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INTERNATIONAL STANDARD

NORME INTERNATIONALE

GROUP SAFETY PUBLICATION
PUBLICATION GROUPÉE DE SÉCURITÉ

Safety requirements for electrical equipment for measurement, control, and laboratory use –
Part 2-091: Particular requirements for cabinet X-ray systems

Règles de sécurité pour appareils électriques de mesurage, de régulation et de laboratoire –
Partie 2-091: Exigences particulières pour les équipements à rayons X montés en armoire

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FOREWORD

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International Standard IEC 61010-2-91 has been prepared by IEC technical committee 66: Safety of measuring, control and laboratory equipment.

It has the status of a group safety publication as specified in IEC Guide 104.

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

FDIS	Report on voting
66/462/FDIS	66/470/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.

This Part 2-091 is intended to be used in conjunction with IEC 61010-1. It was established on the basis of the third edition (2010). Consideration may be given to future editions of, or amendments to, IEC 61010-1.

This Part 2-091 supplements or modifies the corresponding clauses in IEC 61010-1 so as to convert that publication into the IEC standard: *Particular requirements for CABINET X-RAY SYSTEMS*.

Where a particular subclause of Part 1 is not mentioned in this part 2, that subclause applies as far as is reasonable. Where this part states “addition”, “modification”, “replacement”, or “deletion”, the relevant requirement, test specification or note in Part 1 should be adapted accordingly.

In this standard:

a) the following print types are used:
   - requirements: in roman type;
   - NOTES: in small roman type;
   - *conformity and tests: in italic type*;
   - terms used throughout this standard which have been defined in Clause 3: SMALL ROMAN CAPITALS.

b) subclauses, figures, and tables which are additional to those in Part 1 are numbered starting from 101; additional annexes are lettered starting from AA and additional list items are lettered from aa).

This publication has been drafted in accordance with the ISO/IEC Directives, Part 2.

The following differing practices exist in the countries indicated below:

- 7.1: Conveyor systems are required to meet the requirements of ANSI/ASME B20.1 (USA).

A list of all parts of the IEC 61010 series, published under the general title *Safety requirements for electrical equipment for measurement, control, and laboratory use*, can be found on the IEC website.

The committee has decided that the contents of this publication will remain unchanged until the stability date indicated on the IEC web site under "http://webstore.iec.ch" in the data related to the specific publication. At this date, the publication will be

- reconfirmed,
- withdrawn,
- replaced by a revised edition, or
- amended.

SAFETY REQUIREMENTS FOR ELECTRICAL EQUIPMENT FOR MEASUREMENT, CONTROL, AND LABORATORY USE –

Part 2-091: Particular requirements for CABINET X-RAY SYSTEMS

1 Scope and object

This clause of Part 1 is applicable, except as follows:

1.1.1 Equipment included in scope

Replacement:

Replace the text with the following:

This part of IEC 61010 specifies particular safety requirements for CABINET X-RAY SYSTEMS.

A CABINET X-RAY SYSTEM is a system that contains an X-ray tube installed in a cabinet which, independently of existing architectural structures except the floor on which it may be placed, is intended to contain at least that portion of a material being irradiated, provide radiation attenuation, and exclude personnel from the interior during generation of X-radiation.

These CABINET X-RAY SYSTEMS are used in industrial, commercial, and public environments, for example, to inspect materials, to analyze materials, and to screen baggage.

1.1.2 Equipment excluded from scope

Addition:

Add the following new items to the list:

aa) equipment intended to apply X-radiation to humans or animals;

bb) equipment incorporating an X-ray tube but not incorporating complete shielding against X-radiation hazards, such as:

1) equipment intended to be used within a shielded room which excludes personnel during operation;

2) equipment intended to be used with separate portable or temporary shielding;

3) equipment intended to produce an emerging beam of X-radiation.

1.2.1 Aspects included in scope

Addition:

Add the following text at the end of the first paragraph:

This part of IEC 61010 specifies requirements for the design and methods of construction of CABINET X-RAY SYSTEMS to provide adequate protection for OPERATORS, bystanders, trained service personnel, and the surrounding area against unintentionally-emitted X-radiation and from mechanical HAZARDS related to their conveyors.

