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INSULATION COORDINATION (PHASE-TO-EARTH AND PHASE-TO-PHASE, ABOVE 1 kV)

Part 1—BASIC PRINCIPLES, STANDARD INSULATION LEVELS AND TEST PROCEDURES

STANDARDS ASSOCIATION OF AUSTRALIA
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- Australian Electrical and Electronic Manufacturers Association
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- Electricity Supply Association of Australia
- Institution of Engineers, Australia
- Railways of Australia Committee
- Testing Authorities

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AUSTRALIAN STANDARD

INSULATION COORDINATION (PHASE-TO-EARTH AND PHASE-TO-PHASE, ABOVE 1 kV)

Part 1
BASIC PRINCIPLES, STANDARD INSULATION LEVELS AND TEST PROCEDURES

AS 1824.1—1985

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PREFACE

This edition of this standard was prepared by the Association's Committee on Power Switchgear to supersede AS 1824, Insulation Coordination, Part 1—1976, Basic Principles, Standard Insulation Levels and Test Procedures.

It deals with the basic principles of insulation coordination, insulation levels and test procedures and applies to all equipment for a.c. systems having nominal voltages above 1 kV for use in exposed installations.

An application guide is available (see AS 1824.2) which provides guidance on the selection of electric strength of equipment, of surge diverters or protective gaps, degree of switching overvoltage control and suggests rational and economic solutions for system insulation coordination.

The standard is based on IEC 71-1, Insulation Coordination, Part 1: Terms, Definitions, Principles and Rules and on IEC 71-3, Insulation Coordination, Part 3: Phase-to-phase Insulation Coordination—Principles, Rules and Application Guide, and acknowledgement is made of the assistance received therefrom.

This standard differs from the IEC standards mainly in respect of the standard insulation levels in Range A which applies to highest voltages for equipment below 52 kV. This range in the IEC standard includes two values of lightning impulse withstand voltage and one value of power frequency withstand voltage for each value of highest voltage for equipment. However, only the higher values of lightning impulse withstand voltage have been included herein as the committee considered the inclusion of the lower values to be unnecessary.

Where this standard differs technically from IEC 71-1 and IEC 71-3, this fact is highlighted by a rule in the margin against the clause or part thereof affected and such deviations are summarized in the Annex.

This standard differs from the previous edition in respect of phase-to-phase insulation coordination which affects the standard insulation levels for highest voltages for equipment of 245 kV and above.

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FOREWORD

This standard covers only the system voltages and corresponding insulation levels that are recommended for Australia. However this edition differs from AS 1824, Part 1—1976 in that the continuing need for increased insulation levels of 12, 24 and 36 kV equipment is now accepted for distribution installations which may be severely exposed to overvoltages and appropriate values are shown in parentheses in Table 4.1.

Lightning impulse voltage withstand levels for all values of highest voltage for equipment are the same for both phase-to-earth and phase-to-phase insulation coordination. However higher values of lightning-impulse withstand voltage apply for the insulation coordination in Range C equipment which is not effectively protected against overvoltages.

For equipment in Range C, highest voltage for equipment 300 kV and above, switching overvoltages are the predominant factor and ability to withstand such overvoltages should be verified by both phase-to-earth and phase-to-phase switching-impulse tests. A 1-minute power-frequency test is not recommended for insulation coordination purposes in Range C. However power-frequency tests of one kind or another will remain necessary to ascertain ability to withstand normal voltages and sustained overvoltages as regards ageing of internal insulation or behaviour of external insulation in polluted conditions, but, in this highest voltage range, any specifications concerning the appropriate power-frequency tests are a matter for the appropriate equipment standard and only general indications are given in this standard.

For equipment in Ranges A and B, highest voltage for equipment above 1 kV and less than 52 kV and from 52 kV to less than 300 kV respectively, both lightning-impulse voltage withstand and power-frequency voltage withstand tests are applicable for insulation coordination purposes. It is not intended to introduce a switching-impulse voltage test into Ranges A or B for insulation coordination purposes until this matter has been further studied.

For the impulse voltage withstand tests on external insulations fifteen impulses are recommended, with two sparkovers permitted; this test has approximately the same severity for the same applied voltage, but is deemed more selective than a previously used test with five impulses followed by ten additional ones without sparkover, if a sparkover has taken place during the first five.

Probabilistic concepts and a probabilistic language are used in some procedures of insulation coordination as such concepts afford a better knowledge of system and equipment behaviour and should contribute to more economical design.

The traditional approach to insulation coordination was, and still is, to evaluate the highest overvoltage to which an equipment may be subjected at a certain location on a system, and to select from a table of standardized values the withstand voltage presenting a suitable safety margin. Both overvoltage evaluation and safety margin selection are largely empirical, and, in many cases, the choice of the insulation level is still more readily based upon previous experience in the system or other similar systems.

In a statistical approach, it is recognized that overvoltages are random phenomena and that it is uneconomical to design plant that can sustain the highest overvoltages which have a low probability of occurrence. It is also acknowledged that tests do not ascertain a withstand level with certainty. In consequence it is realized that insulation failures can occur occasionally in well-designed plant, and that the problem is to limit their frequency of occurrence to the most economical value, taking into account equipment cost and service continuity. Insulation coordination should be