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LV Induction Motor (IE3 standard)

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富士電機グループ

Motor High Efficiency of Background

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- **The global electric power consumption is 20 trillion kWh a year, approximately 40 % of which is consumed by motors.**
  - **Energy consumption reduction of a motor has a lot of energy conservation effect.**
- **In 1997, the "Kyoto Protocol" for prevention of global warming was adopted, which made reduction of greenhouse gas emissions a global commitment.**

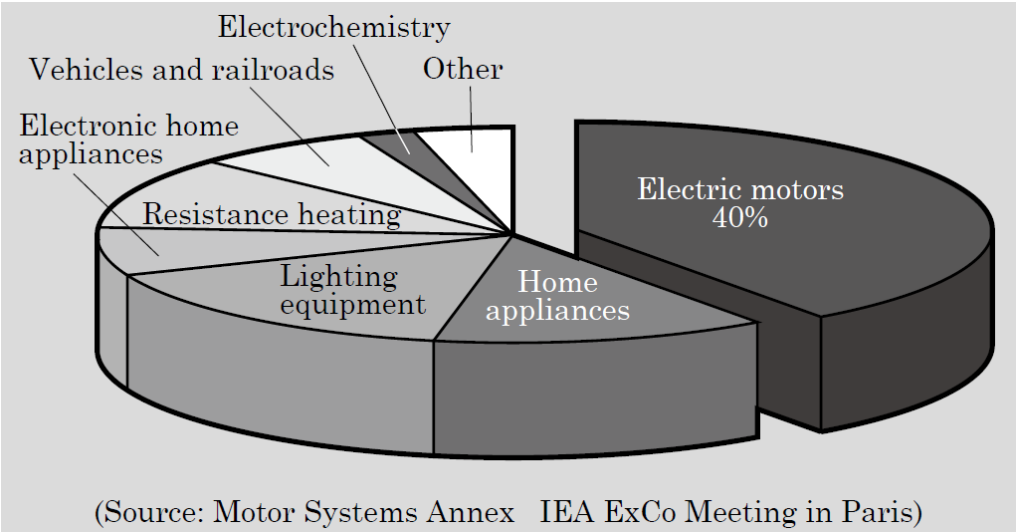


Fig. Breakdown of global electric power consumption.

American EPAct-1992 is at the beginning of the regulation. Efficiency class is IE2.

IE-code establishes by IEC publication in 2008. An efficient class was standardized in the world.

Efficiency regulation begins it at various countries and areas. Efficient class IE3 or IE2.

Japan was planning for energy conservation by applying rotating speed control using inverter. However, efficient regulation has also started in Japan, because the energy conservation effect is improved.

Introduction of efficient regulation is increasing.

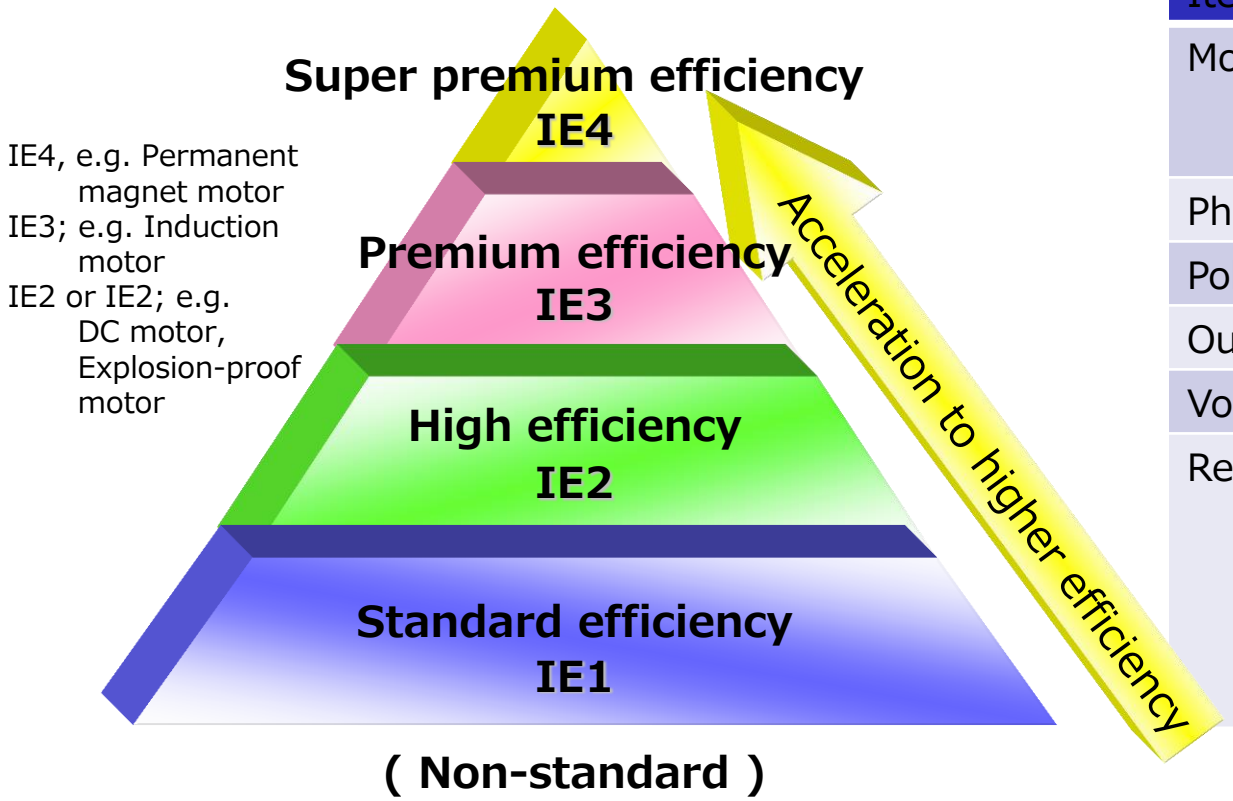
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What is Efficiency Class ?

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◆**The efficiency classes of a motor is regulation in IEC60034-30-1.**
- **The latest edition is issued in March, 2014.**
- **Single-speed electric motors that are rated according to motor.**
- **Efficiency Class; 5 stages from non-standard to IE4.**

・IEC60034-30-1: Rotating electrical machines - Part 30-1: Efficiency classes of line operated AC motors (IE code)
・IE: **I**nternational **E**nergy-efficiency



IE4, e.g. Permanent magnet motor
IE3; e.g. Induction motor
IE2 or IE2; e.g. DC motor, Explosion-proof motor

