

NEMA MG 10011-2024

*Power Index Calculation Procedure—Standard Rating Methodology for
Motors, Power Drive Systems, and Complete Drive Modules*

Published by

National Electrical Manufacturers Association
1300 North 17th Street, Suite 900
Rosslyn, Virginia 22209

www.nema.org

© 2024 National Electrical Manufacturers Association. All rights including translation into other languages, reserved under the Universal Copyright Convention, the Berne Convention for the Protection of Literary and Artistic Works, and the International and Pan American Copyright Conventions.

NOTICE AND DISCLAIMER

The information in this publication was considered technically sound by the consensus of persons engaged in the development and approval of the document at the time it was developed. Consensus does not necessarily mean that there is unanimous agreement among every person participating in the development of this document.

NEMA standards and guideline publications, of which the document contained herein is one, are developed through a voluntary consensus standards development process. This process brings together volunteers and/or seeks out the views of persons who have an interest in the topic covered by this publication. While NEMA administers the process and establishes rules to promote fairness in the development of consensus, it does not write the document and it does not independently test, evaluate, or verify the accuracy or completeness of any information or the soundness of any judgments contained in its standards and guideline publications. NEMA disclaims liability for any personal injury, property, or other damage of any nature whatsoever, whether special, indirect, consequential, or compensatory, directly or indirectly, resulting from the publication, use of, application, or reliance on this document.

NEMA disclaims and makes no guaranty or warranty, express or implied, as to the accuracy or completeness of any information published herein and disclaims and makes no warranty that the information in this document will fulfill any of your particular purposes or needs. NEMA does not undertake to guarantee the performance of any individual manufacturer or seller's products or services by virtue of this standard or guide.

In publishing and making this document available, NEMA is not undertaking to render professional or other services for or on behalf of any person or entity, nor is NEMA undertaking to perform any duty owed by any person or entity to someone else. Anyone using this document should rely on his or her own independent judgment or, as appropriate, seek the advice of a competent professional in determining the exercise of reasonable care in any given circumstances. Information and other standards on the topic covered by this publication may be available from other sources, which the user may wish to consult for additional views or information not covered by this publication.

NEMA has no power, nor does it undertake to police or enforce compliance with the contents of this document. NEMA does not certify, test, or inspect products, designs, or installations for safety or health purposes. Any certification or other statement of compliance with any health or safety-related information in this document shall not be attributable to NEMA and is solely the responsibility of the certifier or maker of the statement.

Contents

1	Scope	1
1.1	Included Products	1
1.1.1	Group 1—Synchronous and Inverter Only Electric Motors	1
1.1.2	Group 2—Fixed Speed and Inverter Capable Electric Motors	1
1.2	Electric Motor Rated Speed Limits and Speed Groups	1
1.3	Excluded Products	2
2	Referenced Standards and Documents	3
3	Definitions	3
4	Reference Values for Metric Calculation	6
4.1	Default Loss Values	6
4.2	Baseline Motor	6
4.2.1	Polyphase Motor Baseline	6
4.2.2	Line Start Synchronous Motor (LSSM) Baseline	7
4.2.3	Small Electric Motor (SEM) Baseline	7
4.2.4	Single-Phase Motor Baseline	7
4.2.5	Inverter Fed Polyphase Motor Baseline	7
4.3	PDS Baseline Selection, Selection by Single or Polyphase	8
4.4	Usage of Baselines	8
5	Test Methods	8
5.1	Testing in Accordance with Existing Industry Standards and Interpolation at Target Test Points	10
5.1.1	Option 1: PDS Testing of Group 1 OR Group 2 Electric Motor, Providing Measured Drive Performance	10
5.1.2	Option 2: PDS Testing of Group 1 OR Group 2 Electric Motor, Providing Default Drive Performance	11
5.1.3	Option 3: Test of Group 1 Electric Motor, Paired with IEC 61800-9-2 Test of Drive (or Equivalent AEDM)	11
5.1.4	Option 4: Test of Group 1 Electric Motor, Paired with IEC 61800-9-2 Drive Defaults (i.e., IEC IE2 RCDM)	11
5.1.5	Option 5: Test of Group 2 Electric Motor, Paired with IEC 61800-9-2 Test of Drive (or Equivalent AEDM)	12
5.1.6	Option 6: Test of Group 2 Electric Motor, Paired with IEC 61800-9-2 Drive Defaults (i.e., IEC IE2 RCDM)	12
5.1.7	Option 7: Test of Group 1 Electric Motor According to Fixed Speed Methodology	12
5.1.8	Option 8: Test of Group 2 Electric Motor According to Fixed Speed Methodology	12
5.1.9	Option 9: Direct Bench Measurement of Power Index Points for a PDS (or Extended Product)	13
6	Calculation of Metric	14
6.1	Metric Points	14
6.1.1	Measurement Points for Variable Speed Metric (Group 1 and 2) Electric Motors	14
6.1.2	Interpolation Equation for IEC Test Points	14
6.1.3	Fixed Speed Metric (Group 2)	15
6.2	Metric Weighting	15
6.2.1	Rating to the Variable Speed Metric	15