2 Normative references

This clause of Part 1 is applicable, except as follows:

Addition:

Add the following references to the list:

IEC 62061, *Safety of machinery – Functional safety of safety-related electrical, electronic and programmable electronic control systems*

ISO 13849-1, *Safety of machinery – Safety-related parts of control systems – Part 1: General principles for design*

3 Terms and definitions

This clause of Part 1 is applicable, except as follows:

3.2 Parts and accessories

Addition:

Add the following new definitions:

3.2.101
ACCESS PANEL
barrier or panel which is designed to be removed or opened for maintenance or service purposes to permit access to the interior of the cabinet

3.2.102
APERTURE
opening in the outside surface of the cabinet, other than a PORT, which remains open during generation of X-radiation

3.2.103
DOOR
barrier which is designed to be movable or opened for routine operation purposes, does not generally require TOOLS to open, and permits access to the interior of the cabinet

Note 1 to entry: Inflexible hardware rigidly affixed to the DOOR is considered part of the DOOR.

3.2.104
EXTERNAL SURFACE
outside surface of the CABINET X-RAY SYSTEM, including DOORS, ACCESS PANELS, latches, control knobs, and other permanently mounted hardware, the virtual surface across any APERTURE or PORT, and the bottom of the cabinet

3.2.105
PORT
opening in the EXTERNAL SURFACE of the cabinet which is designed to remain open during generation of X-rays, for the purpose of conveying objects into and out of the cabinet, or for partial insertion for irradiation of an object with a dimension that does not permit complete insertion into the cabinet

4 Tests

This clause of Part 1 is applicable.

5 Marking and documentation

This clause of part 1 is applicable, except as follows:

5.1 Marking

Replacement:

Replace the title with:

5.1 Marking, indicators, and annunciators

Addition:

Add the following new subclauses:

5.1.101 Markings for CABINET X-RAY SYSTEMS

The equipment shall be marked at the location of each control which may be used to initiate X-ray generation, with the text, "Caution: X-rays generated when activated", or substantially similar text.

Equipment shall be marked adjacent to each PORT which is sufficiently large to admit human body parts to the direct X-ray beam, with the text, "Caution: X-ray hazard. Do not insert any part of the body when system is activated", or substantially similar text.

The indicators required by 5.1.102 shall be marked "X-ray on", or equivalent.

NOTE 1 If a milliammeter is used as one of the required indicators, it is marked as specified in 5.1.102, and is not marked "X-ray on".

For CABINET X-RAY SYSTEMS designed so that humans may enter the cabinet for specified purposes, permanent markings shall be provided inside the cabinet to describe the function of the signals and controls required by 5.1.102 c) and 5.1.102 d).

NOTE 2 National regulations may require a nationally-accepted language for safety instructions and markings.

Conformity is checked by inspection.

5.1.102 Indicators and annunciators for CABINET X-RAY SYSTEMS

The equipment shall include all of the following indicators and annunciators.

a) Two independent means to indicate when X-rays are being generated, located so that at least one indicator is discernible from any location at which the initiation of X-ray generation is possible. The indicators shall be activated only when X-rays are being generated, except that if the X-ray generation period is less than 0,5 s, then the indicator shall be activated for at least 0,5 s. No SINGLE FAULT CONDITION shall disable both indicators. A combination of software, hardware and digital control may be used to generate two redundant "X-ray on" signals.

   One, but not both, of these indicators may be a milliammeter labeled to indicate X-ray tube current.

b) Additional indicators shall be provided as needed to ensure that at least one indicator is visible from each DOOR, ACCESS PANEL, and PORT.

c) For CABINET X-RAY SYSTEMS which are designed so that humans may enter the cabinet for specified purposes, audible and visual warning signals within the cabinet shall be provided. These signals shall be activated for at least 10 s immediately prior to the first initiation of X-ray generation after closing a DOOR designed so that humans may enter the cabinet. No SINGLE FAULT CONDITION shall disable the audible and the visual indicators at the same time.

d) For CABINET X-RAY SYSTEMS which are designed so that humans may enter the cabinet for specified purposes, a visible warning signal shall be provided within the cabinet. The indicator shall be activated only when X-rays are being generated, except that, if the X-ray generation period is less than 0,5 s, then the indicator shall be activated for at least 0,5 s.

Conformity is checked by inspection.

5.4.1 General

Replacement:

Replace item d) with the following item:

d) the information specified in 5.4.2 to 5.4.6 and 5.4.101;

Addition:

Add the following new subclause:

5.4.101 Documentation for cabinet X-ray systems

Instructions for the RESPONSIBLE BODY shall include:

a) voltage, current, and, if applicable, duty cycle RATINGS of the X-ray generation equipment;

b) instructions concerning radiological safety procedures and precautions which may be necessary because of unique features of the equipment;

c) a schedule of maintenance necessary to keep the equipment in compliance with this standard; and

d) a recommendation to consult national authorities to determine any local operational requirements.