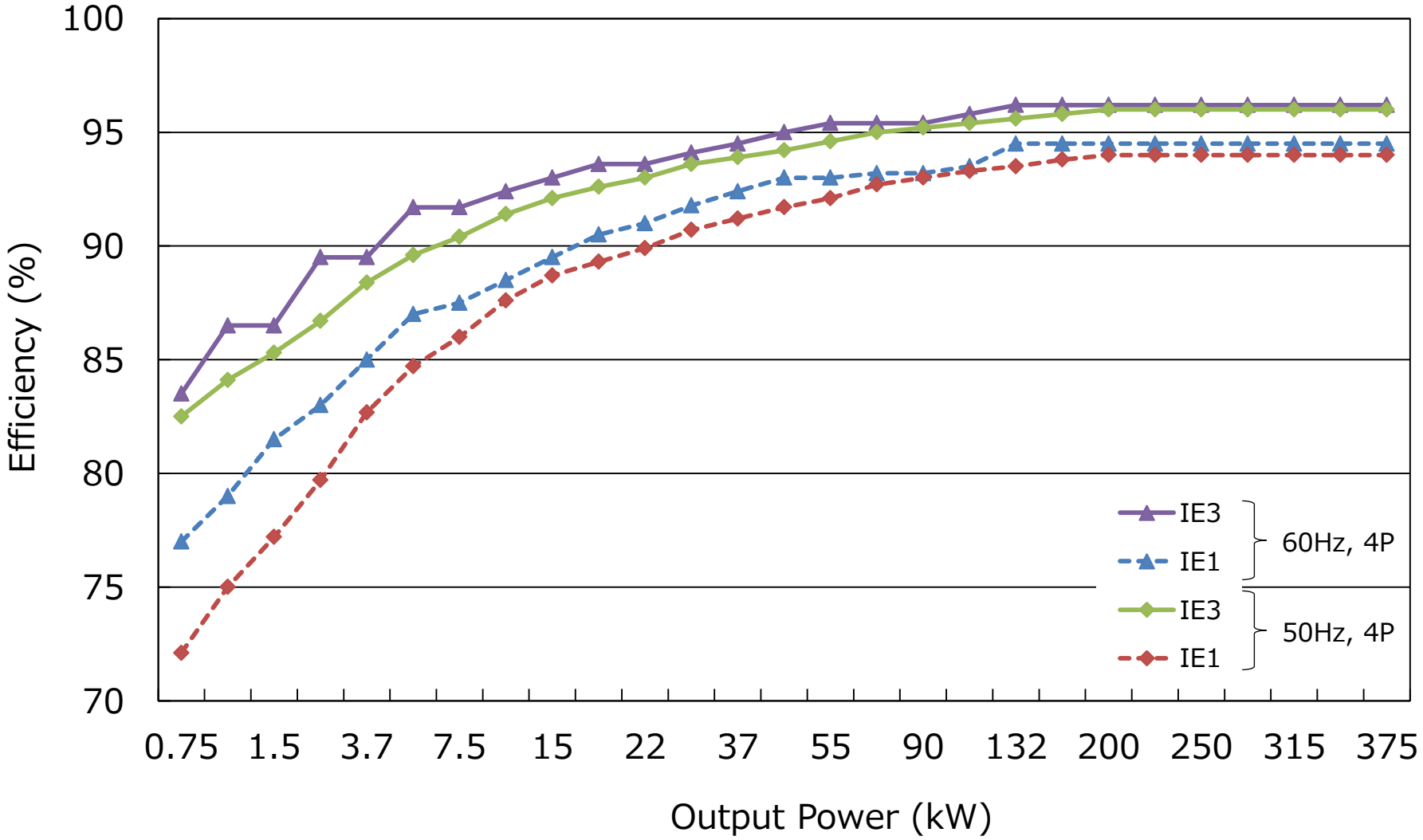
Item	IEC60034-30-1:2014
Model	・Squirrel-cage induction motor ・Wound-rotor induction motor ・Self-starting type magnet motor
Phase	Single or Three–phase
Pole	2 / 4 / 6 / 8 P
Output	0.12 ～ 1000kW
Voltage	50 ～ 1000V
Remarks	IE5 is mentioned as reference. When loss of IE4 is reduced 20 %, it'll be IE5.
	The following is also subject; ・Geared motor ・Special flange motor ・Explosion-proof motor

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Efficiency of IE1 and IE3, 4 Pole ①

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◆The difference in the efficiency with IE1 and IE3 is great for small output.



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Efficiency of IE1 and IE3, 4 Pole ②

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◆IEC60034-30-1 establishes a set of limit efficiency values based on frequency, number of poles and motor power.

For example: 7.5kW, 4P and 50Hz

◆IE1

	50Hz	60Hz
:		
5.5kW	84.7%	87.0%
7.5kW	86.0%	87.5%
11kW	87.6%	88.5%
:		

◆IE2

	50Hz	60Hz
:		
5.5kW	87.7%	89.5%
7.5kW	88.7%	89.5%
11kW	89.8%	91.0%
:		

◆IE3

	50Hz	60Hz
:		
5.5kW	89.6%	91.7%
7.5kW	90.4%	91.7%
11kW	91.4%	92.4%
:		

◇**7.5kW, 4P and 50Hz**

IE class	Efficiency	Loss
Non-standard	> 86.0 %	<1,221W
IE1	86.0%	1,221W
IE2	88.7%	955W
IE3	90.4%	796W

・The difference between IE1 and IE3
Efficiency: 4.4 points up
Loss : 424W reduction

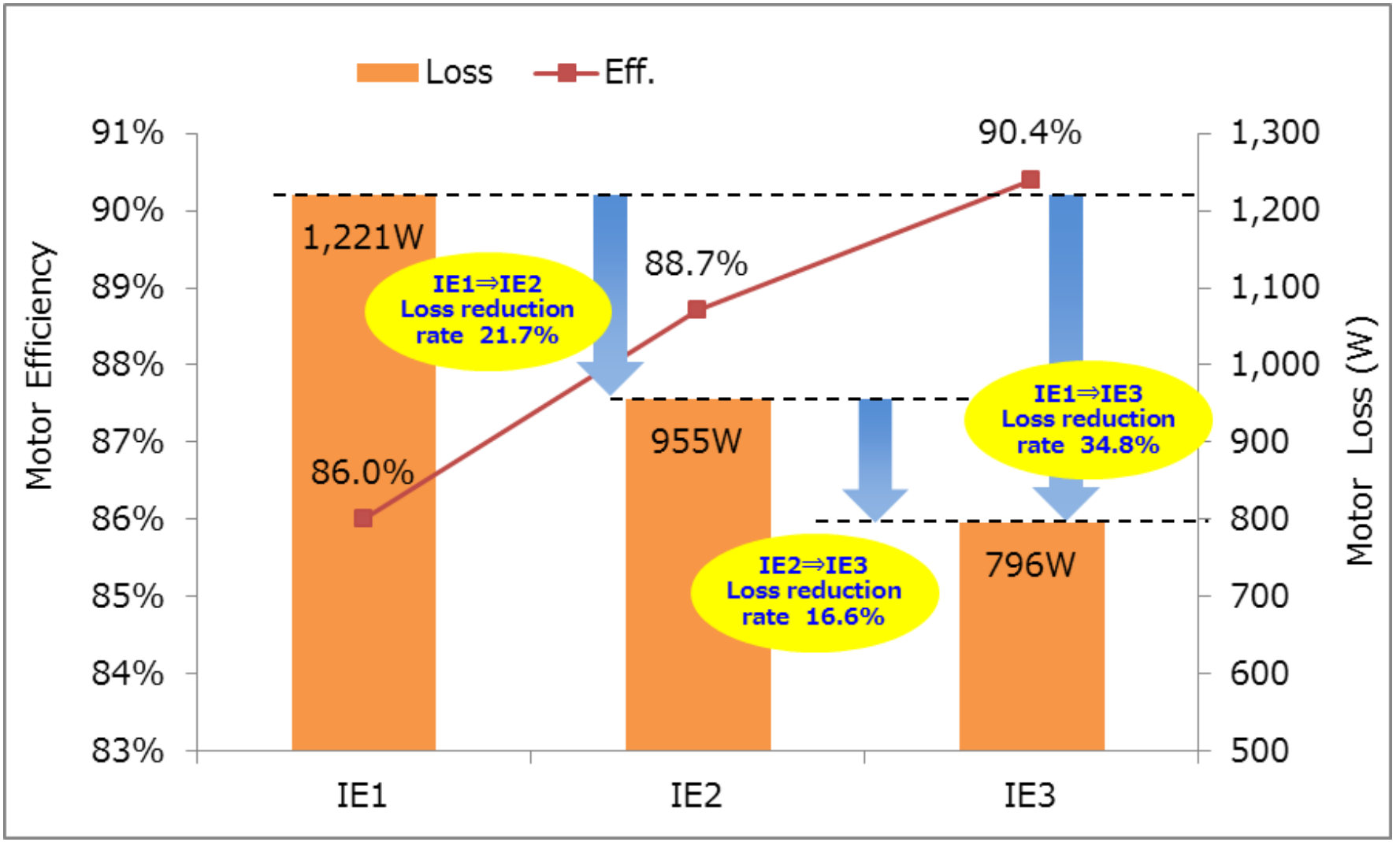
IE3 = loss of IE1 is reduced 35%.

