameters which are generally applicable as criteria of acceptable performance. However, guidance is given to indicate the degree of variation in single measurements which might require appropriate action.

This standard does not deal with:

- a) aspects of mechanical and electrical safety;
- b) optimization of imaging performance.

*This part of IEC 1223 describes a method to check, in terms of functional parameters, the constancy of the quality of images reproduced by IMAGE DISPLAY DEVICES in order to ensure that the required conditions for displaying images of consistent quality are maintained, after the calibration and adjustment have been carried out.

2 Normative references

The following normative documents contain provisions which, through reference in this text, constitute provisions of this part of IEC 1223. At the time of publication, the editions indicated were valid. All normative documents are subject to revision, and parties to agreements based on this part of IEC 1223 are encouraged to investigate the possibility of applying the most recent editions of the normative documents listed below. Members of IEC and ISO maintain registers of currently valid International Standards.

IEC 788:1984, *Medical radiology — Terminology*.

IEC 1223-1:1993, *Evaluation and routine testing in medical imaging departments — Part 1: General aspects*.

IEC 1223-2-1:1993, *Evaluation and routine testing in medical imaging departments — Part 2-1: Constancy tests — Film processors*.

IEC 1223-2-2:1993, *Evaluation and routine testing in medical imaging departments — Part 2-2: Constancy tests — Radiographic cassettes and film changers — Film-screen contact and relative sensitivity of the screen-cassette assembly*.

IEC 1223-2-3:1993, *Evaluation and routine testing in medical imaging departments — Part 2-3: Constancy tests — Darkroom safelight conditions*.

IEC 1223-2-4:1994, *Evaluation and routine testing in medical imaging departments — Part 2-4: Constancy tests — Hard copy cameras*.

IEC 1223-2-12:19XX, *Evaluation and routine testing in medical imaging departments — Part 2-12: Constancy tests — Film illuminators*. (under consideration)

3 Terminology

3.1 Degree of requirements

In this part of IEC 1223 the verbal form:

- “shall” implies that compliance with a requirement is mandatory for compliance with the standard;
- “should” implies that compliance with a requirement is strongly recommended but is not mandatory for compliance with the standard;
- “may” implies that compliance with a requirement is permitted to be accomplished in a particular manner, for compliance with the standard.

The term

- “specific” when used with parameters or conditions: refers to a particular value or standardized arrangement, usually to those required in an IEC standard or a legal requirement;
- “specified” when used with parameters or conditions: refers to a value or arrangement to be chosen for the purpose under consideration and indicated usually in ACCOMPANYING DOCUMENTS.

3.2 Use of terms

In this part of IEC 1223, terms printed in SMALL CAPITALS are used as defined in IEC 788, 3.3 of this standard or other IEC publications referenced in Annex A. Where a defined term is used as a qualifier in another defined or undefined term it is not printed in capital letters, unless the concept thus qualified is defined, or recognized as a derived term without definition.

NOTE Attention is drawn to the fact that, in cases where the concept addressed is not strongly confined to the definition given in one of the publications listed above, a corresponding term is printed in lower-case letters.

3.3 Definitions

3.3.1

IMAGE DISPLAY DEVICE

device capable of displaying images from an input signal provided by an imaging system

NOTE Definition from IEC 1223-2-4: HARD COPY CAMERA: Device producing non-erasable images on a sheet of material from an input signal provided by an imaging system.

4 General aspects of CONSTANCY TESTS

For diagnostic imaging systems every link in the imaging chain may limit or degrade the image quality of the system. This holds especially for HARD COPY CAMERAS and IMAGE DISPLAY DEVICES.

*If the HARD COPY CAMERA and IMAGE DISPLAY DEVICE are properly adjusted and maintained (see clause 2) both should consistently produce images that appear similar.

The methods for testing the constancy described in this standard are intended to enable the OPERATOR to detect changes in image quality of images produced by IMAGE DISPLAY DEVICES.

For the results of the CONSTANCY TESTS described in this standard to be valid, it is essential to ensure that they are not significantly influenced by anything other than changes in the parameters under test.

In particular, attention shall be paid to darkroom safelight conditions and proper film processing (see IEC 1223-2-3, reference in clause 2). Special attention should also be paid to ambient lighting conditions, when using FILM ILLUMINATORS (see 1223-2-12, reference in clause 2).