Instructions for service personnel shall include instructions for test after repair or modification to assure that the equipment remains in compliance with this standard.

Instructions for installation and commissioning shall also include instructions for assembly, adjustment, and test to ensure that the equipment is safe after it is commissioned. See also 12.101.2.

Conformity is checked by inspection.

6 Protection against electric shock

This clause of Part 1 is applicable.

7 Protection against mechanical HAZARDS

This clause of Part 1 is applicable, except as follows:

7.1 General

Addition:

Add a new paragraph and a new Note 101 following the existing note:

Conveyors of CABINET X-RAY SYSTEMS shall comply with the applicable requirements of 7.2 to 7.7, and if any HAZARD is not adequately addressed by those subclauses a RISK assessment (see Clause 17) shall be performed.

NOTE 101 In the United States of America, conveyor systems are required to meet the requirements of ANSI/ASME B20.1.

Replacement:

Replace the conformity statement with:

Conformity is checked as specified in 7.2 to 7.7, and if applicable, Clause 17.

8 Resistance to mechanical stresses

This clause of Part 1 is applicable.

9 Protection against the spread of fire

This clause of Part 1 is applicable.

10 Equipment temperature limits and resistance to heat

This clause of Part 1 is applicable.

11 Protection against HAZARDS from fluids

This clause of Part 1 is applicable.

12 Protection against radiation, including laser sources, and against sonic and ultrasonic pressure

This clause of Part 1 is applicable, except as follows:

12.2.1.1 General

Replacement:

Replace the first paragraph and the conformity statement with the following:

CABINET X-RAY SYSTEMS shall meet the requirements of 12.101.

Equipment containing or generating ionizing radiation from radioactive sources, and equipment that generates X-radiation other than in CABINET X-RAY SYSTEMS shall meet the following requirements.

Conformity is checked as specified in 12.101, by inspection of the IEC 60405 compliance documentation, or as specified in 12.2.1.2 or 12.2.1.3, as applicable.

Addition:

Add the following new subclause:

12.101 Ionizing radiation from CABINET X-RAY SYSTEMS

12.101.1 Emitted X-radiation

Radiation emitted from a CABINET X-RAY SYSTEM shall not exceed 5 μSv/h at any point 50 mm outside the EXTERNAL SURFACE or at the plane of any APERTURE or PORT.

Conformity is checked by measurements covering the entire outer surface of the cabinet, averaged over cross-sectional areas of 1 000 mm^2, with no linear dimension greater than 50 mm, with the CABINET X-RAY SYSTEM operated at those combinations of X-ray tube potential, current, beam orientation, and conditions of scatter which produce the maximum X-ray exposure at each EXTERNAL SURFACE, APERTURE, and PORT with the DOORS and ACCESS PANELS fully closed, and again with the DOORS and ACCESS PANELS in any other positions that permit the generation of X-rays.

12.101.2 Construction

CABINET X-RAY SYSTEMS may be provided with a cabinet bottom or may be designed to be permanently mounted to a floor of a building, whereby the floor of the building becomes the bottom of the system. If the CABINET X-RAY SYSTEM is designed to be permanently mounted to a floor of a building then instructions shall state that radiation measurements must be performed in any dwelling space below the cabinet after it is installed, to ensure that the limit of 12.101.1 is not exceeded, and that additional shielding may be required.

Conformity is checked by inspection.

12.101.3 Controls

The CABINET X-RAY SYSTEM shall be equipped with the following controls:

a) a key-actuated control to ensure that X-ray generation is not possible with the key removed;

b) one or more controls to initiate and terminate X-ray generation other than by functioning of an interlock or the MAINS switch;

c) if designed so that humans may enter the cabinet for specified purposes, a control within the cabinet for preventing and terminating X-ray generation, which cannot be reset, overridden, or bypassed from the outside of the cabinet,

d) if the system may be located where the public has access, a control to ensure operator presence at the control area before X-ray generation can be initiated or maintained;

e) if the system may be located where the public has access, a control to terminate the X-ray exposure or the preset succession of exposures at any time.

CABINET X-RAY SYSTEMS designed so that humans may enter the cabinet for specified purposes shall not have any means of initiating X-ray generation from within the cabinet.

Conformity is checked by inspection.

13 Protection against liberated gases and substances, explosion and implosion

This clause of Part 1 is applicable.