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Energy Conservation Effect ①

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For example: 7.5kW, 4P and 50Hz



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Energy Conservation Effect ②

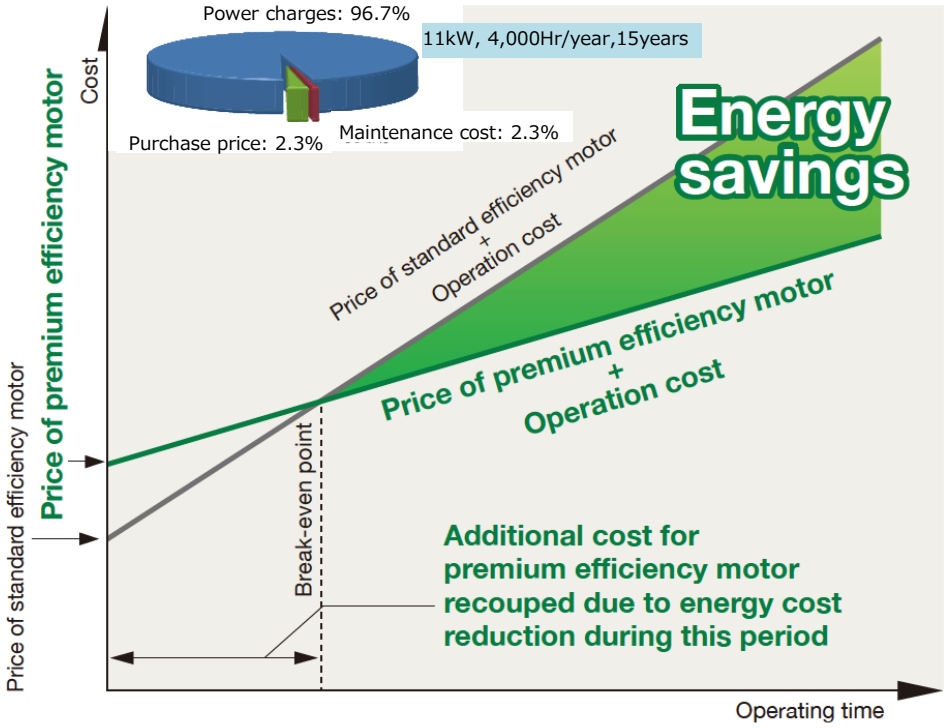
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Energy saving

Running cost greatly decreased

Premium efficiency motors have higher efficiency than standard efficiency motors and offer a higher energy-saving effect with longer-hour applications, improving economic efficiency.

Energy-saving effect



Note:
The coefficient changes by following.
Output, Q'ty, Customer's operating time, Currency(JPY/USD/THB, etc.) and CO_2 emission coefficient

For example: 7.5kW, 4P and 50Hz

Conditions;
◇General coefficient of Japan

- **Q'ty: 1**
- **Load factor: 100%**
- **Operating time: 4,800 Hr/year**
  ····16Hr/day, 300day/year
- **Energy Charge: 16.0 JPY/kWh**
- **CO_2 emission: 0.57 kg-CO_2/kWh**

	IE1	IE3	Effect (Energy saving)
Output(kW)	7.5	7.5	-
Eff.(%)	86.0	90.4	4.4pt
Loss(KW)	1.22	0.80	0.42
Power consumption (kWh/year)	41,860	39,823	20,37
Power charges (JPY/year)	669,767	637,168	32,599
CO2 emission (ton-CO_2/year)	23.86	22.70	1.16

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Regulations in Individual Countries ①

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	～	2010	2011	2012	2013	2014	2015	2016	2017
USA	'97EPAct (IE2)	Dec.'10 ⇒ EISA (NEMA Premium : IE3)・(EPAct : IE2)							
Canada	'95EEAct (IE2)	Jan. '11⇒ EEAct(Premium : IE3)・(Energy Efficient : IE2)							
China	'07 (GB3 : IE1)	Jul.'11, Sep.'12 ⇒ Administration regulation on Energy-efficiency labeling (former GB2: quiv. IE2)・(GB3 : IE2)						Sep.'16, Sep.'17 (GB2 : IE3)	
Taiwan							Jan.'15 (IE2)	Jul.'16 (IE3)	
Korea	'08. Jan., Jul.'10 (IE2)	Jan. '11⇒ Grade Regulation for Energy Consumption (IE2)						Oct.'15, Oct.'16, Oct.'18 (IE3)	
EU		Jun.'11⇒ European Commission Regulation (IE2)					Jan.'15, Jan.'17 (IE3 or IE2+INV. Variable speed drive)		
Brazil	Dec.'09 ⇒ Presidential Order 4508 (IE2)								
Australia ・NZ	Apr. Jun.'06 ⇒ Equipment Energy Efficiency (LEVEL 1A,1B : intermediate between IE2 and IE3)								
Japan							Apr.'15 ⇒Top Runner standard motor (IE3)		

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Regulations in Individual Countries ②

