

Motors and generators



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.



Revision History

CSA C22.2 No. 100:14, Motors and generators

Update No. 1 — April 2017	Revision symbol (in margin)
Clauses 2 , 4.6 , 6.1 , 7.2.8.2 , 12.3.1 , and 12.4.2.2 Annex D	①

Currently in preview, click buy full version

Standards Update Service

CSA C22.2 No. 100:14
July 2014

Title: *Motors and generators*

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

- go to store.csagroup.org
- click on **CSA Update Service**

The **List ID** that you will need to register for updates to this publication is **24332-5**

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.

CSA C22.2 No. 100:14
Motors and generators



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

*Published in July 2014 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 store.csagroup.org
or call toll-free 1-800-463-6727 or 416-747-4044.*

ISBN 978-1-77139-654-7

*© 2014 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	5
Subcommittee on Motors and Generators	8
Preface	10
1 Scope	12
2 Reference publications	13
3 Definitions	14
4 General requirements	18
5 Construction	19
5.1 General	19
5.2 Enclosure	19
5.2.1 Guarded machines	19
5.2.2 Totally enclosed machines	20
5.2.3 Drip-proof and weather-proof enclosures	20
5.3 Non-metallic enclosure materials	20
5.4 Terminal boxes (750 V and less)	20
5.5 Conduit hubs and equivalent threaded openings	22
5.6 Flexible cords	22
5.7 Leads	23
5.7.1 Lead type and size	23
5.7.2 Lead insulation	23
5.7.3 Lead protection	23
5.8 Spacings (low voltage)	24
5.9 Capacitors	25
5.10 Suppressors	25
5.11 Grounding and bonding	25
5.12 Brush holders and terminals	26
5.13 Receptacles	27
5.14 Inverters integrated with a variable-speed machine	27
6 Marking	28
7 Tests	29
7.1 General	29
7.2 Temperature test	30
7.3 Rating	31
7.4 Dielectric strength test	32
7.5 Threaded conduit openings	33
7.6 Strain relief	33
7.7 Guarded machine test	33
7.8 Water tests	33

7.9	Flame tests	35
7.10	Impact test	35
7.11	Physical abuse (terminal boxes)	35
7.12	Integral insulation	36
8	DC machines and AC machines (including universal motors) in IEC frame size 80 and smaller	37
8.1	Scope	37
8.2	Construction	37
8.2.1	General	37
8.2.2	Terminal boxes	37
8.2.3	Spacings	37
8.2.4	Leads (30 V rms and less)	37
8.2.5	Soldered connections	37
8.2.6	Hobby motors	38
8.2.7	Insulation systems	38
8.3	Marking	39
8.4	Tests	39
8.4.1	General	39
8.4.2	Rating — AC motors	39
8.4.3	Rating — DC motors	39
8.4.4	Temperature test	39
8.4.5	Starting of hobby motors	40
8.4.6	Overspeed (AC series and universal motors)	40
8.4.7	Moisture absorption	40
9	AC machines (including universal motors) in IEC frame sizes 90 to 280 and rated 750 V ac and less	41
9.1	Scope	41
9.2	Construction	41
9.2.1	General	41
9.2.2	Leads to embedded detectors	41
9.2.3	Insulation systems	41
9.3	Markings	41
9.4	Tests	41
9.4.1	General	41
9.4.2	Embedded detectors	42
9.4.3	Moisture absorption	42
10	AC machines rated over 750 V ac or in IEC frame size 315 and larger	42
10.1	Scope	42
10.2	Construction	42
10.2.1	General	42
10.2.2	Enclosures	42
10.2.3	Terminal boxes	43
10.2.4	Mechanical strength	43
10.2.5	Insulation (for parts over 750 V)	43
10.2.6	Internal wiring (over 750 V)	44
10.2.7	Internal wiring (750 V ac and less and 500 V dc and less)	44
10.2.8	Terminal box spacings	44

10.2.9	Insulation systems	45
10.3	Marking (see Annex B)	45
10.4	Tests	45
10.4.1	Test voltage	45
10.4.2	Rating	46
10.4.3	Temperature	46
10.4.4	Dielectric strength	46
10.4.5	Water tests	47
11	DC machines in IEC frame size 90 and larger	48
11.1	Scope	48
11.2	Construction	48
11.2.1	General	48
11.2.2	Enclosures	48
11.2.3	Mechanical safe speed	48
11.2.4	Terminal boxes	48
11.2.5	Insulation systems	48
11.2.6	Insulation (for parts over 750 V)	49
11.2.7	Spacings	49
11.2.8	Lifting supports	50
11.3	Marking	50
11.4	Tests	50
11.4.1	General	50
11.4.2	Temperature	50
11.4.3	Motor-rated load current	51
11.4.4	Dielectric strength	51
11.4.5	Overspeed	51
11.4.6	Water tests	51
12	Portable and standby generators	52
12.1	Scope	52
12.2	Construction	52
12.2.1	General	52
12.2.2	Enclosure or panels	52
12.2.3	Terminal boxes (750 V and less)	52
12.2.4	Leads	53
12.2.5	Grounding and bonding	54
12.2.6	Brush holders and terminals	55
12.2.7	Battery chargers	55
12.2.8	Protection and control of generators	55
12.2.9	Inverters integral with portable generators	56
12.2.10	Portable generator output circuits	56
12.3	Marking	57
12.4	Tests	59
12.4.1	Temperature	59
12.4.2	Terminal panel	59
12.4.3	Rating	59
12.4.4	Dielectric strength test	60
12.4.5	Generator probe test	60

