

Australian Standard<sup>®</sup>

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**Power transformers**

**Part 3.0: Insulation levels and  
dielectric tests—General  
requirements**

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This Australian standard, prepared by Committee EL/8, Static Electrical Machinery, was approved on behalf of the Council of the Standards Association of Australia on 8 June 1982 and published on 9 August 1982.

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The following interests were represented on the committee responsible for the preparation of this standard:

Australian-British Trade Association  
Australian Electrical and Electronic Manufacturers Association  
Confederation of Australian Industry  
Defence Standardization Committee  
Electrical testing laboratories  
Electricity Supply Association of Australia  
Electricity Supply Engineers Association of N.S.W.  
Institution of Engineers, Australia  
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## PREFACE

This standard was prepared by the Association's Committee on Static Electrical Machinery. It is based closely on IEC 76-3 (including Amendment No 1), Power Transformers, Part 3: Insulation Levels and Dielectric Tests, and is Part 3 of a six-part standard to supersede AS C61—1970, Power Transformers.

The other Parts of the standard are—

- Part 1—General Requirements
- Part 2—Temperature Rise
- Part 4—Tappings and Connections
- Part 5—Ability to Withstand Short Circuit
- Part 6—Sound Levels

Where the standard differs from IEC 76-3 and changes have been made in compliance with Australian requirements, these changes are indicated by a rule in the margin. Only minor deviations from IEC 76-3 have been made but additional information and requirements have been introduced.

Main changes include the following:

- (a) The tables of withstand test voltages have been edited and the values adjusted to align with the requirements of AS 1824.
- (b) A new clause (Clause 16) covers an insulation resistance test.
- (c) A new appendix (Appendix D) gives supplementary information concerning high-voltage tests.

It should be noted that no changes from those given in IEC 76-3 have been made to requirements concerning partial discharge testing. Present practice in Australia is varied and differs significantly with regard to acceptable levels and voltage ratings of transformers to which they are applicable.

Furthermore, it is considered that impulse testing may be justified as routine tests for transformers of voltage ratings less than 300 kV.

The clauses covering partial discharge testing and impulse testing are under investigation with a view to future amendment.

This standard requires reference to the following standards:

- AS 1018 Recommendations for Partial Discharge Measurements
- AS 1265 Bushings for Alternating Voltages Above 1000 V
- AS 1307 Surge Diverters—Non-linear Resistor Type
- AS 1767 Insulating Oil for Transformers and Switchgear
- AS 1824 Insulation Co-ordination
- AS 1852 International Electrotechnical Vocabulary
- AS 1883 Guide to Maintenance and Supervision of Insulating Oils in Service
- AS 1931 High Voltage Testing Techniques
- AS 2326 On-load Tap-changers
  - Part 1—Requirements
  - Part 2—Application Guide
- AS 2558 Transformers for Use on Single Wire Earth Return Distribution Systems
- AS C1 Standard Voltages and Frequency for A.C. Transmission and Distribution Systems
- AS C320 Classification of Insulating Materials for Electrical Machinery and Apparatus on the Basis of Thermal Stability in Service
- SAA MP12 Report on Preferred Numbers and Their Use

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## STANDARDS ASSOCIATION OF AUSTRALIA

**Australian Standard**  
for  
**POWER TRANSFORMERS**

## PART 3.0—INSULATION LEVELS AND DIELECTRIC TESTS—GENERAL REQUIREMENTS

**1 SCOPE.** This standard specifies the insulation levels and dielectric tests for power transformers.

**2 DEFINITIONS.** For the purposes of this standard the following definitions apply. Other terms used have the meanings ascribed to them in AS 2374, Part 1, or in AS 1852.

**2.1 Highest voltage for equipment applicable to a transformer winding**  $U_m$ —the highest r.m.s. phase-to-phase voltage for which a transformer winding is designed in respect of its insulation.

NOTE:  $U_m$  is the maximum value of the highest voltage of a system to which the winding may be connected, in respect of its insulation.

**2.2 Rated insulation level**—two alternative definitions are used:

(a) The rated lightning impulse and short duration power frequency withstand voltages.

NOTE: Definition (a) applies for all windings with highest voltage for equipment  $U_m$  lower than 300 kV, and for windings with  $U_m$  equal to or greater than 300 kV that are specified according to Method 1 (see Clause 5).

(b) The rated lightning and switching impulse withstand voltages (phase-to-earth).

NOTE: Definition (b) applies for windings with  $U_m$  equal to or greater than 300 kV that are specified according to Method 2 (see Clause 5).

**2.3 Uniform insulation of a transformer winding**—the insulation of a transformer winding when all its leads connected to terminals have the same power frequency withstand voltage to earth.

**2.4 Non-uniform insulation of a transformer winding**—the insulation of a transformer winding when it has an end intended for direct or indirect connection to earth, and is designed with a lower insulation level assigned to this earth or neutral winding end.

**3 GENERAL.** The insulation requirements for power transformers and the corresponding insulation tests are given with reference to specific windings and their terminals.

For oil-immersed transformers, the requirements apply to the internal insulation only. Any additional requirements or tests regarding external insulation which are deemed necessary shall be subject to agreement between the purchaser and the manufacturer.

NOTE: Where appropriate these tests can be type tests on a suitable model of the configuration.

If the purchaser intends to make the connections to the transformer in a way which may reduce the clearances provided by the transformer alone, this should be brought to attention in the enquiry.

Where an oil-immersed transformer is specified for operation at an altitude higher than 1000 m, clearances shall be designed accordingly. It may then be necessary to select bushings designed for higher insulation levels than those specified for the internal insulation of the transformer windings (see AS 1265).

Bushings are subject to separate type and routine tests according to AS 1265, which verify their phase-to-earth insulation, external as well as internal.

It is presupposed that bushings and tap-changers are specified, designed and tested in accordance with relevant Australian standards. The insulation tests on the complete transformer, however, constitute a check on the correct application and installation of these components.

The insulation tests shall generally be made at the manufacturer's works with the transformer approximately at ambient temperature.

The transformer shall be completely assembled as in service, except that for oil-immersed transformers the fitting of external cooling and supervisory equipment is not necessary.

If a transformer fails to meet its test requirements and the fault is in a bushing, it is permissible to replace this bushing temporarily with another bushing provided the position and connection structure remains substantially unchanged and continue the tests on the transformer to completion without delay. A particular case arises for tests with partial discharge measurements, where certain types of commonly used high-voltage bushings create difficulty because of their relatively high level of partial discharge in the dielectric. When such bushings are specified for the transformer, it is permitted to exchange them for bushings of a partial discharge-free type during the testing of the transformer (see Appendix A).

Transformers for cable box connection or direct connection to metal-enclosed SF<sub>6</sub> installations should be designed so that temporary connections can be made for insulation tests, using temporary bushings if necessary.

Where the manufacturer intends to use non-linear elements or surge arresters (built into the transformer or externally fitted) for the limitation of transferred overvoltage transients, this shall be brought to the purchaser's attention.

**4 HIGHEST VOLTAGE FOR EQUIPMENT AND INSULATION LEVEL.** To each winding of a transformer is assigned a value of 'highest voltage for equipment'  $U_m$  (Clause 2.1). The rules for coordination of transformer insulation with respect to transient overvoltages are formulated differently depending on the value of  $U_m$ . When rules about specific tests for different windings in a transformer are in conflict, the rule for the winding with the highest  $U_m$  value shall apply.