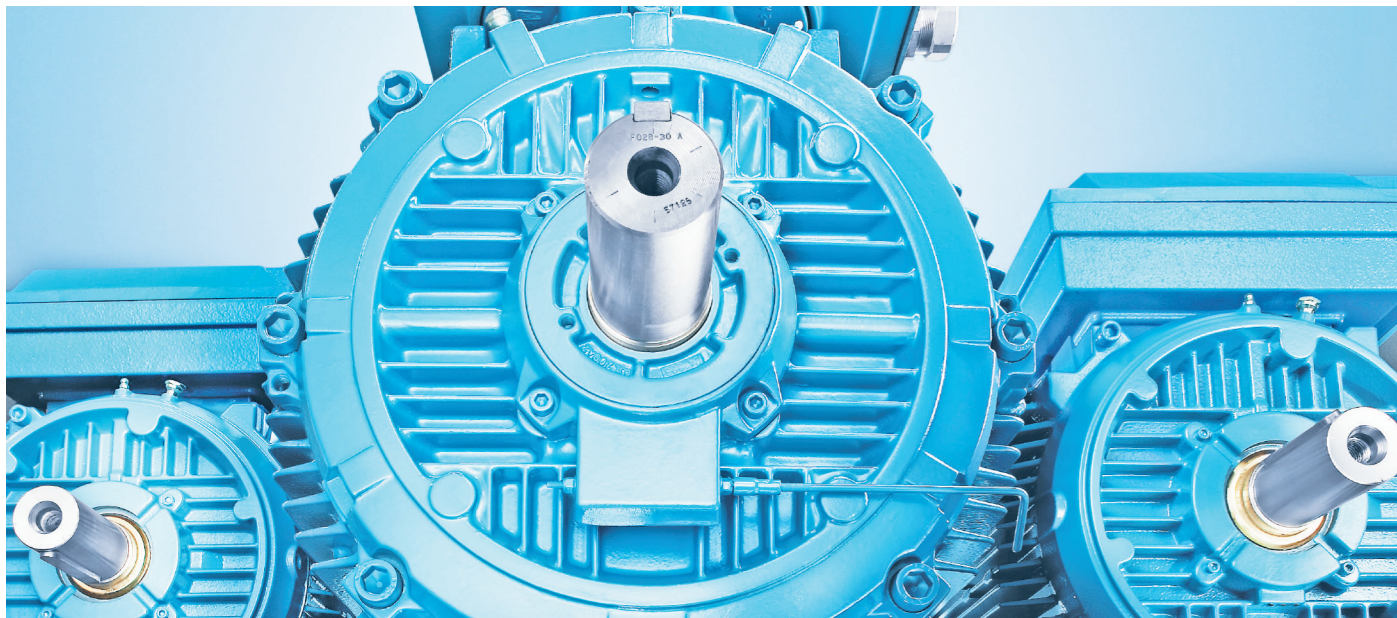


Technical note

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



The International Electrotechnical Commission (IEC) has introduced a revised edition 2.0 of the standard IEC 60034 Part 2-1: Standard methods for determining losses and efficiency from tests (excluding machines for traction vehicles). Edition 2.0 that came into force in June 2014 replaced the first edition 1.0 that was introduced in 2007.

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 power by means of a power analyzer and the output power by means of the rotational speed and torque applied 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 subtracted 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, rotational speed and torque. Additional load losses are determined from the residual losses that are defined from the partial load tests.

Key changes in Ed. 2.0 vs. Ed. 1.0

The major changes in the Ed. 2.0 vs. Ed. 1.0 are related to improving the uncertainty and accuracy of testing. Major changes as below:

- preferred testing methods defined for specific rating and type of machines
- some refined requirement for the instrumentation and accuracy
- specific test sequence for tests to be performed and introduced for the first time
- small changes in the formulas for the loss calculations

As a whole these improvements do not make any big change in the loss calculation and efficiency determination when comparing Ed. 2.0 and Ed. 1.0, but the new edition makes testing more reliable and test results more comparable.

How do the efficiency figures differ when tested according to Ed. 1.0 and Ed. 2.0?

Basically no remarkable difference can be found from the efficiency if the testing procedure defined in the Ed. 2.0 has been used in tests or if the same test sequence has already been in use since Ed. 1.0 came into force. Small changes in the calculation formulas of the standard have no significant influence in the efficiency itself. This is the case for the test results performed by ABB.

The indirect method as defined in the standard IEC 60034-2-1 is very close to the methods defined in IEEE 112 Method B and in CSA 390-98 and the differences in the loss calculation can be considered very small as well as the final efficiency values to be equal.

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?

Under the efficiency testing standard (IEC 60034-2-1: 2014);

- 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 IEC/EN 60034-2-1: 2014 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 Part 30-1.

For more information please contact:

www.abb.com/motors&generators

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Key to abbreviations:

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