- 12.4.6 Flame tests 60
- 12.4.7 Impact test 61
- 12.4.8 Physical abuse (terminal boxes) 61
- 12.4.9 Integral insulation 61

13 Inverter-duty AC machines 62

- 13.1 Scope 62
- 13.2 Construction 62
- 13.3 Tests 62
 - 13.3.1 General 62
 - 13.3.2 Power supply 62
 - 13.3.3 Rating 62
 - 13.3.4 Test requirements 63
 - 13.3.5 Dielectric strength 63
- 13.4 Marking 63

-
- Annex A (informative) — Drip test 80
 - Annex B (informative) — Marking translations 81
 - Annex C (informative) — Acceptable labels 84
 - Annex D (normative) — Installation of engine-driven electric generators for use in recreational vehicles 85

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>
D.P. Badry	Government of Yukon, Whitehorse, Yukon <i>Category: Government and/or Regulatory Authority</i>	
B.M. Baldwin	Startco Engineering ULC, Saskatoon, Saskatchewan <i>Category: Producer Interest</i>	
W.J. Bryans	Electro-Federation Canada, Toronto, Ontario	<i>Associate</i>
R.B. Buckler	ASCO Power Technologies Canada, Brantford, Ontario	<i>Associate</i>
W.J. Burr	Burr and Associates, Campbell River, British Columbia	<i>Associate</i>
F. Chan	Schneider Electric Canada, Inc., Mississauga, Ontario	<i>Associate</i>
P.D. den Bakker	Shell Global Solutions Canada, Calgary, Alberta	<i>Associate</i>
S.W. Douglas	International Association of Electrical Inspectors, Toronto, Ontario	<i>Associate</i>
J.H. Raymond	Peterborough, Ontario	<i>Associate</i>
V.V. Gagachev	Eaton, Burlington, Ontario <i>Category: Producer Interest</i>	

R.J. Kelly	Government of Nunavut-Dept of Community & Government Services, Iqaluit, Nunavut	<i>Associate</i>
A. Leslie	Curtiss Wright Controls, Integrated Sensing, Stratford, Ontario	<i>Associate</i>
D.R. MacLeod	Department of Labour and Advanced Education, Halifax, Nova Scotia <i>Category: Government and/or Regulatory Authority</i>	
N. Mancini	Mississauga, Ontario <i>Category: General Interest</i>	
D. Mascarenhas	Independent, Brampton, Ontario <i>Category: General Interest</i>	
A. Milne	21st Olympiad Sales, Burlington, Ontario	<i>Associate</i>
D.G. Morlidge	Fluor Canada Ltd., Calgary, Alberta <i>Category: General Interest</i>	
T. Olechna	Electrical Safety Authority, Mississauga, Ontario <i>Category: Government and/or Regulatory Authority</i>	
R. Pack	SaskPower, Saskatoon, Saskatchewan <i>Category: Government and/or Regulatory Authority</i>	
V. Rowe	Marex Canada Limited, Nanaimo, British Columbia	<i>Associate</i>
M. Smith	Rockwell Automation Canada Inc. Control Systems, Cambridge, Ontario <i>Category: Producer Interest</i>	
C. Thwaites	Mersen Canada Toronto Inc., Mississauga, Ontario	<i>Associate</i>

A.Z. Tsisserev Applied Engineering Solutions Ltd.,
Vancouver, British Columbia
Category: General Interest

