MAKING MODERN LIVING POSSIBLE

Saving energy with geared motors

Standards, classifications and solutions

BAUER geared motors

The Gear Motor Specialist

Introduction

Danfoss welcomes the EU Directive

We are all familiar with the figures: around 70 per cent of industrial energy demand comes from electric motors. This represents CO2 emissions on the order of some 427 million tons. The European Commission is convinced that savings equal to the electrical power consumption of Sweden could be achieved with suitable measures.

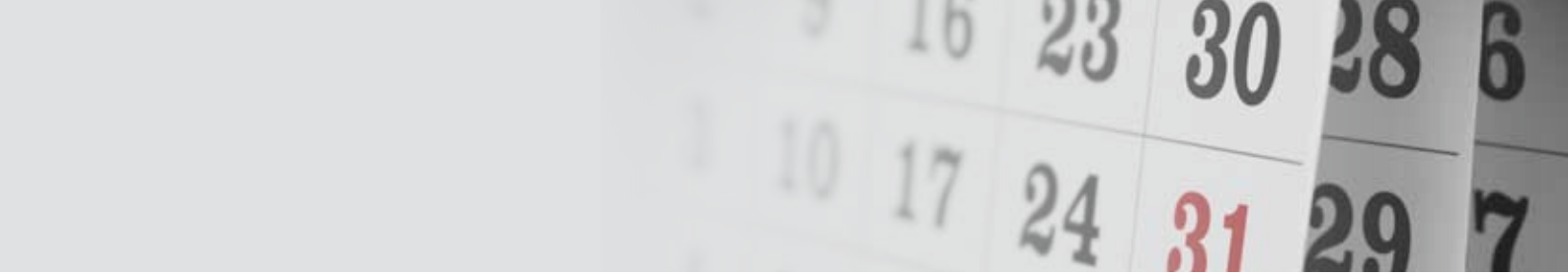
EU Directive 2005/32/EC (Eco-design Requirements for Energy-using Products) defines the conditions for these savings. The EU member states gave their support to the new rules for reducing the energy demand of industrial motors at a meeting of the ecodesign regulatory committee on 11 March 2009.

A briefing on the same date quotes the words of Energy Commissioner Andris Piebalg: „This measure contributes substantially to the realisation of the goals set by the EU with regard to energy efficiency and climate protection. It will quickly lead to significant energy savings and considerable benefits for society and industry, as provided for in the European Economic Recovery Plan." He referred hereby to the hope, associated with the proposed regulation, that around 40,000 new jobs will be created by 2020 and that energy savings of 9 billion euros will be achieved.

The ordinance sets out three stages: from 16 June 2011 onward, motors must comply as a minimum with MEPS (Minimum Efficiency Performance Standards) energy efficiency class **IE2** (**High Efficiency; formerly EFF1**). From January 2015 onward, energy efficiency class **IE3** (**Premium Efficiency**) will be the standard for motors with rated power of 7.5 to 375 kW, and from January 2017 onward for motors with rated power of 0.75 to 375 kW. Motors controlled by frequency converters are exempt from this regulation. For such motors, IE2 is sufficient.

Company policy

Danfoss sees ecodesign as an affirmation of the group's own efforts. A footnote in the 2008 Annual Report states: „Danfoss strives to reach its goals with minimum consumption of raw materials and energy, the least possible impact on the environment, and efficient use of resources." Some years ago, the Danish industrial enterprise endorsed the International Chamber of Commerce ‚Charter for Long-term Sustainable Development', thus undertaking to prevent possible environmental damage and above all to encourage the development and dissemination of environmentally friendly technologies. A memo to employees says: „Danfoss fully supports the Directive, especially because most of our developments are committed to energy savings. The philosophy of the Directive is also in tune with our system of values and our mission."



What does the EU directive mean?
EN 60034-30 is an international standard for energy-efficient motors and will in future years be used worldwide in this area.

Electric motors account for approximately 1.07 billion kWh of the total energy demand of the EU. Using energy efficient motors would achieve energy savings of 20 to 30 per cent, thereby reducing the total cost of ownership (TCO) and reducing global warming.

As things stand today
New IE (International Energy Efficiency) efficiency classes were introduced at the beginning of 2009:

IE1 = Standard Efficiency (~ EFF2)

IE2 = High Efficiency (~ EFF1)

IE3 = Premium Efficiency (10–15 % higher efficiency than IE2)

IE4 = Super Premium Efficiency

The IE classes cover the following:

Rated voltage
up to 1,000 V
Power
0.75 kW to 375 kW
Number of poles
2, 4 or 6 (50 and 60 Hz)
Operating modes
S1 or S3 with duty cycle > 80 %
Remarks
A new consideration: geared motors

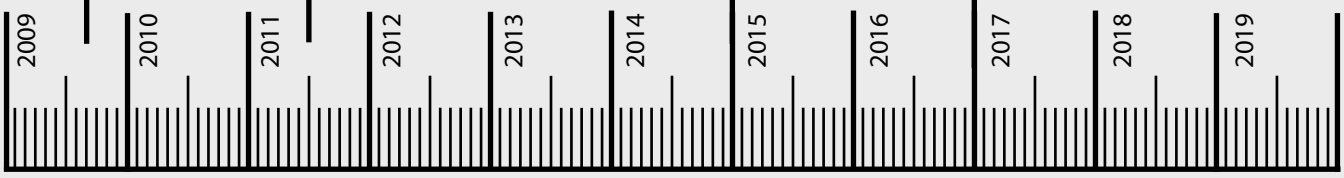
What happens when?

