



## REDLINE VERSION



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

INTERNATIONAL  
ELECTROTECHNICAL  
COMMISSION

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ICS 19.080; 71.040.10

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## INTERNATIONAL ELECTROTECHNICAL COMMISSION

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

#### **Part 2-091: Particular requirements for cabinet X-ray systems**

#### FOREWORD

- 1) The International Electrotechnical Commission (IEC) is a worldwide organization for standardization comprising all national electrotechnical committees (IEC National Committees). The object of 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, IEC publishes International Standards, Technical Specifications, Technical Reports, Publicly Available Specifications (PAS) and Guides (hereafter referred to as "IEC Publication(s)"). 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. IEC collaborates closely with the International Organization for Standardization (ISO) in accordance with conditions determined by agreement between the two organizations.
- 2) The formal decisions or agreements of IEC on technical matters express, as nearly as possible, an international consensus of opinion on the relevant subjects since each technical committee has representation from all interested IEC National Committees.
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- 4) In order to promote international uniformity, IEC National Committees undertake to apply IEC Publications transparently to the maximum extent possible in their national and regional publications. Any divergence between any IEC Publication and the corresponding national or regional publication shall be clearly indicated in the latter.
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#### **DISCLAIMER**

**This Redline version is not an official Standard and is intended to provide the user with an indication of what changes have been made to the previous version. Only the IEC International Standard provided in this package is to be considered the official Standard.**

**This Redline version provides you with a quick and easy way to compare all the changes between this standard and its previous edition. A vertical bar appears in the margin wherever a change has been made. Additions are in green text, deletions are in strikethrough red text.**

International Standard IEC 61010-2-091 has been prepared by IEC technical committee 66: Safety of measuring, control and laboratory equipment.

This second edition cancels and replaces the first edition published in 2012. It constitutes a technical revision.

This edition includes the following significant changes from the first edition, as well as numerous other changes:

- The scope of the document has been clarified and limited to equipment up to 500 kV.
- Additional marking requirements for X-ray generating assemblies have been added. (5.1)
- Requirements for high-voltage cables used in the X-ray assembly have been added. (6.5)
- Insulation requirements have been added. (6.7)
- Temperature requirements for beam-limiting devices have been added. (10.3)
- Clarification has been provided on PROTECTED EQUIPMENT and PARTIALLY PROTECTED EQUIPMENT, and test methods. (12)
- Requirements for INTERLOCKS have been modified, taking into account functional safety standards. (15)
- Requirements for reasonably foreseeable misuse have been clarified. (16)
- Risk assessment has been made mandatory for specific aspects. (17)

The text of this International Standard is based on the following documents:

FDIS	Report on voting
66/684/FDIS	66/686A/RVD

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

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

This document is intended to be used in conjunction with IEC 61010-1. It was established on the basis of the third edition (2010) of IEC 61010-1, including its Amendment 1 (2016), hereinafter referred to as Part 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*.

Clauses of Part 1 that are fully applicable are indicated by the statement "This clause of Part 1 is applicable." Where this Part 2-091 identifies a particular subclause and states "addition", "modification", "replacement", or "deletion", the text of that particular subclause Part 1 is adapted accordingly. Where a particular subclause of Part 1 is not mentioned in this Part 2-091, that subclause applies as far as is reasonable.

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).

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 document will remain unchanged until the stability date indicated on the IEC website under "<http://webstore.iec.ch>" in the data related to the specific document. At this date, the document will be

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

**IMPORTANT – The “colour inside” logo on the cover page of this publication indicates that it contains colours which are considered to be useful for the correct understanding of its contents. Users should therefore print this publication using a colour printer.**

## INTRODUCTION

IEC 61010-1 specifies the safety requirements that are generally applicable to all equipment within its scope. For certain types of equipment, the requirements of IEC 61010-1 and its amendments will be supplemented or modified by the special requirements of one, or more than one, particular Part 2s of the standard, which are to be read in conjunction with the Part 1 requirements.

This document has been prepared, based on IEC 61010-1:2010 including its Amendment 1:2016, to specify additional safety requirements for cabinet X-ray systems. It provides additional guidance for construction and assessment of extra high voltage circuits, mechanical HAZARDS and ionizing radiation HAZARDS which can be present in this type of equipment.

This document has been written to provide protection against both radiation HAZARDS from the direct X-ray beam and any scattered X-radiation caused by reflections of the X-ray beam on any part of the equipment or on the sample subjected to X-rays.

The minimum safety requirements specified in this document are considered to provide for a practical degree of safety in the operation of cabinet X-ray systems.

## 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 Scope

##### 1.1.1 Equipment included in scope

*Deletion:*

*Delete the first paragraph.*

*Replacement:*

*Replace the second paragraph (above items a) to c)) with the following new text:*

This part of IEC 61010 specifies particular safety requirements for cabinet X-ray systems, which fall under any of categories a), b) or c) below.

*Addition:*

*Add the two following new paragraphs at the end of the subclause:*

Equipment covered by this document can be both PROTECTED EQUIPMENT or PARTIALLY PROTECTED EQUIPMENT, with X-ray generator voltage up to 500 kV.

