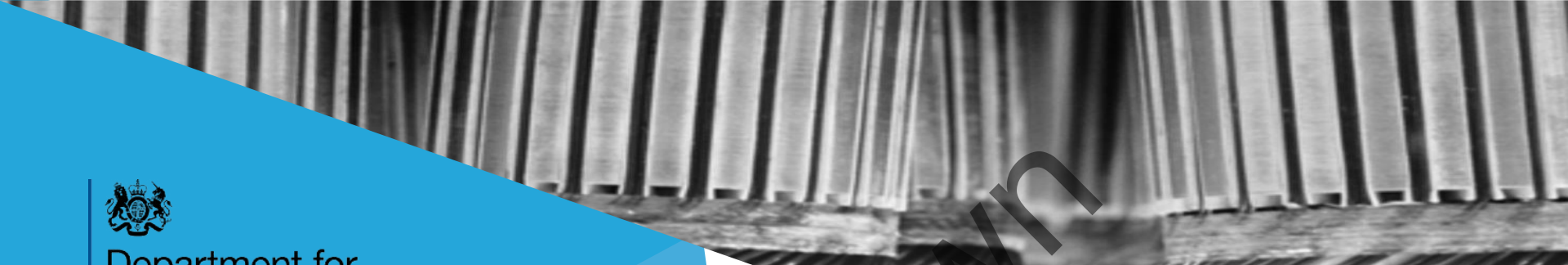

Department for Business, Energy & Industrial Strategy

Energy Technology List

Motors and Drives:

A guide to energy efficient equipment listed on the Energy Technology List (ETL)

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Introduction

The ETL is a government register of energy saving products. When you select products from the list you are choosing from amongst the most energy efficient products in the marketplace.

When replacing equipment, businesses are often tempted to opt for equipment with the lowest capital cost. However, such immediate cost savings may prove to be a false economy. Considering higher energy efficient products, means that life cycle costs are reduced, improving cash flow in the longer term.

Businesses can also claim accelerated tax relief through the Annual Investment Allowance (AIA) for investments in plant and machinery equipment. The AIA has been temporarily increased to £1 million from January 2019.

This leaflet illustrates the benefits of investing in motors and drives energy saving equipment which qualifies for the ETL.

The ETL comprises two lists:

- **Energy Technology Criteria List**: defines the performance criteria that equipment must meet to qualify for the ETL;
- **Energy Technology Product List**: is the list of products that have been assessed as being compliant with ETL criteria.

Eligible motors and drives products on the ETL can be searched at:
https://etl.beis.gov.uk/engetl/fox/live/ETL_PUBLIC_PRODUCT_SEARCH

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Setting the scene

Did you know?
Information about an individual motor can be found on its name/ rating plate, and further detailed information is provided in the motor manufacturer's product literature

Definition

An electric motor is a device for converting electrical energy to rotary kinetic (movement) energy in order to power a process such as a pump, fan or conveyor. Motors can be found in the vast majority of equipment, for example:

- The fans that provide combustion air for gas to burn in a heating system.
- The pumps that deliver hot water to a heating system's radiators.
- The prime mover in an air compressor.
- The device that drives a conveyor belt in a production line.

Electric motors are available in standardised sizes and power ratings typically ranging from 10W to several MW. There are different types of motor, each of which has different characteristics, advantages and applications. By far the most commonly used motor is the AC induction motor, which typically runs at a fixed speed when connected to an electrical supply.

The term 'drive' is used to mean many things in industry, including being used as a generic word for motors, for drive trains (such as gearboxes or pulley systems), and for motor controllers (e.g. variable speed drive).

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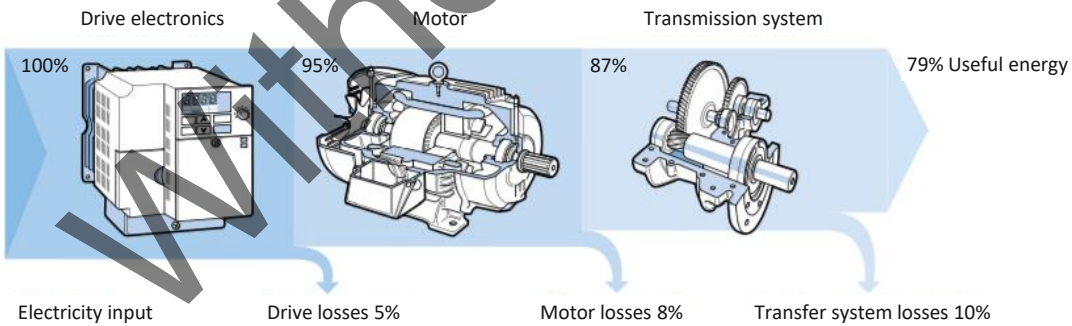
Setting the scene

Did you know?
Globally, electric motors and electric-motor driven systems are estimated to consume almost 50% of all electricity consumption and account for 70% of electricity consumption in industry

Losses can be minimised and energy savings can be achieved by purchasing and installing energy efficient ETL listed equipment.

