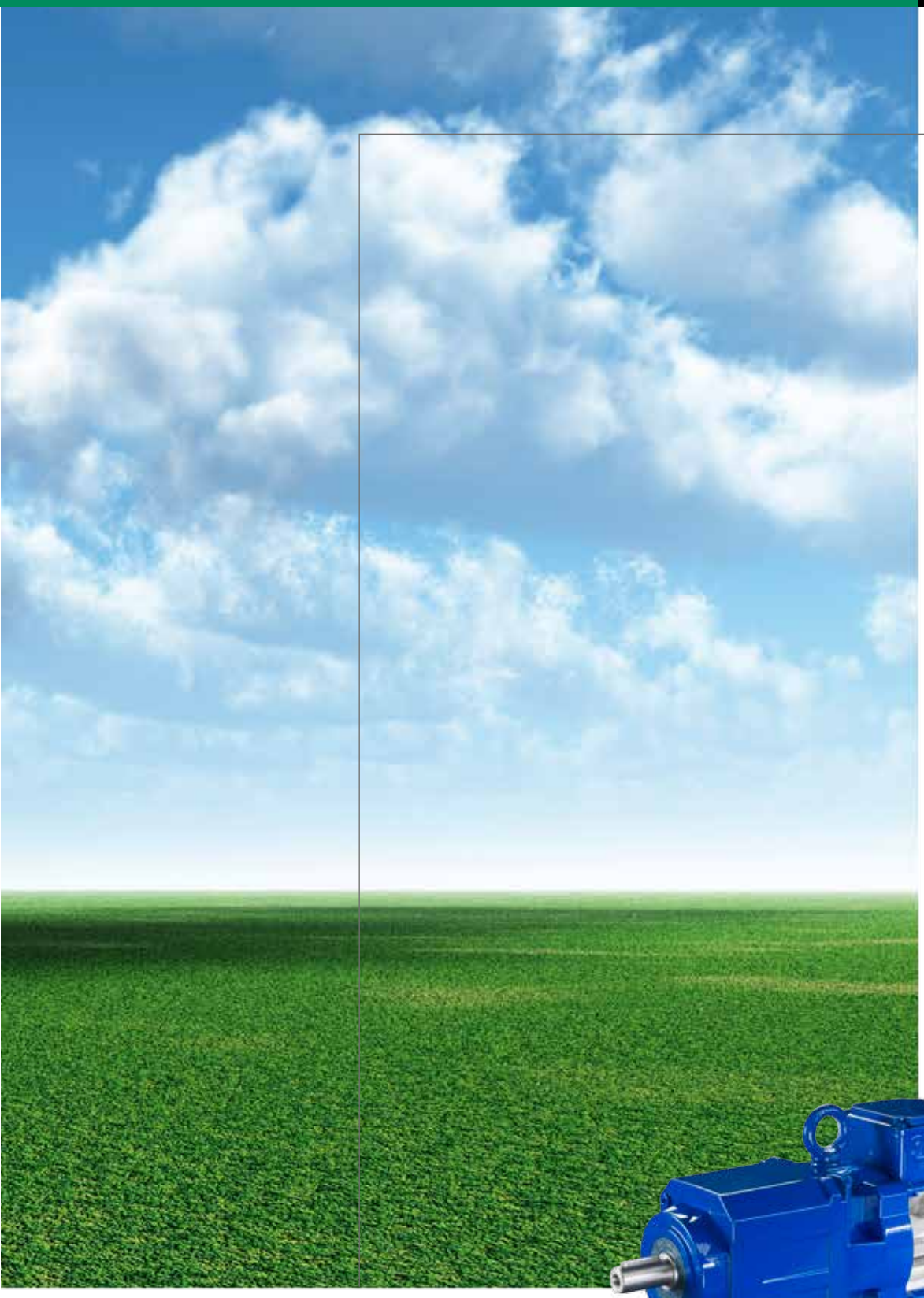


Ecodesign Requirements according to EN 50598

Products for highest system efficiency

Bauer® Gear Motor

An Altra Industrial Motion Company

Climate targets of the European Union

The numbers are familiar; around 70 percent of the energy demand of industry is due to electric motors. This corresponds to a CO2 emission of around 427 million tons. The European Commission is convinced that savings corresponding to the power consumption of Sweden can be achieved by appropriate measures.

EU Directive ErP 2009/125/EC (Ecodesign requirements for energy-related products) defines the relevant preconditions. The EU member states agreed on 11 March 2009 at a meeting of the Ecodesign Regulatory Committee the new regulations for reducing the energy demand of industrial motors.

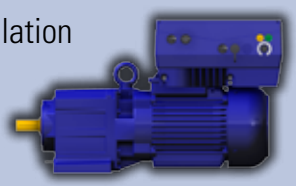
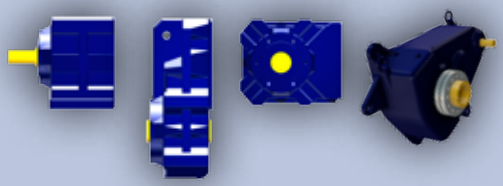
In an information statement issued the same day the commissioner responsible for energy, Andris Piebalgs, said: “This measure is a concrete contribution to achieving the targets that the EU has set in relation to energy efficiency and climate protection. It will rapidly lead to significant energy savings and considerable advantages for business and industry, as is envisaged in the European Economic Recovery Plan”. The commissioner also hoped that the proposed regulation would lead to the creation of around 40,000 new jobs by 2020 and achieve savings in power consumption of nine billion Euros.