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◆Example of regulation

	USA	EU	China	Japan
Legal name	EISA; Energy Independence and Security Act)	Commission Regulation (EC) No.640/2009	Act on the Rational Use of Energy	Act on the Rational Use of Energy - Top runner
Regulation	NEMA MG1-12-12		GB18613:2012	JIS C4213:2014
Output	1～500HP (0.75～373kW)	0.75～375kW	0.75～375kW	0.75～375kW
Efficiency level	NEMA Premium(IE3)	IE3	GB2(IE3)	Top runner(IE3)
Pole	2/4/6/8	2/4/6	2/4/6	2/4/6
Voltage	＜600V	＜1000V	＜1000V	＜1000V
Frequency	60Hz	50, 60, 50/60Hz	50Hz	50, 60, 50/60Hz
Commencing time	June 1, 2016	Jan. 1, 2015 7.5～375kW Jan. 1, 2017 0.75～375kW	Sept. 1, 2016 7.5～375kW Sept. 1, 2017 0.75～375kW	April 1, 2015,
Remarks	・Acquisition obligation of ee No. ・Fine: 100USD×Q'ty ×Days	・RoHS Compliance ・CE marking	・China Energy Label ・Small output: CCC is needed. ・China RoHS	・Top runner Label

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For IE3 Realization

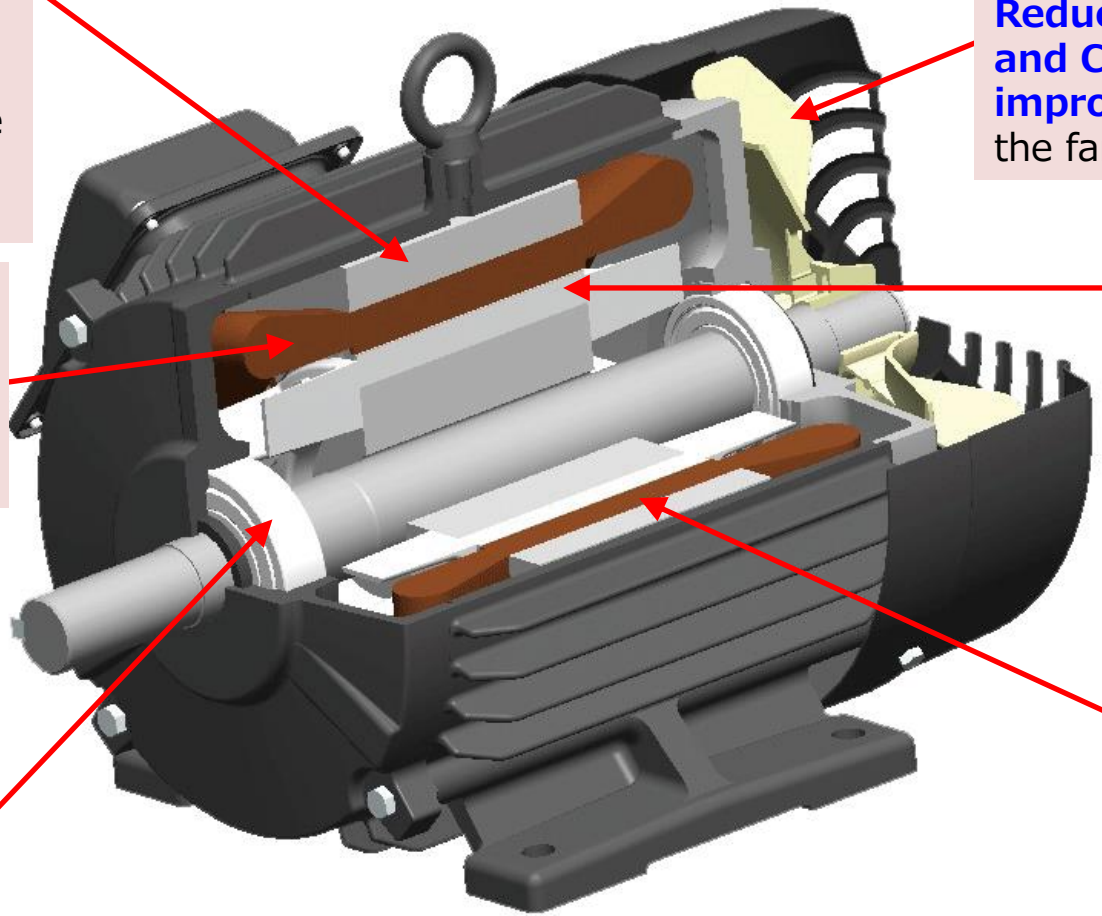
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- **Design for each loss reduction.**
- **IE3 motor uses the high grade material, many copper wires. The price is different in IE1 and IE3 as a result.**

Reduction of iron loss: use of low core loss material, reconsideration with the slot shape of the stator, increase of the iron core volume

Reduction of primary copper loss: improvement of the space factor, shortening of the coil end

Reduction of mechanical loss: bearing size, grease type, rotor size



Reduction of windage loss and Cooling efficiency improvement : review of the fan shape,

Reduction of secondary copper loss: reconsideration with the slot shape of the rotor

Reduction of Stray load loss: reduction of cross flow and magnetic flux leakage

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Point of difference of IE1 and IE3

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◆**The following point is different in IE1 motor and IE3 motor.**
◆**When a replace does IE1 to IE3 in particular, confirmation is needed.**

Manufacturer A (IE1) ⇒ manufacturer A (IE3).
Manufacturer B (IE1) ⇒ manufacturer C (IE3).

} The numerical value is different, but the same tendency is indicated.

1. The **motor size** sometimes becomes larger than a present machine.
2. The **rated rotational speed** of a motor tends to become faster.
3. The **locked rotor current** of a motor tends to become larger.
4. The torque of motor:

   The **locked rotor torque** tends to become small.

   The **maximum torque** tends to become large.

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Attention: Replace to IE3 ①

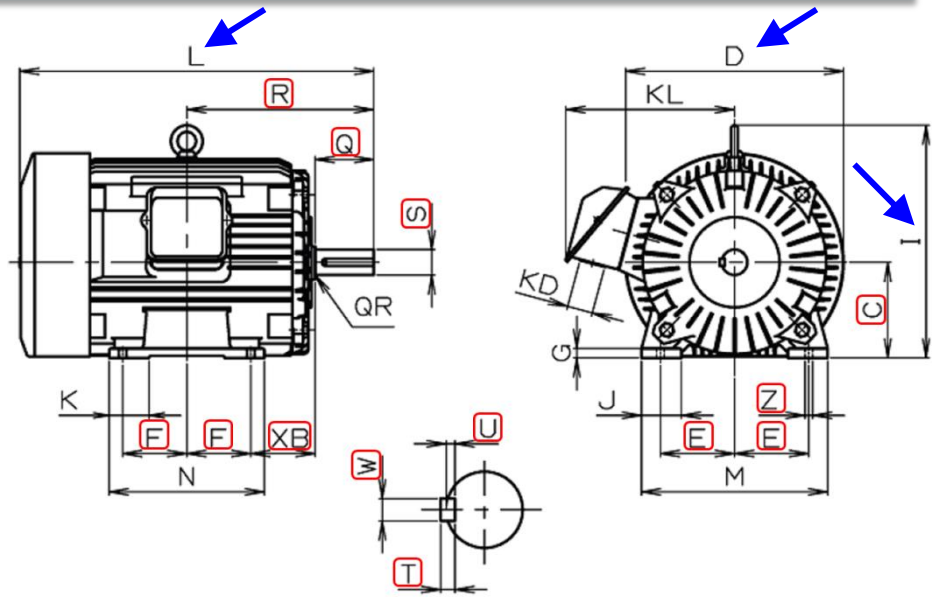
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◆**The motor size sometimes becomes larger than a present machine.**
- **The mounting dimension size is same.**
- **The full length of the motor tends to become longer, mass tends to become heavier.**
- **Start-up time becomes long, because the inertia of the motor becomes large.**

・The iron core volume is increased, because to reduce iron loss. A result and the motor size become large

・The mounting dimension size don't change, fundamentally; however,
IE3 motor will be mass increase, the full length long and inertia increase.

