

Non-destructive testing — Radioscopic testing —

Part 1: Quantitative measurement of imaging properties

The European Standard EN 13068-1:1999 has the status of a
British Standard

ICS 19.100

Confirmed December 2008

NO COPYING WITHOUT BSI PERMISSION EXCEPT AS PERMITTED BY COPYRIGHT LAW



Document Sharing Hub

National foreword

This British Standard is the official English language version of EN 13068-1:1999.
The UK participation in its preparation was entrusted to Technical Committee WEE/46, Non-destructive testing, which has the responsibility to:

- aid enquirers to understand the text;
- present to the responsible European committee any enquiries on the interpretation, or proposals for change, and keep the UK interests informed;
- monitor related international and European developments and promulgate them in the UK.

A list of organizations represented on this committee can be obtained on request to its secretary.

Cross-references

The British Standards which implement international or European publications referred to in this document may be found in the BSI Standards Catalogue under the section entitled “International Standards Correspondence Index”, or by using the “Find” facility of the BSI Standards Electronic Catalogue.

A British Standard does not purport to include all the necessary provisions of a contract. Users of British Standards are responsible for their correct application.

Compliance with a British Standard does not of itself confer immunity from legal obligations.

Summary of pages

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

The BSI copyright notice displayed in this document indicates when the document was last issued.

This British Standard, having been prepared under the direction of the Electrotechnical Sector Committee, was published under the authority of the Standards Committee and comes into effect on 15 March 2000

© BSI 03-2000

Amendments issued since publication

Amd. No.	Date	Comments

ISBN 0 580 35680 9

English version

Non-destructive testing - Radioscopic testing - Part 1: Quantitative measurement of imaging properties

Essais non destructifs - Contrôle par radioscopique -
Partie 1: Mesure quantitative des caractéristiques d'image

Zerstörungsfreie Prüfung - Radioskopische Prüfung -
Teil 1: Quantitative Messung der bildgebenden
Eigenschaften

This European Standard was approved by CEN on 29 October 1999.

CEN members are bound to comply with the CEN/CENELEC Internal Regulations which stipulate the conditions for giving this European Standard the status of a national standard without any alteration. Up-to-date lists and bibliographical references concerning such national standards may be obtained on application to the Central Secretariat or to any CEN member.

This European Standard exists in three official versions (English, French, German). A version in any other language made by translation under the responsibility of a CEN member into its own language and notified to the Central Secretariat has the same status as the official versions.

CEN members are the national standards bodies of Austria, Belgium, Czech Republic, Denmark, Finland, France, Germany, Greece, Iceland, Ireland, Italy, Luxembourg, Netherlands, Norway, Portugal, Spain, Sweden, Switzerland and United Kingdom.



EUROPEAN COMMITTEE FOR STANDARDIZATION
COMITÉ EUROPÉEN DE NORMALISATION
EUROPÄISCHES KOMITEE FÜR NORMUNG

Central Secretariat: rue de Stassart, 36 B-1050 Brussels

Contents

Foreword 3

1 Scope 4

2 Normative references 4

3 Radioscopic system..... 4

4 Measurement of image quality parameters..... 5

Annex A (informative) Example for a test report according to EN 13068-1..... 22

Foreword

This European Standard has been prepared by Technical Committee CEN/TC 138, Non-destructive testing, the secretariat of which is held by AFNOR.

This European Standard shall be given the status of a national standard, either by publication of an identical text or by endorsement, at the latest by June 2000, and conflicting national standards shall be withdrawn at the latest by June 2000.

According to the CEN/CENELEC Internal Regulations, the national standards organizations of the following countries are bound to implement this European Standard: Austria, Belgium, Czech Republic, Denmark, Finland, France, Germany, Greece, Iceland, Ireland, Italy, Luxembourg, Netherlands, Norway, Portugal, Spain, Sweden, Switzerland and the United Kingdom.

EN 13068 comprises a series of European Standards of radioscopic systems which is made of the following:

EN 13068-1:1999, *Non-destructive testing - Radioscopic testing - Part 1: Quantitative measurement of imaging properties.*

EN 13068-2:1999, *Non-destructive testing - Radioscopic testing - Part 2: Check of long term stability of imaging devices.*

prEN 13068-3, *Non-destructive testing - Radioscopic testing - Part 3: General principles of radioscopic testing of metallic materials by X- and gamma-rays.*

Annex A is informative.

