SLOVENSKI STANDARD
SIST EN 61217:1998

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Oprema za radioterapijo - Koordinate, gibanje in skale (IEC 61217:1996)

Radiotherapy equipment - Coordinates, movements and scales

Strahlentherapie-Einrichtungen - Koordinaten, Bewegungen und Skalen

Appareils utilisés en radiothérapie - Coordonnées, mouvements et échelles

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Radiotherapy equipment
Coordinates, movements and scales
(IEC 1217:1996)

Appareils utilisés en radiothérapie
Coordonnées, mouvements et échelles
(CEI 1217:1996)

Strahlentherapie-Einrichtungen
Koordinaten, Bewegungen und Skalen
(IEC 1217:1996)

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CENELEC
European Committee for Electrotechnical Standardization
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Europäisches Komitee für Elektrotechnische Normung

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Foreword

The text of document 62C/143/FDIS, future edition 1 of IEC 1217, prepared by SC 62C, Equipment for radiotherapy, nuclear medicine and radiation dosimetry, of IEC TC 62, Electrical equipment in medical practice, was submitted to the IEC-CENELEC parallel vote and was approved by CENELEC as EN 61217 on 1996-07-02.

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Endorsement notice

The text of the International Standard IEC 1217:1996 was approved by CENELEC as a European Standard without any modification.

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Radiotherapy equipment – Coordinates, movements and scales

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INTERNATIONAL ELECTROTECHNICAL COMMISSION

RADIOTHERAPY EQUIPMENT – COORDINATES, MOVEMENTS AND SCALES

FOREWORD

1) The IEC (International Electrotechnical Commission) is a worldwide organization for standardization comprising all national electrotechnical committees (IEC National Committees). The object of the IEC is to promote international co-operation on all questions concerning standardization in the electrical and electronic fields. To this end and in addition to other activities, the IEC publishes International Standards. Their preparation is entrusted to technical committees; any IEC National Committee interested in the subject dealt with may participate in this preparatory work. International, governmental and non-governmental organizations liaising with the IEC also participate in this preparation. The IEC collaborates closely with the International Organization for Standardization (ISO) in accordance with conditions determined by agreement between the two organizations.

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International Standard IEC 1217 has been prepared by sub-committee 62C: Equipment for radiotherapy, nuclear medicine and radiation dosimetry, of IEC technical committee 62: Electrical equipment in medical practice.

The text of this standard is based on the following documents:

FDIS	Report on voting
62C/143/FDIS	62C/165/RVD

Full information on the voting for the approval of this standard can be found in the report on voting indicated in the above table.

Annexes A, B, C, D and E are for information only.

INTRODUCTION

RADIOTHERAPY is performed in medical centres where a variety of EQUIPMENT from different MANUFACTURERS is usually concentrated in the RADIOTHERAPY department. In order to plan and simulate the treatment, set up the PATIENT and direct the RADIATION BEAM, such EQUIPMENT can be put in different angular and linear positions and, in the case of MOVING BEAM RADIOTHERAPY, can be rotated and translated during the IRRADIATION of the PATIENT. It is essential that the position of the PATIENT, and the dimensions, directions, and qualities of the RADIATION BEAM prescribed in the treatment plan, be set up or varied by programmes on the RADIOTHERAPY EQUIPMENT with accuracy and without misunderstanding. Standard identification and scaling of coordinates is required for EQUIPMENT used in RADIOTHERAPY, including RADIOTHERAPY SIMULATORS, because differences in the marking and scaling of similar movements on the various types of EQUIPMENT used in the same department may increase the probability of error. In addition, data from EQUIPMENT used to evaluate the tumour region, such as ultrasound, X-ray, CT and MRI should be presented to the treatment planning system in a form which is consistent with the RADIOTHERAPY coordinate system. Coordinate systems for individual geometrical parameters are required in order to facilitate the mathematical transformation of points and vectors from one coordinate system to another.

A goal of this standard is to avoid ambiguity, confusion, and errors which could be caused when using different types of EQUIPMENT. Hence, its scope applies to all types of TELERADIOTHERAPY EQUIPMENT, RADIOTHERAPY SIMULATORS, information from diagnostic EQUIPMENT when used for RADIOTHERAPY, recording and verification EQUIPMENT, and to data input for the treatment planning process.

Movement nomenclature is to be classified as defined terms according to IEC 788 and appendix AA of IEC 601-2-1 and IEC 601-2-29 (see annex E).

This standard is issued as a publication separate from the 601 series of safety standards. It is not a safety code and does not contain performance requirements. Thus, the present requirements will not appear in future editions of the IEC 601-2 series, which deals exclusively with safety requirements.