・It's necessary to confirm the distance with the next machine, start-up time, etc.



▢ Mounting dimension size
⇒ Same size, fundamentally
← Confirmation with the size is needed in particular.

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Attention: Replace to IE3 ②

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◆The rated rotational speed of a motor tends to become faster.
・The rotating speed becomes faster about 3～5 % (about 5～15 r/min).

・Secondary copper loss will be small, that is, slip will be small, therefore, rated rotational speed becomes faster.

↓

・In case of a square reduction torque characteristics of load attention is needed.　e.g. a fan or pump.

↓

・Shaft power of load will be the tendency by which the power consumption increases by increase of the rotating speed.
・The motor is high-efficient. However, there is a possibility that loss increases for a system.

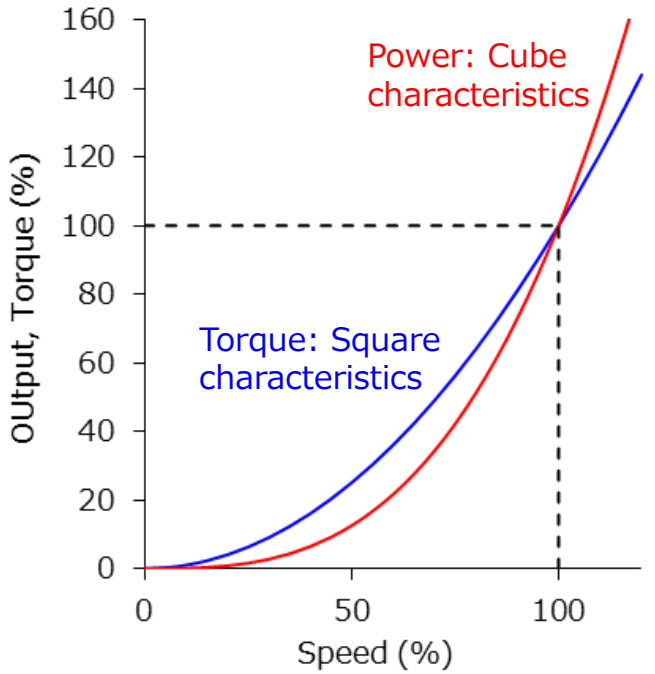


Fig. In the case of the ideal load curve

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Attention: Replace to IE3 ③

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◆**The locked rotor current of a motor tends to become large.**
- **The locked rotor current becomes larger about 20～30 %.**
- **Confirmation of a peripheral device of a breaker is needed, e.g. MCCB, ELB, MCB, thermal relay**

・A design of IE3 is reducing copper loss.

・A result and the locked rotor current of a motor tends to become larger.

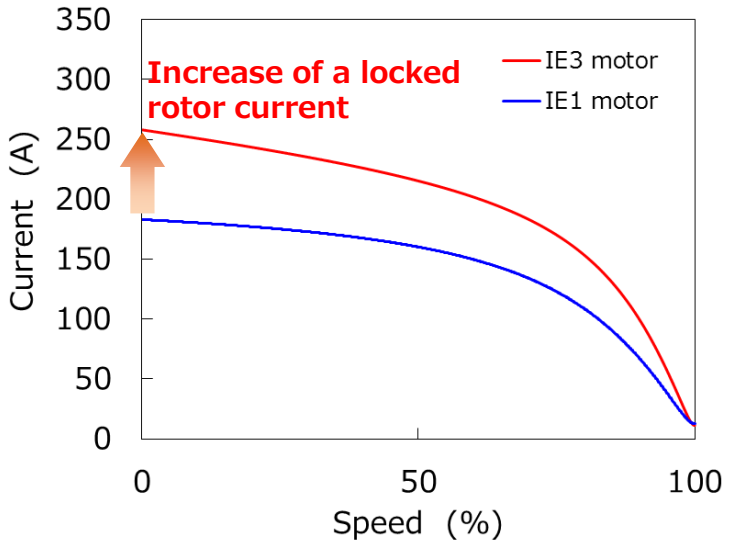


Fig. Reference of a current characteristic.

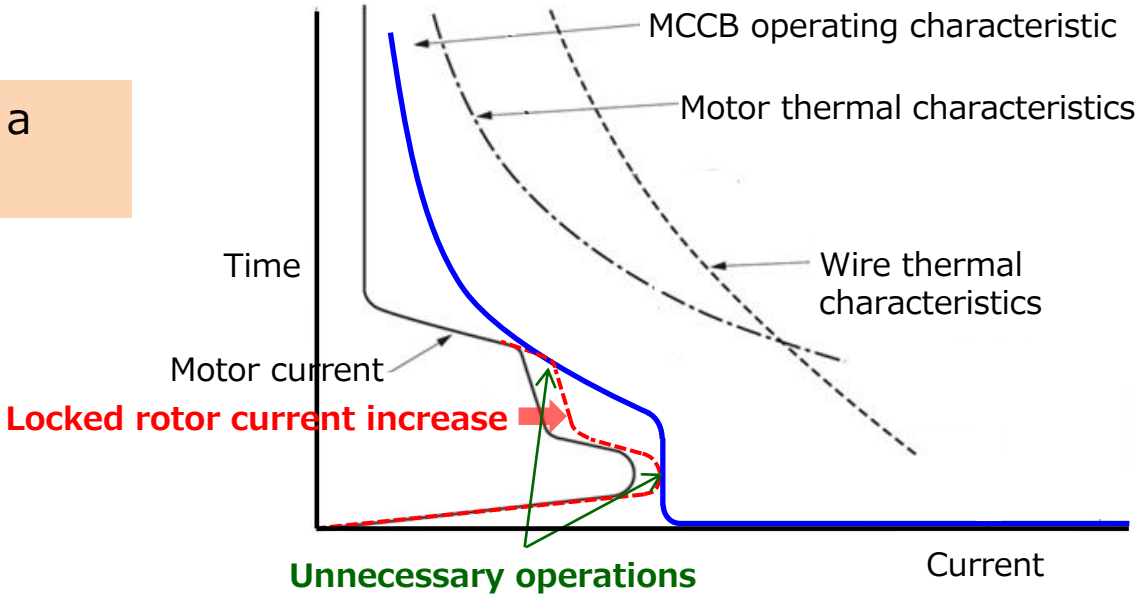


Fig. One case of impact on the selection of MCCB.