August 2009
EN 60034-30 standard introduced.

Starting 16 June 2011
IE2 efficiency class is mandatory.

From 1 January 2015
Efficiency class **IE3** is a legal requirement for motors rated at **7.5 kW** or more. Alternatively, **IE2** motors may be used in combination with a frequency converter.

2017 onward
Efficiency class **IE3** is also mandatory for motors rated less than **7.5 kW**.



Efficiency classes

The final versions of the DIN and European standards[1] are based on the IEC standard[2]; the minimum values of the EN standard are specified in an EU regulation[3] regarding the implementation of Directive 2005/32/EC for selected types of motors.

Class codes
Class codes IE1, IE2, IE3 and IE4 have been introduced. This system is similar to the IP, IM and IC codes uses for many years in the electrical machinery industry. IE stands for ‚International Energy Efficiency Class' and is expected to be widely accepted.

Comparison of efficiency classes
In a direct comparison with the same motor, it can be assumed that the efficiency determined with the new measuring method for IE motors will be lower.

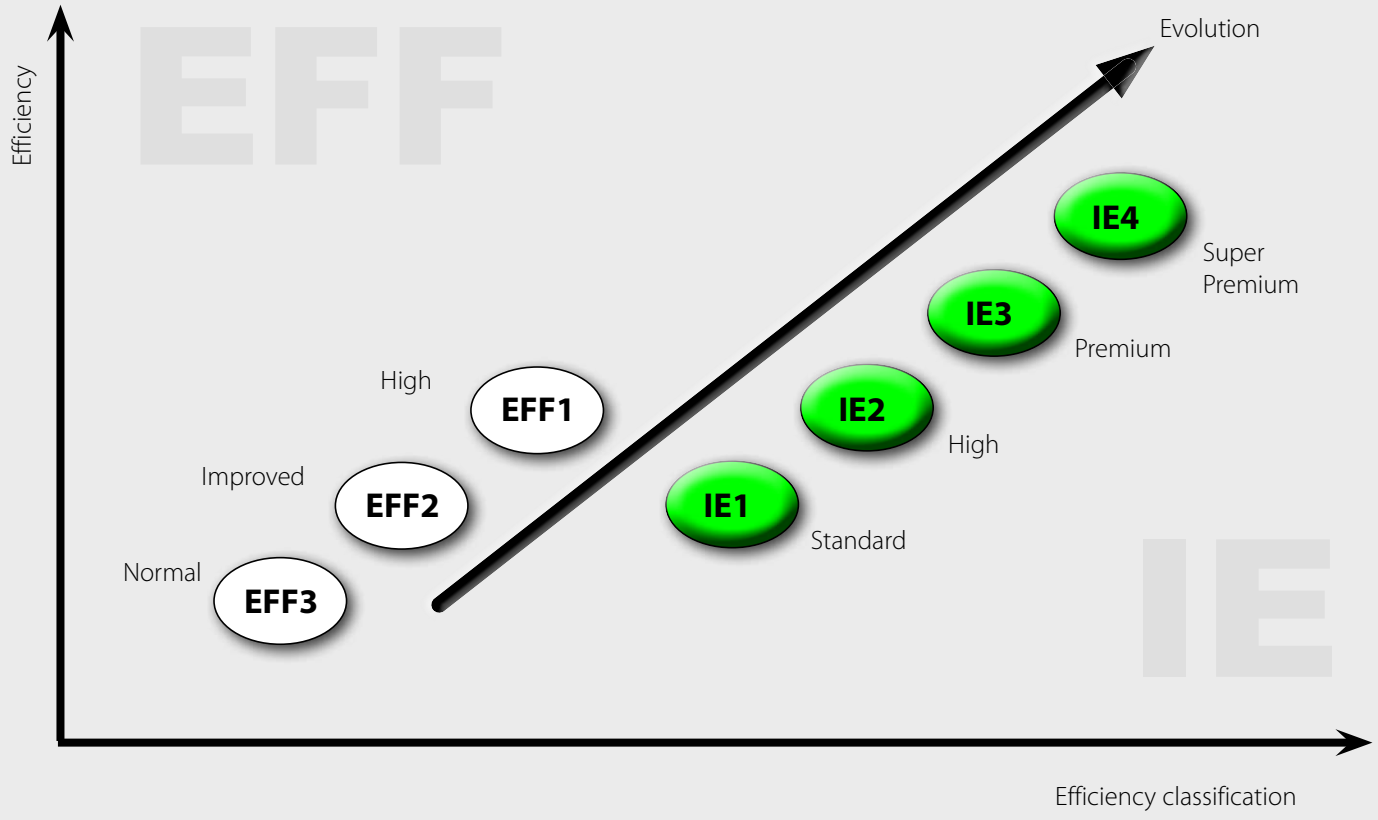
For example, a 4 pole 15 kW EFF1 motor with an efficiency of 91.8% is physically identical to a 4 pole IE2 motor with an efficiency of 90.6%.

