



**CSA  
Group**

**C22.2 No. 253-16**

# **Medium-voltage ac contactors, controllers, and control centres**

Currently in preview, click buy full version

# Legal Notice for Standards

Canadian Standards Association (operating as “CSA Group”) develops standards through a consensus standards development process approved by the Standards Council of Canada. This process brings together volunteers representing varied viewpoints and interests to achieve consensus and develop a standard. Although CSA Group administers the process and establishes rules to promote fairness in achieving consensus, it does not independently test, evaluate, or verify the content of standards.

## Disclaimer and exclusion of liability

This document is provided without any representations, warranties, or conditions of any kind, express or implied, including, without limitation, implied warranties or conditions concerning this document’s fitness for a particular purpose or use, its merchantability, or its non-infringement of any third party’s intellectual property rights. CSA Group does not warrant the accuracy, completeness, or currency of any of the information published in this document. CSA Group makes no representations or warranties regarding this document’s compliance with any applicable statute, rule, or regulation.

IN NO EVENT SHALL CSA GROUP, ITS VOLUNTEERS, MEMBERS, SUBSIDIARIES, OR AFFILIATED COMPANIES, OR THEIR EMPLOYEES, DIRECTORS, OR OFFICERS, BE LIABLE FOR ANY DIRECT, INDIRECT, OR INCIDENTAL DAMAGES, INJURY, LOSS, COSTS, OR EXPENSES, HOWSOEVER CAUSED, INCLUDING BUT NOT LIMITED TO SPECIAL OR CONSEQUENTIAL DAMAGES, LOST REVENUE, BUSINESS INTERRUPTION, LOST OR DAMAGED DATA, OR ANY OTHER COMMERCIAL OR ECONOMIC LOSS, WHETHER BASED IN CONTRACT, TORT (INCLUDING NEGLIGENCE), OR ANY OTHER THEORY OF LIABILITY, ARISING OUT OF OR RESULTING FROM ACCESS TO OR POSSESSION OR USE OF THIS DOCUMENT, EVEN IF CSA GROUP HAS BEEN ADVISED OF THE POSSIBILITY OF SUCH DAMAGES, INJURY, LOSS, COSTS, OR EXPENSES.

In publishing and making this document available, CSA Group is not undertaking to render professional or other services for or on behalf of any person or entity or to perform any duty owed by any person or entity to another person or entity. The information in this document is directed to those who have the appropriate degree of experience to use and apply its contents, and CSA Group accepts no responsibility whatsoever arising in any way from any and all use of or reliance on the information contained in this document.

CSA Group is a private not-for-profit company that publishes voluntary standards and related documents. CSA Group has no power, nor does it undertake, to enforce compliance with the contents of the standards or other documents it publishes.

## Intellectual property rights and ownership

As between CSA Group and the users of this document (whether it be in printed or electronic form), CSA Group is the owner, or the authorized licensee, of all works contained herein that are protected by copyright, all trade-marks (except as otherwise noted to the contrary), and all inventions and trade secrets that may be contained in this document, whether or not such inventions and trade secrets are protected by patents and applications for patents. Without limitation, the unauthorized use, modification, copying, or disclosure of this document may violate laws that protect CSA Group’s and/or others’ intellectual property and may give rise to a right in CSA Group and/or others to seek legal redress for such use, modification, copying, or disclosure. To the extent permitted by treaty or by law, CSA Group reserves all intellectual property rights in this document.

## Patent rights

Attention is drawn to the possibility that some of the elements of this standard may be the subject of patent rights. CSA Group shall not be held responsible for identifying any or all such patent rights. Users of this standard are expressly advised that determination of the validity of any such patent rights is entirely their own responsibility.

## Authorized use of this document

This document is being provided by CSA Group for informational and non-commercial use only. The user of this document is authorized to do only the following:

If this document is in electronic form:

- load this document onto a computer for the sole purpose of reviewing it;
- search and browse this document; and
- print this document if it is in PDF form.

