



**CSA  
Group**

**C22.2 No. 14-13**

# **Industrial control equipment**

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, 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 license 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 format.

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. 14-13***  
***March 2013***

**Title:** *Industrial control equipment*

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 **242217**

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 [csagroup.org/legal](http://csagroup.org/legal) to find out how we protect your personal information.

*C22.2 No. 14-13*  
***Industrial control equipment***



*™A trade-mark of the Canadian Standards Association, operating as "CSA Group"*

*Published in March 2013 by CSA Group  
A not-for-profit private sector organization  
5060 Spectrum Way, Suite 100, Mississauga, Ontario, Canada L4W 5N6*

*To purchase standards and related publications, visit our Online Store at [shop.csa.ca](http://shop.csa.ca)  
or call toll-free 1-800-463-6727 or 416-747-4044.*

*ISBN 978-1-77139-230-3*

*© 2013 CSA Group*

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

# Contents

Technical Committee on Industrial Products 4

Integrated Committee on Industrial Control 6

Preface 7

**1 Scope 9**

**2 Reference publications 10**

**3 Definitions 11**

**4 Construction 12**

4.1 General 12

4.2 Frame and enclosure 13

4.2.1 General 13

4.2.2 Doors, covers, and similar parts of enclosures 13

4.2.3 Thickness of cast-metal enclosures for live parts 14

4.2.4 Thickness of sheet metal enclosures for live parts 14

4.2.5 Openings in enclosures 14

4.2.6 Enclosure thermal insulation 16

4.3 Polymeric enclosures 16

4.4 Protection against corrosion 16

4.5 Special-purpose enclosures 17

4.6 Wiring space and wire-bending space (see Annex A) 17

4.6.1 Wiring space 17

4.6.2 Wire-bending space 17

4.7 Provisions for mounting 18

4.8 Insulating material 18

4.9 Means for switching 18

4.10 Live parts 20

4.11 Protective devices 20

4.11.1 General 20

4.11.2 Overload relays 23

4.11.3 Instantaneous-trip circuit breakers 23

4.11.4 Open-phase protection 24

4.11.5 Phase reversal protection 24

4.11.6 Arrangement of grounded control circuits 24

4.12 Fuseholders 24

4.13 Internal wiring 24

4.14 Supply connections 25

4.14.1 Permanently connected equipment 25

4.14.2 Cord-connected equipment 27

4.15 Electrical spacings 27

4.15.1 General 27

4.15.2 Clearances with controlled overvoltages (Method A) 28

4.15.3	Clearances with controlled overvoltages (Method B)	28
4.16	Grounding and bonding	33
4.16.1	General	33
4.16.2	Polymeric enclosures	34
4.17	Service equipment	34
4.18	Use of intrinsic safety barriers in industrial control equipment intended for installation in ordinary locations	36
<b>5</b>	<b>Marking</b>	<b>37</b>
5.1	General marking requirements	37
5.30	Markings for combination motor controllers	42
<b>6</b>	<b>Tests</b>	<b>47</b>
6.1	General	47
6.2	Temperature	47
6.3	Overvoltage and undervoltage	50
6.4	Overload relay calibration	50
6.5	Overload	52
6.6	Endurance	55
6.7	Current withstand	56
6.8	Dielectric strength	57
6.9	Burnout	58
6.10	Short-circuit calibration of test circuits	59
6.10.1	General	59
6.10.2	Measurement of currents 10 000 A and less	60
6.10.3	Measurement of currents over 10 000 A	60
6.11	Short-circuit tests — Overload relays and equipment incorporating overload relays	63
6.11.1	General	63
6.11.2	Protective devices	64
6.11.3	Test conditions	65
6.11.4	Test circuit	67
6.11.5	Criteria for short-circuit tests performed with fuses	68
6.11.6	Criteria for short-circuit tests performed with inverse-time circuit breakers or instantaneous-trip circuit breakers	68
6.11.7	Magnetic trip-out test	69
6.11.8	Combination short-circuit test	69
6.12	Controllers intended for use on circuits capable of delivering high-fault currents	70
6.12.1	General	70
6.12.2	Test conditions and method	72
6.12.3	Protective devices	72
6.12.4	Short-circuit closing	74
6.12.5	Breaker and controller combinations	74
6.13	Controllers intended for group installation	75
6.14	Instantaneous-trip circuit breakers	76
6.15	Polymeric enclosure materials	77
6.15.1	General	77
6.15.2	Flammability of enclosure	77
6.15.3	Resistance to impact — Enclosures	78
6.15.4	Resistance to impact — Observation openings	79