The regulation involves three stages: since 16 June 2011 motors must satisfy at least the Standard (MEPS – Minimum Efficiency Performance Standards) of energy efficiency class IE2 (High Efficiency, previously eff1). Since January 2015 the energy efficiency class IE3 (Premium Efficiency) applies to the power class 7.5 – 375 kW and from January 2017 for 0.75 – 375 kW motors. Motors that are controlled by a frequency inverter are excluded. These are covered by IE2.

Company Policy

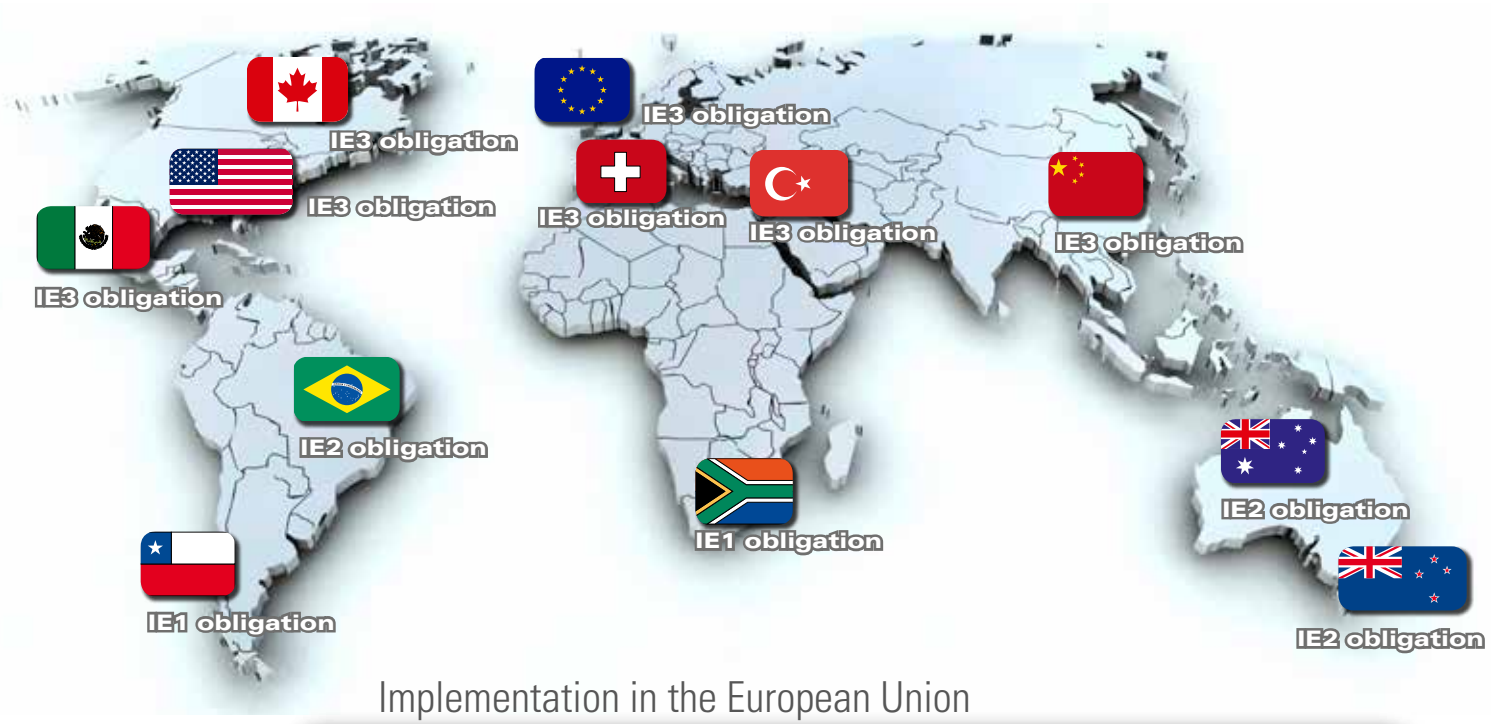
In Ecodesign we furthermore see confirmation of our efforts in this field. Bauer Gear Motor is pursuing its objectives with a minimum consumption of raw materials and energy, the least possible effect on the environment, and an efficient use of resources. Bauer Gear Motor fully supports the Directive, especially as most of our developments have taken energy saving on board.

Where are the potential energy savings?

Where are the potential energy savings?	%	Bauer's solution
Use of Energy Saving Motors	10%	I Motors 
Electronic Speed Regulation	30%	II Speed regulation 
Mechanical System Optimisation	60%	III Gear technologies  IV Focus on the working machine 

Source: ZVEI – Energy savings with electric motors

Worldwide regulations for energy-saving motors



Implementation in the European Union

2020 * — 1 January
- IE3: 0.75 ... 375 kW, 2,4,6 pole
- IE2: < 0.75 kW, 2,4,6 pole

2019

2018 * — 1 January
- IE3: 0.75 ... 375 kW, 2,4,6 pole
- IE2: 0.75 ... 375 kW, 2,4,6 pole

2017

2016 — 1 January
- IE3: 0.75 ... 375 kW, 2,4,6 pole
- IE2: 0.75 ... 375 kW, 2,4,6 pole

2015 — 1 January
- IE3: 7.5 ... 375 kW
- IE2: 2,4,6 pole
  - 7.5 ... 375 kW
  - 0.75 ... 5.5 kW

2014

2013

2012 — 16 June
- IE2: 0.75 ... 375 kW, 2,4,6 pole

2011

* Data according to (EC) 640/2009 and (EU) 4/2014. Entry into force not yet determined. All data on country specific efficiency regulations subject to correction.

European Standard EN 50598

The new Standard EN 50598 consisting of 3 parts specifies Ecodesign requirements for drive systems, motor starters, power electronics and their driven devices.

