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Rotating electrical machines - Rating and performance

旋转电机 定额与性能

(IEC 60034-1:2022, Rotating electrical machines - Part 1: Rating and performance, IDT)

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Rotating electrical machines - Rating and performance

1 Scope

This document applies to all rotating electrical machines, except those for rolling stock and road vehicles covered by the IEC 60349 series of standards.

Motors within the scope of this document may also comply with superseded, modified, or supplemented requirements of other national and IEC standards, such as IEC 60079 and IEC 60092.

Note: If certain provisions of this document are modified to accommodate specific applications, such as radiation-resistant motors or aerospace motors, all other provisions remain in effect to the extent applicable.

2 Normative references

The contents of the following documents constitute essential provisions of this document through normative reference. For dated references, only the edition corresponding to that date applies to this document. For undated references, the latest edition (including all amendments) applies to this document.

GB/T 21210-2016 Starting performance of single-speed three-phase cage induction motors (IEC 60034-12:2016, IDT)

IEC 60027-1 Letter symbols for use in electrical technology - Part 1: General

Note: GB/T 2987-1996 Letter symbols of parameter for electronic tubes (IEC 60027-1:1992, NEQ)

IEC 60027-4 Letter symbols for use in electrical technology - Part 4: Rotating electric machines

IEC 60034-2 (all parts) Rotating electric machines - Part 2: Standard methods for determining losses and efficiency from tests (excluding machines for traction vehicles)

IEC 60034-3 Rotating electrical machines - Part 3: Specific requirements for synchronous generators driven by steam or combustion gas turbines

IEC 60034-5 Rotating electrical machines - Part 5: Degrees of protection provided by the integral design of rotating electrical machines (IP code) - Classification

CISPR 11 Industrial, scientific and medical equipment - Radiofrequency disturbance characteristics - Limits and methods of measurement

Note: GB 4824-2019 Industrial, scientific and medical equipment - Radio-frequency disturbance characteristics - Limits and methods of measurement (CISPR 11:2015, IDT)

CISPR 14 (all parts) Electromagnetic compatibility - Requirements for household appliances, electric tools and similar apparatus

CISPR 16 (all parts) Specification for radio disturbance and immunity measuring apparatus and methods

3 Terms and definitions

The terms and definitions defined in IEC 60050-411, as well as the following terms and definitions, apply to this document.

Note 1: For cooling and cooling media, see IEC 60034-6, except for 3.17 ~ 3.22.

Note 2: "Agreement" in this document means "agreement between the manufacturer and the user."

The websites for the terminology databases maintained by ISO and IEC for standardization are as follows:

- IEC Electronics Encyclopedia: http://www.electropedia.org/;

- ISO Online Browsing Platform: http://www.iso.org/obp.

3.1

Rated value

A value usually specified by the manufacturer for a motor under specified operating conditions.

Note: Rated voltage or voltage range refers to the line-terminal rated voltage or voltage range.

[Source: GB/T 2900.25-2008, 411-51-23]

3.2

Rating

A set of rated values and operating conditions.

[Source: GB/T 2900.25-2008, 411-51-24]

3.36

Converter duty machine

A motor specifically designed to operate with power electronic inverters, with a temperature rise within the specified insulation class or thermal classification.

Note: Such motors do not have IEC design or NEMA design codes, which may be excluded from energy efficiency regulations in the EU, North America, and other regions.

3.37

Shaft voltage

The power-frequency voltage measured between the motor shaft ends, which may be caused by magnetic asymmetry.

Note 1: For more information on the root causes of shaft voltage, see 5.5 and 6 of IEC TS 60034-24.

Note 2: Power-frequency shaft voltage should not be confused with high-frequency shaft voltage, which can be caused by high-frequency (HF) common-mode inrush currents.

4 Duty cycles

4.1 Expression of duty cycles

The user is responsible for indicating the duty cycles. The user may indicate the duty cycle in one of the following ways:

a) Numerically indicating that the load remains constant or changes in a known manner;

b) Using a time diagram of the changing load;

c) Selecting a duty cycle from S1 ~ S10 that is no less complex than the desired duty cycle.

The duty type shall be indicated using an appropriate abbreviation according to 4.2, written after the load value.

The cyclic duration factor is indicated in the corresponding duty cycle diagram.

The user is generally unable to provide the motor's moment of inertia (J_M) or relative warm-up life (TL); see Appendix A. The manufacturer shall provide this data.

If the user does not indicate the duty cycle, the manufacturer shall assume that the S1 duty cycle (continuous duty cycle) applies.