Careful consideration shall be given to the operating and test conditions, under which the equipment is checked, including environmental influences.

All equipment under test or used for testing shall be marked in order to permit easy identification as those items are used in the initial CONSTANCY TEST and to assist in ensuring that the same items are used subsequently in related CONSTANCY TESTS. Prior to testing, the constancy of all equipment that is used for CONSTANCY TESTS shall be checked.

4.1 General conditions affecting test procedures

The CONSTANCY TESTS described in this standard have been designed to be robust, that is, their results should be affected only by changes in the parameters under investigation. The range of TEST DEVICES and test equipment has been kept to a minimum and restricted where possible to devices that are passive, inherently simple or reasonably stable. However, it is important:

- to consider the influence of environmental changes, particularly variations in supply voltage, on the results;
- to use photographic film which is handled, processed and viewed in accordance with the standards or technical reports referenced in clause 2.

4.2 Establishment of BASELINE VALUES

When new diagnostic imaging equipment is brought into use, or any component of the diagnostic imaging equipment, ACCESSORIES or test equipment is changed which may cause a variation in the test result, an initial CONSTANCY TEST shall be carried out immediately after an ACCEPTANCE TEST or STATUS TEST has indicated that the standard of performance is satisfactory. The purpose of the initial CONSTANCY TEST is to establish new BASELINE VALUE(S) for the parameter(s) tested.

4.3 Frequency of CONSTANCY TESTS

The CONSTANCY TESTS should be repeated as indicated for the individual test procedures. In addition, the CONSTANCY TESTS should be repeated:

- a) whenever malfunction is suspected;
- b) immediately after the equipment has undergone maintenance that could affect the performance parameter(s) under test;
- c) whenever the CONSTANCY TEST leads to results outside the established criteria, to confirm the test result.

4.4 Identification of equipment, instrumentation and test conditions

All equipment under test or used for testing shall be unequivocally identified.

4.5 Measured functional parameters

In order to detect significant changes in equipment performance, the following functional parameters are measured:

- grey-scale reproduction;
- geometry of the image;
- spatial resolution and low-contrast resolution;
- image stability and image artifacts;
- colour-related aspects.

Careful consideration shall be given to the appropriate choice of standard test conditions, under which the equipment is checked, including environmental parameters.

All related tests made in accordance with this standard shall be made:

- using the identical equipment components, ACCESSORIES and test instrumentation as during the initial CONSTANCY TEST;
- with geometrical arrangements and environmental conditions kept as constant as possible.

When a significant deviation between CONSTANCY TEST results and BASELINE VALUES is observed, not only the test instrumentation shall be re-checked, but also the positioning of the instrumentation, including the test pattern and the measurements repeated. If a significant deviation is still observed, appropriate action shall be taken (see Annex C).

When a component, which may cause a significant variation in the test result is changed, either in the equipment or the test instrumentation, new BASELINE VALUES shall be determined.

Records of all test results shall be kept for as long as the IMAGE DISPLAY DEVICES remain in use.

5 Test methods

5.1 Summary

Test images are used to check the constancy of the quality of images produced by an IMAGE DISPLAY DEVICE. The test images allow testing of grey-scale reproduction, spatial resolution, low-contrast resolution, geometry of the image, line structure and colour aspects.

5.2 Test equipment

5.2.1 Luminance meter

A luminance meter of the reflex-viewer type with an accuracy of $\pm 10\%$ shall be used to check the constancy of the luminance of the display.

The measuring range shall be between $0,1 \text{ cd/m}^2$ and 500 cd/m^2 .

The angle of measurement at the aperture of the meter should be 1° and shall not exceed 5° .

5.2.2 Test images

*A test image (or set of test images) of a digitally or electronically generated technical test pattern should consist of a technical test pattern and a clinical test image typical for the application involved. This clinical test image is called the clinical reference image.

Each test image is provided with predefined display parameters.

The technical test pattern provides a standard signal to test the constancy of the IMAGE DISPLAY DEVICE. The size of the test pattern, in pixels, shall be identical to the size of a typical clinical image.

The test images shall allow testing of the following functional parameters:

- a) grey-scale reproduction (Figure 1);
- b) spatial resolution and low-contrast resolution (Figure 4);
- c) geometry (Figure 2 and Figure 3);
- d) colour-related aspects (Figure 5).