

Australian Standard[®]

Instrument transformers

**Part 2: Inductive voltage transformers
(IEC 60044-2:Ed.1 2003) MOD)**

STANDARDS
Australia



This Australian Standard® was prepared by Committee EL-013, Measurement and Protection Transformers. It was approved on behalf of the Council of Standards Australia on 17 January 2007.

This Standard was published on 20 February 2007.

The following are represented on Committee EL-013:

- Australian Electrical and Electronic Manufacturers Association
 - Cigre APA2
 - Energy Networks Association
 - National Measurement Institute
 - University of South Australia
-

This Standard was issued in draft form for comment as DR 6515.

Standards Australia wishes to acknowledge the participation of the expert individuals that contributed to the development of this Standard through their representation on the Committee and through public comment period.

Keeping Standards up-to-date

Australian Standards® are living documents that reflect progress in science, technology and systems. To maintain their currency, all Standards are periodically reviewed, and new editions are published. Between editions, amendments may be issued.

Standards may also be withdrawn. It is important that readers assure themselves they are using a current Standard, which should include any amendments that may have been published since the Standard was published.

Detailed information about Australian Standards, drafts, amendments and new projects can be found by visiting www.standards.org.au

Standards Australia welcomes suggestions for improvements, and encourages readers to notify us immediately of any apparent inaccuracies or ambiguities. Contact us via email at mail@standards.org.au, or write to Standards Australia, GPO Box 476, Sydney, NSW 2001.

Australian Standard[®]

Instrument transformers

**Part 2: Inductive voltage transformers
(IEC 60044-2:Ed.1.2:2003) MOD)**

Originally as part of AS C45—1928.
Previous edition AS 60044.2—2003.
Second edition 2007.

COPYRIGHT

© Standards Australia

All rights are reserved. No part of this work may be reproduced or copied in any form or by any means, electronic or mechanical, including photocopying, without the written permission of the publisher.

Published by Standards Australia GPO Box 476, Sydney, NSW 2001, Australia

ISBN 0 7337 8027 X

PREFACE

This Standard was prepared by the Standards Australia Committee EL-013, Measurement and Protection Transformers to supersede AS 60044.2—2003.

The objective of this Standard is to provide users and manufacturers of voltage transformers with definitions of terms, safety requirements, methods of specifying performance and methods of test.

This Standard is Part Two of a series covering instrument transformers. This series consists of the following Standards:

AS

60044 Instrument transformers

60044.1 Part 1: Current transformers

60044.2 Part 2: Single-phase inductive voltage transformers (this Standard)

This Standard is an adoption with national modifications of IEC 60044-2, Ed.1.2 (2003), *Instrument transformers, Part 2: Inductive voltage transformers* (including Amendment 1:2001 and Amendment 2:2002).

Variations to IEC 60044-2, Ed.1.2 (2003) are indicated at the appropriate places throughout this standard. Strikethrough (**example**) identifies IEC text, tables and figures which, for the purposes of this Australian Standard, are deleted. Where text, tables or figures are added, each is set in its proper place and identified by shading (**example**). Added figures are not themselves shaded, but are identified by a shaded border.

As this Standard is reproduced from an International Standard, the following applies:

- (a) Its number does not appear on each page of text and its identity is shown only on the cover and title page.
- (b) In the source text 'this Part of IEC 60044' should read 'this Part of AS 60044'.
- (c) A full point should be substituted for a comma when referring to a decimal marker.

In January 1997, the IEC commenced numbering its Standards from 60 000 by adding 60 000 to the number of each existing standard. Publications printed earlier than 1997 will continue to carry the old series of numbers.

Attention is drawn to the following differences between this Standard and AS 1243—1982:

- (a) This Standard introduces temperature rise testing of voltage transformers with voltage factors of 1.1 for 30 s, 1.9 for 30 s and 1.9 for 8 h starting after the voltage transformers have reached equilibrium at $1.2 U_n$. See Clause 5.4, Limits of temperature rise.
- (b) This Standard has a new thermal class for windings in oil and hermetically sealed that allows 65 K temperature rise (see Table 3, Limits of temperature rise of windings).
- (c) This Standard introduces requirements and tests for winding withstand capability. See Clause 6.2, Short-circuit withstand capability.
- (d) This Standard has highest voltages for equipment of 170 kV and 245 kV in place of 245 kV in AS 1243—1982. See Clause 6.1.1, Rated insulation levels for primary windings).