The main difference between the EFF and IE classes is in the method used to determine the efficiency.

Exceptions to the classification requirement IEC 60034-30

Operating mode
S2, S3 < 80%, S4 to S10
Supply power
Inverter-driven motors that cannot be operated directly from the mains.
Construction
Motors that cannot be independently measured, such as pump motors with wet rotors.

Efficiency class comparison



Efficiency class comparison

Figure 1 is a visual comparison for the most important group of motors (4 pole, 50 Hz). The scales are therefore relatively coarse. Exact limits for the efficiency classes can be found in the standard.

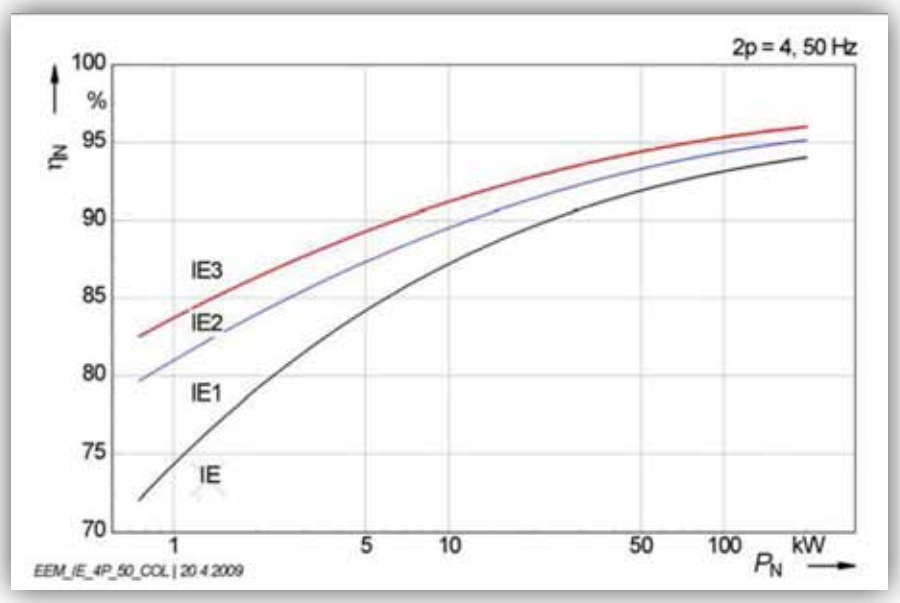


Figure 1
Comparison of the three efficiency classes based on 4-pole motors for 50 Hz operation and rated power P_N of 0.75 to 200 kW

Below standard	*(no IE marking)*
Standard	*(IE1)*
High	*(IE2)*
Premium	*(IE3)*

Super Premium class IE4 for new technology

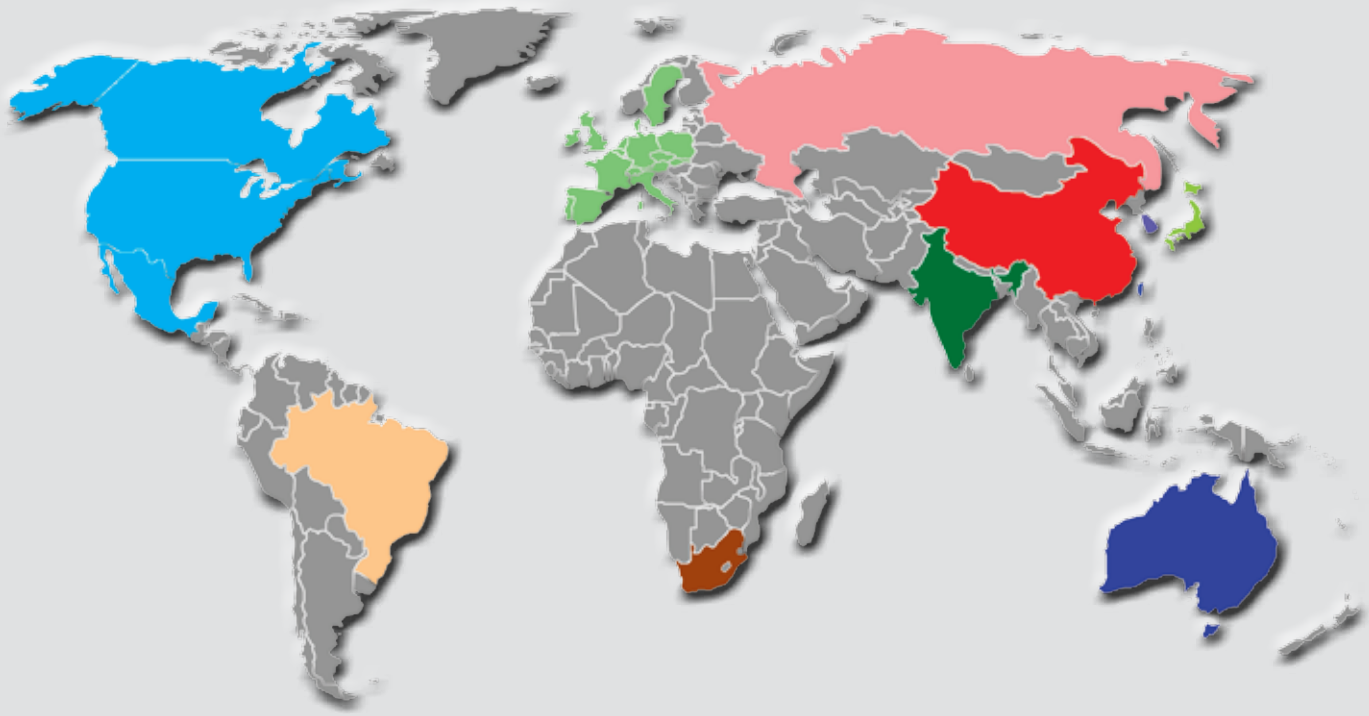
This technology is under development and was described in the draft version of the IEC 60034-30 standard and can now be found in the Annex A of the IEC 60034-31 application guide. The foreseen limits for Super Premium efficiency class IE4 are stated there for information purposes. They are expected to reduce power dissipation by up to 15% compared to class IE3.