IEC 601-2-1, IEC 601-2-11, IEC 601-2-29, IEC 976, IEC 977, IEC 1168 and IEC 1170 include EQUIPMENT movements and scale conventions. A number of changes and additions have been made in this standard. These are summarized in annex D.

A major value of a standard coordinate system is its contribution to safety in RADIOTHERAPY treatment planning. The scales that are demonstrated in this standard are consistent with the coordinate systems described herein. USERS may use other scale conventions. It is anticipated that MANUFACTURERS will normally employ the scale conventions of this standard for new EQUIPMENT.

If MANUFACTURERS provide other optional scale conventions when requested by USERS, such as to match existing EQUIPMENT in a USER'S facility or to comply with local convention or regulations, such EQUIPMENT cannot be said to comply with this standard.

It is also anticipated that MANUFACTURERS may provide, as options, scales to convert a USER'S existing EQUIPMENT to the scale conventions of this standard.

This standard does not address non-ISOCENTRIC EQUIPMENT and pitch or roll movements of the RADIATION HEAD, due to limited clinical use.

It is anticipated that future amendments may address the following:

– PATIENT coordinate system;
– Three-dimensional RADIOTHERAPY SIMULATORS;
– CT type RADIOTHERAPY SIMULATORS;
– non-ISOCENTRIC EQUIPMENT.

RADIOTHERAPY EQUIPMENT – COORDINATES, MOVEMENTS AND SCALES

1 Scope and object

This International Standard applies to EQUIPMENT and data related to the process of TELERADIOTHERAPY, including PATIENT image data used in relation with RADIOTHERAPY treatment planning systems, RADIOTHERAPY SIMULATORS, ISOCENTRIC GAMMA BEAM THERAPY EQUIPMENT, ISOCENTRIC MEDICAL ELECTRON ACCELERATORS, and non-ISOCENTRIC EQUIPMENT when relevant.

The object of this standard is to define a consistent set of coordinate systems for use throughout the process of TELERADIOTHERAPY, to define the marking of scales (where provided), to define the movements of EQUIPMENT used in this process, and to facilitate computer control when used.

2 Coordinate systems

An individual coordinate system is assigned to each major part of the EQUIPMENT which can potentially be moved in relation to another part, as illustrated in figure 1a and summarized in table 1. Furthermore a fixed reference system is defined. Each major part (e.g. GANTRY, RADIATION HEAD) is always stationary with respect to its own coordinate system.

Perspective views of an ISOCENTRIC MEDICAL ELECTRON ACCELERATOR and a RADIOTHERAPY SIMULATOR are shown in figures 1a, 14a and 14b. Isometric projection drawings of coordinate systems are shown in several figures. In the figures, an elliptic (isometric projection) arrow around an axis of a coordinate system always shows clockwise rotation of that coordinate system about that axis when viewed from its origin and in the positive direction.

NOTE – In the following description of individual coordinate systems, counter-clockwise (ccw) rotations are sometimes described in which the axis of rotation is not viewed from the origin of the individual coordinate system.

The definitions of coordinate systems, as stated in the following subclauses, allow mathematical transformations (rotation and/or translation) for the transfer of a point or vector coordinates in one system to any other coordinate system. See annex A for examples of coordinate transformations.

2.1 *General rules*

2.1.1 All coordinate systems are Cartesian right-handed. The positive parameter directions of linear and angular movements between systems are identified in figure 2. With all coordinate system angles set to zero, all coordinate system Z axes are vertically upward.

2.1.2 Coordinate axes are identified by a capital letter followed by a lower-case letter, representing coordinate system identification.

2.1.3 Coordinate systems have a hierarchical structure (mother-daughter relation) in the sense that each system is derived from another system. The common mother system is the fixed reference system. Figure 3 and table 2 show the hierarchical structure which is divided into two sub-hierarchical structures, one in relation to the GANTRY, the second in relation to the PATIENT SUPPORT.

2.1.4 The position and orientation of each daughter coordinate system (d) is derived from its mother coordinate system (m) by translation of its origin Id along one, two or three axes of its mother system and then by rotation of the daughter system about one of the daughter translated system axes.

NOTE – The mechanical motions of parts of the EQUIPMENT may follow a different sequence, as long as the EQUIPMENT ends up in the same position and orientation as it would have done if the indicated sequence had been followed.

Figures 1b and 1c show examples of translation of the daughter system origin Id along the mother system coordinate axes Xm, Ym, Zm.

Figure 1b shows translation of origin Id along Xm, Ym, Zm and rotation about axis Zd which is parallel to Zm.

Figure 1c shows translation of origin Id along Xm, Ym, Zm and rotation about axis Yd which is parallel to Ym.

Example: The BEAM LIMITING DEVICE coordinate system is derived from the GANTRY system and the latter from the fixed system. Thus, a rotation of the GANTRY system causes an analogous rotation of the coordinate axes of the BEAM LIMITING DEVICE coordinate system in the fixed system and the origin of the BEAM LIMITING DEVICE system (position of the RADIATION SOURCE) is displaced in the fixed system (in space).