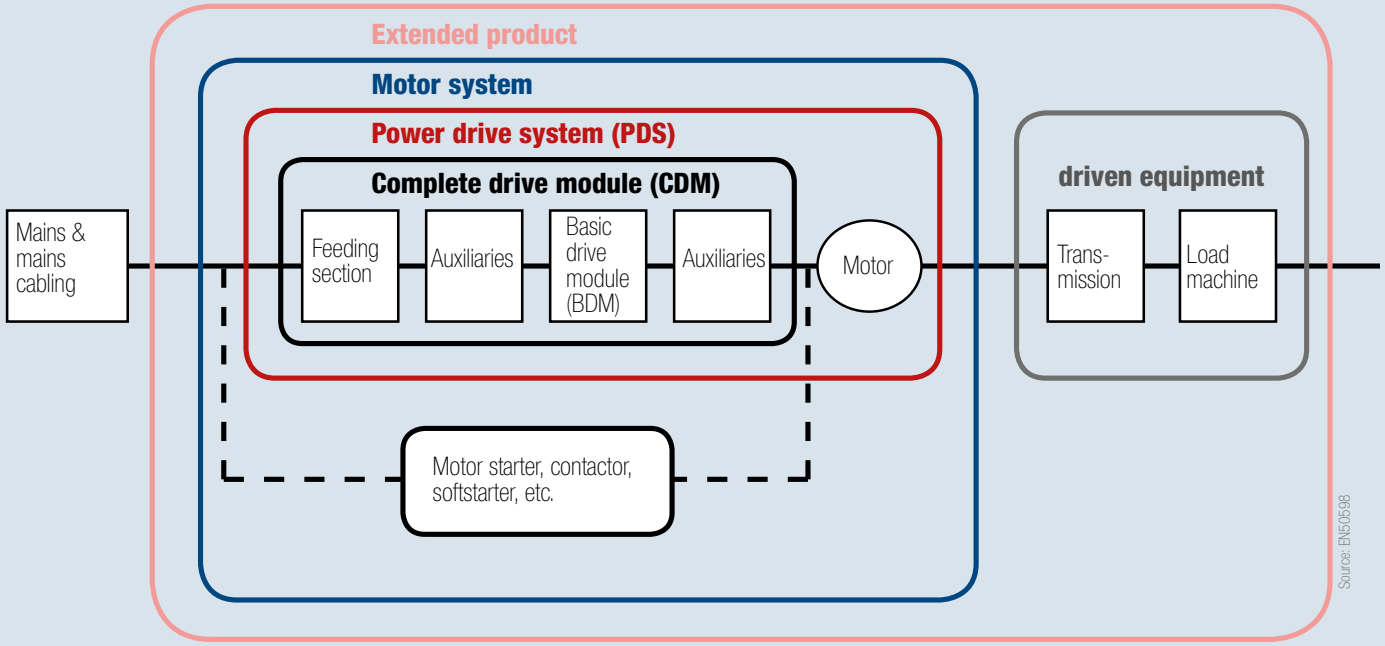
Part 1: General requirements for establishing standards for the energy efficiency of electrically operated equipment according to the expanded product approach (EPA) with semi-analytic models (SAM).
This part specifies the procedure for determining the losses of the extended product approach and its components. A product committee is thereby able to couple the power losses of the installed electrical motor system with any type of plant driven thereby and determine the system energy efficiency for the extended product.

Part 2: Indicators for the energy efficiency of drive systems and motor starters.
This part of EN 50598 specifies the procedure for determining the losses of the complete motor system, power drive system (PDS) and CDM (Complete Drive Module) in 8 application-relevant operating points for motor drive applications in the power range from 0.12 kW to 1,000 kW.

In addition losses of the reference motor, reference CDM and the reference PDS are laid down for the specified 8 operating points and new efficiency classes are redefined for the drive system PDS (IES0-IES2) and also for the CDM (IE0-IE2). As reference motor (RM) the losses are derived from four-pole asynchronous motors with 50-Hz-IE2 efficiency values according to EN 60034-30 and various factors described in this Standard.

Part 3: Quantitative Ecodesign approach by means of eco balancing including product category regulations and their environmental declarations content.
This part of the Standard deals with the topic “Ecodesign” and considers essential environmental aspects in the product design of motor systems (motor starter/ drive controller, motor).

Illustration of the extended product approach



Drive Solution

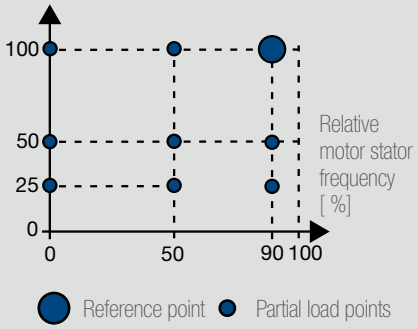
Operating Points

Efficiency classes

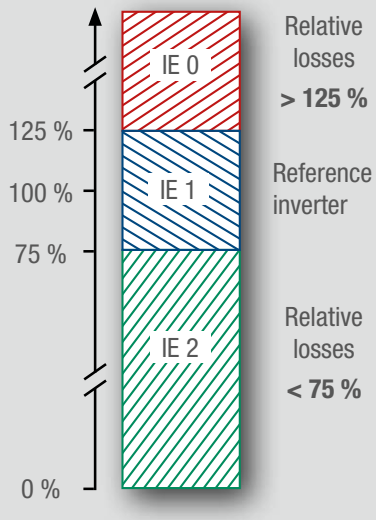
System efficiencies

CDM
Complete Drive Module

Relative torque current [%]

