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Basics of induction Motors

Name plate details of induction motor Part 1

What is name plate of an Induction motor?

A name plate is a display of all the important electrical and mechanical parameters of an Induction motor. Not only an Induction motor but, name plate is available for any electrical appliance or equipment.

Nameplate- defined parameters for the motor such as power factor, efficiency, torque, and current are at rated voltage and frequency. Application at other than nameplate voltage will likely produce different performance. It is common for manufacturers to nameplate a wide variety of voltages on one motor nameplate.

Efficiency Classes:

As part of a concerted effort worldwide to reduce energy consumption, CO_2 emissions and the impact of industrial operations on the environment, various regulatory authorities in many countries have introduced, or are planning, legislation to encourage the manufacture and use of higher efficiency motors. This article looks at the development of the premium efficiency standard (IE3) and premium efficiency motors (PEMs) and associated environmental, legal and energy-related topics.

The efficiency of an electric motor is defined as the ratio of usable shaft power to electric input power.

$$\eta_{mot} = P_{shaft} \div P_{in}$$

η_{mot} = motor efficiency [%] P_{shaft} = shaft Power [kW]

P_{in} = electrical input from power supply [kW]

The shaft power is transferred to the machine driven; the electric input power is what is metered and charged for. Loss in motor efficiency is determined by the difference between the input power and output or shaft power.

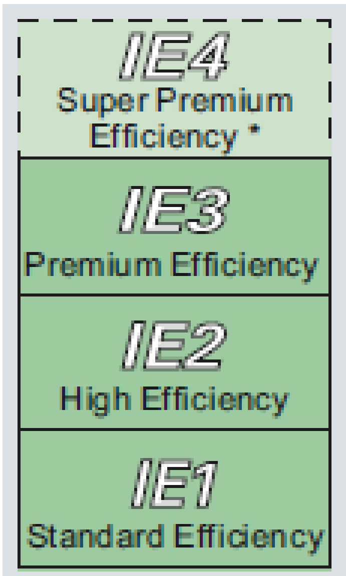
$$P_{loss} = P_{in} - P_{shaft}$$

P_{loss} = losses of electric motor [kW]

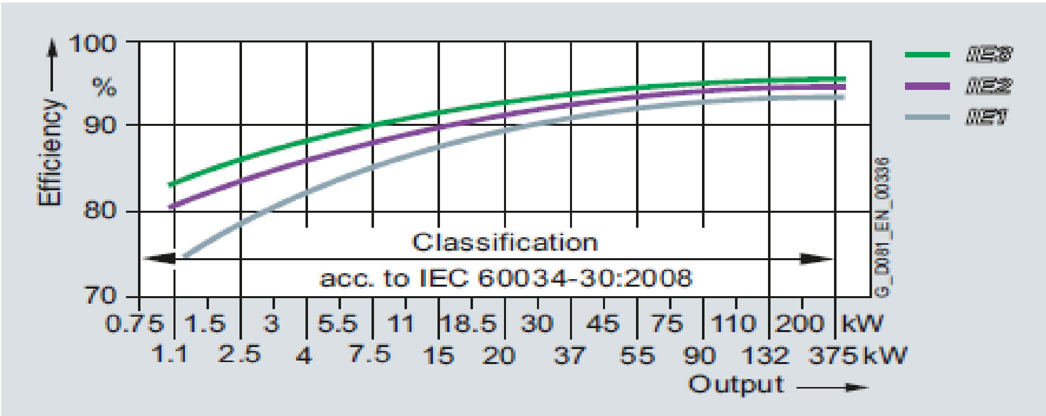
Motor energy loss is mainly heat caused by many factors, including loss from the coil winding (resistance), loss in the rotor bars and slip rings, loss due to magnetizing of the iron core, and loss from friction of bearings.

The efficiency classes are grouped according to the following nomenclature:

- IE1 (Standard Efficiency)
- IE2 (High Efficiency)
- IE3 (Premium Efficiency)
- IE4 (Super Premium Efficiency)



Power	IE1			IE2			IE3		
kW	2-pole	4-pole	6-pole	2-pole	4-pole	6-pole	2-pole	4-pole	6-pole
4	83.1	83.1	81.4	85.8	86.6	84.6	88.1	88.6	86.8
5.5	84.7	84.7	83.1	87.0	87.7	86.0	89.2	89.6	88.0
7.5	86.0	86.0	84.7	88.1	88.7	87.2	90.1	90.4	89.1
11	87.6	87.6	86.4	89.4	89.8	88.7	91.2	91.4	90.3
15	88.7	88.7	87.7	90.3	90.6	89.7	91.9	92.1	91.2
18.5	89.3	89.3	88.6	90.9	91.2	90.4	92.4	92.6	91.7
22	89.9	89.9	89.2	91.3	91.6	90.9	92.7	93.0	92.2
30	90.7	90.7	90.2	92.0	92.3	91.7	93.3	93.6	92.9
37	91.2	91.2	90.8	92.5	92.7	92.2	93.7	93.9	93.3
45	91.7	91.7	91.4	92.9	93.1	92.7	94.0	94.2	93.7
55	92.1	92.1	91.9	93.2	93.5	93.1	94.3	94.6	94.1



Why higher efficiency is required for any electrical machine?
Let us consider a 5.5KW motor for two cases i.e...

Case 1: Efficiency is 87.0%
Input Voltage 415V
Power factor 0.8
and an Efficiency of 87.0%.

Calculating the full load current
i.e,. I/P Power = sqrt(3) * V_L * I_L * P.F
O/P = 5.5 KW = 5500 W.
Efficiency = (O/P) / (I/P)
0.87 = 5500/ (sqrt(3) * 415 * I_L * 0.8)
I_L = 10.99 ~ 11 A

Calculating the Energy (KWhr) per year
Let us consider the motor is working for 10 hrs a day

Case 2: Efficiency is 92.0%
Input Voltage 415V
Power factor 0.8
and an Efficiency of 92.0%.

Calculating the full load current
i.e,. I/P Power = sqrt(3) * V_L * I_L * P.F
O/P = 5.5 KW = 5500 W.
Efficiency = (O/P) / (I/P)
0.92 = 5500/ (sqrt(3) * 415 * I_L * 0.8)
I_L = 10.39 ~ 10.4 A

Calculating the Energy (KWhr) per year
Let us consider the motor is working for 10 hrs a day

i.e., Power * No. of working hours of motor
KWhr = input KW * no. of working hours * no. of days of days
KWhr = sqrt(3) * 415 * 11 * 0.8 * 10 * 365 * 10^{-3}
KWhr = 23087 Units

Calculating power bill at a tariff of Rs. 4 /- a unit
Total Bill = 23087 * 4 = Rs. 92,384 /-

i.e., Power * No. of working hours of motor
KWhr = input KW * no. of working hours * no.
KWhr = sqrt(3) * 415 * 10.4 * 0.8 * 10 * 365 *
KWhr = 21828 Units

Calculating power bill at a tariff of Rs. 4 /- a unit
Total Bill = 21828 * 4 = Rs. 87,312 /-

So, for an induction motor of same output rating but with higher efficiency the energy consumption per year is reduced.

And the difference in above case is Rs. 5,072 /- per year.