Australian Standard®

Power transformers

Part 3.0: Insulation levels and dielectric tests—General requirements

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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 MP19	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 ends 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_6 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.