6.15.5	Dielectric strength	79
6.15.6	Conduit connections	79
6.16	Securement of snap-on covers	81
6.17	Compression	81
6.18	Deflection	81
6.19	Transient-voltage-surge suppression	81
6.20	Dielectric voltage-withstand test in lieu of measuring spacings	82
6.21	Printed circuit board coatings	82
6.21.1	General	82
6.21.2	Dielectric strength (new samples)	82
6.21.3	Dielectric strength (aged samples)	83
6.21.4	Dielectric strength (after humidity conditioning)	83
6.21.5	Adhesion	83
6.22	Voltage withstand	83
6.23	Additional test requirements for manual controllers intended for use as a motor disconnect	84
6.23.1	Temperature	84
6.23.2	Overload and endurance	84
6.23.3	Dielectric strength	84
6.23.4	Short-circuit	84
6.24	Printed wiring board abnormal operation test	85
6.25	Strain relief	86

## **7 Field-installed accessories** 86

7.1	General	86
7.2	Construction	86
7.2.1	Wire connector kits and bonding kits	86
7.2.2	Other kits	87
7.3	Marking	87

---

Annex A (informative)	— Examples of wiring space and wire-bending space	144
Annex B (normative)	— Marking transitions	145
Annex C	— Requirements for fire pump controllers	149
Annex D (normative)	— Requirements for electro-mechanical, pressure sensitive floor mats for personnel protection	150

# Technical Committee on Industrial Products

<b>K. Powell</b>	Criteria, Glen Williams, Ontario <i>Representing Manufacturers</i>	<i>Chair</i>
<b>R.M. Bartholomew</b>	Electric Power Equipment Ltd, Vancouver, British Columbia <i>Representing Manufacturers</i>	<i>Vice-Chair</i>
<b>D. Stefancic</b>	CSA Group, Mississauga, Ontario	<i>Project Manager</i>

## Representing Regulatory Authorities

<b>D.P. Badry</b>	Government of Yukon, Whitehorse, Yukon Territory
<b>D.R.A. MacLeod</b>	Nova Scotia Department of Labour and Advanced Education, Halifax, Nova Scotia
<b>T. Olechna</b>	Electrical Safety Authority, Mississauga, Ontario
<b>R. Pack</b>	SaskPower, Saskatoon, Saskatchewan

## Representing Manufacturers

<b>W.K. Jones</b>	Eaton, Burlington, Ontario
<b>M. Smith</b>	Rockwell Automation Canada Inc. Control Systems, Cambridge, Ontario

## Representing General Interests

<b>N. Mancini</b>	Mississauga, Ontario
-------------------	----------------------

**D.G. Morlidge**

Fluor Canada Ltd.,  
Calgary, Alberta

**A.Z. Tsisserev**

Stantec Consulting Ltd,  
Vancouver, British Columbia

Currently in preview, click buy full version

# *Integrated Committee on Industrial Control*

<b>M. Smith</b>	Rockwell Automation Canada Inc. Control Systems, Cambridge, Ontario	<i>Chair</i>
<b>B. Baldwin</b>	Startco Engineering Ltd. o/a Littelfuse Startco, Saskatoon, Saskatchewan	
<b>R.M. Bartholomew</b>	Electric Power Equipment Ltd, Vancouver, British Columbia	
<b>R.P. de Lhorbe</b>	Schneider Electric Canada, Inc., Richmond, British Columbia	
<b>D.L. Duff</b>	David L. Duff and Associates, Burlington, Ontario	
<b>V.V. Gagachev</b>	Eaton, Burlington, Ontario	
<b>T. Olechna</b>	Electrical Safety Authority, Mississauga, Ontario	
<b>B. Pandya</b>	Siemens Canada Limited, Burlington, Ontario	
<b>N. Scott</b>	Tangent Design Engineering Ltd, Calgary, Alberta	
<b>D. Sladek</b>	Eaton Corporation Industrial Control Division, Milwaukee, Wisconsin, USA	
<b>P.M. Walthers</b>	Omron Electronics LLC, Schaumburg, Illinois, USA	
<b>J.R. Wright</b>	Siemens Industry, Inc., West Chicago, Illinois, USA	
<b>D. Zefancic</b>	CSA Group, Mississauga, Ontario	<i>Project Manager</i>

# Preface

This is the twelfth edition of CSA C22.2 No. 14, *Industrial control equipment*, one of a series of Standards issued by the Canadian Standards Association under Part II of the *Canadian Electrical Code*. It supersedes the previous editions, published in 2010, 2005, 1995, 1991, 1987, 1985, 1973, 1966, 1953, 1942, and 1935.

This edition incorporates numerous revisions. The major revisions include adding requirements for Type F combination motor controllers by making changes to the text and tables, adding Annex D for pressure sensitive floor mats and the addition of numerous clauses and Table 55 to outline the requirements for reduced spacings. Numerous other changes to various clauses and figures have been added to clarify or update specific requirements. Secondly, some changes were made to align the requirements of this edition with the requirements in CANENA-developed trinational documents that are based on the IEC 60947 series of Standards and are being adopted by Canada.