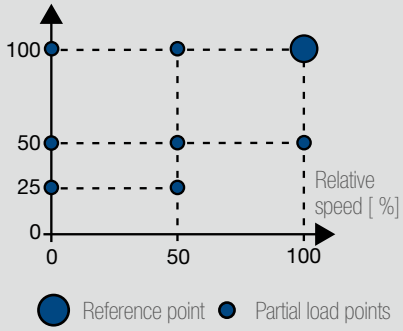


Relative losses compared to the reference inverter

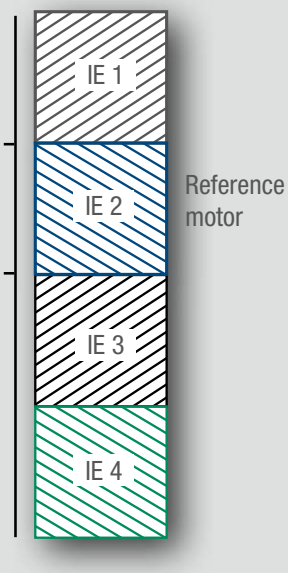


Motor

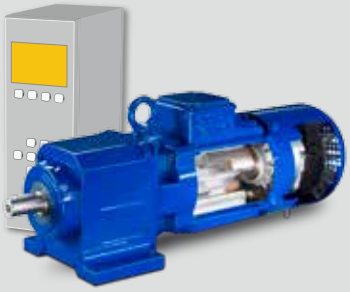
Relative torque [%]



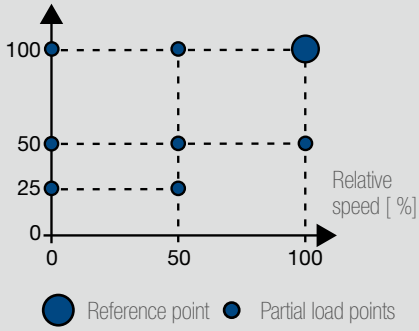
Efficiency classes according to IEC 60034-30-1



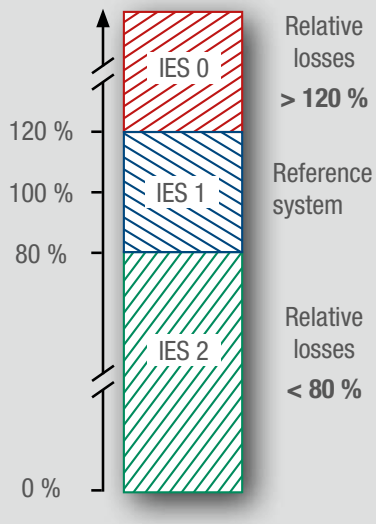
PDS
Power Drive System



Relative torque [%]



Relative losses compared to the reference system



IE1
Loss values
P_{L},CDM(90,100)

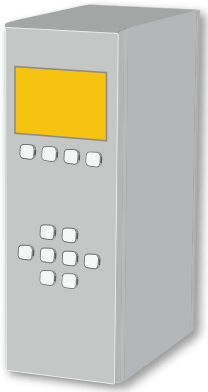
+

IE2
Loss values
P_{L},M(100,100)

=

IES1
Loss values
P_{L},PDS(100,100)

CDM – Complete Drive Module



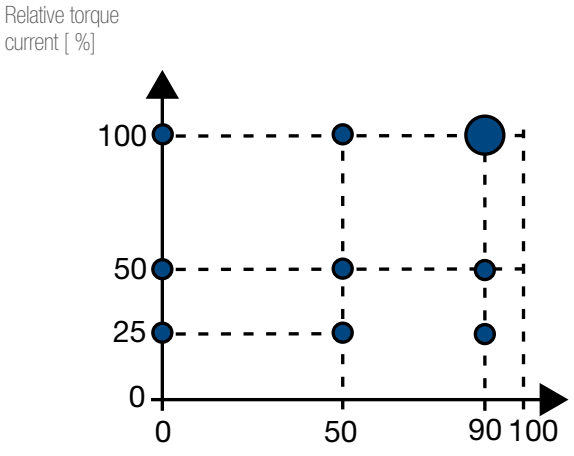
The CDM - Complete Drive Module – contains the drive controller as well as auxiliary devices and input components. The efficiency classes IE0 to IE2 of the drive controller that are specified in EN 50598 refer to the 90;100 operating point, i.e. 90 % motor stator frequency and 100 % torque current. The reference drive controller has the efficiency class IE1. The following table shows the losses of a reference CDM (400 V, efficiency class IE1) according EN 50598.

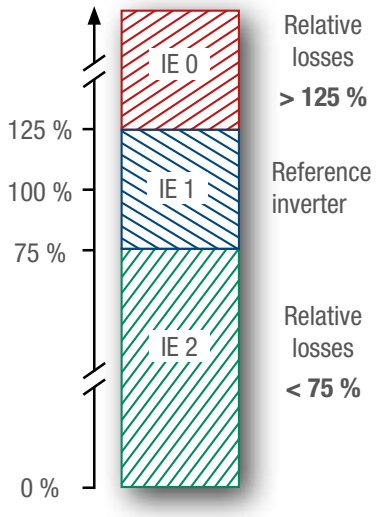
Reference values according to EN 50598-2

