

Interpreting IE Efficiency Class for Aircore EC

The IE efficiency class mandated by European Ecodesign regulations are becoming a popular specification item for NEMA (<https://www.nema.org/>) motor applications as well. This document explains the nuances of applying IE efficiency specifications for an integrated drive-motor such as Aircore EC in a NEMA application.



IE Efficiency: Electric Motor Efficiency Regulatory in Europe

International Efficiency (IE) classes are defined by IEC standards (<https://iec.ch/homepage>).

- IEC 60034-30-1 standard specifies efficiency classes (IE1 to IE4) and applies to single speed, direct online (DOL) motors.
- IEC 60034-30-2 standard specifies efficiency classes (IE1 to IE5) and applies to variable speed motors.

Established within the European Ecodesign regulations, the 60034-30 set of standards set nominal efficiency values for electric motors. The standard strictly applies to the

electromechanical component i.e. motors and NOT to the VFD (Variable Frequency Drive also called Variable Speed Drive, VSD) and connected electronics.

IE efficiency class applies to the motor only and not the VFD.


As a motor-specific efficiency standard for direct online (DOL) and Variable Speed Motors, IEC 60034-30 set of standards disregards partial load efficiencies. The partial load efficiency is a critical factor when designing motors for HVAC and other variable speed applications.


When an integrated drive-motor or inverter-only motor manufacturer claims and IE efficiency class on the nameplate, its typically at the 'Rated' conditions for the motor and not the VFD.

IE Efficiency and Nameplates


Motors sold in Europe (with CE mark (https://single-market-economy.ec.europa.eu/single-market/ce-marking_en)) are required by European Ecodesign regulations to indicate the IE efficiency class on the motor nameplate.

When an integrated drive-motor manufacturer claims an IE efficiency class on the nameplate, its typically at 'Rated' condition for just the motor while ignoring the VFD efficiency. When using such motors for variable speed HVAC and pump applications, it's important that the manufacturer shares system efficiency at partial loads.

				
AIRCORE EC				
AE20-1000-1800-AAAS-AA40				
0000WWW000000		REF. PROTOTYPE		
INPUT 460Y/267VAC 3Φ 60Hz				
OUTPUT 10 HP / 7.5 kW			RPM 1800	
SF 1.0	IP54	AMPS 12.0	CONT	INS B
ENC. TEFC	EFF. AMCA 207	EPL	REV. P00	



WARNING: The Infinitum motor is only intended for operation with the integrated drive. Do not operate this motor with any other VFD.
AVERTISSEMENT: Le moteur Infinitum est uniquement conçu pour fonctionner avec le variateur intégré. N'utilisez pas ce moteur avec un autre EFV.



Intertek
5022037

Conforms to UL STD
1004-1, 1004-7 &
61800-5-1
Certified to CSA STD
C22.2#77, 100 & 274
MODEL# AE4B20A5

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Manufactured in MEXICO

On the other hand, when an EC Fan manufacturer claims an IE efficiency class on the nameplate, its typically at 'Rated' condition for just the motor while ignoring the efficiency of both the VFD and the fan. When using such motors for variable speed HVAC applications, it's important that the manufacturer shares the partial load system efficiencies. In fact, the wire-to-air system efficiency as tested in AMCA207 provides a holistic view since the motor, the VFD and the fan is included in the calculations.

Whether an EC Fan or Integrated drive-motor, customers might be misguided on the efficiency of the product they bought. Customers need to be aware that nameplate efficiency is a design reference while system-efficiency is what matters for energy savings.

What is IES Efficiency

IES efficiency class, a relative of the afore mentioned IE efficiency, stands for International Efficiency of Systems, which is part of International Standard IEC 61800-9-2 and mandated by European Ecodesign regulations.

While the IE class is solely the efficiency classification of an electromechanical component (e.g. motor), the IES is a classification for a drive system consisting of motors, motor starters, VFD, and other connected devices. IES defines IES0, IES1 and IES2 efficiency classes. Interestingly, IES classes require manufacturers to determine system efficiencies at eight different load points. As opposed to IE efficiency, manufacturers following the European Ecodesign regulations are not required to indicate the IES class on their nameplates. Unlike IE efficiency classes, the IES system efficiency class is mathematically calculated leading to its limited popularity and discernability outside of European Ecodesign regulatory environment.

Did you know?

- IE efficiency classes (IE1, IE2, IE3, IE4) do not apply to VFDs
- IE efficiency classes are required by law in Europe to meet the European Ecodesign regulations and CE directives but not required by law in North American or NEMA markets.
- NEMA has developed comparable efficiency standards that roughly follows IE
- An IE5 equivalent to NEMA, the Ultra-Premium Efficiency class does not exist today.
- An IE5 labeled EC motor or fan only applies to the motor and that too at the rated operating point only. Drive efficiency and motor efficiency at partial load is ignored.
- While IE efficiency classes only apply to the electromechanical equipment such as motors, the IES classification is more applicable to motor-drive systems but is not mandated in Europe or North America.

Electric Motor Efficiency: Regulatory Landscape in USA and Canada

The Energy Policy and Conservation Act, among others defines energy standards for various consumer, commercial and industrial equipment, including electric motors in the USA. The efficiency standards are regulated by the Department of Energy (DoE) as set by NEMA in its MG-1 Standard.