Energy Usage

Electric motive power is likely to form a large part of an organisation's energy consumption. The energy consumed by a motor and drive system can be seen in the diagram below. In the example below, for every unit of electrical energy (kWh) supplied to a system less than 80% might be converted into useful movement at the load. It is not uncommon to see further energy losses in the system from the equipment being driven (for example a fan being driven by this system might result in a further 25-30% of energy losses).



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Setting the scene

Assumptions

An ETL listed motor or drive must meet defined energy efficiency levels under various load conditions. In this document, the baseline scenario below has been used to calculate the potential financial (£), energy (kWh) and carbon savings (tonnes CO_2) unless otherwise indicated:

- Motor system operates continuously, 8,760 hours a year
- Price for electricity 11.14p/kWh
- Carbon emissions for electricity 0.35156 kgCO_2/kWh
- Assumed 89% existing efficiency replaced with 93% standard (IE3 motor) or ETL listed 94.5% efficiency (IE4 motor)
- Assumed typical saving of 25% when using a variable speed drive, and a variable speed drive efficiency of 95%
- ETL listed products are presumed to be in the top 25% of energy efficient products available in the marketplace

Energy cost and emissions data from BEIS 2017

© Ziehl-Abegg Variable Speed Drive

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Products eligible under the ETL:
Line Operated Motors 1/2

Line operated motors are covered by the ETL

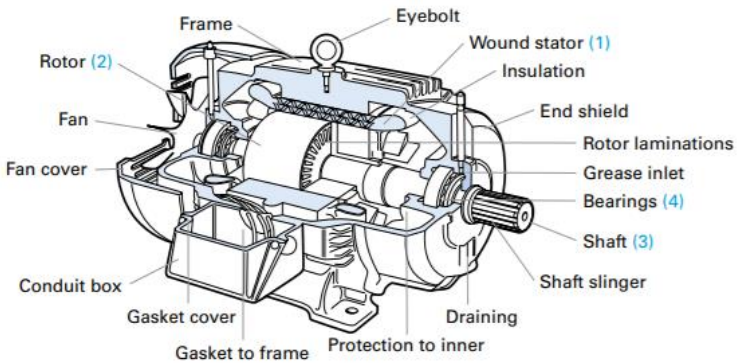
Line operated motors

The line operated ac motors technology covers products that are specifically designed to convert standard three phase electrical power into mechanical power, and to rotate a drive shaft at a fixed speed that is directly related to the frequency of the electrical power supply.

Line operated ac motors are used to drive plant and machinery throughout industry and commerce, and a wide range of 'general purpose' products are available in internationally agreed, standard designs with different rated power outputs, frame sizes, fixed operating speeds, and energy efficiency ratings.

The majority of line operated motors are ac induction motors. However, there are a series of new and more efficient motors entering the market. For example, hybrid permanent magnet motors use built in permanent magnets to reduce rotor losses and increase overall energy efficiency.

The diagram below shows the components of a fixed speed cage induction motor. As electrical power is applied to the motor, a rotating magnetic field is created around the stator (1). This induces currents and associated magnetic fields in the rotor (2), causing the rotor and shaft (3) to spin. The shaft is mounted on bearings (4) and is able to rotate freely.



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Products eligible under the ETL:
Line Operated Motors 2/2

Line operated motors are covered by the ETL

Line operated motors

Line operated motors eligible under the ETL are fixed speed, three-phase caged motors, which operate from a supply voltage less than or equal to 1,000 Volts ac at a frequency of 50Hz. These motors must exceed a minimum efficiency level which depends on the kW rating and the number of poles the motor has. The number of poles in a motor relates to the rated fixed speed of that motor.

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Example: Replacing a 22kW 4-pole single speed induction motor which has previously been rewound, by an equivalent ETL model operating 24 hours a day, 365 days a year at full load will result in the following potential annual savings:

- £1,400
- 12,600 kWh
- 4.4 tonnes CO_2

Choosing an ETL listed replacement will save approximately £360, 3,300kWh and 1.1tCO_2 more than a standard (IE3) replacement motor.

With a typical additional capital cost of £270*, and lifetime energy and AIA benefits of around £3,760 compared to a non-ETL listed unit at today's prices, the financial benefit of choosing an ETL listed product is over 13 times the additional cost. Furthermore, with a potential AIA of approximately £220 in year 1 plus additional energy savings, the extra capital cost is recovered within the first year of purchase.

