



CSA C22.2 No. 286:23
National Standard of Canada



Industrial control panels and assemblies



scc  ccn

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 licence 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

CSA C22.2 No. 286:23

April 2023

Title: *Industrial control panels and assemblies*

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

- go to www.csagroup.org/store/
- click on **Product Updates**

The **List ID** that you will need to register for updates to this publication is **2430558**.

If you require assistance, please e-mail techsupport@csagroup.org or call 416-747-2233.

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

Canadian Standards Association (operating as “CSA Group”), under whose auspices this National Standard has been produced, was chartered in 1919 and accredited by the Standards Council of Canada to the National Standards system in 1973. It is a not-for-profit, nonstatutory, voluntary membership association engaged in standards development and certification activities.

CSA Group standards reflect a national consensus of producers and users — including manufacturers, consumers, retailers, unions and professional organizations, and governmental agencies. The standards are used widely by industry and commerce and often adopted by municipal, provincial, and federal governments in their regulations, particularly in the fields of health, safety, building and construction, and the environment.

More than 10 000 members indicate their support for CSA Group’s standards development by volunteering their time and skills to Committee work.

CSA Group offers certification and testing services in support of and as an extension to its standards development activities. To ensure the integrity of its certification process, CSA Group regularly and continually audits and inspects products that bear the CSA Group Mark.

In addition to its head office and laboratory complex in Toronto, CSA Group has regional branch offices in major centres across Canada and inspection and testing agencies in fourteen countries. Since 1919, CSA Group has developed the necessary expertise to meet its corporate mission: CSA Group is an independent service organization whose mission is to provide an open and effective forum for activities facilitating the exchange of goods and services through the use of standards, certification and related services to meet national and international needs.

For further information on CSA Group services, write to
CSA Group
178 Rexdale Boulevard
Toronto, Ontario, M9W 1R3
Canada

A National Standard of Canada is a standard developed by a Standards Council of Canada (SCC) accredited Standards Development Organization, in compliance with requirements and guidance set out by SCC. More information on National Standards of Canada can be found at www.scc.ca.

SCC is a Crown corporation within the portfolio of Innovation, Science and Economic Development (ISED) Canada. With the goal of enhancing Canada’s economic competitiveness and social wellbeing, SCC leads and facilitates the development and use of national and international standards. SCC also coordinates Canadian participation in standards development, and identifies strategies to advance Canadian standardization efforts.

Accreditation services are provided by SCC to various customers, including product certifiers, testing laboratories, and standards development organizations. A list of SCC programs and accredited bodies is publicly available at www.scc.ca.

Standards Council of Canada
600-55 Metcalfe Street
Ottawa, Ontario, K1P 6L5
Canada



Cette Norme Nationale du Canada est disponible en versions française et anglaise.

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 to judge its suitability for their particular purpose.

®A trademark of the Canadian Standards Association, operating as “CSA Group”

National Standard of Canada

CSA C22.2 No. 286:23

***Industrial control panels and
assemblies***



*®A trademark of the Canadian Standards Association,
operating as "CSA Group"*



*Published in April 2023 by CSA Group
A not-for-profit private sector organization
178 Rexdale Boulevard, Toronto, Ontario, Canada M9W 1R3*

*To purchase standards and related publications, visit our Online Store at
www.csagroup.org/store/ or call toll-free 1-800-463-6727 or 416-747-4044.*

*ICS 29.130.01
ISBN 978-1-4883-4726-9*

*© 2023 Canadian Standards Association
All rights reserved. No part of this publication may be reproduced in any form whatsoever
without the prior permission of the publisher.*