Limited copies of this document in print or paper form may be distributed only to persons who are authorized by CSA Group to have such copies, and only if this Legal Notice appears on each such copy.

In addition, users may not and may not permit others to

- alter this document in any way, or remove this Legal Notice from the attached standard;
- sell this document without authorization from CSA Group; or
- make an electronic copy of this document.

If you do not agree with any of the terms and conditions contained in this Legal Notice, you may not load or use this document or make any copies of the contents hereof, and if you do make such copies, you are required to destroy them immediately. Use of this document constitutes your acceptance of the terms and conditions of this Legal Notice.



# ***Standards Update Service***

*C22.2 No. 253-16*  
*January 2016*

**Title:** *Medium-voltage ac contactors, controllers, and control centres*

To register for e-mail notification about any updates to this publication

- go to [shop.csa.ca](http://shop.csa.ca)
- click on **CSA Update Service**

The **List ID** that you will need to register for updates to this publication is **24223-5**

If you require assistance, please e-mail [techsupport@csagroup.org](mailto:techsupport@csagroup.org) or call 416-747-2233.

Visit CSA Group's policy on privacy at [www.csagroup.org/legal](http://www.csagroup.org/legal) to find out how we protect your personal information.



Association of Standardization and Certification  
NMX-J-564/106-ANCE  
Second Edition



CSA Group  
CSA C22.2 No. 253-16  
Second Edition



Underwriters Laboratories Inc.  
UL 347  
Sixth Edition

## Medium-Voltage AC Contactors, Controllers, and Control Centres

JANUARY 29, 2016



ANSI/UL 347-2016

## **Commitment for Amendments**

This standard is issued jointly by the Association of Standardization and Certification (ANCE), the Canadian Standards Association (operating as "CSA Group"), and Underwriters Laboratories Inc. (UL). Comments or proposals for revisions on any part of the standard may be submitted to ANCE, CSA Group, or UL at any time. Revisions to this standard will be made only after processing according to the standards development procedures of ANCE, CSA Group, and UL. CSA Group and UL will issue revisions to this standard by means of a new edition or revised or additional pages bearing their date of issue. ANCE will incorporate the same revisions into a new edition of the standard bearing the same date of issue as the CSA Group and UL pages.

---

## **Copyright © 2016 ANCE**

Rights reserved in favour of ANCE.

---

## **ISBN 978-1-77139-155-9 © 2016 CSA Group**

All rights reserved. No part of this publication may be reproduced in any form whatsoever without the prior permission of the publisher.

This Standard is subject to review five years from the date of publication, and suggestions for its improvement will be referred to the appropriate committee. To submit a proposal for change, please send the following information to [inquires@csagroup.org](mailto:inquires@csagroup.org) and include "Proposal for change" in the subject line: Standard designation (number); relevant clause, table and/or figure number; wording of the proposed change; and rationale for the change.

To purchase CSA Group Standards and related publications, visit CSA Group's Online Store at [www.shop.csa.ca](http://www.shop.csa.ca) or call toll-free 1-800-463-6727 or 416-777-4044.

---

## **Copyright © 2016 Underwriters Laboratories Inc.**

UL's Standards for Safety are copyrighted by UL. Neither a printed nor electronic copy of a Standard should be altered in any way. All of UL's Standards and all copyrights, ownerships, and rights regarding those Standards shall remain the sole and exclusive property of UL.

This ANSI/UL Standard for Safety consists of the Sixth Edition.

The most recent designation of ANSI/UL 347-2016 as an American National Standard (ANSI) occurred on January 29, 2016. ANSI approval for a standard does not include the Cover Page, Transmittal Pages, Title Page (front and back), or the Preface.

Comments or proposals for revisions on any part of the Standard may be submitted to UL at any time. Proposals should be submitted via a Proposal Request in UL's On-Line Collaborative Standards Development System (CSDS) at <http://csds.ul.com>.