Class IE4 applies to all types of electric motors, in particular squirrel cage induction motors and permanent magnet synchronous motors with inverter supply. These motors are generally rated by torque rather than power. The overall efficiency is determined taking into account the power dissipation in the converter and the often considerable process gains achieved with speed control. A direct comparison of motor classes IE4 and IE3 is therefore not meaningful.

References:
[1] DIN EN 60034-30 (VDE 0530-30):2009-08: Drehende elektrische Maschinen – Teil 30: Wirkungsgrad-Klassifizierung von Drehstrommotoren mit Käfigläufern, ausgenommen polumschaltbare Motoren (IE-Code); (IEC60034-30:2008); German version of EN 60034-30:2009
[2] IEC 60034-30: Rotating electrical machines. Part 30: Efficiency classes of single speed, three-phase, cage induction motors (IE code)
[3] Commission Regulation (EU) No. 640/2009 of 22 July 2009 implementing Directive 2005/32/EC of the European Parliament and of the Council with regard to ecodesign requirements for electric motors

Standards

Standards around the world



NEMA: USA, Canada, Mexico

CEMEP: Europe

CCC: China

ABNT: Brazil

GOST: Russia

CNS: Taiwan

SABS: South Africa

JIS: Japan

IS: India

KEMCO: Korea

AS/NS: Australia

Legal start dates

Country	Efficiency class		Start date
Europe	IE2 IE3 IE2 with converter IE3	0.75 kW ... 375 kW 7.5 kW ... 375 kW 7.5 kW ... 375 kW 0.75 kW ... 375 kW	June 2011 January 2015 January 2015 January 2017
USA	NEMA Premium	(cf. IE3)	December 2010
Canada	NEMA Premium	(cf. IE3)	January 2011
Mexico	MEPS	(cf. IE2)	since 2004
Brazil	Alto Redimento	(cf. IE2)	December 2009
Korea	EFF1	(cf. IE2)	January 2010
China	Grade 2	(cf. IE2)	June 2011
Australia	MEPS	(cf. IE2)	since 2006

Exceptions to EuP motor regulation (EC) no. 640/2009 of 22 July 2009:

Operating conditions

- Motors designed to operate fully submerged in a liquid

Construction

- motors that are completely integrated in a product (such as a transmission, pump, fan or compressor) whose energy efficiency cannot be determined independently of this product

Ambient conditions

- at heights above 1,000 metres above sea level
- at ambient temperatures above 40° C
- at maximum operating temperatures above 400 °C
- at ambient temperatures below -15° C (all motors) or ambient temperatures below 0° C (air cooled motors)
- with coolant temperatures at product intake below
- 5 °C or above 25 °C

Ambient conditions

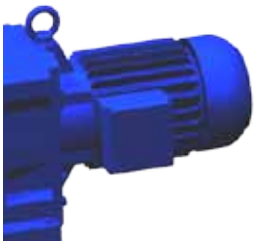
- in areas with a potentially explosive atmosphere as mentioned in Directive 94/9/EC of the European Parliament and the Council

Other

- Brake motors are formally excluded.