Contents

Technical Committee on Industrial Products	3
Integrated Committee on Industrial Control	5
Preface	7
1 Scope	9
2 Reference publications	10
3 Definitions	11
4 Construction requirements	12
4.1 General	12
4.2 Enclosure	12
4.2.1 General	12
4.2.2 Openings in enclosures	13
4.2.3 Enclosure thermal insulation	14
4.3 Grounding and bonding	15
4.3.1 General	15
4.3.2 Bonding of polymeric enclosures	16
4.4 Connection means	17
4.4.1 General	17
4.4.2 Field wiring terminals and leads	17
4.4.3 Cord or portable power cable connections	18
4.4.4 Receptacle connections	19
4.4.5 Inlet connections	19
4.5 Wire bending space and wiring space	19
4.5.1 Wire bending space	19
4.5.2 Wiring space	20
4.6 Internal wiring	21
4.6.12 Wiring ferrules and pin (pigtail) adapters	22
4.7 Installation of components	23
4.8 Protection for industrial control panels and assemblies	24
4.8.1 General	24
4.8.2 Transformers	25
4.9 Supplementary protection	27
4.10 Disconnecting means	28
4.11 Instantaneous trip breakers	29
4.12 Temperature	29
4.13 Assembly short-circuit current ratings	31
4.13.1 Control circuits tapped from feeder circuits	31
4.13.2 Control circuits tapped from the load-side of a motor branch circuit protective device	31
4.13.3 Determining assembly SCCRs	31
4.13.4 High fault short-circuit current rating of bus bars	33
4.13.5 Power transformers used to limit the available short-circuit current	34

- 4.13.6 Current limiting circuit breakers used to limit the available short-circuit current in feeder circuits 34
- 4.13.7 Class CC, G, J, L, RK1, RK5, or T fuses used to limit the available short-circuit current in feeder circuits 35
- 4.13.8 Current-limiting circuit breakers and current-limiting fuses 36
- 4.13.9 Overall SCCR of the panel 36
- 4.13.10 Isolated power circuits 37
- 4.13.11 Components connected to the secondary circuit of a transformer 37
- 4.14 Electrical spacings 37

5 Markings 39

6 Specific application requirements 43

- 6.1 Service entrance equipment 43
- 6.2 Electric heating controllers 45
- 6.3 Use of intrinsic safety barriers 46
- 6.4 Oil and gas burning 47
- 6.5 Compressor controllers 48
- 6.6 Industrial electrical machinery 48

7 Testing 48

- 7.1 General 48
- 7.2 Temperature 48
- 7.3 Dielectric strength 50
- 7.4 Resistance to impact for observation openings 51
- 7.5 Strain relief 52
- 7.6 Abnormal operations test 52

-
- Annex A (normative) — French translations of cautions, warnings, and safety instructions 77
 - Annex B (informative) — Examples of wiring space and wire-bending space 80
 - Annex C (normative) — Calculating available fault current 82
 - Annex D (informative) — Guidelines for the use of supplementary protectors 95
 - Annex E (informative) — Production line dielectric strength testing 103

Technical Committee on Industrial Products

M. Smith	Kitchener, Ontario, Canada <i>Category: General Interest</i>	<i>Chair</i>
A. Z. Tsisserev	AES Engineering Ltd., Vancouver, British Columbia, Canada <i>Category: User Interest</i>	<i>Vice-Chair</i>
B. M. Baldwin	Baldwin Services Inc., Saskatoon, Saskatchewan, Canada <i>Category: General Interest</i>	
G. Benjamin	ABB Electrification Canada SRI, Dorval, Québec, Canada <i>Category: Producer Interest</i>	
C. C. Cormier	Nova Scotia Power, Lakeside, Nova Scotia, Canada <i>Category: Regulatory Authority</i>	
R. P. de Lhorbe	Vancouver, British Columbia, Canada <i>Category: User Interest</i>	
S. W. Douglas	QPS Evaluation Services Inc., Toronto, Ontario, Canada <i>Category: General Interest</i>	
T. S. Driscoll	OBIEC Consulting Ltd., Calgary, Alberta, Canada <i>Category: User Interest</i>	
V. V. Gagachev	Eaton, Burlington, Ontario, Canada <i>Category: Producer Interest</i>	
R. Leduc	Marex Canada Limited, Calgary, Alberta, Canada <i>Category: User Interest</i>	
M. Lusk	CSA Group, Charlotte, North Carolina, USA <i>Category: General Interest</i>	