To purchase UL Standards, visit Comm 2000 at [http://www.comm-2000.com/help/how\\_to\\_order.aspx](http://www.comm-2000.com/help/how_to_order.aspx) or call toll-free 1-888-853-3503.

---

## CONTENTS

Preface .....	6
1 General .....	8
1.1 Scope and object .....	8
1.2 Normative references, component standards, and general requirements .....	8
2 Normal and Special Service Conditions .....	9
2.1 Normal service conditions .....	9
2.2 Special service conditions .....	10
3 Definitions .....	10
3.1 General terms .....	10
3.2 Assemblies of controlgear .....	13
3.3 Parts of assemblies .....	13
3.4 Switching devices .....	13
3.5 Parts of a controller .....	15
3.6 Operation .....	16
3.7 Characteristic quantities .....	17
3.101 Fuses .....	21
3.203 Index of definitions .....	22
4 Controller and Control Center Ratings and Characteristics .....	25
4.1 Rated maximum voltage ( $U_r$ ) .....	25
4.2 Rated insulation level ( $U_d$ ), ( $U_p$ ) .....	26
4.3 Rated frequency ( $f_r$ ) .....	26
4.4 Rated continuous current and temperature rise .....	26
4.5 Rated short-time withstand current ( $I_k$ ) .....	27
4.6 Rated peak and momentary withstand current .....	27
4.7 Rated duration of short-circuit ( $t_k$ ) .....	28
4.8 Rated supply voltage of operating devices and of auxiliary and control circuits ( $U_a$ ) ..	29
4.9 Rated supply frequency of closing and opening devices and of control circuits .....	29
4.10 Rated pressure of compressed gas supply for installation and/or operation .....	29
4.101 Rated operational current or rated operational power ( $I_e$ ) .....	29
4.102 Rated duties .....	30
4.103 Rated making and breaking capacities .....	30
4.104 Utilization category .....	30
4.105 Mechanical endurance (standard and optional) .....	30
4.106 Electrical endurance .....	30
4.107 Coordination with medium-voltage fuses .....	30
4.108 Types and characteristics of automatic change-over devices and automatic acceleration control devices .....	31
4.109 Types and characteristics of autotransformers or reactors .....	31
4.110 Types and characteristics of the starting resistors for rheostatic motor starters .....	31
4.111 Characteristics dependent on starter type .....	31
4.112 Rated capacitive switching currents .....	31
4.201 Characteristics of Class E2 controllers .....	32
4.202 Fault-interrupting rating .....	33
4.203 Control center short-circuit rating .....	33
4.204 Starting duty of reduced-voltage starters .....	33
5 Design and Construction .....	34
5.1 Requirements for liquids .....	34
5.2 Requirements for gases .....	35
5.3 Provisions for protective grounding .....	35

5.4	Auxiliary and control equipment	37
5.5	Dependent power operation	37
5.6	Stored energy operation	37
5.7	Independent manual operation	37
5.8	Operation of releases	38
5.9	Low- and high-pressure interlocking and monitoring devices	38
5.10	Markings	38
5.11	Interlocks	44
5.12	Position indication	46
5.13	Degrees of protection (optional)	47
5.14	Spacings	47
5.15	Gas and vacuum tightness	49
5.16	Liquid tightness	49
5.17	Flammability	49
5.18	Electromagnetic compatibility	49
5.19	X-ray emission	49
5.101	Types of relay or release	49
5.102	Enclosures	49
5.201	Latched controllers	53
5.202	Power circuit isolating means	54
5.203	Equipment protection	55
5.204	Service equipment	57
5.205	Internal wiring	61
5.206	Terminals and connections	62
5.207	Bus bar connections	64
5.208	Connector and grounding kits	64
5.209	Insulating material	65
5.210	Wire-bending space for field-installed conductors	65
5.211	Field-installed accessories (kits)	65
5.212	Blank spaces, provision for future controllers, and spare controllers	66
5.213	Insulated bus (optional)	67
5.214	Controllers – general requirements	67
6	Type Tests	67
6.1	General	67
6.2	Dielectric tests	68
6.3	Radio interference voltage (RIV) test	72
6.4	Resistance measurement	72
6.5	Temperature rise tests	73
6.6	Short-time, momentary, and peak withstand current bus tests	80
6.101	Mechanical tests	82
6.102	Make and break capacity	84
6.103	Overload test	86
6.104	Fault interruption test	88
6.105	Verification of operating limits and characteristics of overload relays	92
6.106	Verification of coordination with SCPDs	92
6.107	Electrical endurance tests	93
6.108	Motor switching tests	93
6.109	Capacitive current switching tests	93
6.201	Switching capacity test – isolating means	96
6.202	Short-time capability	97
6.203	Driven rain test	98
6.204	Mechanical tests of viewing panes	99
6.205	Enclosure ground integrity test	100