6.2.2	Rating to the Fixed Speed Metric	15
6.2.3	Comparison to Existing Equipment Weighted Average Input Power (i.e., “Adjusted Variable Speed Metric”)	15
7	Reporting of Metric	17
7.1	Applicability of Metric to CT and CHp Equipment.....	17
Annex A Tables and Equations Incorporated by Reference (Normative)		18
A.1	DOE ESEM NOPR Tables 14-16 [as Defined in DOE ESEM NOPR Pre-Publication p. 316-317].....	18
A.2	IEC 61800-9-2 Ed. 2 Interpolation Formula for Segment 2, with Reference Graphic	19
A.3	IEC 61800-9-2 Ed. 2, Equation E.8 and Reference Tables	21
A.4	IEC TS 60034-30-2 Nominal Efficiency Interpolation Equation and Tables	23

Figures

Figure 1	Test Pathways for Existing C.F.R. Test Methods, Resulting in Fixed Speed Metric Scores	9
Figure 2	Test Pathways for New and Replacement Test Methods, Resulting in Variable Speed Metric Scores	10

Tables

Table 1	Motor Maximum rpm Selection by Pole Count	2
Table 2	Test Sections by Motor Category, Metric Type, Presence of a CDM, and Choice of Drive Default Losses	9

Foreword

This standard establishes a calculation procedure for use on fixed speed induction, synchronous, and inverter-only motors in standalone configurations and as part of a power drive system.

This metric provides a means to compare the relative energy savings of motors (both fixed and variable speed) to a standard baseline motor. For polyphase equipment, this is a premium efficient direct on line motor (i.e., IE3 equivalent). This metric provides a rank ordering and a conservative estimate of energy savings relative to a single speed baseline product.

NEMA MG 10011-2024 supersedes and replaces NEMA MG 10011-2022.

NEMA thanks the International Electrotechnical Commission (IEC) for permission to reproduce information from its International Standards. All such extracts are copyright of IEC, Geneva, Switzerland. All rights reserved. Further information on the IEC is available from www.iec.ch. IEC has no responsibility for the placement and context in which the extracts and contents are reproduced by NEMA, nor is IEC in any way responsible for the other content or accuracy therein.

Proposals for modification or improvement of this standard are welcome. They should be sent to the National Electrical Manufacturers Association, 1300 N 17th Street, Suite 900, Arlington, VA 22209, or sent via the NEMA website (<http://www.nema.org>).

The first edition of this standard was developed jointly by Northwest Energy Efficiency Alliance (NEEA) and the NEMA Motors and Generators Section. The current edition was developed in collaboration with NEEA, Alliance Standards Awareness Project, technical experts representing the California IOUs, CADEO Group, and the NEMA Motors and Generators Section. At the time of publication, this section was composed of the following members:

ABB Motors and Mechanical, Inc.—Fort Smith, AK
Adventech, LLC—Florence, AL
Bison Gear & Engineering Corporation—St. Charles, IL
Brook Crompton North America—Toronto, Canada
Cummins, Incorporated—Minneapolis, MN
GE Industrial Motors, A Wolong Company—Houston, TX
Generac Power Systems—Waukesha, WI
Infinitum Electric—Round Rock, TX
JIE USA, Inc.—Carol Stream, IL
Nidec Motor Corporation—St. Louis, MO
NORD Gear Corporation—Waukesha, WI
Regal Rexnord Corporation—Beloit, WI
SEW-Eurodrive, Incorporated—Lyman, SC
Siemens Inverter Drives—Norwood, OH
Sterling Electric, Incorporated—Indianapolis, IN
Tatung Electric Company of America—Tustin, CA
Techtrop Industries, Inc.—Peachtree Corners, GA
T-O-Westinghouse Motor Company—Round Rock, TX
Toshiba International Corporation—Houston, TX
WEG Electric Corp—Duluth, GA
WorldWide Electric Corporation—Rochester, NY

< This page is intentionally left blank. >

Currently in preview, click buy full version

1 Scope

1.1 Included Products

This test procedure applies to polyphase and single-phase electric motors that are in scope of 10 CFR Part 431 *Subparts B, X and Z* (“covered electric motor”),¹ where not additionally excluded in Section 1.3.

In addition, the scope includes only electric motors with rated speed at full load as specified in Section 1.2.

This scope of products is split into the two following groups:

1.1.1 Group 1—Synchronous and Inverter Only Electric Motors

Group 1 includes covered electric motor(s) that meet the characteristics in Section 1.1 and meet the definition of inverter-only or synchronous motors in Section 3.

1.1.2 Group 2—Fixed Speed and Inverter Capable Electric Motors

Group 2 includes all covered electric motor(s) meeting these characteristics defined in Section 1.1, other than synchronous and inverter only electric motors in Group 1.

1.2 Electric Motor Rated Speed Limits and Speed Groups

Synchronous electric motors have no scope limitations on pole count and are categorized into baseline groups (see Section 4.2) by the rated speed of the motor compared with the IEC TS 60034-30-2 reference speed ranges, shown below in Table 1. Synchronous motors within scope must be within the lowest and highest allowable rpm in the table, which are 350 and 5400 rpm, respectively.

All other electric motors (e.g., induction motors) within scope must have a rated speed (i.e., nameplate, including slip) less than the maximum rpm provided in Table 1 for that pole count, and rated frequency at rated speed less than or equal to the parenthetical value for that pole count. Pole counts outside of 2 through 8 poles are exempt from scope.

¹ (A)(1) polyphase electric motors, (2) between 0.25 and 750 Horsepower (HP), (3) between 90 Volts and 600 Volts, (4) 2,4,6 or 8 poles, (5) in a standard NEMA or IEC frame, (6) rated for at least one continuous duty or continuous operation rating and, (7) in standard enclosures and IP ratings, or (B)(1) single-phase electric motors, (2) between 0.25 and 5 HP, also meeting criteria (A)(3-7).