

Methods for

**Determining the
characteristics of focal spots
in diagnostic X-ray tube
assemblies for medical use**

Committees responsible for this British Standard

The preparation of this British Standard was entrusted by the Health Care Standards Policy Committee (HCC/-) to Technical Committee HCC/71, upon which the following bodies were represented:

- Association of X-ray Equipment Manufacturers (BEAMA Ltd.)
- British Institute of Radiology
- College of Radiographers
- Department of Health
- Disablement Services Authority
- Institute of Physical Sciences in Medicine (IPSM)

This British Standard, having been prepared under the direction of the Health Care Standards Policy Committee, was published under the authority of the Standards Board and comes into effect on 15 February 1994

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Methods for determining the characteristics of focal spots in
diagnostic X-ray tube assemblies for medical use

NOTE. The European Committee for Electrotechnical Standardization (CENELEC) has accepted IEC 336 : 1993 as a European Standard designated as EN 60336 : 1995. This amendment implements EN 60336 : 1995 as a British Standard in the BS EN series.

Implementation of European Standard

Front cover

Delete the outside front cover and substitute the attached.

AMD 8835/October 1995

National foreword

At the end of paragraph 1 insert the following new paragraph.

In 1995 the European Committee for Electrotechnical Standardization (CENELEC) accepted IEC 336 : 1993 as European Standard EN 60336 : 1995. As a consequence of implementing the European Standard this British Standard is renumbered as BS EN 60336 and any reference to BS 6530 should be read as a reference to BS EN 60336.

AMD 8835/October 1995

New EN title page and foreword

Immediately after the national foreword, insert the attached EN title page and foreword.

AMD 8835/October 1995

New annex ZA

Immediately after annex C, insert the attached new annex ZA.

AMD 8835/October 1995

X-ray tube assemblies for medical diagnosis Characteristics of focal spots

The European Standard EN 60336 : 1995 has the status of a
British Standard

English version

X-ray tube assemblies for medical diagnosis Characteristics of focal spots

(IEC 336 : 1993)

Gaines équipées pour diagnostic médical
Caractéristiques des foyers
(CEI 336 : 1993)

Kennwerte von Brennflecken von
Röntgenstrahlern für medizinische Diagnostik
(IEC 336 : 1993)

This European Standard was approved by CENELEC on 1995-03-06. CENELEC 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 CENELEC 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 CENELEC member into its own language and notified to the Central Secretariat has the same status as the official versions.

CENELEC members are the national electrotechnical committees of Austria, Belgium, Denmark, Finland, France, Germany, Greece, Iceland, Ireland, Italy, Luxembourg, Netherlands, Norway, Portugal, Spain, Sweden, Switzerland and United Kingdom.

CENELEC

European Committee for Electrotechnical Standardization
Comité Européen de Normalisation Electrotechnique
Europäisches Komitee für Elektrotechnische Normung

Central Secretariat: rue de Stassart 35, B-1050 Brussels

Foreword

The text of the International Standard IEC 336 : 1993, prepared by SC 62B, Diagnostic imaging equipment, of IEC TC 62, Electrical equipment in medical practice, was submitted to the Unique Acceptance Procedure and was approved by CENELEC as EN 60336 on 1995-03-06 without any modification.

This European Standard supersedes HD 509 S1 : 1988.

The following dates were fixed:

- latest date by which the EN
has to be implemented at
national level by publication
of an identical national
standard or by endorsement (dop) 1996-03-15
- latest date by which the
national standards conflicting
with the EN have to be
withdrawn (dow) 1996-03-15

For products which have complied with HD 509 S1 : 1988 before 1996-03-15, as shown by the manufacturer or by a certification body, this previous standard may continue to apply for production until 1998-06-13.

Annexes designated 'normative' are part of the body of the standard. Annexes designated 'informative' are given for information only. In this standard, annex ZA is normative and annexes A, B and C are informative. ANNEX ZA has been added by CENELEC.

Annex ZA (normative)

Other international publications quoted in this standard with the references of the relevant European publications

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.

NOTE. When the international publication has been modified by CENELEC common modifications, indicated by (mod), the relevant EN/HD applies.

IEC Publication	Date	Title	EN/HD	Date
417	1973	<i>Graphical symbols for use on equipment Index, survey and compilation of the single sheets</i>		
417G	1985	<i>Seventh supplement</i>	HD 243 S12*	1995
601-2-28	1993	<i>Medical electrical equipment Part 2: Particular requirements for the safety of X-ray source assemblies and X-ray tube assemblies for medical diagnosis</i>	EN 60601-2-28	1993
613	1989	<i>Electrical, thermal and loading characteristics of rotating anode X-ray tubes for medical diagnosis</i>	EN 60613	1990
788	1984	<i>Medical radiology — Terminology</i>	HD 501 S1	1988

* HD 243 S12 is based on IEC 417 : 1973 and its supplements A : 1974 to M : 1994

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National foreword

This British Standard has been prepared under the direction of the Health Care Standards Policy Committee. It is identical with IEC 336 : 1993 *X-ray tube assemblies for medical diagnosis — Characteristics of focal spots*, prepared by Technical Committee 62 'Electrical equipment in medical practice' of the International Electrotechnical Commission (IEC). It supersedes BS 6530 : 1984, which is withdrawn.

BS 6530 : 1984 revised and replaced BS 5269 : Part 1 : 1975 *Specification for medical electrical and radiological equipment*. BS 6530 : 1984 described methods for the determination of focal spot characteristics.