For general information on the Standards of the *Canadian Electrical Code, Part II*, see the Preface of CAN/CSA-C22.2 No. 0.

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

This Standard was prepared by the Integrated Committee on Industrial Control, under the jurisdiction of the Technical Committee on Industrial Products and the Strategic Steering Committee on Requirements for Electrical Safety, and has been formally approved by the Technical Committee.

**Interpretations:** The Strategic Steering Committee on Requirements for Electrical Safety has provided the following direction for the interpretation of standards under its jurisdiction: “The literal text shall be used in judging compliance of products with the safety requirements of this Standard. When the literal text cannot be applied to the product, such as for new materials or construction, and when a relevant committee interpretation has not already been published, CSA's procedures for interpretation shall be followed to determine the intended safety principle.”

**Notes:**

- 1) *Use of the singular does not exclude the plural (and vice versa) when the sense allows.*
- 2) *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.*
- 3) *This Standard was developed by consensus, which is defined by CSA Policy governing standardization — Code of good practice for standardization as “substantial agreement. Consensus implies much more than a simple majority, but not necessarily unanimity”. It is consistent with this definition that a member may be included in the Technical Committee list and yet not be in full agreement with all clauses of this Standard.*
- 4) *To submit a request for interpretation of this Standard, please send the following information to [inquiries@csagroup.org](mailto:inquiries@csagroup.org) and include “Request for interpretation” in the subject line:*
  - a) *define the problem, making reference to the specific clause, and, where appropriate, include an illustrative sketch;*
  - b) *provide an explanation of circumstances surrounding the actual field condition; and*
  - c) *where possible, phrase the request in such a way that a specific “yes” or “no” answer will address the issue.*

*Committee interpretations are processed in accordance with the CSA Directives and guidelines governing standardization and are available on the Current Standards Activities page at [standardsactivities.csa.ca](http://standardsactivities.csa.ca).*

- 5) *This Standard is subject to periodic review, and suggestions for its improvement will be referred to the appropriate committee. To submit a proposal for change, please send the following information to **inquiries@csagroup.org** and include "Proposal for change" in the subject line:*
- a) *Standard designation (number);*
  - b) *relevant clause, table, and/or figure number;*
  - c) *wording of the proposed change; and*
  - d) *rationale for the change.*

# C22.2 No. 14-13

## Industrial control equipment

### 1 Scope

#### 1.1

This Standard applies to control and protective devices, and accessory devices, rated at not more than 1500 V, for starting, stopping, regulating, controlling, or protecting electric motors, generators, heating apparatus, or other equipment used to control an industrial process that is intended to be installed and used in non-hazardous locations in accordance with the rules of the *Canadian Electrical Code, Part I*.

#### Notes:

- 1) *Examples of the industrial control devices covered by this Standard are manual and magnetic starters and controllers; thermal and magnetic overload relays; push-button stations (including selector switches and pilot lights); control circuit switches and relays; float-, flow-, pressure-, and vacuum-operated switches; resistors and rheostats; proximity switches; time-delay relays and switches; resistors and rheostats intended for heating and lighting, including those for motor generator fields; and control devices intended for heating and lighting.*
- 2) *The term “control” as used throughout this Standard applies to both starters and controllers.*
- 3) *Electrical instruments, such as meters, that can be included as part of control equipment are not covered by this Standard.*

#### 1.2

This Standard also applies to assemblies of industrial control and protective devices rated 750 V or less, and includes assemblies of automatic control and process equipment.

#### 1.3

Certain equipment intended for use with electric elevators, air-conditioning and refrigeration equipment, cranes and hoists, electronic and solid-state control equipment, and “TV”-rated relays, etc., can be subject to additional requirements not included in this Standard.

#### 1.4

This Standard does not apply to equipment covered by other CSA Standards, such as power supplies, programmable logic controllers, assemblies of equipment intended solely for the distribution of power, assemblies for controlling power factor, switches other than manual motor controllers, and electrical components intended to protect circuits other than motor branch-circuits.

#### 1.5

The industrial control equipment covered by this Standard is intended for use in an ambient temperature of 0 to 40 °C.

#### 1.6

In CSA Standards, “shall” is used to express a requirement, i.e., a provision that the user is obliged to satisfy in order to comply with the standard; “should” is used to express a recommendation or that which is advised but not required; “may” is used to express an option or that which is permissible within the limits of the standard; and “can” is used to express possibility or capability. Notes accompanying clauses do not include requirements or alternative requirements; the purpose of a note accompanying a clause is to separate from the text explanatory or informative material. Notes to tables and figures are