$P_{r,M}$	$S_{r,equ}$	$P_{L,RCDM}$ [W]							
kW	kVA	(0;25)	(0;50)	(0;100)	(50;25)	(50;50)	(50;100)	(90;50)	(90;100)
0.12	0.278	94	94	95	94	95	97	96	100
0.18	0.381	96	96	98	97	97	100	98	104
0.25	0.5	99	99	101	99	100	104	102	109
0.37	0.697	103	103	107	104	105	110	107	117
0.55	0.977	109	109	114	110	111	119	115	129
0.75	1.29	116	116	122	117	119	129	123	142
1.1	1.71	117	122	134	119	125	144	131	163
1.5	2.29	127	134	149	129	138	163	146	188
2.2	3.3	150	159	182	152	166	201	177	237
3	4.44	181	193	224	184	202	250	218	299 *
4	5.85	219	235	276	223	247	309	267	374
5.5	7.94	266	288	343	272	304	389	332	477
7.5	9.95	279	307	400	285	326	462	359	581
11	14.4	344	386	520	354	413	609	461	781
15	19.5	419	476	657	433	513	778	577	1,010
18.5	23.9	483	554	774	500	600	923	676	1,207
22	28.3	549	631	894	569	688	1,070	778	1,408
30	38.2	699	810	1,165	726	882	1,402	1,008	1,858
37	47	827	964	1,401	860	1,053	1,692	1,208	2,253
45	56.9	973	1,144	1,667	1,013	1,252	2,020	1,434	2,700

*) This value is used in the example calculation of a PDS on page 9.

Source: EN50598





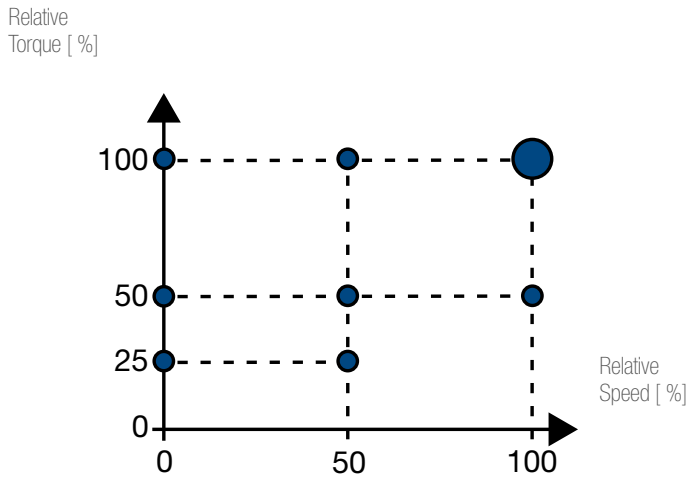
Motors

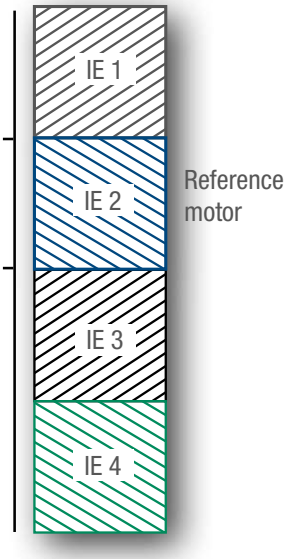
The efficiency classes for motors are subdivided according to IEC 60034-30-1 into the classes IE1 to IE4. The values refer to the operating point 100; 100, i.e. 100 % speed and 100 % torque. Motor manufacturers are not obliged to specify the loss values at all operating points. Bauer assists its customers and gives the loss values of its permanent magnet synchronous motors, so that they themselves can determine the overall losses and – as previously – proceed with their system optimisation and protect their core knowledge.

Loss values of BAUER PMS Motors

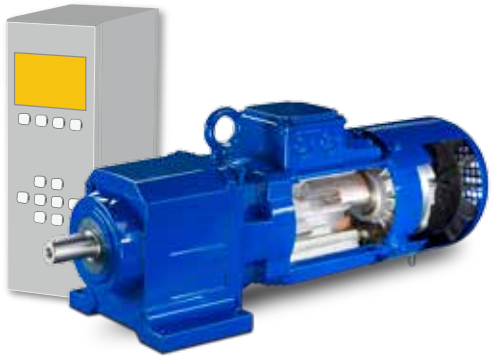
$P_{r,M}$ kW	Type	IE Class	$P_{L,M}$ [W]								IES class
			(0;25)	(0;50)	(0;100)	(50;25)	(50;50)	(50;100)	(100;50)	(100;100)	
0.75	S08MA4	IE4	8	21	99	12	37	103	33	108	**IES2**
1.1	S08MA4	IE3	10	44	207	16	50	208	56	209	**IES2**
1.1	S08LA4	IE4	6	25	115	19	40	134	81	155	**IES2**
1.5	S08LA4	IE3	12	55	247	26	72	268	91	275	**IES2**
1.5	S09SA4	IE4	10	41	153	29	59	178	81	207	**IES2**
2.2	S09SA4	IE3	12	74	292	39	97	330	121	367	**IES2**
2.2	S09XA4	IE4	16	47	171	30	65	194	115	251	**IES2**
3	S09XA4	IE3	26	90	344	43	110	369	162	427	**IES2** *
3	S11SA6	IE4	25	55	229	62	93	269	137	314	**IES2**
4	S11SA6	IE3	35	91	408	67	130	446	175	490	**IES2**
4	S11MA6	IE4	18	47	214	82	112	276	187	348	**IES2**
5.5	S11MA6	IE3	24	89	402	88	153	470	227	537	**IES2**
5.5	S11LA6	IE4	72	63	262	104	144	347	238	445	**IES2**
7.5	S11LA6	IE3	35	118	519	114	200	604	296	703	**IES2**

*) This value is used in the example calculation of a PDS on page 9.