5 Ratings

5.1 Rating selection

The manufacturer shall select a rating in accordance with the provisions of 3.2. When selecting a rating, the manufacturer shall select a rating in accordance with the provisions of 5.2.1 ~ 5.2.6. The rating category code shall be indicated after the rated output. If no rating code is present, the rating is assumed to be continuous duty.

When the manufacturer incorporates accessories (such as reactors and capacitors) as an integral part of the motor, the rated value shall be applied to the power supply terminals of the entire assembly.

Note: This provision does not apply to power transformers connected between the motor and the power supply.

When rating motors fed or supplied by static converters, special considerations apply. IEC TS 60034-25 provides application guidance.

5.2 Rating categories

5.2.1 Continuous duty rating

With this rating, the motor can operate for extended periods while meeting the requirements of this document.

This rating category corresponds to the S1 duty cycle and is designated in the same manner as the S1 duty cycle.

5.2.2 Short-time duty rating

For this rating, the motor may be started at ambient temperature and operated within the specified time limit while meeting the requirements of this document.

This rating corresponds to the S2 duty; the labeling method is same as that of the S2 duty.

5.2.3 Cyclic duty rating

For this rating, the motor may operate according to the designated operation cycle when meeting the requirements of this document.

This rating category corresponds to any of S3 ~ S8 duty cycles, which is designated in the same manner as the corresponding duty.

Unless otherwise specified, the duration of cyclical load shall be 10 minutes; the duty cycle shall be one of the following values:

15%, 25%, 40%, or 60%.

5.2.4 Acyclic duty rating

For this rating, the motor may be operated acyclicly while meeting the requirements of this document.

This rating corresponds to the acyclic duty S9; the labeling method is same as that of S9 duty.

5.2.5 Discrete constant load and speed duty ratings

For this rating, the motor can withstand the combined load and speed of S10 duty cycle for long-term operation, while meeting the requirements of this document. The maximum permissible load within a duty cycle shall take into account all motor components, such as the exponential effectiveness of the insulation structure relative to the expected thermal life, bearing temperature, thermal expansion of other components. Unless otherwise specified in other relevant national or IEC standards, the maximum load shall not exceed 1.15 times the load value based on S1 duty cycle. The minimum load may be zero, at which point the motor is either no-loaded or shutdown and deenergized. For the selection of this rating, see Appendix A.

This rating category corresponds to S10 duty cycle and is designated in the same manner as S10 duty cycle.

Note: Other relevant national or IEC standards allow the maximum load to be specified by limiting the winding temperature (or temperature rise) instead of the load rating based on S1 duty cycle.

5.2.6 Equivalent load rating

A rating established for testing purposes that, while meeting all requirements of this document, allows the motor to be operated at a constant load until thermal stability is achieved, resulting in a stator winding temperature rise equal to the average temperature rise over a duty cycle of the specified duty cycle.

The equivalent rating should take into account variations in load, speed, cooling over a duty cycle.

If this type of rating is used, it is designated "equ."

5.3 Selection of rating category

Motors manufactured for general use shall have a continuous duty rating and be capable of operating at S1 duty cycle.

If the user does not specify the duty cycle, it is assumed to be S1 duty cycle; the rating shall be the continuous duty rating.

For motors rated for short-term duty, the rating shall be based on S2 duty cycle, see 4.2.2.

For motors used with variable loads or loads including no-load, shutdown, de-energized, their ratings shall be the cyclic duty ratings based on one of the S3 ~ S8 duty cycles, see 4.2.3 ~ 4.2.8.

For motors used for variable speed operation (including overload) under non-cyclic variable loads, their ratings shall be the non-cyclic duty ratings based on the S9 duty cycle, see 4.2.9.

For motors used with discrete constant loads, including overload or no-load (or rest and de-energized), their ratings shall be the discrete constant load ratings based on the S10 duty cycle, see 4.2.10.

5.4 Output of various rating categories

When determining ratings:

- For S1 ~ S8 duty cycles, the rated output shall be the constant load rating, see 4.2.1 ~ 4.2.8;

- For S9 and S10 duty cycles, the rated output shall be the load reference value based on S1 duty cycle, see 4.2.9 and 4.2.10.

5.5 Rated output

5.5.1 DC generators

Rated output is the output power at the terminals and shall be expressed in watts (W).

5.5.2 AC generators

Rated output is the apparent power at the terminals and shall be expressed in volt-amperes (VA) and power factor.

Unless otherwise agreed with the purchaser, the rated power factor of synchronous generators shall be 0.8 lagging (overexcited).

Note: The P-Q output diagram (power diagram) for AC generators indicates the operating limits and provides additional information on generator performance parameters.

5.5.3 Electric motors

Rated output refers to the effective mechanical power delivered to the shaft and shall be expressed in watts (W).

Note: In some countries, the actual mechanical power delivered to the shaft of an electric motor

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