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Attention: Replace to IE3 ④

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◆**The locked rotor torque of a motor tends to become small.**
　　・The locked rotor torque becomes smaller about 20～30 %.
◆**The maximum torque of a motor tends to become large.**
　　・The maximum torque becomes larger about 5～10 %.

・The torque characteristic changes.

・Decrease of the locked rotor torque.
　⇒ Confirmation of whether it's motor torque necessary to start-up of the load is needed. Especially, star-delta starting.

・Increase of the maximum torque.
　⇒ An impact to a load becomes large. Confirmation on the mechanical side is needed.

・The torque characteristic changes.
　⇒ Start-up time changes.

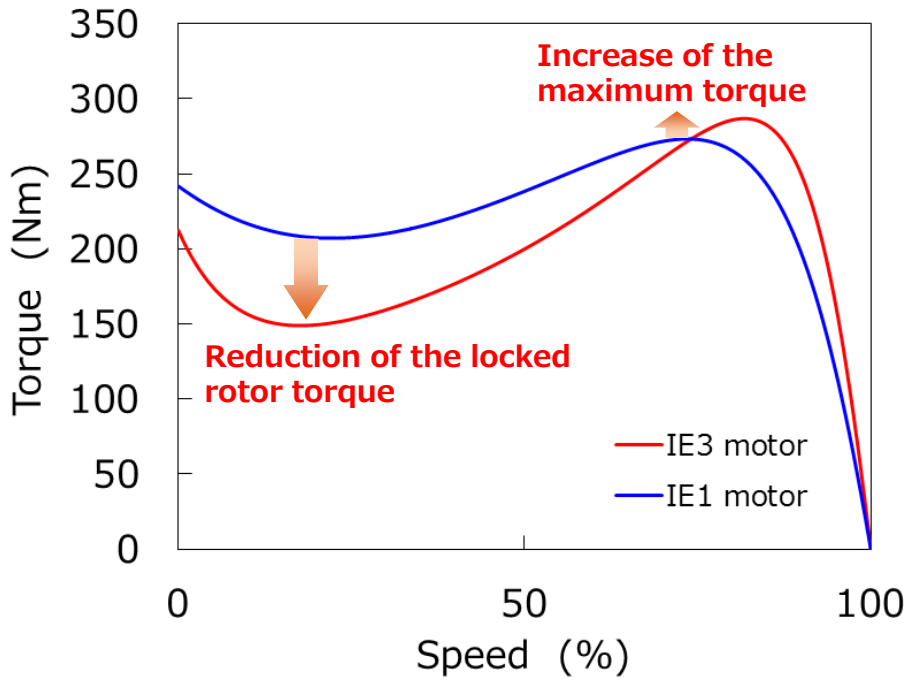


Fig. Reference of a torque characteristic.

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Fuji LV IE3 Motor

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High Efficiency

Satisfying IE3 premium efficiency.

Energy Saving

Drastic cutting of operating expense

Fuji Premium Efficiency Motor



Long life for Shaft seal

Application of non-contact seal for shaft penetrating part

Low noise

Application of improving and optimizing the cooling fan

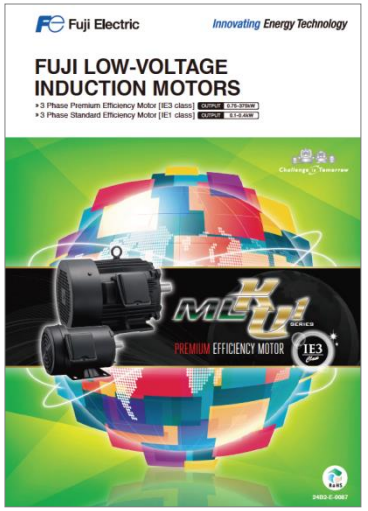
Easy to Displacement

Installation dimensions is same with conventional standard efficiency induction motor. ※Compered to our products.

High Reliability

Application of Cast Iron Frame

Low noise, Anti -corrosive atmosphere



【The motor specification of Fuji】

Totally Enclosed Fan Cooled; Indoor / Outdoor used

Output (kW) : 0.75～375 (frame size 80M～355K)

Number of poles : 2・4・6

Voltage : Less than 600V

Frequency : 50/60Hz common use

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Trend of the Standard ①

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- **The efficiency classes prescribes a Single-speed electric motors by IEC publication.**
- **Efficient regulation has started at each country and an area based on an efficient class of IEC publication.**
- **Standardization of an inverter motor, a PM motor and MV motor will be developed from now on.**

・Following table is the standard and isn't regulation yet.

Standard number	Contents	Issue time; prediction
IEC60034-30-2	Efficiency classes of variable speed AC motors (IE-code)	Beginning of 2017
IEC60034-2-3	Specific test methods for determining losses and efficiency of converter-fed motors.	Middle of 2017
TBD	Efficiency classes of MV motors (IE-code)	2019 or 2020

※ It's assumed that regulation of IE3 motor from output 0.12kW to 1000kW starts from 2018 at Europe.

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Trend of the Standard ②

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◆Explosion-proof motor

・Efficient regulation has started with an explosion-proof motor at each country and an area.

・USA and Canada;
The explosion-proof motor needs IE3 in United States and Canada.

・Europe and Saudi Arabia;
The explosion-proof motor is regulated in IE2 at present at Europe and Saudi Arabia.
Regulation of IE3 will start in Europe and Saudi Arabia in the future.
Saudi Arabia; 1 January, 2017, Europe; 1 January, 2018

・China;
Efficient regulation of a Chinese explosion-proof motor starts the same time as non-explosion-proof motor.

※ The regulation commencing time is sometimes different depending on political situations, so attention is needed.

※ There is sometimes a customer specification. (E.g. Shell DEP, and Petronas Standard)
Please check it to Fuji separately. Basically, Fuji motors are compatible.

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Efficiency of IE1

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◆Nominal limits (%) for Standard Efficiency (IE1) 50Hz : IEC60034-30-1

P_N kW	Number of poles/synchronous speed min^{-1}			
	2/3000	4/1500	6/1000	8/750
0,12	45,0	50,0	38,3	31,0
0,18	52,8	57,0	45,5	38,0
0,20	54,6	58,5	47,6	39,7
0,25	58,2	61,5	52,1	43,4
0,37	63,9	66,0	59,7	49,7
0,40	64,9	66,8	61,1	50,9
0,55	69,0	70,0	65,8	56,1
0,75	72,1	72,1	70,0	61,2
1,1	75,0	75,0	72,9	66,5
1,5	77,2	77,2	75,2	70,2
2,2	79,7	79,7	77,7	74,2
3	81,5	81,5	79,7	77,0
4	83,1	83,1	81,4	79,2
5,5	84,7	84,7	83,1	81,4
7,5	86,0	86,0	84,7	83,1
11	87,6	87,6	86,4	85,0
15	88,7	88,7	87,7	86,2
18,5	89,3	89,3	88,6	86,9
22	89,9	89,9	89,2	87,4
30	90,7	90,7	90,2	88,3
37	91,2	91,2	90,8	88,8
45	91,7	91,7	91,4	89,2
55	92,1	92,1	91,9	89,7
75	92,7	92,7	92,6	90,3
90	93,0	93,0	92,9	90,7
110	93,3	93,3	93,3	91,1
132	93,5	93,5	93,5	91,5
160	93,8	93,8	93,8	91,9
200	94,0	94,0	94,0	92,5
250	94,0	94,0	94,0	92,5
315	94,0	94,0	94,0	92,5
355	94,0	94,0	94,0	92,5
400	94,0	94,0	94,0	92,5
450	94,0	94,0	94,0	92,5
500 up to 1 000	94,0	94,0	94,0	92,5

