

Australian Standard<sup>®</sup>

---

**VOLTAGE MEASUREMENT—  
SPHERE-GAP METHOD  
(ONE SPHERE EARTHED)**

---

This Australian standard was prepared by Committee EL/7, Power Switchgear. It was approved on behalf of the Council of the Standards Association of Australia on 23 April 1986 and published on 7 July 1986.

---

The following interests are represented on Committee EL/7:

Australian British Chamber of Commerce  
Australian Electrical and Electronic Manufacturers Association  
Confederation of Australian Industry  
Electricity Supply Association of Australia  
Institution of Engineers, Australia  
Railways of Australia Committee  
Testing Authorities

---

**Review of Australian Standards.** *To keep abreast of progress in industry, Australian Standards are subject to periodic review and are kept up to date by the issue of amendments or new editions as necessary. It is important therefore that Standards users ensure that they are in possession of the latest edition, and any amendments thereto.*

*Full details of all Australian Standards and related publications will be found in the Standards Australia Catalogue of Publications; this information is supplemented each month by the magazine 'The Australian Standard', which subscribing members receive, and which gives details of new publications, new editions and amendments, and of withdrawn Standards.*

*Suggestions for improvements to Australian Standards, addressed to the head office of Standards Australia, are welcomed. Notification of any inaccuracy or ambiguity found in an Australian Standard should be made without delay in order that the matter may be investigated and appropriate action taken.*

---

*This standard was issued in draft form for comment as DR 85253.*

Australian Standard<sup>®</sup>

---

**VOLTAGE MEASUREMENT—  
SPHERE-GAP METHOD  
(ONE SPHERE EARTHED)**

---

|  |      |
|--|------|
| First published (as AS C329) . . . . . | 1961 |
| AS 2886 first published . . . . .      | 1986 |

PUBLISHED BY STANDARDS AUSTRALIA  
(STANDARDS ASSOCIATION OF AUSTRALIA)  
1 THE CRESCENT, HOMEBUSH, NSW 2140

ISBN 0 7262 4252 7

## PREFACE

This standard was prepared by the Association's Committee on Power Switchgear to supersede AS C329—1961, Method for the Measurement of Voltage with Sphere-gaps (One Sphere Earthed), an endorsement of BS 358:1960.

This standard has been reproduced from IEC 52 (1960) and except for an amended title, a correction to the second equation in Clause 5.3.2 and a correction to the disruptive discharge voltage value in Table I for a 50 cm sphere diameter with 38 cm gap spacing, it is identical with IEC 52 (1960). Thus it has a different format from that of AS C329—1961.

This standard specifies requirements for the sphere-gaps and their use for the measurement of peak alternating voltages, direct voltages, standard lightning impulse voltages and lightning impulse voltages with longer tails.

Sphere-gaps have also been used to measure switching impulse voltages and it is anticipated that, following a study by CIGRE, some amendments will be made to IEC 52 and to this standard to cover the measurement of switching impulse voltages.

IEC 52(1960) was prepared by the International Electrotechnical Commission's Technical Committee IEC TC 42, High-voltage Testing Techniques, has been approved by the majority of National Committees and has achieved worldwide acceptance as a truly international standard for voltage measurement.

For the purpose of this standard, the reference to IEC publications should be replaced by reference to Australian Standards, as follows:

| <i>Reference to IEC Publication</i>  | <i>Appropriate Australian Standard</i>  |
|--------------------------------------|---|
| IEC 60: High voltage test techniques | AS 1931 High Voltage Testing Techniques<br>Part 1— General Definitions,<br>Test Procedures and<br>Measuring Devices |

## © Copyright — STANDARDS AUSTRALIA

Users of Standards are reminded that copyright subsists in all Standards Australia publications and software. Except where the Copyright Act allows and except where provided for below no publications or software produced by Standards Australia may be reproduced, stored in a retrieval system in any form or transmitted by any means without prior permission in writing from Standards Australia. Permission may be conditional on an appropriate royalty payment. Requests for permission and information on commercial software royalties should be directed to the head office of Standards Australia.

Standards Australia will permit up to 10 percent of the technical content pages of a Standard to be copied for use exclusively in-house by purchasers of the Standard without payment of a royalty or advice to Standards Australia.

Standards Australia will also permit the inclusion of its copyright material in computer software programs for no royalty payment provided such programs are used exclusively in-house by the creators of the programs.

Care should be taken to ensure that material used is from the current edition of the Standard and that it is updated whenever the Standard is amended or revised. The number and date of the Standard should therefore be clearly identified.