P. Glowacki CSA Group,
Mississauga, Ontario
Category: General Interest

Subcommittee on Motors and Generators

B. Mistry	General Electric Canada, Peterborough, Ontario	<i>Chair</i>
K.F. Anderson	Underwriters Laboratories Inc., Northbrook, Illinois, USA	<i>Associate</i>
J.S. Barth	A.O. Smith Corporation Electrical Products Company, Tipp City, Ohio, USA	
I. Culbert	Iris Power LP, Mississauga, Ontario	
D.E. Delaney	RBC Manufacturing Corporation, Fort Wayne, Indiana, USA	
J.H. Dymond	Peterborough, Ontario	
M. Gonzalez	GE Power Conversion, Shelbyville, Kentucky, USA	
R. Hopkins	Infrastructure Health and Safety Association, Mississauga, Ontario	
G. Kang	TECO-Westinghouse Motors (Canada) Inc., Cambridge, Ontario	
G.J. Marchand	Briggs & Stratton Power Products Group, LLC, Wauwatosa, Wisconsin, USA	
E. Massey	Baldor Electric Company, Greenville, South Carolina, USA	
D.J. Murray	Burlington, Ontario	
L. Murray	Nidec Motor Corporation, St. Louis, Missouri, USA	
P.R. Quintaes	WEG Equipamentos Eletricos S.A., Jaragua Do Sul, , Brazil	

B. Robinson	Honda Canada Inc, Markham, Ontario	
J. Rydeski	Marathon Electric Manufacturing Corporation, Wausau, Wisconsin, USA	
S. Sappington	Caterpillar Inc., Griffin, Georgia, USA	
H. Sedding	Kinectrics Inc., Toronto, Ontario	<i>Associate</i>
R. Steffen	GE Commercial Motors by Regal-Beloit, Fort Wayne, Indiana, USA	
M. Stranges	GE Infrastructure - Energy, Peterborough, Ontario	<i>Associate</i>
N. Stranges	General Electric Canada, Peterborough, Ontario	
A. Tétrault	Vibrosystm Inc., Longueuil, Québec	
T.N. Young	RBC Manufacturing Corporation, Fort Wayne, Indiana, USA	
P. Glowacki	CSA Group, Mississauga, Ontario <i>Category: General Interest</i>	

Preface

This is the seventh edition of CSA C22.2 No. 100, *Motors and generators*, 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 2004, 1995, 1992, 1985, 1982, and 1974.

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

Significant changes from the previous edition are as follows:

- a) Updates 1, 2, and 3 from the previous edition incorporated;
- b) Clause 3: Definitions — added “Stabilization temperature”;
- c) Clause 4.5 added;
- d) Clause 7.2.1c) added;
- e) Clause 7.4.7 added;
- f) Clause 10.4.3.2 second paragraph added to clarify temperature;
- g) Requirements for protection and control of generators removed from Clause 12.2.7 and added to new Clause 12.2.8;
- h) Clause 12.2.9 added: Inverters integral with portable generators;
- i) Clause 12.2.10 added: Portable generator output circuits;
- j) Clause 13.2.2 rewritten for clarity;
- k) Note added to Clause 13.3.2 for clarity;
- l) Notes 1 and 2 added to Clause for clarity;
- m) Table 3: second note added;
- n) Table 4: Note 3 updated for clarity;
- o) Table 10: Note 4 added;
- p) Table 11: Note 4 added;
- q) Table 11: Note 3 added; and
- r) Figures 5, 6, and 7 updated for clarity.

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 was prepared by the Subcommittee on Motors and Generators, 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** and include "Request for interpretation" in the subject line:
- define the problem, making reference to the specific clause, and, where appropriate, include an illustrative sketch;
 - provide an explanation of circumstances surrounding the actual field condition; and
 - 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**.

- 5) 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 **inquiries@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.

Committee interpretations are processed in accordance with the CSA Directives and guidelines governing standardization and are published in CSA's periodical Info Update, which is available on the CSA Web site at www.csa.ca.

CSA C22.2 No. 100:14

Motors and generators

1 Scope

1.1

This Standard applies to electric motors and generators for installation and use, in accordance with the Rules of the *Canadian Electrical Code, Part I*, in non-hazardous locations.

Note: The term “machine” throughout this Standard should be assumed to mean “motor” and “generator”.

1.2

Clauses 2 to 7 are general in nature and apply, unless otherwise noted, to the motors and generators covered by Clauses 8 to 13 as follows:

- a) Clause 8 — DC machines and AC machines (including universal motors) in IEC frame size 80 and smaller;
- b) Clause 9 — AC machines (including universal motors) in IEC frame sizes 90 to 280 and rated 750 V ac and less;
- c) Clause 10 — AC machines rated over 750 V ac or in IEC frame size 315 and larger;
- d) Clause 11 — DC machines in IEC frame size 90 and larger;
- e) Clause 12 — portable and standby generators; and
- f) Clause 13 — inverter-duty AC machines.

1.3

This Standard provides basic requirements for machines and does not exclude any additional requirements given in other Standards of the *Canadian Electrical Code, Part II*.

1.4

This Standard does not apply to

- a) sealed- (hermetic-) type motors such as those used in refrigerant compressors; or
- b) electric machines for use in aircraft, marine service installations, drives for land transportation equipment, or machines used in underground mining.

1.5

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 (nonmandatory) to define their application.