This revision of BS 6530 takes into account the significant development of X-ray tube technology as well as the systematic investigation of imaging procedures since 1970.

Reference to the standard should indicate that the methods used are in accordance with BS 6530.

Cross-references

International standard	Corresponding British Standard
IEC 601-2-28 : 1993	BS EN 60601 <i>Medical electrical equipment</i> Part 2. <i>Particular requirements for safety</i> Section 2.128 : 1993 <i>Specification for X-ray source assemblies and X-ray tube assemblies for medical diagnosis</i> (Identical)
IEC 613 : 1989	BS 6058 : 1989 <i>Method of specifying and verifying the characteristics of rotating anode X-ray tubes and X-ray tube assemblies used in medical diagnosis</i> (Identical)
IEC 788 : 1984	BS 6641 : 1985 <i>Glossary of medical radiology terms</i> (Identical)

The Technical Committee has reviewed the provisions of IEC 417 : 1973 and IEC 417G : 1983 to which normative reference is made in the text, and has decided that they are acceptable for use in conjunction with this standard. There is no British Standard equivalent to the NBS Handbooks 78 and 89 referred to in the introduction. The Handbooks are obtainable from the National Bureau of Standards, Washington DC, USA.

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

INTRODUCTION

The first edition of International Standard IEC 336: 1970, *Measurement of the dimensions of focal spots of diagnostic X-ray tubes using a pinhole camera*, was based upon an earlier ICRU Recommendation and upon national standards and has become well established as a valuable means of determining the dimensions of FOCAL SPOTS.

Since its publication, X-RAY TUBE technology as well as the systematic investigation of imaging procedures has developed significantly. The method for the determination of the dimensions of a FOCAL SPOT based upon a FOCAL SPOT PINHOLE RADIOGRAM becomes very difficult for NOMINAL FOCAL SPOT VALUES smaller than 0,3 because the results are affected by factors, such as TRANSMISSION through the shielding of the diaphragm and the need for repeated IRRADIATIONS of the RADIOGRAPHIC FILM due to tube-loading considerations. Therefore, a new method, using a pair of FOCAL SPOT SLIT RADIOGRAMS, has been developed which will be applied over the entire range of usual NOMINAL FOCAL SPOT VALUES. It avoids former uncertainties in determining the dimensions of FOCAL SPOTS and gives valuable results even in cases of distorted FOCAL SPOTS. Furthermore, it provides basic data in the form of a pair of FOCAL SPOT SLIT RADIOGRAMS allowing determination of the imaging properties of the FOCAL SPOT in the form of a pair of one-dimensional MODULATION TRANSFER FUNCTIONS.

Thus, not only the method for the determination of the dimensions of FOCAL SPOTS but also that for the determination of the MODULATION TRANSFER FUNCTION will be based exclusively upon the use of the pair of FOCAL SPOT SLIT RADIOGRAMS for all NOMINAL FOCAL SPOT VALUES.

In addition, further methods are described in this standard for establishing FOCAL SPOT characteristics. These are in common use and will continue to have their place for use by manufacturers (FOCAL SPOT PINHOLE RADIOGRAMS) and in the field (FOCAL SPOT STAR RADIOGRAMS).

In its report in 1958 (see NBS handbook 78), ICRU recommended applying to the measured length of line FOCAL SPOTS a multiplier of 0,7. This correction factor was confirmed by ICRU in 1963 (see NBS handbook 89).

The same factor was incorporated in the first edition of IEC 336 and after very careful consideration, has been retained in this standard (see table 5). In this way, discrepancies between NOMINAL FOCAL SPOT VALUES according to the present standard and the dimensions of FOCAL SPOTS, well established through the application of the first and second edition of IEC 336, are avoided.

Maintaining the multiplier 0,7 for NOMINAL FOCAL SPOT VALUES of 0,3 and greater is justifiable due to the fact that these FOCAL SPOTS are almost exclusively designed for very high loads which cause the distribution in radiant intensity over the length to exhibit a pronounced peak with relatively shallow shoulders. This results in larger linear dimensions for the length of the FOCAL SPOT compared to the width even though the MODULATION TRANSFER FUNCTIONS for both width and length may be approximately equal.

FOCAL SPOTS in the range below 0,3 are normally designed for magnification techniques with a more rectangular distribution of the radiant intensity over both width and length. Here the MODULATION TRANSFER FUNCTIONS are comparatively equal so indicating the same

dimensions for width and length. Additionally, in the absence of any earlier standards there is no sound reason to perpetuate the factor of 0,7 for the new range.

For FOCAL SPOTS in X-RAY TUBE ASSEMBLIES specified for special applications, such as for RECONSTRUCTIVE TOMOGRAPHY, where different properties of the width and the length of a FOCAL SPOT are intended, the multiplier 0,7 will not be applied.

The production of FOCAL SPOT STAR RADIOGRAMS has been standardized because of their usefulness in making a simple assessment of the imaging properties of a system under field conditions by establishing the STAR PATTERN RESOLUTION LIMIT under those conditions (assuming the FOCAL SPOT has such a characteristic).

Within the scope of this standard it is not intended to recommend or require that a statement of these characteristics should be part of the specification of an X-RAY TUBE ASSEMBLY. The information to be given with an X-RAY TUBE ASSEMBLY is the subject of IEC 601-2-28. This requires the NOMINAL FOCAL SPOT VALUE and the one-dimensional MODULATION TRANSFER FUNCTION to be given in the ACCOMPANYING DOCUMENTS (see the following table).