6.206 Shutter integrity test .....	100
6.207 Rod entry test .....	100
7 Routine Tests .....	100
7.1 Power-frequency voltage withstand test on the main circuit .....	100
7.2 Power-frequency voltage withstand test on auxiliary and control circuits .....	101
7.3 Measurement of the resistance of the main circuit .....	101
7.4 Tightness test (vacuum integrity test) .....	101
7.5 Design and visual checks .....	101
7.101 Operating tests .....	101
7.102 Tests dependent on controller type .....	102
7.201 Routine tests – general .....	102

#### **Annex A (Normative) – References**

#### **Annex B (Reserved)**

#### **Annex C (Informative) – Markings required to be translated and supplied in French and Spanish translations**

#### **Annex D (Informative) – Standards for components**

#### **Annex E (Normative) - Voltage Dividers Used in Medium Voltage Controllers**

E1.0 Scope .....	127
E2.0 Definitions .....	127
E3.0 Construction .....	127
E4.0 Performance .....	128
E4.2 Dielectric withstand test .....	128

## Preface

This is the harmonized ANCE, CSA Group, and UL Standard for medium-voltage ac contactors, controllers, and control centres. It is the second edition of NMX-J-564/106-ANCE, the second edition of CSA C22.2 No. 253, and the sixth edition of UL 347. This edition of CSA C22.2 No. 253 supersedes the previous edition published in 2009. This edition of UL 347 supersedes the previous edition published on November 10, 2009.

This harmonized Standard was prepared by the Association of Standardization and Certification, CSA Group and Underwriters Laboratories Inc. The efforts and support of the medium-voltage control manufacturing industry and the CANENA Technical Harmonization Subcommittee THSC TC1, WC1 – Medium Voltage Controllers, which includes representatives of UL, CSA Group, ANCE, and North American medium voltage control manufacturers, are gratefully acknowledged.

The present Mexican Standard was developed by the CT GTD – Generación, Transmisión y Distribución from the Comité de Normalización de la Asociación de Normalización y Certificación, A.C., CONANCE, with the collaboration of the medium-voltage controller manufacturers and users.

This Standard is considered suitable for use for conformity assessment within the stated scope of the standard.

This Standard was reviewed by the CSA Task Force on Medium Voltage Controllers, under the jurisdiction of the CSA Technical Committee on Industrial Products and the CSA Strategic Steering Committee on Requirements for Electrical Safety, and has been formally approved by the CSA Technical Committee.

This Standard has been approved by the American National Standards Institute (ANSI) as an American National Standard.

**Note:** Although the intended primary application of this Standard is stated in its Scope, it is important to note that it remains the responsibility of the users of the Standard to judge its suitability for their particular purpose.

### Level of harmonization

This Standard was prepared by comparing UL 347, existing CSA Group standards, and ANCE and IEC 60470-2000 requirements. These requirements were reviewed, compared, and, where possible, harmonized. Where harmonization was not possible due to local installation codes, the differing requirements are noted in the text of the document. When conflicts between existing North American and IEC practices existed, the practice in North America is retained.