Solutions

P_N in kW	Typ IE1	Typ IE2	Typ IE3
0,75	DSE08LA4	DHE08XA4	DPE09SA4
		DHE09SA4	
1,1	DSE08XA4	DHE09LA4	DPE09XA4
	DSE09SA4		
1,5	DSE09LA4	DHE09XA4	DPE11SA4
2,2	DSE09XA4	DHE09XA4C	DPE11MA4
		DHE11SA4	
3,0	DSE11SA4	DHE11MA4	DPE11LA4
4,0	DSE11MA4	DHE11LA4	DPE13MA4
5,5	DSE11LA4	DHE11LA4C	DPE13LA4
		DHE13MA4	
7,5	DSE13MA4	DHE13LA4	DPE16LA4
9,5	DSE13LA4	DHE16MA4	DPE16XA4
		DHE16LA4	
11	DSE16MA4	DHE16LA4	DPE18LA4
15	DSE16LA4	DHE16XA4	DPE18XA4
18,5	DSE16XA4	DHE18LA4	on request
22	DSE18LA4	DHE18XA4	on request
30	DSE18XA4	DNFHE20LG4	on request
37	DNFSE22SG4	DNFHE22SG4	on request
45	DNFSE22MG4	DNFHE22MG4	on request



Motors

- Power 0.75 kW to 45 kW
- Mains supply 110 V to 690 V, 50/60 Hz
- Enclosure IP 65 (standard), IP 66 (optional)
- Connection Standard with CAGE CLAMP®
- Integral solutions with energy efficient motors
- Many motor ratings to choose from

General

- All extension options of the proven B2000 modular system
- Danfoss Bauer geared motors can be supplied with attached brakes, which do not impair the operation of the motor. These motors therefore fall under the EuP motor regulation.

IE1 energy efficient motors

P_N	Typ	n_N	M_N	I_N 400 V	η (100 %)	η (75 %)	η (50 %)
kW		1/min	Nm	A	%	%	%
0,75	DSE08LA4	1400	5,1	1,95	75,6	76,2	72,7
1,1	DSE08XA4	1380	7,6	2,8	75,5	76,8	73,5
1,1	DSE09SA4	1420	7,5	2,6	80,0	80,3	77,5
1,5	DSE09LA4	1420	10,1	3,5	80,7	80,9	79,5
2,2	DSE09XA4	1420	15	4,9	80,5	81,1	80,4
3	DSE11SA4	1420	20	6,5	84,4	84,6	83,8
4	DSE11MA4	1420	27	8,4	84,0	84,5	84,2
5,5	DSE11LA4	1420	36,8	11,3	85,5	86,9	85,4
7,5	DSE13MA4	1440	50	15,5	87,6	87,5	87,1
9,5	DSE13LA4	1440	63	19,4	87,5	88,2	87,5
11	DSE16MA4	1460	72	22,6	87,8	87,8	87,3
15	DSE16LA4	1460	98	29,5	88,9	89,9	88,9
18,5	DSE16XA4	1460	121	37,5	89,5	90,3	88,5
22	DSE18LA4	1460	144	41,5	90,7	90,8	90,5
30	DSE18XA4	1460	196	56	91,1	91,3	90,8

