High Efficiency Industrial Motors

Three Phase Asynchronous Motor

AsynMotor

Asen Kron Motor
Asynchronous (Induction) Motor

Efficiency class of IE2, IE3 and IE4
Robust design
High power factor
High start-up torque
Low start-up current
Low thermal resistance between winding and housing
Inverter duty design
Aluminium or copper rotor design
Low stray-load loss due to design with low harmonic content
Motor design for different mounting arrangements (B3, B5, B14...)
Induction motor design for submersible pump application, rewindable or encapsulated

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Three Phase Asynchronous Motor

Asynchronous motor technology can be considered as the most widespread electric machine type for industrial applications such as, pumps, fans, compressors, conveyor, traction, lifting etc. The power consumption of electrical motor is about 70% of total consumption in the industry. On the other hand, the cost of a motor in its whole life is due to energy consumption for about 98% and purchase and maintenance costs for about the remaining 2%. These two items show the importance of efficiency level of motors electrically used in industry.

In March 2014 the standard IEC 60034-30-1 has been published to replace the standard IEC 60034-30:2008. The updated standard IEC 60034-30-1 has declared the new efficiency levels for 3 phase Induction motor and IE4 efficiency level.

The updated standard includes the following items:

<table>
<thead>
<tr>
<th>Commencement Date</th>
<th>Requirements</th>
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<tbody>
<tr>
<td>16-Jun-11</td>
<td>IE2 is the minimum efficiency class allowed to be newly marketed in the EU. New motors of IE1 are no longer allowed</td>
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<tr>
<td>01-Jan-14</td>
<td>IE3 is the minimum efficiency class for motors with rated output power between 7.5kW and 375kW. IE2 is also allowed if motors are operated or equipped with variable speed drive (VSD)</td>
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<tr>
<td>02-Jan-17</td>
<td>The scope of requirement of IE3 and IE2 with VSD will be expanded to motors with rated output power form 0.75kW to 375kW</td>
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Electrical & Magnetic Design

Asynchronous motor design is performed by using analytical model and optimized with this model. Next step is to check the design by the means of FEM or BEM analysis. For higher efficiency designing, losses in the model should be estimated accurate so that efficiency can be calculated accurate. Especially stray load loss is depending on harmonics in magnetic field and current under load. FEM or BEM analysis is necessary to simulate harmonic effects on the motor.

Winding insulation system is designed generally for both thermal class of B and F. For inverter duty motor, the insulation system designing should be modified depending on supply voltage level according to IEC 60034-25.

Mechanical Design

Mechanical design includes following items:

1. Aluminium or Iron Cast housing designing
2. Bearing system design
3. Terminal box design for electrical connection
4. Stress and thermal analysis of full system with fan or without fan

Increasing Efficiency

The way of efficiency increase in any motor is to decrease losses. Main losses for induction motor are stator copper loss, rotor copper loss, iron loss, friction loss, stray load loss and windage loss.

Copper and Iron losses can be decreased by using more material. IR losses can be decreased by adding more copper and lower current density. Iron losses can be decreased by adding more magnetic steel to decrease flux density or by changing magnetic steel with high grade with lower power loss density.

Ways to decrease

- Increased copper usage
- Lower current density
- Higher slot fill
- Increased iron usage
- Decreased flux density
- High grade steel
- Low harmonic content in current and magnetic field
- More Al material
- Cu cage injection or inserting both Cu & Al cage
- Increased iron usage
- Decreased flux density
- High grade steel
- Special bearing with low friction
- Optimized fan design

10% decrease in loss means 10% increased material usage