2.1.5 A point defined in one system can be defined in the coordinates of the next higher system (its mother) or the next lower system (its daughter) by applying a coordinate transformation, see figure 3 and annex A. Thus, it is possible to calculate, for a point defined in the BEAM LIMITING DEVICE system, its coordinates in the table top system by application of successive coordinate transformations (rotations and translations of the origin, as defined in 2.1.4), going first from the BEAM LIMITING DEVICE system upwards to the fixed system (i.e. BEAM LIMITING DEVICE system to GANTRY system to fixed system) and from this downwards to the table top system (i.e. fixed system to PATIENT SUPPORT system to table top eccentric rotation system, if available, to table top system). Such a coordinate transformation may considerably facilitate the solution of complex geometrical problems encountered in treatment planning, as well as minimize errors in the positioning of EQUIPMENT.

2.1.6 *Notations*

2.1.6.1 Capital letters are used for coordinate axis identification and lower-case letters are used for coordinate system identification.

Example: Yg means y axis of the GANTRY system.

2.1.6.2 The rotation of one coordinate system with respect to its mother system about one particular axis of its own system is designated by the rotation angle which identifies the axis about which it rotates (ψ about X, φ about Y, and θ about Z), and by a lower-case letter identifying the system involved.

Example: θb = 30° means rotation of the "b" system with respect to the "g" system by an angle of 30° (clockwise as viewed from ISOCENTRE) around axis Zb of the "b" system (see figures 12a, 12b and also figure 5, where θb= 15°).

2.1.6.3 The linear position of the origin of a coordinate system within its mother system is designated by capital letters identifying the daughter coordinate system and by the designation of the coordinate axis of the mother system along which it is translated.

Example: Ry = (numerical value) means position of the origin of the X-RAY IMAGE RECEPTOR coordinate system along coordinate axis Yg (of its mother system).

2.1.6.4 For a movable component part which does not have its own coordinate system, its position within the system in which it moves is designated by a capital letter identifying the device in movement and a lower-case letter identifying the coordinate axis of the coordinate system along which it moves.

Example: X1 [Xb] = (numerical value) means position of RADIATION FIELD or DELINEATED RADIATION FIELD edge X1 along axis Xb of the BEAM LIMITING DEVICE system.

NOTE – When a component part position can be displaced along only one coordinate axis, then the designation of this coordinate axis can be omitted. Thus, for the above example, X1 = (numerical value) is sufficient.

2.1.6.5 The position of a point within a coordinate system is given by the numerical values of its coordinates in that system.

Example: Coordinate values of a point in the X-RAY IMAGE RECEPTOR system

xr = +20 cm

yr = –10 cm

zr = 0 cm

2.2 *Fixed reference system ("f")* (figure 1a)

The fixed coordinate system "f" is stationary in space. It is defined by a horizontal coordinate axis Yf directed from the ISOCENTRE toward the GANTRY, by a coordinate axis Zf directed vertically upward and by a coordinate axis Xf, normal to Yf and Zf and directed to the viewer's right when facing the GANTRY. For ISOCENTRIC EQUIPMENT the origin If is the ISOCENTRE Io and, therefore, Yf is the rotation axis of the GANTRY.

2.3 GANTRY *coordinate system ("g")* (figure 4)

The "g" coordinate system is stationary with respect to the GANTRY and its mother system is the "f" system. Its origin Ig is the ISOCENTRE. Its coordinate axis Zg passes through and is directed towards the RADIATION SOURCE. Coordinate axes Yg and Yf coincide.

The "g" system is in the zero angular position when it coincides with the "f" system.

The rotation of the "g" system is defined by the rotation of coordinate axes Xg, Zg by an angle φg about axis Yg (therefore about Yf of the "f" system).

An increase in the value of φg corresponds to a clockwise rotation of the GANTRY as viewed along the horizontal axis Yf from the ISOCENTRE towards the GANTRY.

2.4 *BEAM LIMITING DEVICE or DELINEATOR coordinate system ("b")* (figure 5)

The "b" coordinate system is stationary with respect to the BEAM LIMITING DEVICE or DELINEATOR system and its mother system is the "g" system. Its origin Ib is the RADIATION SOURCE. Its coordinate axis Zb coincides with and points in the same direction as axis Zg. The coordinate axes Xb and Yb are perpendicular to the corresponding edges X1, X2, Y1 and Y2 of the RADIATION FIELD or DELINEATED RADIATION FIELD (see 6.4).

NOTE – The positions of the RADIATION FIELD edges are defined by the coordinate system. The coordinate system is not defined by the RADIATION FIELD edges.