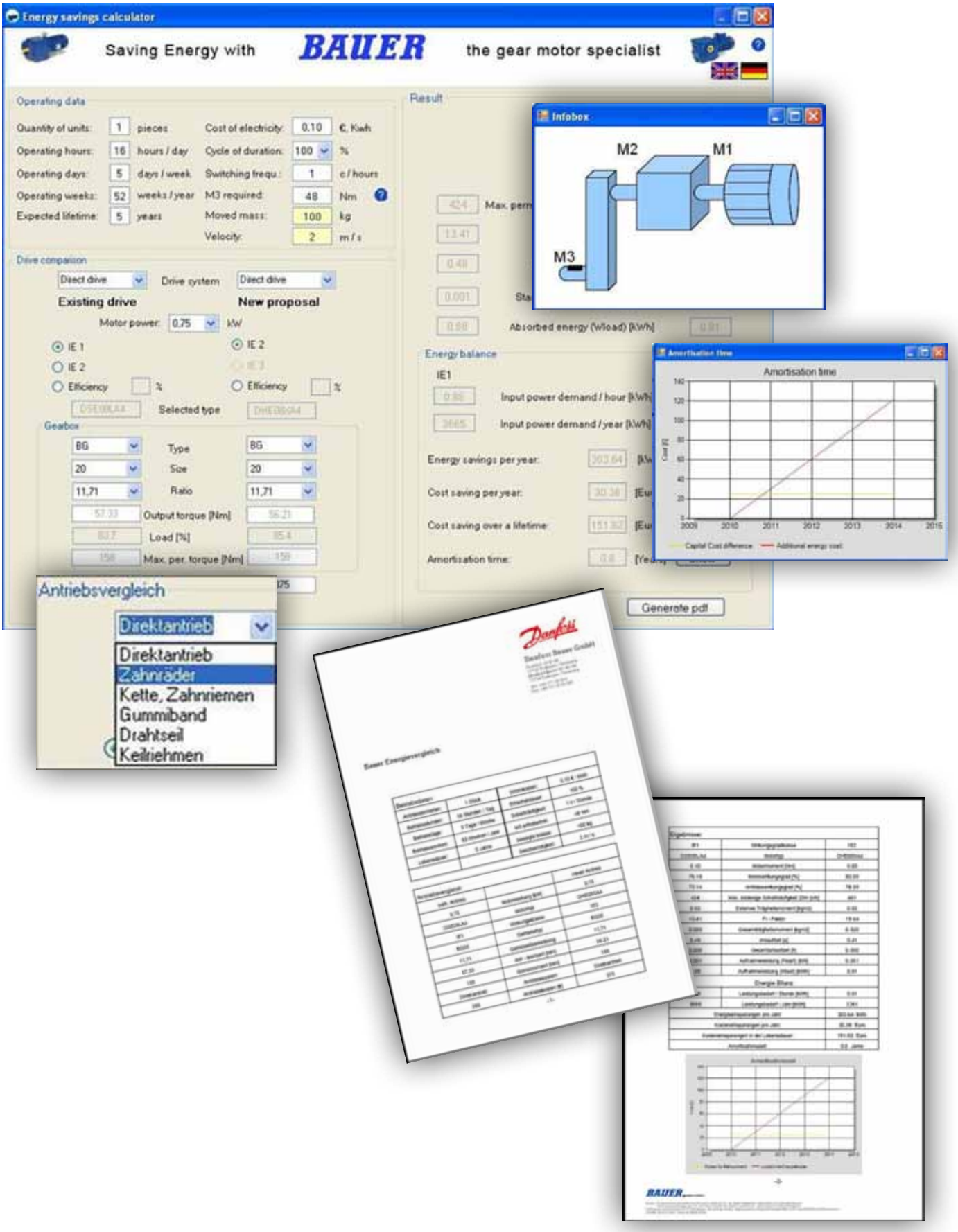
IE2 energy efficient motors

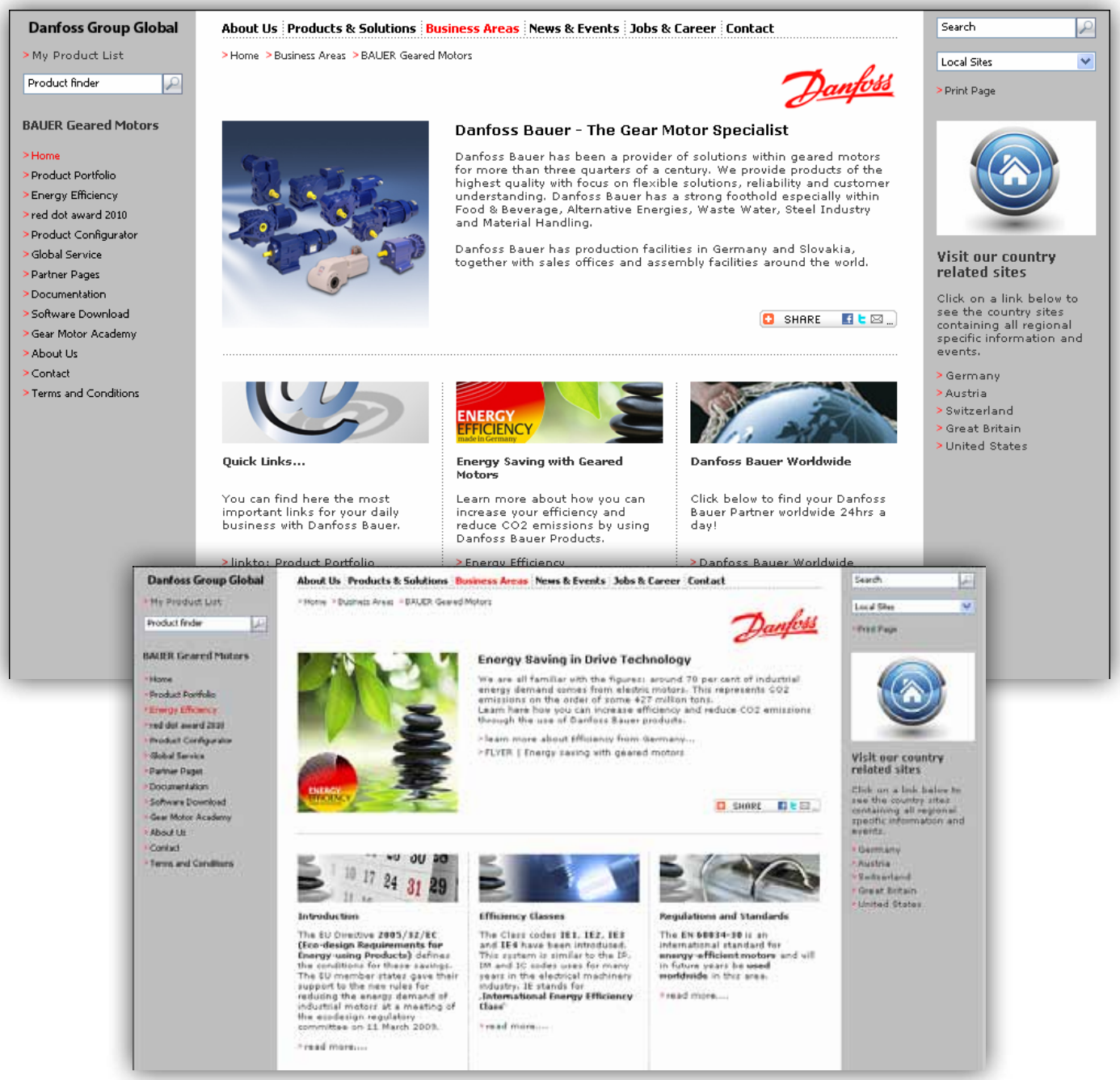
P_N	Typ	n_N	M_N	I_N 400 V	η 100 %	η 75 %	η 50 %
kW		1/min	Nm	A	%	%	%
0,75	DHE08XA4	1420	5	1,88	79,7	80,0	77,4
0,75	DHE09SA4	1440	5	1,8	81,6	81,0	77,4
1,1	DHE09LA4	1440	7,3	2,5	82,7	82,3	79,8
1,5	DHE09XA4	1440	10	3,3	83,2	82,8	79,5
2,2	DHE11SA4	1440	14,5	4,6	86,2	86,0	84,7
3	DHE11MA4	1440	20	6,3	86,5	86,5	84,7
4	DHE11LA4	1440	26,6	8,4	87,5	87,0	85,3
5,5	DHE13MA4	1460	36	11	88,9	88,9	87,6
7,5	DHE13LA4	1460	49	15,1	88,9	89,2	87,9
9,5	DHE16MA4	1470	62	19,7	89,4	89,4	86,5
9,5	DHE16LA4	1470	61	18,8	90,4	90,4	88,8
11	DHE16LA4	1470	71	22,5	90,3	90,0	88,3
15	DHE16XA4	1470	97	31	90,6	90,8	88,8
18,5	DHE18LA4	1470	120	35	91,5	91,7	90,0
22	DHE18XA4	1470	142	43,5	92,0	91,6	89,6
30	DNFHE20LG4	1480	194	53	92,6	92,6	92,1
37	DNFHE22SG4	1480	238	63	93,3	93,3	92,7
45	DNFHE22MG4	1480	289	77	93,3	93,3	92,8

