Australian/New Zealand Standard™

Rotating electrical machines—General requirements

Part 102.3: Methods for determining losses and efficiency—Three-phase cage induction motors

Standards Australia

STANDARDS NEW ZEALAND

This Joint Australian/New Zealand Standard was prepared by Joint Technical Committee EL/46, Rotating Electrical Machinery—Efficiency. It was approved on behalf of the Council of Standards Australia on 15 August 2000 and on behalf of the Council of Standards New Zealand on 2 August 2000. It was published on 13 November 2000.

The following interests are represented on Committee EL/46:

Australian Chamber of Commerce and Industry
Australian Electrical and Electronic Manufacturers Association
Australian Greenhouse Office
Bureau of Steel Manufacturers of Australia
Electricity Supply Association of Australia
Energy Efficiency and Conservation Authority of New Zealand
National Appliance and Equipment Energy Efficiency Committee (Australia)

Keeping Standards up-to-date

Standards are living documents which reflect progress in science, technology and systems. To maintain their currency, all Standards are periodically reviewed, and new editions are published. Between editions, amendments may be issued. Standards may also be withdrawn. It is important that readers assure themselves they are using a current Standard, which should include any amendments which may have been published since the Standard was purchased.

Detailed information about joint Australian/New Zealand Standards can be found by visiting the Standards Australia web site at www.standards.com.au or Standards New Zealand web site at www.standards.co.nz and looking up the relevant Standard in the on-line catalogue.

Alternatively, both organizations publish an annual printed Catalogue with full details of all current Standards. For more frequent listings or notification of revisions, amendments and withdrawals, Standards Australia and Standards New Zealand offer a number of update options. For information about these services, users should contact their respective national Standards organization.

We also welcome suggestions for improvement in our Standards, and especially encourage readers to notify us immediately of any apparent inaccuracies or ambiguities. Please address your comments to the Chief Executive of either Standards Australia International or Standards New Zealand at the address shown on the back cover.

This Standard was issued in draft form for comment as DR 99198.

Australian/New Zealand Standard™

Rotating electrical machines—General requirements

Part 102.3: Methods for determining losses and efficiency—Three-phase cage induction motors

First published as AS/NZS 1359.102.3:2000.

Jointly published by Standards Australia International Ltd, GPO Box 5420, Sydney, NSW 2001 and Standards New Zealand, Private Bag 2439, Wellington 6020

ISBN 0 7337 3581 9

PREFACE

This Standard was prepared by the Joint Standards Australia/Standards New Zealand Committee EL/46, Rotating Electrical Machinery—Efficiency.

The objective of this Standard is to provide industry in general, and suppliers of electric motors and testing institutions in particular with an internationally aligned method for determining losses and efficiency of three-phase cage induction electric motors. This Standard provides the basis for a more accurate definition and application of efficiency.

This Standard is part of the AS 1359 series, *Rotating electrical machines—General requirements.* The AS 1359 series is published in Parts as detailed in AS 1359.0, *Introduction and list of Parts*. This Standard complements the following Parts on this particular subject:

AS 1359. 102.1: Methods for determining losses and efficiency—General

AS 1359. 102.2: Methods for determining losses and efficiency—Calorimetric method.

At the time of publication of this Standard, the editions of documents referred to were valid. Since all Standards are subject to revision, concerned parties are encouraged to investigate the possibility of applying the most recent editions. Members of IEC and ISO maintain registers of currently valid International Standards.

This Standard is being published awaiting the final publication of the IEC Standard currently in draft stage. When it becomes available, this Standard will then be reviewed.

The term ‘informative’ has been used in this Standard to define the application of the appendices to which it applies. An ‘informative’ appendix is only for information and guidance.

CONTENTS

FOREWORD

Traditionally in IEC, losses in rotating electrical machines have been determined in accordance with IEC 60034-2, *Rotating electrical machines*, Part 2: *Methods for determining losses and efficiency of rotating electrical machinery from tests (excluding machines for traction vehicles)*. The current edition is reproduced as AS 1359.102.1—1997 (refer to Preface).

