



**CSA
Group**

C22.2 No. 290-15

Photovoltaic combiners

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. 290-15
December 2015*

Title: *Photovoltaic combiners*

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

- go to shop.csa.ca
- click on **CSA Update Service**

The **List ID** that you will need to register for updates to this publication is **24236.1**

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.

C22.2 No. 290-15
Photovoltaic combiners



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

*Published in December 2015 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 shop.csa.ca
or call toll-free 1-800-463-6727 or 416-747-4044.*

ISBN 978-1-77139-925-8

© 2015 CSA Group

*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
Working Group 290 on Photovoltaic Combiners — C22.2 No. 290	5
Preface	6
1 Scope	7
2 Reference publications	7
3 Definitions and abbreviations	9
3.1 Definitions	9
3.2 Abbreviations	10
4 Construction	10
4.1 General	10
4.2 Disconnecting means	10
4.3 Enclosures	11
4.4 Openings in enclosures	12
4.5 Bases	13
4.6 Fastening and support of current-carrying parts	13
4.7 Bus bars	14
4.8 Wiring terminals	15
4.9 Wiring terminal kits	16
4.10 Combiners rated for high voltage	16
4.11 Electrical spacings	17
4.11.1 General	17
4.11.2 Electrical spacings for equipment rated up to 600 V ac or 848.5 V peak or dc	17
4.11.3 Electrical spacings for equipment rated above 600 V ac or 848.5 V peak or dc	18
4.12 Alternate approach to spacings	19
4.12.1 General	19
4.12.2 Overvoltage category (V _{oc})	19
4.12.3 Surge suppression	19
4.12.4 Pollution degree (p _d)	19
4.12.5 Instructions	20
4.13 Wiring space and wire bending space	20
4.14 Conduit entry clearance requirements	20
4.15 Separation of circuits	21
4.16 External signal, control, and communication circuits	22
4.17 Equipment bonding	23
4.18 Common connection bus bar	23
4.19 Switching devices	23
4.20 Conductor identification	24
5 Marking	24
6 Tests	28

6.1	Temperature tests	28
6.2	Dielectric strength test	31
6.3	Heat cycling test for joints in current-carrying parts	32
6.4	Flammability test	32
6.5	Moisture absorption test	33
6.6	Deflection test (metal enclosures)	33
6.7	Impact test (polymeric enclosures)	33
6.8	Impulse test	34

7 Auxiliary equipment for combiner boxes 35

Annex A (normative)	— French translations of cautions, warnings, and safety instructions	4
Annex B (informative)	— Sample nameplates	45

Technical Committee on Industrial Products

R.M. Bartholomew	Electric Power Equipment Ltd., Vancouver, British Columbia <i>Category: Producer Interest</i>	<i>Chair</i>
R.P. de Lhorbe	Schneider Electric Canada, Inc., Richmond, British Columbia <i>Category: Producer Interest</i>	<i>Vice-Chair</i>
B.M. Baldwin	Representing Startco Engineering ULC, Saskatoon, Saskatchewan <i>Category: Producer Interest</i>	
C.C. Cormier	Alberta Municipal Affairs, Edmonton, Alberta <i>Category: Regulatory Authority</i>	
V.V. Gagachev	Eaton, Burlington, Ontario <i>Category: Producer Interest</i>	
D.R.A. MacLeod	Department of Labour and Advanced Education, Halifax, Nova Scotia <i>Category: Regulatory Authority</i>	
N. Mancini	Mississauga, Ontario <i>Category: General Interest</i>	
D. Mascarenhas	Brampton, Ontario <i>Category: General Interest</i>	
D.G. Morlidre	Fluor Canada Ltd., Calgary, Alberta <i>Category: General Interest</i>	
T. Olechna	Electrical Safety Authority, Mississauga, Ontario <i>Category: Regulatory Authority</i>	
R. Pack	SaskPower, Saskatoon, Saskatchewan <i>Category: Regulatory Authority</i>	

Working Group 290 on Photovoltaic Combiners — C22.2 No. 290

C. Thwaites	Mersen Canada Toronto Inc., Mississauga,	<i>Chair</i>
L. Cantelo	Sherwood Park, Alberta	
R.H. Doe	Power-One, Inc, San Jose, California, USA	
S.W. Douglas	International Association of Electrical Inspectors, Toronto, Ontario	
J.A. Eichner	Schneider Electric, Burnaby, British Columbia	
V.V. Gagachev	Eaton, Burlington, Ontario	
N. Hanna	Electrical Safety Authority, Mississauga, Ontario	
P. Morton	TUV Rheinland Canada, Toronto, Ontario	
R. Pack	SaskPower Saskatoon, Saskatchewan	
S. Poutissou	CSA Group, Richmond, British Columbia	
L. Silecky	Mersen Canada, Mississauga, Ontario	
G. Thompson	Toronto Hydro-Electric System, Toronto, Ontario	
D. Stefancic	CSA Group, Toronto, Ontario	<i>Project Manager</i>

Preface

This is the first edition of C22.2 No. 290, *Photovoltaic combiners*, one of a series of Standards issued by CSA Group under Part II of the *Canadian Electrical Code*.

For general information on the Standards of the *Canadian Electrical Code, Part II*, see the Preface of CAN/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 Working Group on Photovoltaic Combiners, under the jurisdiction of the Integrated Committee on Photovoltaics, 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 CSA committee interpretation has not already been published, CSA Group’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;*
 - 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 standards.activities.csa.ca.
- 5) *This Standard is subject to review five years from the date of publication. 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;*
 - d) *rationale for the change.*

C22.2 No. 290-15

Photovoltaic combiners

1 Scope

1.1

This Standard applies to photovoltaic combiners rated up to 2000 V dc or 750 V ac, for use on photovoltaic (PV) systems installed in nonhazardous locations in accordance with the *Canadian Electrical Code, Part I*.

1.2

Combiners for use in photovoltaic systems that are ungrounded, positive grounded, and/or negative grounded are within the scope of this Standard.

1.3

This Standard does not cover panelboards, switchgear assemblies, and switchboards as covered by CSA C22.2 No. 29, CSA C22.2 No. 31, and CSA C22.2 No. 244.

1.4

In this Standard, “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; and “may” is used to express an option or that which is permissible within the limits of the Standard.

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 considered part of the table or figure and may be written as requirements.

Annexes are designated normative (mandatory) or informative (non-mandatory) to define their application.

2 Reference publications

This Standard refers to the following publications, and where such reference is made, it shall be to the edition listed below, including all amendments published thereto.

CSA Group

B19.2-1965

Helical spring washers

C22.1-15

Canadian Electrical Code, Part I