PDS - Power Drive System

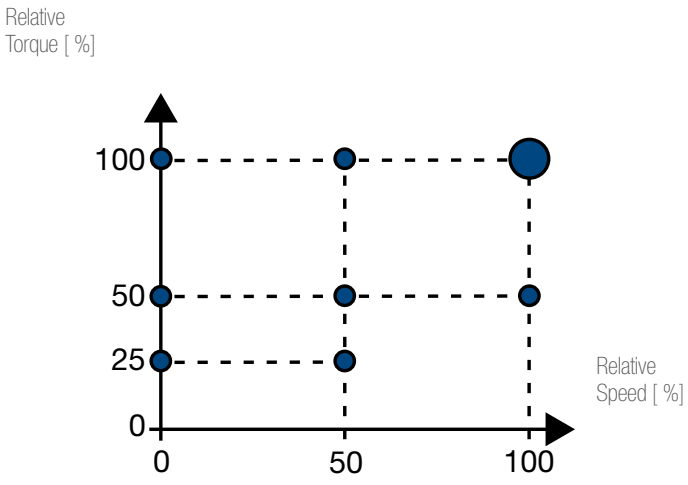


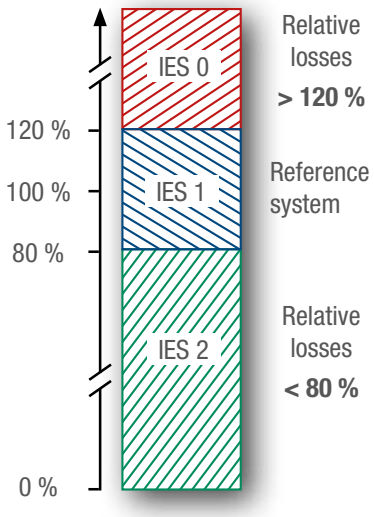
A PDS or Power Drive System consists of a CDM – Complete Drive Module – and a motor. EN 50598-2 defines Reference Power Drive Systems that are based on a 4-pole reference motor of efficiency class IE2 and a Reference CDM with 400 V. The efficiency classes IES 0 to IES 2 refer to the operating point 100; 100, i.e. 100 % speed and 100 % torque. The reference values according to EN 0598-2 are given in the following table.

Reference values according to EN 50598-2

$P_{r,M}$	$P_{L,PDS}$ [W]							
kW	(0;25)	(0;50)	(0;100)	(50;25)	(50;50)	(50;100)	(100;50)	(100;100)
0.12	129	133	167	138	143	177	164	207
0.18	139	145	183	152	158	196	187	229
0.25	147	155	196	162	170	212	206	256
0.37	158	168	220	176	186	238	226	295
0.55	173	189	266	192	209	285	248	338
0.75	185	204	293	208	227	314	283	387
1.1	199	229	359	228	261	388	329	484
1.5	217	257	418	254	300	458	379	585
2.2	264	317	523	315	372	595	487	760
3	316	382	638	379	451	736	597	948
4	371	451	764	448	539	886	720	1,164
5.5	431	530	921	530	640	1,082	869	1,462
7.5	466	585	1,097	584	724	1,302	1,009	1,801
11	586	760	1,477	750	953	1,753	1,340	2,376
15	690	926	1,782	899	1,158	2,159	1,643	2,997
18.5	797	1,073	2,089	1,036	1,339	2,533	1,889	3,486
22	902	1,203	2,389	1,186	1,525	2,895	2,169	3,983
30	1,149	1,500	3,024	1,476	1,902	3,651	2,739	5,053
37	1,310	1,739	3,474	1,746	2,239	4,244	3,219	5,973
45	1,512	1,998	3,915	2,003	2,556	4,856	3,780	6,957

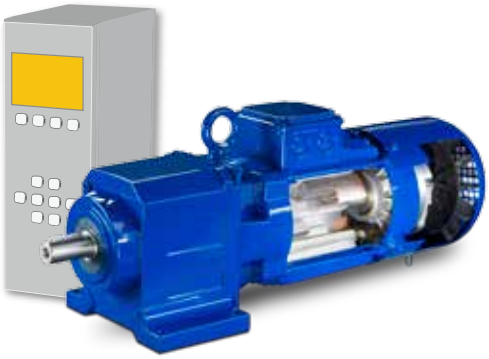
Source: EN50598

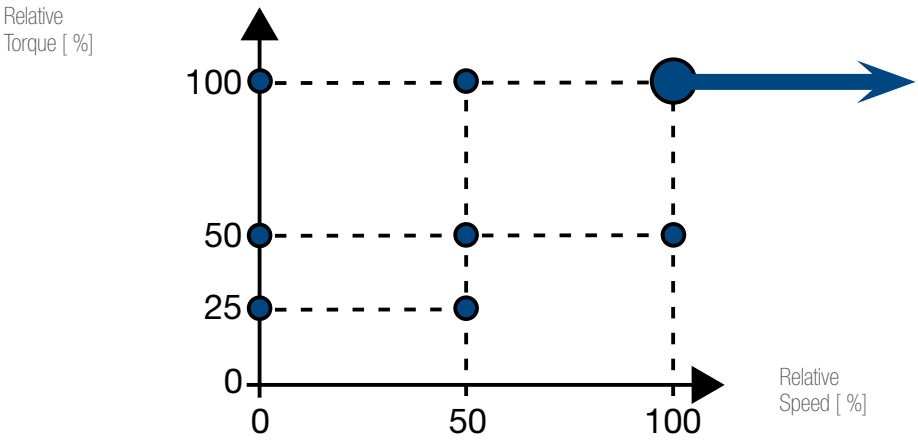


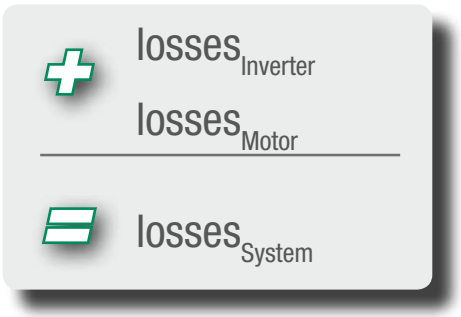


How is the efficiency class of the PDS-System determined?