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~~ prevent operator access to the radiation beam, during generation of X-radiation.

These cabinet X-ray systems are used in industrial, commercial, and public environments, for example, to inspect materials, to analyse 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:
  - equipment intended to be used within a shielded room which excludes personnel during operation;
  - equipment intended to be used with separate portable or temporary shielding;

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

## 1.2 Object

### 1.2.1 Aspects included in scope

*Addition:*

*Add the following new text to 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*



# INTERNATIONAL STANDARD

# NORME INTERNATIONALE

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**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 mesure, de régulation et de laboratoire –  
Partie 2-091: Exigences particulières pour les équipements à rayons X montés en armoire**



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## COMMISSION ÉLECTROTECHNIQUE INTERNATIONALE

### 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

##### AVANT-PROPOS

- 1) La Commission Électrotechnique Internationale (IEC) est une organisation mondiale de normalisation composée de l'ensemble des comités électrotechniques nationaux (Comités nationaux de l'IEC). L'IEC a pour objet de favoriser la coopération internationale pour toutes les questions de normalisation dans les domaines de l'électricité et de l'électronique. À cet effet, l'IEC – entre autres activités – publie des Normes internationales, des Spécifications techniques, des Rapports techniques, des Spécifications accessibles au public (PAS) et des Guides (ci-après dénommés "Publication(s) de l'IEC"). Leur élaboration est confiée à des comités d'études, aux travaux desquels tout Comité national intéressé par le sujet traité peut participer. Les organisations internationales, gouvernementales et non gouvernementales, en liaison avec l'IEC, participent également aux travaux. L'IEC collabore étroitement avec l'Organisation Internationale de Normalisation (ISO), selon des conditions fixées par accord entre les deux organisations.
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La Norme internationale IEC 61010-2-91, a été établie par le comité d'études 66 de l'IEC: Sécurité des appareils de mesure, de commande et de laboratoire.

Cette deuxième édition annule et remplace la première édition parue en 2012. Cette édition constitue une révision technique.

Cette édition inclut les modifications techniques majeures suivantes par rapport à la première édition, ainsi que de nombreuses autres modifications.

- Le domaine d'application du document a été clarifié et limité aux appareils inférieurs à 500 kV.

- Des exigences supplémentaires de marquage pour les ensembles générant des rayons X ont été ajoutées. (5.1)
- Des exigences relatives aux câbles à haute tension utilisés dans l'ensemble radiogène ont été ajoutées. (6.5)
- Des exigences relatives à l'isolation ont été ajoutées. (6.7)
- Des exigences relatives à la température pour les LIMITEURS DE FAISCEAU ont été ajoutées. (10.3)
- Une clarification a été ajoutée concernant les APPAREILS PROTEGES et PARTIELLEMENT PROTEGES, et des méthodes d'essai. (12)
- Les exigences relatives aux VERROUILLAGES ont été modifiées, prenant ainsi en compte les normes de sécurité fonctionnelle. (15)
- Les exigences relatives au mauvais usage raisonnablement prévisible ont été clarifiées. (16)
- L'appréciation du risque a été rendue obligatoire pour des aspects spécifiques. (17)

Le texte de cette Norme internationale est issu des documents suivants:

FDIS	Rapport de vote
66/684/FDIS	66/686A/RVD

Le rapport de vote indiqué dans le tableau ci-dessus donne toute information sur le vote ayant abouti à l'approbation de cette Norme internationale.

Ce document a été rédigé selon les Directives ISO/IEC, Partie 2.

La présente Partie 2-091 est destinée à être utilisée conjointement avec l'IEC 61010-1. Elle a été établie sur la base de la troisième édition (2010) de l'IEC 61010-1, y compris son Amendement 1 (2016), ci-après dénommée la Partie 1.

La présente Partie 2-091 complète ou modifie les articles correspondants de l'IEC 61010-1 de façon à la transformer en norme IEC: *Exigences particulières pour les équipements à rayons X montés en armoire.*

Les articles de la Partie 1 qui sont entièrement applicables comportent l'énoncé "Cet article de la Partie 1 est applicable." Lorsque la présente Partie 2-091 identifie un paragraphe particulier et indique "addition", "modification", "remplacement" ou "suppression", le texte de ce paragraphe particulier de la Partie 1 est adapté en conséquence. Lorsqu'un paragraphe particulier de la Partie 1 n'est pas mentionné dans cette Partie 2-091, ce paragraphe s'applique pour autant qu'il soit raisonnable.

Dans la présente norme:

- a) les caractères d'imprimerie suivants sont employés:
  - exigences: caractères romains;
  - NOTES: petits caractères romains;
  - conformité et essais: *caractères italiques*;
  - termes définis à l'Article 3 et utilisés dans toute cette norme: PETITES MAJUSCULES EN CARACTERES ROMAINS.
- b) les paragraphes, figures et tableaux qui viennent en supplément de ceux de la Partie 1 sont numérotés à partir de 101. Les annexes complémentaires sont nommées à partir de AA et les listes de termes additionnels à partir de aa).