Canada's Energy Efficiency Act and Energy Efficiency Regulations are administered by Natural Resources Canada. The Canadian energy efficiency standards closely follow that set by NEMA.

Efficiency Classification for NEMA Products

Unlike in Europe, the IE and IES efficiency classes are not regulated in North America. However, NEMA has developed its own efficiency classifications that closely mirrors IE levels in coordination with DoE and Natural Resources Canada. NEMA currently doesn't have a classification equivalent to IES efficiency class. NEMA's motor efficiency classes; Standard, Energy Efficient and Premium Efficiency and Super Premium Efficiency are roughly equivalent to the IE1, IE2, IE3 and IE4 classes.

A future version of the IEC 61800-9-2 standard is expected to formalize the IE5 class, and its NEMA equivalent, known as Ultra Premium Efficiency. Although the IE5/Ultra Premium Efficiency class is not yet formally published by IEC, the IEC TS 60034-2 (provides guidance for manufacturers.

System efficiencies of Integrated drive-motors (among others) are outside the scope of the NEMA efficiency standards. As a motor-specific efficiency standard, NEMA disregards partial load efficiency too.

Aircore EC and IE Efficiency with NEMA

As we have explained, the applicable efficiency classes for an integrated motor-drive in a NEMA environment falls into a grey area. Owing to the confusion, some manufacturers are claiming efficiency classes for just the motor when they sell an integrated motor-drive. Others, come up with their own invented efficiency classes such as 'IE6' to claim an improvement over IE5.

As the manufacturer of integrated motor-drives sold in North America, Infinitum takes the following steps to remove ambiguity for our customers.

- Unlike other brands, Aircore EC motors are NOT nameplated for IE5 efficiency. Since Aircore EC is ALWAYS sold as an integrated motor-drive, nameplating just the motor for IE5 compliance is confusing and misleading to the user. Contact your Inifinitum account executive for a compliance letter for project specific submittal purposes.
- Inifinitum's Aircore EC product line is certified to UL/CSA standards and adheres to NEMA mounting and NEC wiring guidelines for products sold in North America. Therefore, Inifinitum is not bound by the European (CE mark) nameplate requirements for IE labeling as defined by the European Ecodesign regulations.
- Aircore EC doesn't nameplate the NEMA efficiency class either. As described earlier, NEMA neither has an IE5 equivalent nor an IES type system efficiency classification yet. Besides, NEMA efficiency classes only applies to DOL, Squirrel cage induction motors. Aircore EC is neither DOL, nor squirrel cage or AC induction.
- Unlike EC fans, Inifinitum sells a general-purpose motor-drive that could be used in a variety of industries such as fans, pumps or material handling, where each industry has their own efficiency requirements. Contact your Inifinitum account executive for more information on Inifinitum's custom labeling process and how to add industry or project specific labels for the product.

Reference Materials

US Energy Conservation Standards for Electric Motors	https://www.federalregister.gov/documents/2023/06/01/2023-10019/energy-conservation-program-energy-conservation-standards-for-electric-motors (https://www.federalregister.gov/documents/2023/06/01/2023-10019/energy-conservation-program-energy-conservation-standards-for-electric-motors%20)
European Ecodesign Regulation	https://europa.eu/youreurope/business/product-requirements/compliance/ecodesign/index_en.htm (https://europa.eu/youreurope/business/product-requirements/compliance/ecodesign/index_en.htm%20)
Natural Resources Canada	https://natural-resources.canada.ca/energy-efficiency/energy-efficiency-regulations/guide-canadas-energy-efficiency-regulations/motors-1-500-hp0746-375-kw/6885 (https://natural-resources.canada.ca/energy-efficiency/energy-efficiency-regulations/guide-canadas-energy-efficiency-regulations/motors-1-500-hp0746-375-kw/6885%20)
NEMA MG 1 Standard	https://www.nema.org/standards/view/motors-and-generators (https://www.nema.org/standards/view/motors-and-generators%20)

IEC Efficiency Class for Motors	IEC Scope	NEMA Efficiency Class	NEMA Scope
IE5	Motor at Rated load point. IEC 60034-1 IEC60034-2	Ultra Premium Efficiency ¹	NEMA Design B or C line operated, single-speed, Squirrel Cage Motors
IE4		Super Premium Efficiency	
IE3		Premium Efficiency	
IE2		High Efficiency	
IE1		Standard Efficiency	

IEC Efficiency Class for Integrated Motor-Drives	IEC Scope	NEMA Efficiency Class
IES0	Motor-Drive System at 8 pre-defined load points	Does not exist
IES1		
IES2		

Relative Torque (%)

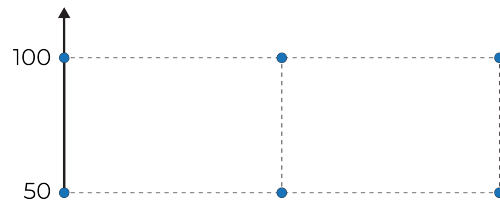


Figure 1 IES Classification