The use of material in print form or in computer software programs to be used commercially, with or without payment, or in commercial contracts is subject to the payment of a royalty. This policy may be varied by Standards Australia at any time.

## CONTENTS

|  | <i>Page</i> |
|--|-------------|
| 1. SCOPE AND OBJECT .....  | 4           |
| 2. STANDARD SPHERE-GAP .....   | 4           |
| 2.1 REQUIREMENTS FOR THE SPHERES .....   | 4           |
| 2.2 CONSTRUCTION OF THE SHANKS OF THE SPHERES .....  | 5           |
| 2.3 HEIGHT OF THE SPHERES ABOVE THE HORIZONTAL<br>EARTH PLANE .....  | 6           |
| 2.4 CLEARANCE ROUND THE SPHERES .....  | 6           |
| 2.5 CLEARANCE ROUND THE SPHERES (TABLE) .....  | 6           |
| 3. CONNECTION OF THE SPHERE-GAP .....  | 7           |
| 3.1 EARTHING .....   | 7           |
| 3.2 HIGH-VOLTAGE CONDUCTOR .....   | 7           |
| 3.3 PROTECTIVE SERIES RESISTANCE IN THE MEASUREMENT<br>OF ALTERNATING AND DIRECT VOLTAGES .....                            | 7           |
| 3.4 PROTECTIVE SERIES RESISTANCE IN THE MEASUREMENT<br>OF IMPULSE VOLTAGES .....   | 8           |
| 4. THE USE OF THE SPHERE-GAP .....   | 8           |
| 4.1 IRRADIATION .....  | 8           |
| 4.2 VOLTAGE MEASUREMENTS .....   | 8           |
| 5. SPHERE-GAP DISRUPTIVE DISCHARGE VOLTAGES .....  | 9           |
| 5.1 NUMERICAL VALUES IN THE TABLES .....   | 9           |
| 5.2 ACCURACY OF THE TABLES .....   | 10          |
| 5.3 INFLUENCE OF ATMOSPHERIC CONDITIONS .....  | 10          |
| APPENDICES   |             |
| A RANGE OF EXPERIMENTAL CALIBRATIONS .....   | 12          |
| B PROCEDURE BY WHICH THE VALUES IN TABLES I AND II<br>HAVE BEEN DERIVED FROM NATIONAL STANDARDS AND<br>OTHER SOURCES ..... | 13          |
| TABLES OF DISRUPTIVE DISCHARGE VOLTAGES  |             |
| I .....  | 14          |
| II .....   | 16          |
| FIGURES FOR VERTICAL AND HORIZONTAL SPHERE-GAPS  |             |
| 1 .....  | 18          |
| 2 .....  | 19          |

## STANDARDS ASSOCIATION OF AUSTRALIA

---

**Australian Standard  
for  
VOLTAGE MEASUREMENT—SPHERE-GAP METHOD (ONE SPHERE EARTHED)**

---

## 1. SCOPE AND OBJECT

These recommendations concern the construction and use of sphere-gaps for voltage measurement. The rules apply to the measurement of the peak value of:

- a) alternating voltages
- b) full standard impulses as defined in I.E.C. Publication 60 and impulses with longer tails
- c) direct voltages.

The peak values of the disruptive voltages in air for various spacings between the spheres are given in two tables.

Appendix A gives the limits of voltage and frequency over which the tables have been derived from experiments and can be presumed to be accurate within the tolerances specified in Clause 5.2.

Appendix B gives the procedure by which the values in the tables have been derived from previous National Standards and other sources.

## 2. STANDARD SPHERE-GAP

The standard sphere-gap is a peak voltage measuring device constructed and arranged in accordance with the rules in this document. It consists of two metal spheres of the same diameter ( $D$ ) with their shanks, operating gear, insulating supports, supporting frame and leads for connection to the point at which the voltage is to be measured. Standard values of  $D$  are 2 - 5 - 6.25 - 10 - 12.5 - 15 - 25 - 50 - 75 - 100 - 150 and 200 cm. The spacing between the spheres is designated  $S$ .

The points on the two spheres which are closest to each other are called the sparking points. In practice the disruptive discharge may occur between other neighbouring points.

Figures 1 and 2 show two arrangements, one of which is typical of sphere-gaps with a vertical axis and the other of sphere-gaps with a horizontal axis.

## 2.1 Requirements for the spheres

## 2.1.1 Tolerances on size and shape

The spheres shall be carefully made so that their surfaces are smooth and their curvature is as uniform as possible.

The requirements on their shapes are as follows:

*General Shape*

The diameter of each sphere shall nowhere differ by more than 2 % from the nominal value.