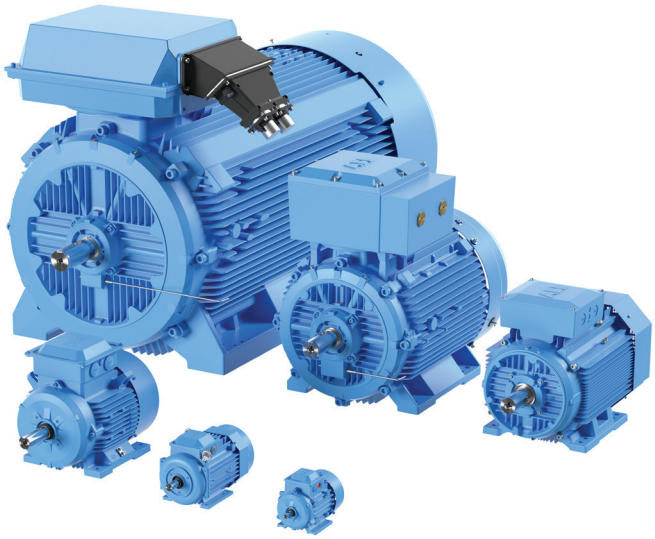
TECHNICAL NOTE

IEC 60034-2-1 standard on efficiency measurement methods for low voltage AC motors



The International Electrotechnical Commission (IEC) has introduced a revised edition 3.0 of the standard IEC 60034 Part 2-1: Standard methods for determining losses and efficiency from tests (excluding machines for traction vehicles). The recent edition 3.0 replaces the edition 2.0 from 2014.

How is efficiency determined?
The efficiency of a motor is defined as the ratio of output (mechanical) power to input (electrical) power. Determination can be done by using direct or indirect method.

Direct method simply requires a measurement of the input and output power by means of a power analyzer. The efficiency of a motor is determined directly from the measured output power, based on the rotational speed and torque, and divided by the measured input power to a motor.

Indirect measurement is based on the loss segregation method leading to the sum of losses ie. total losses, calculated in each six load point as defined in the standard. Total losses are then substracted from the input power thus giving the output power used for the determination of the efficiency in each load point.

Motor losses can be divided in the following groups:
- load losses that are of stator winding and rotor losses
- iron losses
- friction and windage losses
- additional load losses (stray load losses)

Of these, the first four types of loss can be determined from input power, voltage, current, speed and torque. Additional load losses are determined from the residual losses defined from the partial load tests.

Key changes in Ed. 3.0 vs. Ed. 2.0
The new Edition 3.0 is improving the uncertainty, accuracy of testing and clarifies the text in different clauses. Major changes as below:
- dynamometer test or method is not recognized anymore
- improved text regarding several clauses
- torque measurement
- test resistance
- state of machine under test and test categories
- allowed ambient temperature during testing increased

These improvements do not make any changes in the loss calculation and efficiency determination when comparing Ed. 3.0 and Ed. 2.0.

How do the efficiency figures differ when tested according to Ed. 3.0 and Ed. 2.0?
No changes in the loss calculation nor results affecting to the losses and finally to the efficiency determination.

The indirect method as defined in the standard IEC 60034-2-1 is almoust identiacl to the methods defined in IEEE 112 Method B and in CSA 390-98. Today the testing standard IEC 60034-2-1 is also recognized by the US Department of Energy.

How can motor users identify which measuring method has been used?
The motor documentation must state which method was used.

Please note that efficiency values provided by different motor manufacturers are comparable only if the same measuring method has been used.

How does ABB apply the new edition of the standard?
Since these are no changes in the measurement, loss calculation nor efficiency determination the new edition can be referenced in our catalogs and test reports without further notice. Under the efficiency testing standard (IEC 60034-2-1 Ed.2.0 from 2014 or Ed.3.0 from 2024);

- ABB has calculated efficiency values according to indirect method, with additional losses determined from measurement, which is the preferred low uncertainty method outlined in the standard.
- equipment used by ABB are of higher accuracy class than defined in the standard.
- ABB provides efficiency values according to edition 2.0 or 3.0
  IEC 60034-2-1 and publish the values in the printed technical catalogs.

International Efficiency (IE) classes
Standard IEC 60034-30-1, published in March 2014, defines four IE (International Efficiency) classes of single-speed, “line operated AC motors” that are rated for sinusoidal voltage supply and;

- have 2, 4, 6 or 8 poles
- rated power from 0.12 kW up to 1000 kW
- rated voltage from 50V up to 1000V
- are capable of continuous operation at their rated power with a temperature rise within the specified thermal class
- marked within the ambient range of -20°C to +60°C (any ambient temperature)
- marked with an altitude up to 4000m

More detailed information about the scope as well as exclusions can be found from the IEC 60034-30-1

Key to abbreviations:

iEC	International Electrotechnical Commission
IEEE	Institute of Electrical and Electronics Engineers
CSA	Canadian Standards Association
CSA	European Norm

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9AKK107318 EN 04-2024