1 Scope

The procedures given in this standard can be applied to all radiosopic systems which provide an electronic signal to a display unit or an automated image interpretation system. The radiosopic system is analysed for the response to a well defined test specimen. The measurement should be performed by a sufficiently equipped laboratory.

From the results, the specifications of the imaging system regarding image properties can be derived.

This standard so far does not include imaging properties under moving conditions.

2 Normative references

This European Standard incorporates, by dated or undated reference, provisions from other publications. These normative references are cited at the appropriate places in the text and the publications are listed hereafter. For dated references, subsequent amendments to or revisions of any of these publications apply to this European standard only when incorporated in it by amendment or revision. For undated references the latest edition of the publication referred to applies.

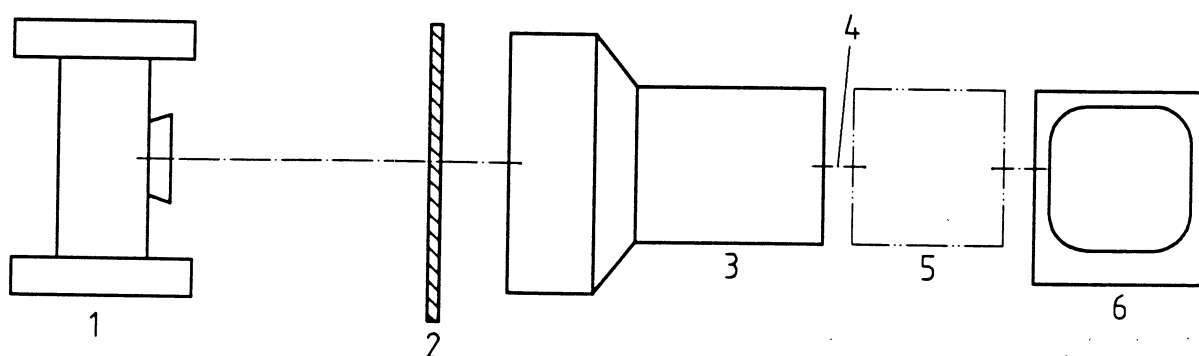
EN 29241-2, *Ergonomic requirements for office work with visual display terminals (VDTs) - Part 2: Guidance on task requirements.* (ISO 9241-2:1992)

EN 29241-3, *Ergonomic requirements for office work with visual display terminals (VDTs) - Part 3: Visual display requirements.* (ISO 9241-3:1992)

3 Radioscopic system

In the context of this standard a radiosopic system consists of a radiation source, a handling system, collimators, filters and an imaging device.

An imaging device consists of an X- or gamma ray conversion device which transforms the radiation relief into an output signal S for numerical or optical presentation (see Figure 1). Image processing systems can be part of the imaging device. In the case of visual evaluation it includes the display unit. In cases of fully automated image evaluation systems the display unit is not part of the system.



