ABB DRIVES AND MOTORS

30 top tips to tackle HVAC challenges

No.05 - Induction motors

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Not all motor technology is suitable for HVAC. Try the standard induction motor.

Induction motors (IMs) have been with us for many years: the technology is well understood, they are easy to control and to repair and they have become more efficient over time. As building regulations change, IMs, however, struggle to achieve specific fan powers in selected cases.

A premium efficiency low voltage AC IM may be slightly larger than its lower efficiency counterpart and will save energy, but for typical HVAC powers (<22 kW) IMs are struggling to meet efficiency standards.

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Technical

Specific fan power (SFP)
SFP is a measure of how much electric power is required by a fan to move a given air volume. The SFP is influenced by flow rate, resistance of the ventilation system and efficiency of the fan system. By stipulating a maximum SFP, it is possible to limit the power requirements for transporting air throughout an entire building, air handling units (AHUs) and individual fans.

To meet the requirements of the SFP as stipulated in Part L of the building regulations a system design is needed. The HVAC market generally recognises four electric motor types:

- Brushless DC motor, or electronically commutated motor (ECM).
- Synchronous reluctance motor (SynRM) together with variable speed drive (VSD).
- Conventional fan controlled by conventional induction motor (IM) and VSD.
- Permanent magnet (PM) motor.

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Technical

Standard induction motor (IM)

Advantages

- Well known mechanical sizes, most popular and common motor design. Air handler bed plates, etc., have standard mechanical interfaces to these motors.
- Efficiency levels are improving with IE4 now available on larger machines.
- Easy to maintain and operate: can be readily re-wound and spares are widely available.
- Magnet-free: no generated electricity from freewheeling loads, making the HVAC practice of isolation safe.
- Can operate direct-on-line or with a VSD. Building regulations now require a VSD, which brings energy savings of between 20 to 80 percent.
- To get the best energy efficiency from an IM, fit a VSD and control the fan speed effectively.

Technical

Standard induction motor (IM)

Disadvantages

- The IM requires a second magnet to be induced into the rotor (hence the name).
- The rotor is a source of I^2R losses within the motor, making it hard to achieve very high efficiencies.
- Smaller power motors are particularly difficult to make high efficiency.
- It is very hard to increase the cross sectional area of conductors and add copper whilst keeping motors small. Making motors below 7.5 kW efficient, therefore, is why other technologies like ECM, PM and SynRM are often considered.
- SynRM is the preferred alternative as it is built into a package that matches an IM's mechanics, so conversion to SynRM is easier than with other technologies.

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Technical

	HO SynRM	IE4 SynRM	IE4 IM	Typical PM
Motor size	Smaller	Same	Bigger	Smaller
Replaceability	Not always	Yes	Not always	Not always
Repairability	Same – copy wind	Same – copy wind	Same – copy wind	More difficult
Efficiency	Same or higher	Higher	Higher	Higher
Ease of service	Same	Same	Same	More difficult
Price	Same	Same as IE3	Higher than IE3	Higher (2-300%)
Reliability	Same or higher	Same or higher	Same or higher	Magnets can demagnetise
Availability	1.1 – 350 kW	11 – 315 kW	Above 75 kW now	Depends on manufacturer
Weight	Lower	Lower	Same or higher	Higher
Operating noise	Lower	Lower	Same	Similar
Package efficiency testing	Yes	Yes	No	No

Compared to IE 2 motors

Frequently Asked Questions

How do I choose between an ECM, SynRM, IM or PM motor?
The motor description within this e-book has a comparison table to help with these choices. Some choices will be financial or technical while others are based on safety. IMs are well known, and SynRM replaces an IM like for like.

What are the limitations of using an IM?
IMs struggle to get to high efficiencies in smaller powers, due to the I^2R losses in the rotor.

What is the best way to save energy using an IM?
Stop using IMs direct-on-line and start using VSD technology, as the building regulations already demand. It is then important to control the speed of the motor with the VSD to achieve the savings. Running at 50 Hz with a VSD just wastes energy and defeats the purpose of building regulations.

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Hints

IM technology is understood and efficiency levels are acceptable. Lower power motors are difficult to make premium efficiency, hence the need to choose new technologies like SynRM.

The best way to save energy with any motor is to vary its speed to match the load. Whether it is a refrigeration chiller compressor or an air handler fan, controlling motor speed always saves significant amounts of energy. Fans typically save 20 percent with a possibility to save 80 percent.

Building regulations demand that VSDs are fitted. To fit a VSD then run it at 50 Hz wastes energy. The savings come by controlling the IM to be best efficiency point for the system.

Specifying robust systems with proper control is the best way to save energy in HVAC applications.

Ask your motor-drive supplier to help specify these components and operating points.

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This is one of 30 top tips for users of variable speed drives in heating, ventilation and air conditioning applications. To ensure that you receive ALL the tips as they are published, please register your interest by **clicking here**

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