For polyphase induction motors, IEC 60034-2 *assumes* that additional load losses (sometimes called stray load losses) equal 0.5% of the rated input power, whereas it is generally known that these losses are far more significant than the 0.5%. In comparison, the Japanese (JEC) Standard totally neglects stray load losses. Hence, efficiency tests on cage motors as per IEC or JEC tend to overstate the efficiency of motors.

In North America, IEEE 112—1996, *Standard test procedure for polyphase induction motors and generators*, specifies Method B (recommended for machines rated up to 180 kW and is also suitable for machines of higher rating). This employs a direct method to obtain the stray load losses and also provides means to reduce the influence of measurement error, thereby determining efficiency very close to the actual value*.

There is a subtle difference between the IEC and IEEE methods. The IEC method corrects the winding temperature to its rated value while the IEEE method uses the actual winding temperature corrected to an ambient of 25°C.

IEC Subcommittee 2G, Test Methods and Procedures initiated a project with the objective of achieving improved accuracy in testing and determination of efficiency of cage induction motors. This involved using a method technically equivalent to proven national standards that *measure* additional load losses, similar to IEEE 112 and (the Canadian) CAN/CSA C390—1993, *Energy efficiency test methods for three-phase induction motors* .

Independently, the European Commission (EC) agreed to undertake a similar new assignment. Eventually this should lead to publication, in parallel with IEC, of a European Standard (EN) by CENELEC, Brussels.

IEC 2G issued the first committee draft in March 1998. A committee draft for voting 2G/102A/CDV was sent in October 1998. (Also to CENELEC interests). This was followed by a revised committee draft 2G/107/CDV for voting in November 1999. The voting closed on 17 April 2000.

Australia/New Zealand, on the advice of Committee EL-046, voted against the circulated voting draft 2G/102A/CDV because of errors and lack of clarity. The committee however voted in favour of the subsequent revised 2G/107/CDV draft recommending text from this document.

This Standard comprises EL-046 committee recommendations sent to IEC SC 2G for inclusion in the final pending IEC publication.

---

* *Comparison of standards for determining efficiency of three-phase induction motors*, B Renier, K Hameyer, R Belmans, PE-441-EC-0-07-1998, IEEE, New Jersey, USA, July 2, 1998.

Standards Australia/Standards New Zealand

Australian/New Zealand Standard

Rotating electrical machines— General requirements

Part 102.3: Methods for determining losses and efficiency— Three-phase cage induction motors

1 SCOPE

This Standard specifies two indirect methods for determining losses and efficiency of three-phase cage induction motors by the summation of losses:

(a) Method 1, for motors of any rating with additional load losses determined from torque measurements under various load conditions.

NOTE: For motors rated over 200 kW, refer to Clause 5.3.

(b) Method 2, for motors in the output range 1 kW to 200 kW, without torque measurements, and with additional load losses assigned herein.

NOTE: When using Method 2 with assigned additional load losses it has to be understood that the curve in Table 1 does not represent an average but an upper envelope of a large number of measured values, and will in most cases yield lower values of efficiency than Method 1.

The methods above give similar results for motors generally, but Method 1 is intended to be used where efficiency is required to be known with a greater accuracy.

2 REFERENCED DOCUMENTS

The following Standards contain provisions that, through reference in this text, constitute this Standard.

IEC

60027-1: 1971 Letter symbols to be used in electrical technology—Part 1: General

60034-1: 1996 Rotating electrical machines—Part 1: Rating and performance

60034-2: 1972 Rotating electrical machines—Part 2: Methods for determining losses and efficiency of rotating electrical machinery from tests (excluding machines for traction vehicles) with amendments 1: 1995 and 2: 1996

60044-1: 1996 Instrument transformers, Part 1: Current transformers

60044-2: 1997 Instrument transformers, Part 2: Inductive voltage transformers

60051-1: 1984 Direct acting indicating analogue electrical measuring instruments and their accessories – Part 1: Definitions and general requirements common to all parts

3 DEFINITIONS

For the purposes of this Standard the following definitions apply.

3.1 Core losses

Losses in active iron and other metal parts during no-load operation.

3.2 Additional load losses

Losses produced by the load current in active iron and other metal parts other than conductors.

NOTE: These losses are also known as stray load loss in some countries.