This Standard is published as an equivalent standard for ANCE, CSA Group, and UL. An equivalent standard is a standard that is substantially the same in technical content except for national differences resulting from conflicts in codes and governmental regulations. Presentation is word for word except for editorial changes.

### Formatting

This Standard is formatted to facilitate comparison to IEC 60470 requirements, and to IEC 60694, which is the common clauses document to which IEC 60470 is subservient. Requirements are categorized and arranged in the clause numbering structure currently used for IEC 60470. Where the requirements in this Standard are equivalent to those in IEC 60470, the subclause is assigned the equivalent IEC subclause number. Where this Standard does not include a subclause equivalent to those in IEC 60470, the entry

"[Vacant]" is shown for the IEC 60470 subclause number. Where this Standard includes a requirement not shown in IEC 60470, the subclause is assigned a number of a higher numerical value than those used in the IEC document.

In order to simplify the cross-referencing of corresponding requirements, the following clause numbering system is used:

- The clauses follow the IEC 60470 (and IEC 60694) format for clauses 1 through 7.
- Subclauses numbered .1 through .99 (but not subdivisions, e.g., those numbered .1.1, .1.2, .1.3, etc.) correspond to subclauses in IEC 60470 (and IEC 60694).
- Subclauses numbered .101 through .199 correspond to subclauses in IEC 60470.
- Subclauses numbered .201 through .299 are CANENA requirements not found or numbered in IEC 60470.

The purpose of this Standard is to harmonize as far as practicable all rules and requirements of a general nature in order to obtain uniformity of requirements and tests throughout the corresponding range of equipment and to avoid the need for testing to different standards.

#### **Interpretations**

The interpretation by the standards development organization of an identical or equivalent standard is based on the literal text to determine compliance with the standard in accordance with the procedural rules of the standards development organization. If more than one interpretation of the literal text has been identified, a revision is to be proposed as soon as possible to each of the standards development organizations to more accurately reflect the intent.

# MEDIUM-VOLTAGE AC CONTACTORS, CONTROLLERS, AND CONTROL CENTERS

## 1 General

### 1.1 Scope and object

This standard is applicable to ac contactors applied at voltages in the range of 1 501V to 15kV, and metal-enclosed contactor-based controllers, control centers, and other control assemblies and associated equipment applied at voltages in the range of 751V to 15kV, designed for operation at frequencies of 50 or 60 Hz on three-phase systems. These requirements cover equipment intended for use in ordinary (non-hazardous) locations and installed in accordance with the applicable local installation codes and standards (see Annex A, Item 1). These requirements, as modified by the applicable national standards for fire pump controllers, also cover fire pump controllers (see Annex A, Item 2).

This standard also includes requirements for controllers intended for service entrance applications. (See 5.204 and Annex A, Item 3.)

This standard does not cover:

- a) equipment for use in classified (hazardous) locations as defined in the applicable installation codes or standards;
- b) components contained in contactors and contactor-based controllers for which individual component standards exist; and
- c) auxiliary low voltage control assemblies (see Annex A, Item 4).

This standard also includes requirements for reduced-voltage solid state controllers. It does not, however, cover equipment consisting solely of electronic or solid state devices, circuits, or systems, nor does it cover electronic variable speed motor controllers (power conversion equipment). This standard does not cover full-voltage controllers using only solid state devices in the main circuit.

### 1.2 Normative references, component standards, and general requirements

#### 1.2.1 General

Products covered by this standard shall comply with the reference installation codes and standards noted in Annex A.

For undated references to standards, such reference shall be considered to refer to the latest edition and all revisions to that edition up to the time when this standard was approved. For dated references to standards, such reference shall be considered to refer to the dated edition and all revisions published to that edition up to the time the standard was approved.