The efficiency class of the system is determined by adding the losses of the CDM and motor at the operating point 100; 100, i.e. 100 % speed and 100 % torque. The IES class can then be read from the table.







Loss values according to EN 50598-2

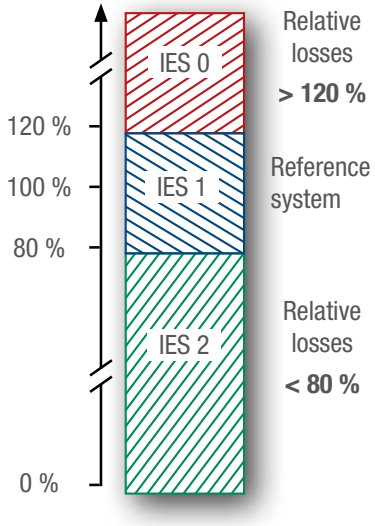
P	$P_{L,RM}$	$P_{L,RCDM}$	$P_{L,RPDS}$	IES class		
kW	W	W	W	IES 0	IES 1	IES 2
0.12	96	100	207	> 248 W	166 W - 248 W	< 166 W
0.18	113	104	229	> 275 W	183 W - 275 W	< 183 W
0.25	132	109	256	> 307 W	205 W - 307 W	< 205 W
0.37	160	117	295	> 354 W	236 W - 354 W	< 236 W
0.55	188	129	338	> 406 W	270 W - 406 W	< 270 W
0.75	221	142	387	> 464 W	310 W - 464 W	< 310 W
1.1	289	163	484	> 581 W	387 W - 581 W	< 387 W
1.5	358	188	585	> 702 W	468 W - 702 W	< 468 W
2.2	471	237	760	> 912 W	608 W - 912 W	< 608 W
3	585	299	948	> 1,138 W	758 W - 1,138 W	< 758 W
4	712	374	1,164	> 1,397 W	931 W - 1,397 W	< 931 W
5.5	887	477	1,462	> 1,754 W	1,170 W - 1,754 W	< 1,170 W
7.5	1099	581	1,801	> 2,161 W	1,441 W - 2,161 W	< 1,441 W
11	1437	781	2,376	> 2,851 W	1,901 W - 2,851 W	< 1,901 W
15	1790	1,010	2,997	> 3,596 W	2,398 W - 3,596 W	< 2,398 W
18.5	2053	1,207	3,486	> 4,183 W	2,789 W - 4,183 W	< 2,789 W
22	2,320	1,408	3,983	> 4,780 W	3,186 W - 4,780 W	< 3,186 W
30	2,878	1,858	5,053	> 6,064 W	4,042 W - 6,064 W	< 4,042 W
37	3351	2,253	5,973	> 7,168 W	4,778 W - 7,168 W	< 4,778 W
45	3835	2,700	6,957	> 8,348 W	5,566 W - 8,348 W	< 5,566 W

Source: EN50598

Calculation example:
3 kW PMSM motor (IE 4) with an inverter (IE 1)

Inverter losses: 299 W IE1
Motor losses : 427 W IE4

System losses 726 W IES2



Bauer Products for efficient system solutions

IE-Class \ kW	0.12	0.18	0.25	0.37	0.55	0.75	1.1	1.5	2.2	3	4	5.5	7.5	9.5	11	15	18.5	22	30
IE1	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
IE2	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	
IE3	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	
IE4					✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓				

Modular

The „all-rounder“ for diverse applications.

- Material Handling
- Material conveyance

BG series helical gear

Power	0.03 ... 75	kW
Torque	20 ... 18,500	Nm
Your benefits	Robust construction ensures long service life.	

BF series parallel shaft gear

Power	0.03 ... 75	kW
Torque	90 ... 18,500	Nm
Your benefits	Compact design and versatile mounting options reduce space requirements.	

BK series bevel gear

Power	0.03 ... 75	kW
Torque	80 ... 18,500	Nm
Your benefits	Energy-efficient thanks to high efficiency in the two-stage basic design.	

BS series worm gear

Power	0.03 ... 5.5	kW
Torque	25 ... 1,000	Nm
Your benefits	Compact and resilient thanks to high-quality worm gearing. This results in a long service life and low maintenance costs.	

Application specific

The „application master“ - ideally adapted to your application.

- Foundry and smelting
- Food and beverage
- Crane technologies
- Bulk material handling
- Water/wastewater
- Textiles
- Chemical industry
- Automotives

Custom Engineered

The „integration expert“ - optimally integrated into your machine.

- Textile industry
  - Flatbed weft knitting machine
  - Circular weft knitting machine
  - Weaving machines
- Printing industry
  - Offset printing machines:
  - Roller and sheet-fed machines
- Packaging industry
  - Strapping machines
  - Pallet packing presses
  - Rotary arm winders

Where are the advantages for you?

Bauer Motors provide efficiency advantages in partial load applications

The specially developed Bauer permanent magnet synchronous motors of course meet the legal requirements of IE3 and IE4. Their strength lies however in their use in the partial load region. Owing to the use of Bauer permanent magnet synchronous motors, in standard applications under partial load conditions often more than 30 % energy savings can be achieved compared to the asynchronous motor technology.

Reducing power supply output saves money

End users and machine manufacturers benefit from the higher energy efficiency that can be achieved by careful product selection from the most appropriate component manufacturers. In many applications a smaller permanent magnet synchronous motor can be used instead of an asynchronous motor, which allows the choice of smaller components along the whole drive chain. Accordingly, machine manufacturers can not only improve the efficiency but can also optimise the costs of the overall system. Additional energy savings reduce the power costs for the end user and lower the power output, and thus the operating costs of the whole production site.