Une liste de toutes les parties de l'IEC 61010, publiées sous le titre général *Règles de sécurité pour appareils électriques de mesure, de régulation et de laboratoire*, peut être consultée sur le site web de l'IEC.

Le comité a décidé que le contenu de ce document ne sera pas modifié avant la date de stabilité indiquée sur le site web de l'IEC sous "<http://webstore.iec.ch>" dans les données relatives au document recherché. À cette date, le document sera

- reconduit,
- supprimé,
- remplacé par une édition révisée, ou
- amendé.

## INTRODUCTION

L'IEC 61010-1 spécifie les exigences de sécurité qui sont d'application générale à tous les appareils entrant dans son domaine d'application. Pour certains types d'appareils, les exigences de l'IEC 61010-1 et ses amendements seront complétées ou modifiées par les exigences particulières d'une ou de plusieurs normes particulières en Partie 2, qui doivent être lues conjointement avec les exigences de la Partie 1.

Le présent document a été établie, sur la base de l'IEC 61010-1:2010 y compris son Amendement 1:2016, pour spécifier des exigences supplémentaires de sécurité pour les équipements à rayons X montés en armoire. Il fournit des recommandations supplémentaires pour la construction et l'évaluation des circuits à très haute tension, les DANGERS mécaniques et les DANGERS résultant des rayonnements ionisants pouvant être présents dans ce type d'appareils.

Le présent document a été rédigé pour fournir une protection contre les DANGERS résultant des rayonnements issus du faisceau direct de rayons X et du rayonnement X diffusé provoqué par les réflexions du faisceau de rayons X sur une quelconque partie de l'appareil ou sur l'échantillon soumis aux rayons X.

Les exigences minimales de sécurité spécifiées dans le présent document sont considérées comme assurant un degré pratique de sécurité dans le fonctionnement des équipements à rayons X montés en armoire.

## 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

#### 1 Domaine d'application et objet

Cet article de la Partie 1 est applicable à l'exception de ce qui suit:

##### 1.1 Domaine d'application

##### 1.1.1 Appareils inclus dans le domaine d'application

*Suppression:*

*Suppression du premier alinéa.*

*Remplacement:*

*Remplacer le deuxième alinéa (au-dessus des points a) à c)) par le nouveau texte suivant:*

La présente partie l'IEC 61010 spécifie les exigences de sécurité particulières pour les équipements à rayons X montés en armoire, qui relèvent de n'importe laquelle des catégories de 1.1.1 a), b) ou c).

*Addition:*

*Ajouter les deux nouveaux alinéas suivants à la fin du paragraphe:*

Les appareils couverts par le présent document peuvent être des APPAREILS PROTEGES ou des APPAREILS PARTIELLEMENT PROTEGES, avec une tension de générateur de rayons X jusqu'à 500 kV.

Un équipement à rayons X monté en armoire est un appareil équipé d'un tube radiogène installé dans une armoire qui, indépendamment des structures architecturales existantes à l'exception du sol sur lequel il peut être placé, est destiné à contenir au moins une partie d'un matériau en cours d'irradiation, à fournir une atténuation du rayonnement et à empêcher l'accès de l'opérateur au faisceau de rayonnement durant la production de rayons X.

Ces équipements à rayons X montés en armoire sont utilisés dans des environnements industriels, commerciaux et publics pour, par exemple, l'inspection et l'analyse des matériaux, et pour l'inspection des bagages.

##### 1.1.2 Appareils exclus du domaine d'application

*Addition:*

*Ajouter les nouveaux points suivants à la liste:*

- aa) Équipement destiné à appliquer des rayons X sur des humains ou des animaux;
- bb) Équipement comportant un tube radiogène mais non équipé d'un blindage intégral contre les DANGERS des rayons X, tels que:

- un équipement destiné à être utilisé à l'intérieur d'une chambre blindée de laquelle le personnel est exclu pendant l'exploitation;
- un équipement destiné à être utilisé avec un blindage séparé portable ou temporaire;
- un équipement destiné à produire un faisceau émergent de rayons X.

## 1.2 Objet

### 1.2.1 Aspects inclus dans le domaine d'application

*Addition:*

*Ajouter le nouveau texte suivant à la fin du premier alinéa:*

La présente partie de l'IEC 61010 définit les exigences de conception et de méthodes de construction des équipements à rayons X montés en armoire afin de fournir une protection adaptée aux OPERATEURS, aux personnes présentes, au personnel d'entretien qualifié et à la zone environnante contre un rayonnement X émis non intentionnellement et contre les DANGERS mécaniques relatifs à leurs convoyeurs.

## 2 Références normatives

Cet article de la Partie 1 est applicable à l'exception de ce qui suit:

*Addition:*

*Ajouter les références suivantes à la liste:*

IEC 62061, *Sécurité des machines – Sécurité fonctionnelle des systèmes de commande électriques, électroniques et électroniques programmables relatifs à la sécurité*

ISO 13849-1, *Sécurité des machines – Parties des systèmes de commande relatives à la sécurité – Partie 1: Principes généraux de conception*