Customer benefits of Bauer energy efficient motors

- IE2 motors have higher efficiency than the previously available EFF2 motors.
- IE2 motors have lower power dissipation due to their higher efficiency.
- IE2 motors have a longer lifespan due to their relatively low machine duty.
- IE2 motors reduce operating costs considerably, particularly in combination with standard Bauer two-stage gearboxes.
- IE2 motors have higher thermal margins, which helps avoid unnecessary safety margins in the design process.
- IE2 motors save energy and reduce CO_2 emissions.

Energy saving calculator

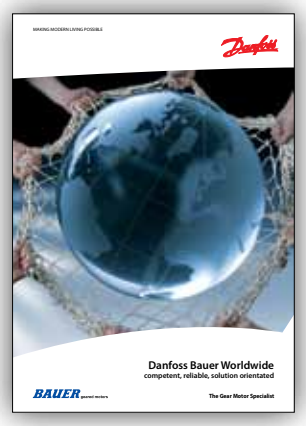




www.danfoss-bauer.com

Heading | Energy Efficiency

Literature



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Heading | Technical literature

Certification

Intensified global competition places ever increasing demands on manufacturers of modern drive systems to continually improve product quality.

We aim to meet these challenges by means of a carefully conceived product range, flexible adaptation to changing market conditions and customer needs and, of course, superlative quality at competitive prices.

In order to optimise the necessary processes, give our discerning customers lasting assurance that we prevent errors and maintain consistent quality, and make our quality measurable, we subscribe to the principal directives and standards of system and product certification schemes, and our performance is verified regularly by audits. This enables us to give our customers the quality they expect and to document it worldwide.

ISO 9001
ISO 14001
OHSAS 18001
in accordance with Directive 94/9/EC (EN 13980)
CCC
GOST-R
UL
CSA
EHEDG
IPA

Product Overview

Helical gear motor – BG series

Compact, economical helical gear motors for long life and high performance under the most difficult conditions.

- Power range 0.03 kW to 75 kW
- 13 gearbox sizes for torques ranging from 20 Nm to 18,500 Nm
- New integration options thanks to low motor height
- High efficiency due to two-stage base design
- High protection rating (IP65) as standard

Shaft mounted gear motor – BF series

Shaft-mounted geared motors with integrated torque arm are easy to install or mount.

- Gearbox housing with integrated torque arm
- Power range 0.03 kW to 75 kW
- 10 gearbox sizes for torques ranging from 90 Nm to 18,500 Nm.
- High efficiency due to two-stage base design
- High protection rating (IP65) as standard

Bevel-geared motor – BK series

Bevel-geared motors ensure high overall efficiency of the drive system, especially in combination with frequency converters.

- Angled gear boxes with universal, space-saving mounting options
- Power range 0.03 kW to 75 kW
- 13 gearbox sizes for torques ranging from 80 to 18,500 Nm
- High efficiency due to two-stage base design
- High protection rating (IP65) as standard

Worm geared motor – BS Series

Space saving worm geared motors, especially for low torques and high gear ratios.