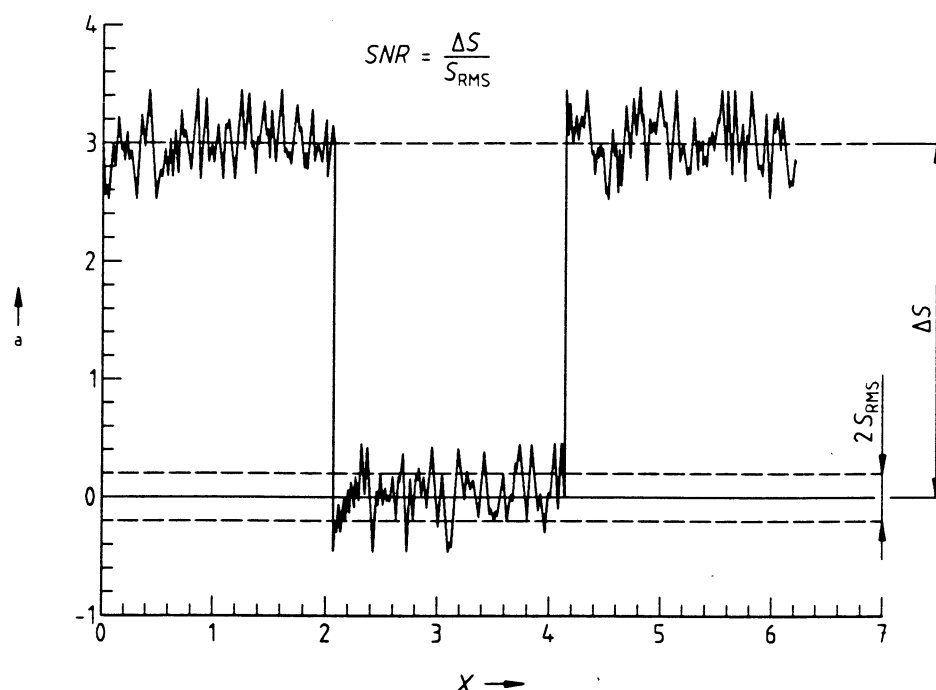
Key

- 1 Radiation source
- 2 Object
- 3 Radiation conversion device
- 4 Output signal
- 5 Image processing
- 6 Display unit

Figure 1 – Typical arrangement of an imaging device

For the specification of the imaging properties of imaging devices, terms and parameters of information theory and radiographic testing are used. The parameters in Table 1 define the image quality of imaging devices.

In some descriptions of image quality parameters the term "signal-to-noise-ratio (SNR)" is used. Within the meaning of information theory, SNR is the ratio of the actual partial scale signal ΔS to rms-value S_{RMS} of the overlay noise signal (see Figure 2).



a Signal

Figure 2 – Determination of ΔS and S_{RMS} from output signal S

4 Measurement of image quality parameters

4.1 Principle

4.1.1 Conversion device

The basis of all measurements with the conversion device is the use of a defined radiation relief by artificial test indicators as an input signal and the measurement of the system response in the linear raw output signal with suitable measuring equipment (see Figure 1). All measurements shall be done with the imaging device itself.

In Figure 3 the principle set up for all measurements is shown. The radiation filter shall be placed in front of the X-ray tube. Collimators shall be used to reduce scattering radiation. All test indicators shall be placed in front of the input screen of the conversion device. They produce a defined radiation relief as an input signal. Measuring equipment shall be connected to the final output signal for measurement of the total system response.

For video signals the measuring equipment shall fulfill the following minimum requirements:

- Amplitude resolution ≥ 10 Bit;
- Time resolution ≥ 10 Bit = 1024 sample points;
- Bandwidth ≥ 50 MHz;
- Minimum sampling rate ≥ 100 MHz;
- Signal averaging function.

Table 1 – Image quality parameters

Image quality parameter	Definition	Explanation	Importance
Inherent unsharpness U_i	$U_i = s_c \times t_r$ $t_r = t_{90\%-\text{ESF}} - t_{10\%-\text{ESF}}$ with and overshoot $\leq 10\%$	Inherent unsharpness is proportional to the rise time t_r of an edge spread function ESF from an intensity step function	Transmission limit for small object details
Spatial modulation transfer function MTF	$MTF(f_x) = \frac{1}{\int_{-\infty}^{+\infty} LSF(x) dx} \left \int_{-\infty}^{+\infty} LSF(x) \times e^{-2\pi j (x f_x)} dx \right $ $LSF(x) = \frac{d \text{ESF}(x)}{d x}$	Magnitude spectrum of the Fourier-transformed and before differentiated spatial edge spread function ESF LSF: Line Spread Function	Contrast transmission as a function of object size; functional description of image sharpness
Contrast ratio C_o	$C_o = \frac{S_o}{S_{pb}}$	Ratio of the mean amplitude S_o without masking to the mean amplitude S_{pb} with 10 % masking of front screen	Description of far-reaching, contrast-reducing disturbing effects within the radioscopic system
Contrast sensitivity C_s	$C_s = \frac{\Delta w_{min}}{w} \times 100\%$ with $SNR(\Delta w_{min}) \geq 2$	Ratio of minimal transmitted wall thickness change Δw_{min} to wall thickness w with SNR $(\Delta w_{min}) \geq 2$	Transmission limit for wall thickness changes as a function of wall thickness