EN 50598 enables partial load losses of the whole system to be determined

EN 50598-2 shifts the focus from the individual component to the efficiency of the whole drive system. The new efficiency classes (International Efficiency for Systems, IES) allow a simple determination of the total losses for a whole drive system (PDS).

Since in the future all component manufacturers will disclose their loss data according to this new standard, optimised applications can be designed with a very wide range of different components.

The new Standard will allow a very accurate preliminary calculation of the power losses, so that the ROI (Return of Investment) can be reliably determined. Up to now the overall efficiency of speed-regulated electric motors was estimated with the aid of approximate energy consumption calculations.

It is now possible to determine for the 8 operating points defined in the Standard the total losses of a system, including the partial load operation, via a simple addition of power losses. Bauer helps its customers to avoid having to rely on system solution providers, so as to ensure that their systems will retain a competitive advantage also in the future.

Bauer customers will obtain for all components clarity on the loss data according to EN 50598 and will thereby be in a position to determine the total losses. Today, customers can already optimise their systems with Bauer in order to protect their core knowledge.

CONCLUSION

Bauer welcomes the new Standard and is convinced that it will bring additional energy savings to the end user, since the overall application has been optimised. The efficiency of the electric motor is no longer considered in isolation. The life cycle costs are transparent and the plant or machine manufacturer enjoys a high degree of freedom in selecting the most appropriate drive components.

Altra Industrial Motion

All Customer Service phone numbers shown in bold

Couplings

Ameridrives Couplings
Mill Spindles, Ameriflex, Ameridisc
Erie, PA - USA
1-814-480-5000
Gear Couplings
San Marcos, TX - USA
1-800-458-0887

Bibby Turboflex
Disc, Gear, Grid Couplings, Overload Clutches
Dewsbury, England
+44 (0) 1924 460801
Boksburg, South Africa
+27 (0) 11 918 4270

TB Wood's
Elastomeric Couplings
Chambersburg, PA - USA
1-888-829-6637– Press #5
For application assistance: 1-888-829-6637 – Press #7
General Purpose Disc Couplings
San Marcos, TX - USA
1-888-449-9439

Ameridrives Power Transmission
Universal Joints, Drive Shafts, Mill Gear Couplings
Green Bay, WI - USA
1-920-593-2444

Huco Dynatork
Precision Couplings and Air Motors
Hertford, England
+44 (0) 1992 501900
Chambersburg, PA - USA
1-888-829-6637

Lamiflex Couplings
Flexible Couplings, Bearing Isolators, and Coupling Guards
São Paulo, SP - Brasil
+55 **(11) 5679-6533**

Guardian Couplings
Flywheel, Jaw, Shear, Gear, Grid, Disc and Engine Couplings
Michigan City, IN - USA
1-219-874-5248

Engineered Bearing Assemblies

Kilian Manufacturing
Engineered Bearing Assemblies
Syracuse, NY - USA
1-315-432-0700

Electromagnetic Clutches and Brakes

Warner Electric
Electromagnetic Clutches and Brakes
New Hartford, CT - USA
1-800-825-6544
For application assistance: 1-800-825-9050
Saint Barthélémy d'Anjou, France
+33 (0) 2 41 21 24 24
Precision Electric Coils and Electromagnetic Clutches and Brakes
Columbia City, IN - USA
1-260-244-6183

Matrix International
Electromagnetic Clutches and Brakes, Pressure Operated Clutches and Brakes
Brechin, Scotland
+44 (0) 1356 602000
New Hartford, CT - USA
1-800-825-6544

Inertia Dynamics
Spring Set Brakes; Power On and Wrap Spring Clutch/Brakes
New Hartford, CT - USA
1-800-800-6445

Overrunning Clutches

Formsprag Clutch
Overrunning Clutches and Holdbacks
Warren, MI - USA
1-800-348-0881– Press #1
For application assistance: 1-800-348-0881 – Press #2

Marland Clutch
Roller Ramp and Sprag Type Overrunning Clutches and Backstops
South Beloit, IL - USA
1-800-216-3515

Stieber Clutch
Overrunning Clutches and Holdbacks
Heidelberg, Germany
+49 (0) 6221 30 47 0

Belted Drives and Sheaves

TB Wood's
Belted Drives
Chambersburg, PA - USA
1-888-829-6637 – Press #5
For application assistance: 1-888-829-6637 – Press #7

Heavy Duty Clutches and Brakes

Wichita Clutch
Pneumatic Clutches and Brakes
Wichita Falls, TX - USA
1-800-964-3262
Bedford, England
+44 (0) 1234 350311

Twiflex Limited
Caliper Brakes and Thrusters
Twickenham, England
+44 (0) 20 8894 1161

Industrial Clutch
Pneumatic and Oil Immersed Clutches and Brakes
Waukesha, WI - USA
1-262-547-3357

Svendborg Brakes
Industrial Brakes and Brake Systems
Vejstrup. Denmark
+45 63 255 255

Gearing

Boston Gear
Enclosed and Open Gearing, Electrical and Mechanical P.T. Components
Charlotte, NC - USA
1-800-825-6544
For application assistance: 1-800-816-5608

Bauer Gear Motor
Geared Motors
Esslingen, Germany
+49 (711) 3518-0
Somerset, NJ - USA
1-732-469-8770

Nuttall Gear and Delroyd Worm Gear
Worm Gear and Helical Speed Reducers
Niagara Falls, NY - USA
1-716-298-4100

Linear Products

Warner Linear
Linear Actuators
Belvidere, IL - USA
1-800-825-6544
For application assistance: 1-800-825-9050
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