

AS 1359.102.1—1997

IEC 34-2:1972

IEC 34-2:1972/Amd.1:1995

IEC 34-2:1972/Amd.2:1996

Australian Standard[®]

Rotating electrical machines— General requirements

Part 102.1: Methods for determining losses and efficiency—General

[IEC title: Rotating electrical machines, Part 2: Methods for determining losses and efficiency of rotating electrical machinery from tests (excluding machines for traction vehicles)]

This Australian Standard was prepared by Committee EL/9, Rotating Electrical Machinery. It was approved on behalf of the Council of Standards Australia on 10 March 1997 and published on 5 July 1997.

The following interests are represented on Committee EL/9:

Australian British Chamber of Commerce
Australian Chamber of Commerce and Industry
Australian Electrical and Electronic Manufacturers Association
Bureau of Steel Manufacturers of Australia
Department of Defence
Electricity Supply Association of Australia
Institution of Engineers Australia

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which subscribing members receive, and which gives details of new publications, new editions and amendments, and of withdrawn Standards.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 96091 and 96206.

Australian Standard[®]

**Rotating electrical machines—
General requirements**

**Part 102.1: Methods for determining
losses and efficiency—General**

Originated as part of AS 1359.33—1983.
Revised and redesignated in part as AS 1359.102.1—1997.

PREFACE

This Standard was prepared by the Standards Australia Committee EL/9, Rotating Electrical Machinery to supersede, in part, AS 1359.33—1983, *General requirements for rotating electrical machines*, Part 33: *Methods for determining losses and efficiency*.

It is identical to and has been reproduced from IEC 34-2:1972, *Rotating electrical machines*, Part 2: *Methods for determining losses and efficiency of rotating electrical machinery from tests (excluding machines for traction vehicles)*, including Amd.1:1995 and Amd.2:1996 as indicated by marginal bars near the affected text. Reproduction was done by scanning the IEC text and adjusting the style of the original publication to conform with later IEC style.

This Standard is a Part of the AS 1359 series listed in AS 1359.0, Part titled: *Introduction and list of Parts*.

The objective of this Standard is to provide the rotating electrical machine industry with standard methods for determining losses and efficiency.

The objective of this Revision is to clarify certain methods and to provide more details of the retardation method (from IEC 34-2 Amd.1); to amend the reference temperature used for correcting I^2R losses (from IEC 34-2 Amd.2); and to transfer the calorimetric method to a new AS 1359.102.2.

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 Recommendation' should read 'this Australian Standard'.
- (c) A full point substitutes for a comma when referring to a decimal marker.
- (d) References to International Standards should be replaced by references to Australian Standards, as follows:

<i>Reference to International Standard</i>	<i>Australian Standard</i>
34 Rotating electrical machines	1359 Rotating electrical machines—General requirements
34-1 Part 1: Rating and performance	1359.101 Part 101: Rating and performance
34-2A First supplement: Measurement of losses by the calorimetric method	1359.102.2 Part 102.2: Methods for determining losses and efficiency—Calorimetric method
50 International Electrotechnical Vocabulary (IEV)	1852 International Electrotechnical Vocabulary
51 Direct acting indicating analogue electrical measuring instruments and their accessories	—

The references in Paragraph A.1.4 to clauses 11 and 13 and to table II of IEC 34-2A apply respectively to Clauses 4.4, 3.7 and Table 2 of AS 1359.102.2.

CONTENTS

Page

Clause

SECTION ONE - GENERAL

1	Scope	1
2	Object	1
3	General	1
3.1	List of symbols	2
4	Definitions	2
4.1	Efficiency	2
4.2	Total loss	2
4.3	Braking test	3
4.4	Calibrated driving machine test	3
4.5	Mechanical back-to-back test	3
4.6	Electrical back-to-back test	3
4.7	Retardation test	3
4.8	Calorimetric test	3
4.9	No-load test	3
4.10	Open-circuit test	3
4.11	Sustained short-circuit test	3
4.12	Zero power factor test	3
2 5	Reference temperature	4

SECTION TWO - D.C. MACHINES

6	Losses to be included	5
6.1	Excitation circuit losses	5
6.2	Constant losses	5
6.3	Load losses	5
6.4	Additional load losses	6
7	Determination of efficiency	6
7.1	Summation of losses	6
7.2	Total loss measurement	10
7.3	Direct measurement of efficiency	10

SECTION THREE - POLYPHASE INDUCTION MACHINES

8	Losses to be included	11
8.1	Constant losses	11
8.2	Load losses	11
8.3	Additional load losses	11
9	Determination of efficiency	12
9.1	Summation of losses	12
9.2	Total loss measurement	14
9.3	Direct measurement of efficiency	14

Clause

SECTION FOUR - SYNCHRONOUS MACHINES

10	Losses to be included	15
10 1	Constant losses	15
10.2	Load losses	15
10.3	Excitation circuit losses	15
10.4	Additional load losses	16
11	Determination of efficiency	16
11.1	Summation of losses	16
11.2	Total loss measurement	19
1 11.3	Direct measurement of efficiency	19

SECTION FIVE - METHODS OF TEST

12	General	20
13	Calibrated machine test	21
14	Zero power factor test	21
15	Retardation method	21
15.1	General	22
15.2	Composition of retardation tests	23
15.3	Retardation test procedure	25
15.4	Taking of measurements	27
16	Electrical back-to-back test	29
17	Calorimetric test	29
18	Schedule of preferred tests	29
18.1	D.C. machines	29
18.2	Polyphase induction machines	30
18.3	Synchronous machines	30

FIGURES (1 to 5)	30
------------------	-----------	----

ANNEX A

2	Provisional methods for determining losses and efficiency of converter-fed cage induction machines	33
---	--	----

© 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.

AUSTRALIAN STANDARD

Rotating electrical machines—General requirements

Part 102.1:

Methods for determining losses and efficiency—General

SECTION ONE - GENERAL**1 Scope**

This Recommendation applies to d.c. machines and to a.c. synchronous and induction machines of all sizes within the scope of IEC Publication 34-1. The principles can, however, be applied to other types of machines such as rotary converters, a.c. commutator motors and single-phase induction motors for which other methods of determining losses are generally used.

2 Object

This Recommendation is intended to establish methods of determining efficiencies from tests, and also to specify methods of obtaining particular losses when these are required for other purposes.

3 General

Tests shall be conducted on a completely sound machine with all covers fitted in the manner required for normal service, with any devices for automatic voltage regulation not a composite part of the machine itself being made inoperative, unless otherwise agreed.

- 1 | Unless otherwise agreed, measuring instruments and their accessories, such as measuring transformers, shunts and bridges used during the test shall have an accuracy of 0,5 or better (IEC 51), excluding three-phase wattmeters and wattmeters for low power factor, for which an accuracy class shall be 1,0 or better.

Instruments shall be selected to give readings over the effective range such that a fraction of a division is a small percentage of the actual reading and can be easily estimated.

On machines with adjustable brushes, the brushes shall be placed in the position corresponding to the specified rating. For measurements on no-load, the brushes may be placed on the neutral axis.

Speed of rotation may be measured by a stroboscopic method, digital counter or tachometer. When measuring slip, the synchronous speed should be determined from the supply frequency during the test.