◆Nominal limits (%) for Standard Efficiency (IE1) 60Hz : IEC60034-30-1

P_N kW	Number of poles/synchronous speed min^{-1}			
	2/3600	4/1800	6/1200	8/900
0,12	57,5	62,0	48,0	36,0
0,18	62,0	66,0	52,5	40,0
0,25	64,0	68,0	57,5	50,5
0,37	70,0	70,0	62,0	57,5
0,55	72,0	74,0	66,0	59,5
0,75	74,0	77,0	72,0	64,0
1,1	78,5	79,0	75,0	73,5
1,5	81,0	81,5	77,0	77,0
2,2	81,5	83,0	78,5	78,0
3,7	84,5	85,0	83,5	80,0
5,5	86,0	87,0	85,0	84,0
7,5	87,5	87,5	86,0	85,0
11	87,5	88,5	89,0	87,5
15	88,5	89,5	89,5	88,5
18,5	89,5	90,5	90,2	88,5
22	89,5	91,0	91,0	90,2
30	90,2	91,7	91,7	90,2
37	91,5	92,4	91,7	91,0
45	91,7	93,0	91,7	91,0
55	92,4	93,0	92,1	91,5
75	93,0	93,2	93,0	92,0
90	93,0	93,2	93,0	92,5
110	93,0	93,5	94,1	92,5
150 up to 1 000	94,1	94,5	94,1	92,5

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Efficiency of IE3

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◆Nominal limits (%) for Premium Efficiency (IE3) 50Hz : IEC60034-30-1

P_N kW	Number of poles/synchronous speed min^{-1}			
	2/3000	4/1500	6/1000	8/750
0,12	60,8	64,8	57,7	50,7
0,18	65,9	69,9	63,9	58,7
0,20	67,2	71,1	65,4	60,6
0,25	69,7	73,5	68,6	64,1
0,37	73,8	77,3	73,5	69,3
0,40	74,6	78,0	74,4	70,1
0,55	77,8	80,8	77,2	73,0
0,75	80,7	82,5	78,9	75,0
1,1	82,7	84,1	81,0	77,7
1,5	84,2	85,3	82,5	79,7
2,2	85,9	86,7	84,3	81,9
3	87,1	87,7	85,6	83,5
4	88,1	88,6	86,8	84,8
5,5	89,2	89,6	88,0	86,2
7,5	90,1	90,4	89,1	87,3
11	91,2	91,4	90,3	88,6
15	91,9	92,1	91,2	89,6
18,5	92,4	92,6	91,7	90,1
22	92,7	93,0	92,2	90,6
30	93,3	93,6	92,9	91,3
37	93,7	93,9	93,3	91,8
45	94,0	94,2	93,7	92,2
55	94,3	94,6	94,1	92,5
75	94,7	95,0	94,6	93,1
90	95,0	95,2	94,9	93,4
110	95,2	95,4	95,1	93,7
132	95,4	95,6	95,4	94,0
160	95,6	95,8	95,6	94,3
200 up to 1 000	95,8	96,0	95,8	94,6

◆Nominal limits (%) for Premium Efficiency (IE3) 60Hz : IEC60034-30-1

P_N kW	Number of poles / synchronous speed min^{-1}			
	2/3600	4/1800	6/1200	8/900
0,12	62,0	66,0	64,0	59,5
0,18	65,6	69,5	67,5	64,0
0,25	69,5	73,4	71,4	68,0
0,37	73,4	78,2	75,3	72,0
0,55	76,8	81,1	81,7	74,0
0,75	77,0	83,5	82,5	75,5
1,1	84,0	86,5	87,5	78,5
1,5	85,5	86,5	88,5	84,0
2,2	86,5	89,5	89,5	85,5
3,7	88,5	89,5	89,5	86,5
5,5	89,5	91,7	91,0	86,5
7,5	90,2	91,7	91,0	89,5
11	91,0	92,4	91,7	89,5
15	91,0	93,0	91,7	90,2
18,5	91,7	93,6	93,0	90,2
22	91,7	93,6	93,0	91,7
30	92,4	94,1	94,1	91,7
37	93,0	94,5	94,1	92,4
45	93,6	95,0	94,5	92,4
55	93,6	95,4	94,5	93,6
75	94,1	95,4	95,0	93,6
90	95,0	95,4	95,0	94,1
110	95,0	95,8	95,8	94,1
150	95,4	96,2	95,8	94,5
185 up to 1 000	95,8	96,2	95,8	95,0

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Permanent-magnet type synchronous motor series