- (e) This Standard introduces reduced levels of permissible partial discharges across the complete range of system earthing types and voltages, with increases in prestress voltage level (from the current $1.3 U_m$ level to the induced voltage withstand test level) and in testing voltage level (from $1.1 U_m$ to $1.3 U_m$). See Clause 6.1.2.3, Partial discharges, and Clause 9.2.4, Partial discharge measurement.
- (f) This Standard introduces requirements for minimum insulator creepage distance and arcing/creepage ratio for four various pollution levels. See Clause 6.1.5, Requirements for the external insulation.
- (g) This Standard requires repeated dielectric testing to be performed at 80% of the initial power frequency voltage (and not 75% as in AS 1243—1982). See Clause 7.2, Routine tests.
- (h) This Standard covers measurement of dielectric dissipation factor as a special test, and not as a routine test as does AS 1243—1982. See Clause 7.3, Special tests.
- (i) This Standard requires testing of radio interference voltage with a prestress voltage of $1.5 U_m/\sqrt{3}$, and a limit of 300 pC or 2500 μV at $1.1 U_m/\sqrt{3}$. This test is also required for voltages 123 kV and upwards (and not from 245 kV as in AS 1243—1982). See Clause 8.5, Radio interference voltage measurement.
- (j) This Standard includes requirements for measurement of partial discharges that are stricter than those in AS 1243—1982 (which calls up AS 2032 which has been withdrawn). See Clause 9.2.4, Partial discharge measurement.
- (k) This Standard introduces new special tests of chopped impulse on primary winding and mechanical testing of primary terminals. See Clause 7.3, Special tests.
- (l) This Standard requires that testing for accuracy be done at a primary voltage of 0.8 to $1.2 U_n$ and a power factor of 0.8 lagging. AS 1243—1982 requires that testing for accuracy be done at a primary voltage of 0.9 to $1.1 U_n$ and a power factor of 1. See Clause 12.2, Limits of voltage error and phase displacement for measuring voltage transformers.
- (m) This Standard has Classes 3P and 6P and does not have the Classes 1P, 2P and 5P of AS 1243—1982. See Clause 13.1.1, Standard accuracy classes for protective voltage transformers.
- (n) This Standard does not include requirements for voltage transformers for laboratory use (Class L in AS 1243). The committee considered that this class is no longer required.
- (o) This Standard introduces a new special test for transmitted overvoltages. See Clause 7.3, Special tests.

The term ‘normative’ is used to define the application of the annex to which it applies. A normative annex is an integral part of a standard.

CONTENTS

	<i>Page</i>
1 General.....	1
1.1 Scope	1
1.2 Normative references.....	1
2 Definitions.....	2
2.1 General definitions.....	2
2.2 Additional definitions for single-phase inductive protective voltage transformers	6
3 General requirements	3
4 Normal and special service conditions	6
4.1 Normal service conditions.....	6
4.2 Special service conditions.....	7
4.3 System earthing.....	8
5 Ratings	8
5.1 Standard values of rated voltages.....	8
5.2 Standard values of rated output.....	9
5.3 Standard values of rated voltage factor.....	9
5.4 Limits of temperature rise	10
6 Design requirements.....	11
6.1 Insulation requirements.....	11
6.2 Short-circuit withstand capability.....	16
6.3 Mechanical requirements	16
7 Classification of tests	17
7.1 Type tests.....	17
7.2 Routine tests.....	17
7.3 Special tests	18
8 Type tests.....	18
8.1 Temperature-rise test.....	18
8.2 Short-circuit withstand capability test.....	18
8.3 Impulse test on primary winding.....	19
8.4 Wet test for outdoor type transformers.....	20
8.5 Radio interference voltage measurement.....	20
9 Routine tests.....	22
9.1 Verification of terminal markings.....	22
9.2 Power-frequency withstand tests on primary windings and partial discharge measurement.....	22
9.3 Power-frequency withstand tests between sections and on secondary windings	24
10 Special tests	24
10.1 Chopped impulse test on primary winding.....	24
10.2 Measurement of capacitance and dielectric dissipation factor	25
10.3 Mechanical tests	25
10.4 Transmitted overvoltage measurement.....	26
11 Markings.....	28
11.1 Rating plate markings	28