D. Mascarenhas	Brampton, Ontario, Canada <i>Category: General Interest</i>	
S. Mercier	Régie du bâtiment du Québec, Montréal, Québec, Canada <i>Category: Regulatory Authority</i>	
M. Pilato	Technical Safety BC, Kelowna, British Columbia, Canada <i>Category: Regulatory Authority</i>	
T. Simmons	British Columbia Institute of Technology, Burnaby, British Columbia, Canada <i>Category: User Interest</i>	
G. Wagner	Wood, Saskatoon, Saskatchewan, Canada <i>Category: Producer Interest</i>	
R. Yousef	Electrical Safety Authority, Mississauga, Ontario, Canada <i>Category: Regulatory Authority</i>	
C. Lee	CSA Group, Toronto, Ontario, Canada	<i>Project Manager</i>

Integrated Committee on Industrial Control

M. Smith	Kitchener, Ontario, Canada	<i>Chair</i>
C. J. Workman	Eaton Industries (Canada) Company, Burlington, Ontario, Canada	<i>Vice-Chair</i>
B. M. Baldwin	Baldwin Services Inc., Saskatoon, Saskatchewan, Canada	
A. Browne	Intertek, Edmonton, Alberta, Canada	
S. R. Chopada	Emerson Innovation Center-Pune/Appleton Group, Pune, Maharashtra, India	
O. Chow	Kimjoss Engineering Limited, Calgary, Alberta, Canada	
R. Dahal	Eaton, Burlington, Ontario, Canada	
R. P. de Lhorbe	Vancouver, British Columbia, Canada	
S. W. Douglas	QPS Evaluation Services Inc., Toronto, Ontario, Canada	
V. V. Gagachev	Eaton, Burlington, Ontario, Canada	
T. George	Omron Management Center of America, Hoffman Estates, Illinois, USA	
C. A. Goetz	Siemens Industry, Inc., Elk Grove Village, Illinois, USA	
S. Jeffery	Noork Consultant, Pomona, California, USA	

J. Kaminski	Siemens Industry, Inc., West Chicago, Illinois, USA	
J. R. Kovacic	Underwriters Laboratories Inc., Northbrook, Illinois, USA	
M. Lusk	CSA Group, Charlotte, North Carolina, USA	
D. Matthews	Eaton, Edmonton, Alberta, Canada	
D. L. Nachtigall	Rockwell Automation, Milwaukee, Wisconsin, USA	
S. Rasaratnam	Schneider Electric, Edmonton, Alberta, Canada	
M. Upadhyay	Polphase Engineered Controls, Edmonton, Alberta, Canada	
H. Yang	Rockwell Automation Canada, Cambridge, Ontario, Canada	
L. Tiracchia	CSA Group, Toronto, Ontario, Canada	<i>Project Manager</i>

Preface

This is the third edition of CSA C22.2 No. 286, *Industrial control panels and assemblies*, one of a series of Standards issued by CSA Group under Part II of the *Canadian Electrical Code*. It supersedes the previous editions published in 2017 and 2015.

The major changes to this edition include

- a) expansion of requirements for connection means;
- b) additional requirements for ferrules and pigtail adapters;
- c) clarifications for requirements for Class 2 (non-safety control devices) components;
- d) additional compliance criteria for panels and assemblies for use outside of the assumed 0–40° C ambient range;
- e) expansion of the short-circuit current rating (SCCR) determination criteria;
- f) revisions to required SCCR markings;
- g) removal of motor control centre requirements; and
- h) addition of strain relief and abnormal operations tests.

In addition, numerous edits have been performed throughout the document to provide additional information and clarify certain requirements.

For general information on the Standards of the *Canadian Electrical Code, Part II*, see the Preface of CSA C22.2 No. 0, *General Requirements — Canadian Electrical Code, Part II*.

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.

This Standard has been developed in compliance with Standards Council of Canada requirements for National Standards of Canada. It has been published as a National Standard of Canada by CSA Group.

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 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;*