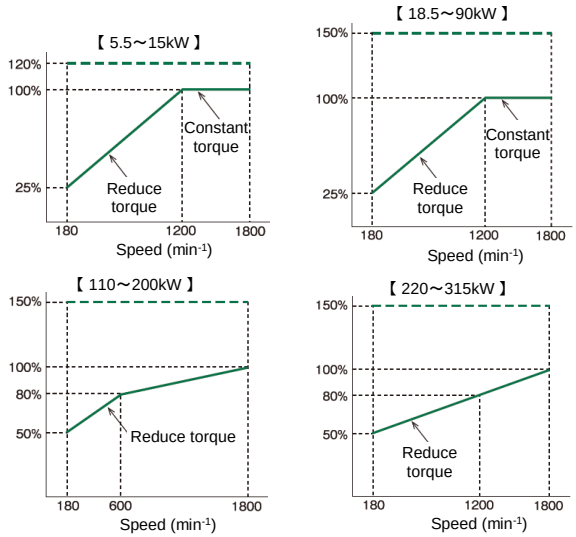
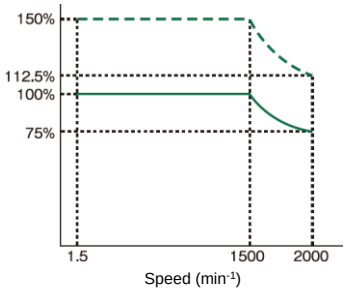
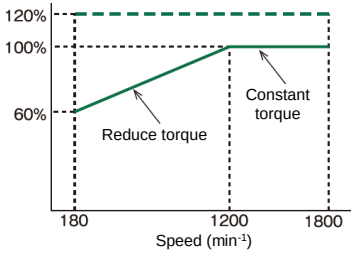
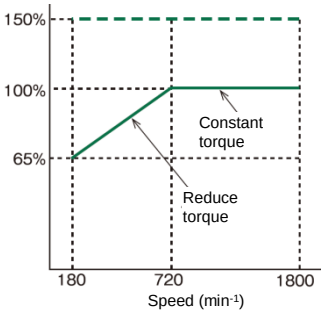
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Type			GNB2 Series Standard type Sensor less		GNF2 Series Standard type, With sensor		GNP1 Series High-efficiency type Sensor less		GNS1 Series Premium-efficiency type Sensor less	
Efficiency Class			IE3(Premium efficiency); equality		IE3(Premium efficiency); equality		IE4(Super-premium efficiency); equality		IE4(Super-premium efficiency); over	
Torque characteristic			Reduced torque characteristics		Constant torque characteristics		Reduced torque characteristics		Reduced torque characteristics	
Base speed (min^{-1})			1800		1500		1800		1800	
Top Speed (min^{-1})			—		2000		—		—	
Motor Type	Voltage (V)		200V Class	400V Class	200V Class	400V Class	200V Class	400V Class	200V Class	400V Class
	Rated output power (kW)	5.5	GNB2114A	GNB2114A	GNF2114A	GNF2114A	GNP1133B	GNP1133B		
		7.5	GNB2115A	GNB2115A	GNF2115A	GNF2115A	GNP1135B	GNP1135B		
		11	GNB2117A	GNB2117A	GNF2117A	GNF2117A	GNP1165B	GNP1165B	GNS1163A	GNS1163A
		15	GNB2118A	GNB2118A	GNF2118A	GNF2118A	GNP1167B	GNP1167B	GNS1165A	GNS1165A
		18.5	GNB2136A	GNB2136A	GNF2136A	GNF2136A	GNP1184B	GNP1184B	GNS1183A	GNS1183A
		22	GNB2137A	GNB2137A	GNF2136A	GNF2136A	GNP1185B	GNP1185B	GNS1185A	GNS1185A
		30	GNB2139A	GNB2139A	GNF2137A	GNF2137A	GNP1187B	GNP1187B	GNS1187A	GNS1187A
		37	GNB2165A	GNB2165A	GNF2139A	GNF2139A	GNP1205B	GNP1205B	GNS1208A	GNS1208A
		45	GNB2167A	GNB2167A	GNF2165A	GNF2165A	GNP1207B	GNP1207B	GNS1206A	GNS1206A
		55	GNB2185A	GNB2185A	GNF2185A	GNF2185A	GNP1221B	GNP1221B	GNS1221A	GNS1221A
		75	GNB2187A	GNB2187A	GNF2187A	GNF2187A	—	GNP1250B	GNS1252A	GNS1252A
		90	GNB2207A	GNB2207A	GNF2207A	GNF2207A	—	GNP1254B	GNS1254A	GNS1254A
		110	—	GNB2222B	—	GNF2224B			—	GNS1282B
		132	—	GNB2224B	—	GNF2226B			—	GNS1284B
		160	—	GNB2252B	—	GNF2254B			—	GNS1312B
		200	—	GNB2254B	—	GNF2256B			—	GNS1314B
		220	—	GNB2256B	—	GNF228FB				
		250	—	GNB228FB	—	GNF228GB				
		280	—	GNB228GB	—	GNF228HB				
		300	—	GNB228HB						
		315	—	GHB228HB						

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Permanent-magnet type synchronous motor series

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Type	GNB2 Series	GNF2 Series	GNP1 Series	GNS1 Series
Product appearance				
Torque characteristic Short time (1min) Continuous (S1)				
Type of construction	IMB3	IMB3	IMB3	IMB3
Over load capacity	15kW or less : 120%－1min 18.5kW or more : 150%－1min	150%－1min	120%－1min	150%－1min
Protective enclosure	90kW or less : IP44 110kW or more : IP54	90kW or less : IP44 110kW or more : IP54	IP54	90kW or less : IP44 110kW or more : IP54
Cooling system	IC411	IC416	IC411	IC411
Insulation class	155(F)	155(F)	155(F)	155(F)
Location	90kW or less : Indoor 110kW or more : Outdoor	90kW or less : Indoor 110kW or more : Outdoor	Outdoor	90kW or less : Indoor 110kW or more : Outdoor
Ambient temperature and humidity	－10～＋40℃, up to 90%RH	－10～＋40℃, up to 90%RH	－10～＋40℃, up to 90%RH	－10～＋40℃, up to 90%RH
Painting color	Munsell symbol : N1.2	Munsell symbol : N1.2	Munsell symbol : 5YR3/2	Munsell symbol : 5G6/4.5

Permanent-magnet type synchronous motor series

Fuji Electric
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Type	GNB2 Series					GNF2 Series					GNP1 Series					GNS1 Series				
Rated output power (kW)	Current (A)		Center height (mm)	Mass (kg)	Moment of inertia ($kg\text{-}m^2$)	Current (A)		Center height (mm)	Mass (kg)	Moment of inertia ($kg\text{-}m^2$)	Current (A)		Center height (mm)	Mass (kg)	Moment of inertia ($kg\text{-}m^2$)	Current (A)		Center height (mm)	Mass (kg)	Moment of inertia ($kg\text{-}m^2$)
	200V Class	400V Class				200V Class	400V Class				200V Class	400V Class				200V Class	400V Class			
5.5	20	10	112	41	0.014	20	10	112	51	0.018	20	10	132	45	0.014					
7.5	29	15	112	45	0.018	29	15	112	55	0.021	26	13	132	50	0.018					
11	42	21	112	58	0.021	42	21	112	69	0.027	40	20	160	80	0.022	40	20	160	95	0.032
15	57	29	112	65	0.029	57	29	112	78	0.036	54	27	160	90	0.027	54	27	160	115	0.041
18.5	70	35	132	86	0.049	71	36	132	100	0.065	64	32	180	130	0.049	64	32	180	145	0.076
22	80	40	132	99	0.065	82	41	132	106	0.070	78	39	180	135	0.054	76	38	180	160	0.096
30	108	54	132	116	0.081	113	57	132	127	0.090	106	53	180	180	0.127	104	52	180	180	0.129
37	144	72	160	162	0.153	140	70	160	170	0.153	130	65	200	210	0.153	130	65	200	270	0.285
45	160	80	160	183	0.191	165	83	160	192	0.191	158	79	200	260	0.350	158	79	200	270	0.325
55	200	100	180	225	0.325	200	100	180	247	0.350	196	98	225	310	0.434	190	95	225	315	0.433
75	270	135	180	297	0.432	270	135	180	325	0.467	–	124	250	430	0.577	256	127	250	510	0.775
90	316	158	200	385	0.721	316	158	200	420	0.805	–	150	250	490	0.721	324	153	250	570	0.795
110	–	190	225	450	0.792	–	198	225	520	0.882						–	186	280	730	1.60
132	–	223	225	480	0.898	–	232	225	580	0.994						–	223	280	790	1.63
160	–	273	250	630	1.72	–	273	250	760	1.96						–	268	315	1220	2.45
200	–	336	250	720	2.00	–	340	250	810	2.22						–	331	315	1320	2.51
220	–	376	250	770	2.26	–	390	280	1000	2.79										
250	–	440	280	970	2.86	–	445	280	1050	3.12										
280	–	465	280	1030	3.19	–	475	280	1100	3.47										
300	–	520	280	1080	3.54															
315	–	545	280	1080	3.54															

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