11.2	Terminal markings	28
12	Accuracy requirements for single-phase inductive measuring voltage transformers	29
12.1	Accuracy class designation for measuring voltage transformers	29
12.2	Limits of voltage error and phase displacement for measuring voltage transformers	29
12.3	Type tests for accuracy of measuring voltage transformers	29
12.4	Routine tests for accuracy of measuring voltage transformers	30
12.5	Marking of the rating plate of a measuring voltage transformer	30
13	Additional requirements for single-phase inductive protective voltage transformers	30
13.1	Accuracy class designation for protective voltage transformers	30
13.2	Limits of voltage error and phase displacement for protective voltage transformers	30
13.3	Rated voltages for secondary windings intended to produce a residual voltage	31
13.4	Output for secondary windings intended to produce a residual voltage	31
13.5	Accuracy class for secondary windings intended to produce a residual voltage	32
13.6	Type tests for protective voltage transformers	32
13.7	Routine tests for protective voltage transformers	32
13.8	Marking of the rating plate of a protective voltage transformer	32
	Figure 1 – Altitude correction factor	33
	Figure 2 – Test circuit for partial discharge measurement	34
	Figure 3 – Alternative circuit for partial discharge measurement	34
	Figure 4 – Example of balanced test circuit for partial discharge measurement	35
	Figure 5 – Example of calibration circuit for partial discharge measurement	35
	Figure 6 – Single-phase transformer with fully insulated terminals and a single secondary	36
	Figure 7 – Single-phase transformer with a neutral primary terminal with reduced insulation and a single secondary	36
	Figure 8 – Three-phase assembly with a single secondary	36
	Figure 9 – Single-phase transformer with two secondaries	37
	Figure 10 – Three-phase assembly with two secondaries	37
	Figure 11 – Single-phase transformer with one multi-tap secondary	37
	Figure 12 – Three-phase assembly with one multi-tap secondary	37
	Figure 13 – Single-phase transformer with two multi-tap secondaries	38
	Figure 14 – Single-phase transformer with one residual voltage winding	38
	Figure 15 – Three-phase transformer with one residual voltage winding	38
	Figure 16 – Example of a typical rating plate	39
	Figure 17 – Measuring circuit	22
	Figure 18 – Transmitted Overvoltages measurement: Test Circuit and GIS Test set-up	40
	Figure 19 – Transmitted Overvoltages measurement: General Test set-up	40
	Figure 20 – Transmitted Overvoltages measurement: Test Waveforms	41
	Table 1 – Temperature categories	6
	Table 2 – Standard values of rated voltage factors	9

Table 3 – Limits of temperature rise of windings	11
Table 4 – Rated insulation levels for transformer primary windings having highest voltage for equipment $U_m < 300$ kV	12
Table 5 – Rated insulation levels for primary windings having highest voltage for equipment $U_m \geq 300$ kV	13
Table 6 – Power-frequency withstand voltages for transformer primary windings having voltage for equipment $U_m \geq 300$ kV	13
Table 7 – Partial discharge test voltages and permissible levels	14
Table 8 – Creepage distances	15
Table 9 – Static withstand test loads	16
Table 10 – Modalities of application of the test loads to be applied to the line primary terminals	27
Table 11 – Limits of voltage error and phase displacement measuring voltage transformers	29
Table 12 – Limits of voltage error and phase displacement for protective voltage transformers	31
Table 13 – Rated voltages for secondary intended to produce a residual voltage	31
Table 14 – Transmitted overvoltage limits	16
Annex ZA (normative) Derivation of voltage error and phase displacement at differing burdens and power factors	42

STANDARDS AUSTRALIA

Australian Standard

**Instrument transformers
Part 2: Inductive voltage transformers
(IEC 60044-2:Ed.1.2 (2003) MOD)**

Any table, figure or text of the international standard that is struck through is not part of this standard. Any Australian table, figure or text that is added is part of this standard and is identified by shading.

1 General**1.1 Scope**

This part of IEC 60044 applies to new inductive voltage transformers for use with electrical measuring instruments and electrical protective devices at frequencies from 15 Hz to 100 Hz.

Although this standard relates basically to transformers with separate windings, it is also applicable, where appropriate, to auto-transformers. This standard does not apply to transformers for use in laboratories.

NOTE Requirements specific to three-phase voltage transformers are not included in this standard but, so far as they are relevant, the requirements in clauses 3 to 11 apply to these transformers and a few references to them are included in those clauses (e.g. see 2.1.4, 5.1.1, 5.2, and 11.2).

Clause 13 covers the requirements and tests, in addition to those in clauses 3 to 12, that are necessary for single-phase inductive protective voltage transformers. The requirements of clause 13 apply particularly to transformers which are required to have sufficient accuracy to operate protective systems at voltages that occur under fault conditions.

1.2 Normative references

References to international standards that are struck through in this clause are replaced by references to Australian or Australian/New Zealand Standards that are listed immediately thereafter and identified by shading. Any Australian or Australian/New Zealand Standard that is identical to the International Standard it replaces is identified as such.

The following referenced documents are indispensable for the application of this document. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

IEC 60028:1925, *International standard of resistance for copper*

IEC 60050:1983, *IEC standard voltages*

AS 1038, *Standard voltages*

~~IEC 60050(321):1986, *International Electrotechnical Vocabulary (IEV) — Chapter 321: Instrument transformers*~~

AS 1852.321, *International electrotechnical vocabulary, Chapter 321: Instrument transformers* (identical to IEC 60050(321):1986)

~~IEC 60060-1:1989, *High-voltage test techniques — Part 1: General definitions and test requirements*~~