- Power range from 0.03 kW to 5.5 kW
- 8 gearbox sizes for torques ranging from 25 to 1,000 Nm
- Hollow shaft versions available for torques as low as 25 Nm
- Heavy duty worm gears for long service life
- High protection rating (IP65) as standard

CAGE CLAMP®

Danfoss Bauer geared motors with power ratings up to 30 kW and CAGE CLAMP® connection technology reduce installation and maintenance costs.

- Cost savings with cable connection
- Easy to use
- Conductor sizes to 25 mm^2 without wire end sleeves
- Cost savings with material and tools
- Vibration- and shock resistant
- Ex approved

Explosion protected Bauer gear motors

Gear motors for use in areas with potentially explosive atmospheres:

Gas	Zones 1 & 2
Dust	Zones 21 & 22

• DXD	Zone 1,	II 2G Ex d(e) II C T4,	0.12 to 90 kW
• DXE	Zone 1,	II 2G Ex e II T3,	0.12 to 11 kW
• DXN	Zone 2,	II 3G Ex nA II T3,	0.03 to 30 kW
• DXC	Zone 21,	II 2D Ex tD A21 IP65 T < 160 °C,	0.03 to 30 kW
• DXC	Zone 21,	II 2D Ex tD A21 IP65 T 120 °C,	0.03 to 11 kW
• DXS	Zone 22,	II 3D Ex tD II T < 160 °C,	0.03 to 30 kW
• DXD	Zone 1/21,	II 2G Ex d(e) II C T4/II 2D Ex tD A21 IP65 T 120 °C,	0.12 to 90kW
• DXE	Zone 1/21,	II 2G Ex e II T3/II 2D Ex tD A21 IP65 T 120 °C,	0.12 to 11 kW
• DXS	Zone 2/22,	II 3G Ex nA II T3/II 3D Ex tD II T < 160 °C,	0.03 to 30 kW

CleanDrive™

Gear motors for the food and beverage industry with protection rating IP66 and acid- and alkali-resistant paint finish as standard.

- Motors without cooling fins or fans
- Motor power 0.12 kW
- Motor winding fitted as standard with thermistors and class F insulation
- Motor connection via standard terminal box or stainless steel cable glands

AsepticDrive™

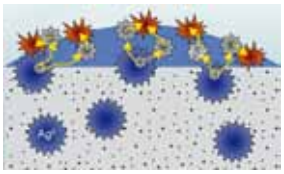
Gear motors for the food and beverage industry as well as all applications with frequent cleaning or high environmental burden, such as dust, fluff, etc.

- Motors without cooling fins or fans
- DA08 motor power from 0.25 kW to 0.55 kW
- DA09 motor power from 0.37 kW to 1.5 kW
- DA11 motor power from 1.1 kW to 2.2 kW
- Available with helical, shaft mount, bevel or worm gearbox
- Motor winding fitted as standard with thermistors and class F insulation
- Available as standard with IP67 or IP 69K enclosure with acid- and alkali-resistant paint finish
- Motor connection via standard stainless-steel round connectors.

CleanConnect®

Specially developed for the requirements of the beverage industry: high protection rating (IP 67), gold-plated contacts and smooth surface for safe power and signal transmission in damp environments.

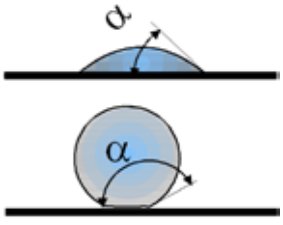
- Easy-to-clean surface, resistant to cleaning agents
- Standard M25 threaded connection
- Connectible without tools; keyed to prevent misconnection
- Large shield connection surface for EMC compliance
- Available with straight or right-angle cable gland



Antibac® Coating

This unique coating kills 99.9% of germs by means of active silver ions.

- Increased security in the production area
- Reduces bacterial growth
- Increases production time by reducing cleaning frequency



Aseptic™ Coating

Specially developed for the requirements of the food and beverage industry. The high hygiene standards of the production process lead to new requirements for optimised coatings for geared motors.

- Cleaning friendly and detergent resistive surface
- FDA compliant
- Hydrophobic
- Non polar finish
- increases reliability in the entire production area
- Distinction between different production sections no longer necessary
- Highly resistant to cleaning products and disinfectants with pH 2 to 12

Danfoss Bauer - The Gear Motor Specialist

For more than three quarters of a century, we have been solving drive problems wherever electric drives with high torques are needed for equipment, machines and apparatus. Based in Esslingen since 1927, we are successful worldwide. Our expertise in geared motors has benefited both our customers and our company.

Diverse challenges have helped us grow

Precision and technical perfection are only one side of the coin. Our work is often defined by the specific tasks which our customers assign to us. We see the tasks as challenges for which we can deliver tailor-made, comprehensive solutions. Extreme conditions are a frequent problem which must be overcome. Cold, heat, dust, dirt and spray all demand special dedication, expertise and creativity. As your drive specialist, we are committed more than ever to helping you achieve the optimal solution.

We're close to you everywhere in the world.

Proximity to the customer, both physically and figuratively, is an important condition for good collaboration. Our highly skilled consultants, technicians and fitters are at your service in every part of the world.

We speak your language and understand your needs.

Danfoss BAUER efficiency

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