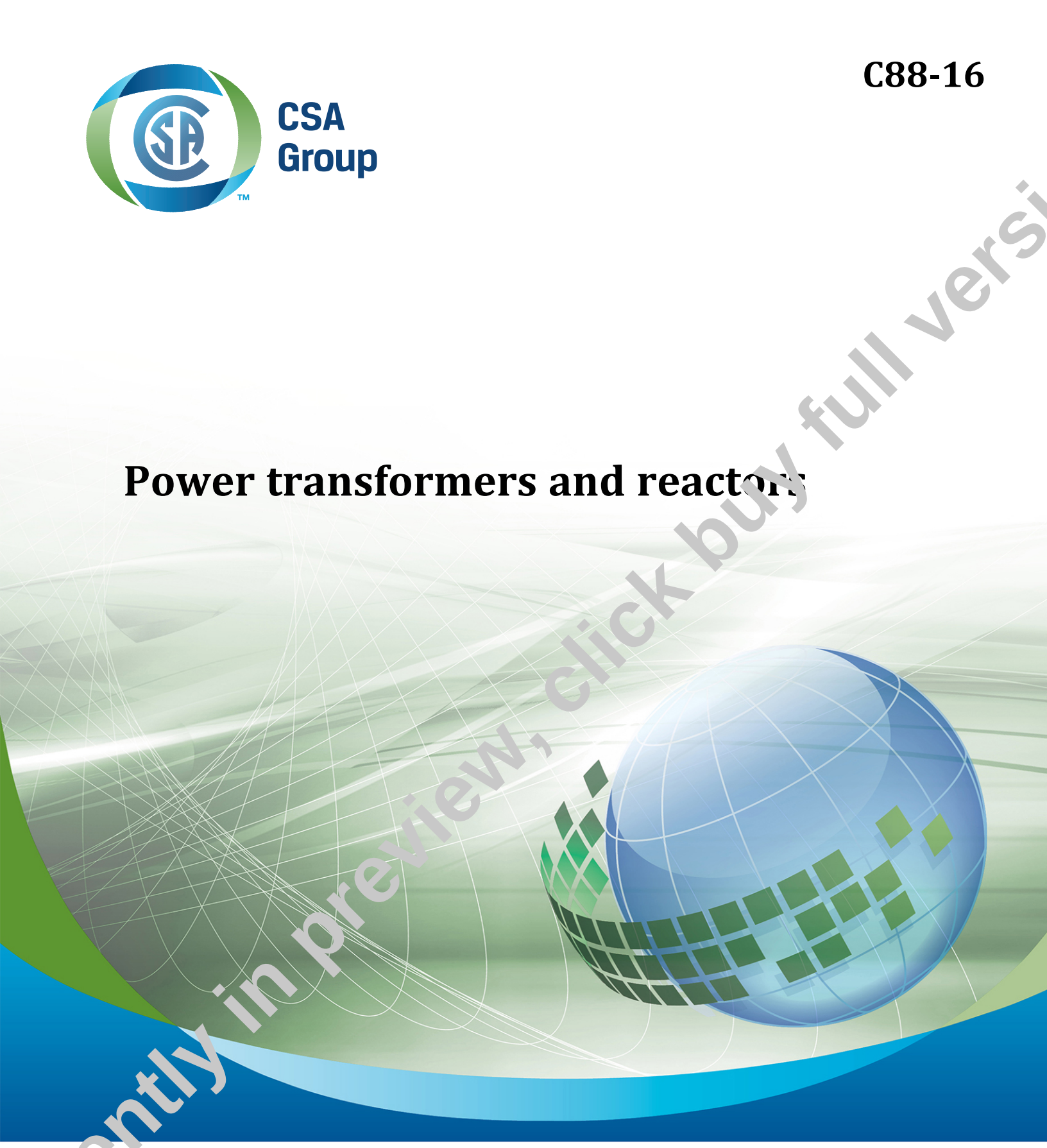
C88-16

Power transformers and reactors



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Power transformers and reactors

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Preface

This is the fifth edition of CSA C88, *Power transformers and reactors*. It supersedes the previous editions published in 1991, 1979, 1968, and 1947.