*£1,170 and £900 capital costs for an ETL and non-ETL compliant unit respectively

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Products eligible under the ETL:
Variable Speed Drives 1/2

Variable speed drives are covered by the ETL

Savings of up to 50% of energy use are achievable by reducing the fan or pump motor speed by 20%

Variable speed drives

Line operated motors (typically induction motors) run at fixed speeds and are ideally suited to applications where a constant motor output speed is required, for example a conveyor. However, there are some applications where varying motor output speeds are preferable, for example fans, pumps, winders and precision tools. Reducing the speed of a pump is more efficient than running the pump at full speed, and closing a valve to control the flow.

A variable speed drive (VSD), is an electronic device that controls the characteristics of a motor's electrical supply. Therefore, it is able to control the speed and torque of a motor, achieving a better match with the process requirements of the machine it is driving. For applications where variable control is desirable, slowing down a motor with a VSD can reduce energy use substantially.

© IMO Precision Controls

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Products eligible under the ETL:
Variable Speed Drives 2/2

Variable speed drives are covered by the ETL

Variable speed drives

Variable speed drives may be purchased either as a stand-alone product or purchased as part of another item of plant or machinery. They are included on the Energy Technology List because they can realise substantial energy savings when used to control the speed of machinery. The ETL covers two categories of products:

1. Variable Speed Drives for line operated ac motors (as defined within the ETL category line operated ac motors)
2. Variable Speed Drives for converter-fed motors (as defined within the ETL category converter-fed motors)

Example: An ETL listed VSD is fitted to an ETL listed 22kW 4-pole single speed (line operated) ac induction motor, which drives a continuously running pump that circulates water around a closed loop. The VSD replaces a valve to modulate the flow in the circuit. There is an assumed 20% reduction in pump speed possible with no change in performance of system. The potential annual savings are:

- £5,700
- 51,200 kWh
- 18 tonnes CO_2

With a typical capital cost of around £1,960 and lifetime energy and AIA benefits of around £57,650 at today's prices, the financial benefit of choosing an ETL listed product is over 29 times the cost. Furthermore, with a potential AIA of approximately £370 in year 1 plus additional energy savings, the capital cost is recovered within the first year of purchase.

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Products eligible under the ETL:
Converter-Fed Motors 1/2

Converter-fed motors are covered by the ETL

Converter-fed motors

Converter-fed motors are products that are specifically designed to convert electrical power into mechanical power, by rotating a drive shaft at a speed that is directly related to the electrical power supplied to the motor.

For the ETL, converter-fed ac motor drives consist of a motor, and a matched, electronic variable speed drive (VSD) that is specifically designed to provide the multi-phase electrical power input needed to operate the motor, and to vary its speed in a controlled manner in response to an external signal.

Converter-fed motors are applied throughout industry and commerce in a wide range of 'general purpose' and specialist applications.

Converter-fed motors are available in a wide range of designs and efficiencies. The ETL aims to supports the purchase of higher efficiency products. The ETL covers three categories of product:

1. Converter-fed ac motors (sold without VSD).
2. Integrated converter-fed motor drive units.
3. Matched converter-fed motor drive packages

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Products eligible under the ETL:
Converter-Fed Motors 2/2

Converter-fed motors are covered by the ETL

Converter-fed motors
As converter-fed motors are powered from converters (variable speed drives) they can realise substantial savings in a wide range of applications, especially when driving variable loads such as fans, pumps, compressors etc. The most common converter-fed motors are permanent magnet synchronous motors (PMSM) and electrically commutated (EC) motors. PMSM rotors are fitted with permanent magnets which create the rotor magnetic field, rather than aluminium or copper rotor bars (used in induction motors) which incur extra losses. EC motors are dc motors with an integrated drive allowing direct connection to ac electricity supply. They are more efficient than induction motors as they use permanent magnets rather than copper windings. In addition, the drive also allows more efficient operation at lower speeds, and they are increasingly commonly supplied with fans. A more recent technology which also falls into this category is synchronous reluctance motors. These are packaged with a drive so can also operate at variable speed, and have an innovative rotor design which reduces losses. Converter-fed motors are often smaller and require less cooling. They generally do not require a gearbox, as they have a high turn down which allows operation across a range of speeds & torques.

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Where can I find more information?

For information about the ETL please visit: https://www.gov.uk/guidance/energy-technology-list and see our Information for Purchasers factsheet. Or contact the ETL Help Line on 0300 330 0657; email ETLQuestions@carbontrust.com

For more information on the ETL:

To search for a product on the ETL please visit:
https://etl.beis.gov.uk/engetl/fox/live/ETL_PUBLIC_PRODUCT_SEARCH