This Standard is written in reference to two winding transformers, although many requirements are common to multi-winding transformers, autotransformers, load-tap-changing transformers, shunt reactors, and series-voltage regulators. Where there are special requirements for these other transformers, there are clauses in the Standard specifically addressed to these other types of transformers.

In addition to general updating, this edition of the Standard includes the following key revisions:

a) Reference publications and definitions have been expanded and updated.
b) A cold start procedure has been included (see Clause 4.6) with informative background material in Annex A.
c) Insulating liquid with a fire point greater than 300 °C has been included (see Clause 6.2.1).
d) Limits of temperature rise with respect to internal hot spot have been revised (see Clause 9.2d)).
e) Requirements for stabilizing windings have been revised (see Clause 12.3).
f) A new clause on gasket materials has been included (see Clause 15.1.27).
g) Requirements for control cabinets have been expanded (see Clause 15.1.22)
h) Several tests have been revised including
    i) induced potential test (see Clause 16.3.3);
    ii) lightning impulse tests (see Clause 16.3.4);
    iii) switching impulse tests (see Clause 16.3.5); and
    iv) loss and impedance tests (see Clause 16.4).
i) A new tank pressure test (Clause 16.9) and gas accumulation test (Clause 16.10) have been included.
j) A new clause on HVDC converter transformers has been included (see Clause 25).
k) A new clause on transformers with high-temperature insulation has been included (see Clause 26).
l) Table 10 has been revised to include a tolerance for load losses.
m) A summary table of tests specified in this Standard has been included (see Table 13).

This Standard was prepared by the Technical Committee on Power Transformers under the jurisdiction of the Strategic Steering Committee on Power Engineering and EMC (SCOPE), and has been formally approved by the technical committee.

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 standardsactivities.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; and*
d) *rationale for the change.*

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Power transformers and reactors

1 Scope

1.1

This Standard, except as noted in Clause 1.2, applies to all liquid-filled transformers, autotransformers, booster transformers, load-tap-changing transformers, grounding transformers, phase-shifting transformers, series-voltage regulators, and shunt reactors.

Note: *The term "transformer(s)" in this Standard refers to the overall unit and not just to the electrical components implied by the definition.*

1.2

This Standard does not apply to the following:

a) distribution transformers (see CAN/CSA-C2.1 and CAN/CSA-C2.2);
b) instrument transformers (see CAN/CSA-C60044 series and CAN/CSA-C61869 series);
c) dry-type transformers (see CSA C9);
d) pad-mounted transformers (see CAN/CSA-C227 Series of Standards);
e) submersible transformers (see CSA C301 Series of Standards);
f) three-phase network transformers (see CSA C199); and
g) rectifier transformers, welding transformers, furnace transformers, starting transformers, testing transformers, or current-limiting reactors.

Note: *In the above list, the pertinent CSA Group standard number has been noted where such exists. Where no CSA Group standard exists, this Standard may be used insofar as it applies.*

1.3

This Standard does not include energy efficiency requirements. For such requirements, see CSA C802.3 for maximum losses for power transformers up to 10 MVA.

1.4

The values given in SI units are the units of record for the purposes of this Standard. The values given in parentheses are for information and comparison only.

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 (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

CAN/CSA-C50-14
Mineral insulating oil, electrical for transformers and switches

CAN/CSA-C71-1-99 (R2015)
Insulation co-ordination — Part 1: Definitions, principles and rules

CAN/CSA-C71-2-98 (R2011)
Insulation co-ordination — Part 2: Application guide

CAN/CSA-C88.1-96 (R2015)
Power transformer and reactor bushings

C802.3-15
Minimum efficiency values for power transformers

ANSI (American National Standards Institute)

S1.4-1983 (R2006)
Specification for Sound Level Meters

IEC (International Electro technical Commission)

60076-1:2011
Power transformers — Part 1: General

60076-5:2006
Power Transformers — Part 5: Ability to withstand short circuit

60076-14:2009
Power transformers — Part 14: Design and application of liquid-immersed power transformers using high-temperature insulation materials

60076-57-1202 (under development)
Liquid-immersed phase-shifting transformers

60214-1:2003
Tap-changers — Part 1: Performance requirements and test methods

60214-2:2004
Tap-changers — Part 2: Application guide

