MALAYSIAN STANDARD
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(THIRD REVISION)

Chapter 7
Electric Power and Distribution

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CONTENTS

WG members for Electric Power and Distribution

- Association of Consulting Engineers Malaysia
- FMM Malaysia Insulation Manufacturers Group
- Jabatan Kerja Raya
- SIRIM Berhad
- The Institution of Engineers, Malaysia

Major modifications for Chapter 7

a) Range of motor capacity coverage increased
b) Peak Efficiency Index (PEI) introduced for larger range of Transformers
c) Cogeneration highlighted

7. Electric Power and Distribution

7.1 Alternating Current (AC) electric motors

7.2 Transformers

7.3 Cabling

7.4 Power factor

7.5 Sub-metering

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7.1 Alternating Current (AC) electric motors

Motors included are AC 2 pole, 4 pole, 6 pole and 8 pole, 3 phase induction motors, in the range of 0.12kW to 1,000kW.
Motor continuous rating should not exceed 30% of its estimated maximum load.

Annex B Table B1 depicts the Minimum efficiency values of IE1, IE2, IE3 and IE4 motors as defined in IEC 60034-30-1:2014 for 50 Hz motors

Minimum efficiency values defined in IEC 60034-30-1:2014 for 50 Hz motors (based on test methods specified in IEC 60034-2-1:2014)

Table B1. Minimum efficiency values defined in IEC 60034-30-1:2014 for 50 Hz motors

P_N	2 pole				4 pole				6 pole				8 pole			
(kW)	IE1	IE2	IE3	IE4	IE1	IE2	IE3	IE4	IE1	IE2	IE3	IE4	IE1	IE2	IE3	IE4
0.12	45.0	53.6	60.8	66.5	50.0	59.1	64.8	69.8	38.3	59.1	57.7	64.9	31.0	39.8	50.7	62.3
0.18	52.8	60.4	65.9	70.8	57.0	64.7	69.9	74.7	45.5	64.7	63.9	70.1	38.0	45.9	58.7	67.2
0.20	54.6	61.9	67.2	71.9	58.5	65.9	71.1	75.8	47.6	65.9	65.4	71.4	39.7	47.4	60.6	68.4
0.25	58.2	64.8	69.7	74.3	61.5	68.5	73.5	77.9	52.1	68.5	68.6	74.1	43.4	50.6	64.1	70.8
0.37	63.9	69.5	73.8	79.1	66.0	72.7	77.3	81.1	59.7	72.7	73.5	78.0	49.7	56.1	69.3	74.3
0.40	64.9	70.4	74.6	78.9	66.8	73.5	78.0	81.7	61.1	73.5	74.4	78.7	50.9	57.2	70.1	74.9
0.55	69.0	74.1	77.8	81.5	70.0	77.1	80.8	83.9	65.8	77.1	77.2	80.9	56.1	61.7	73.0	77.0
0.75	72.1	77.4	80.7	83.5	72.1	79.6	82.5	85.7	70.0	79.6	78.9	82.7	61.2	66.2	75.0	78.4
1.10	75.0	79.6	82.7	85.2	75.0	81.4	84.1	87.2	72.9	81.4	81.0	84.5	66.5	70.8	77.7	80.8
1.50	77.2	81.3	84.2	86.5	77.2	82.8	85.3	88.2	75.2	82.8	82.5	85.9	70.2	74.1	79.7	82.6
2.20	79.7	83.2	85.9	88.0	79.7	84.3	86.7	89.5	77.7	84.3	84.3	87.4	74.2	77.6	81.9	84.5
3.00	81.5	84.6	87.1	89.1	81.5	85.5	87.7	90.4	79.7	85.5	85.6	88.6	77.0	80.0	83.5	85.9
4.00	83.1	85.8	88.1	90.0	83.1	86.6	88.6	91.1	81.4	86.6	86.8	89.5	79.2	81.9	84.8	87.1
5.50	84.7	87.0	89.2	90.9	84.7	87.7	89.6	91.9	83.1	87.7	88.0	90.5	81.4	83.8	86.2	88.3
7.50	86.0	88.1	90.1	91.7	86.0	88.7	90.4	92.6	84.7	88.7	89.1	91.3	83.1	85.3	87.3	89.3
11.00	87.6	89.4	91.2	92.6	87.6	89.8	91.4	93.3	86.4	89.8	90.3	92.3	85.0	86.9	88.6	90.4
15.00	88.7	90.3	91.9	93.3	88.7	90.6	92.1	93.9	87.7	90.6	91.2	92.9	86.2	88.0	89.6	91.2
18.50	89.3	90.9	92.4	93.7	89.3	91.2	92.6	94.2	88.6	91.2	91.7	93.4	86.9	88.6	90.1	91.7
22.00	89.9	91.3	92.7	94.0	89.9	91.6	93.0	94.5	89.2	91.6	92.2	93.7	87.4	89.1	90.6	92.1
30.00	90.7	92.0	93.3	94.5	90.7	92.3	93.6	94.9	90.2	92.3	92.9	94.2	88.3	89.8	91.3	92.7
37.00	91.2	92.5	93.7	94.8	91.2	92.7	93.9	95.0	90.8	92.7	93.3	94.5	88.8	90.3	91.8	93.1
45.00	91.7	92.9	94.0	95.0	91.7	93.1	94.2	95.4	91.4	93.1	93.7	94.8	89.2	90.7	92.2	93.4
55.00	92.1	93.2	94.3	95.3	92.1	93.5	94.6	95.7	91.9	93.5	94.1	95.1	89.7	91.0	92.5	93.7
75.00	92.7	93.8	94.7	95.6	92.7	94.0	95.0	96.0	92.6	94.0	94.6	95.4	90.3	91.6	93.1	94.2
90.00	93.0	94.1	95.0	95.8	93.0	94.2	95.2	96.1	92.9	94.2	94.9	95.6	90.7	91.9	93.4	94.4
110.00	93.3	94.3	95.2	96.0	93.3	94.5	95.4	96.3	93.3	94.5	95.1	95.8	91.1	92.3	93.7	94.7
132.00	93.5	94.6	95.4	96.2	93.5	94.7	95.6	96.4	93.5	94.7	95.4	96.0	91.5	92.6	94.0	94.9
160.00	93.8	94.8	95.6	96.3	93.8	94.9	95.8	96.6	93.8	94.9	95.6	96.2	91.9	93.0	94.3	95.1
200.00	94.0	95.0	95.8	96.5	94.0	95.1	96.0	96.7	94.0	95.1	95.8	96.3	92.5	93.5	94.6	95.4
250.00	94.0	95.0	95.8	96.5	94.0	95.1	96.0	96.7	94.0	95.1	95.8	96.5	92.5	93.5	94.6	95.4
315.00	94.0	95.0	95.8	96.5	94.0	95.1	96.0	96.7	94.0	95.1	95.8	96.6	92.5	93.5	94.6	95.4
355.00	94.0	95.0	95.8	96.5	94.0	95.1	96.0	96.7	94.0	95.1	95.8	96.6	92.5	93.5	94.6	95.4
400.00	94.0	95.0	95.8	96.5	94.0	95.1	96.0	96.7	94.0	95.1	95.8	96.6	92.5	93.5	94.6	95.4
450.00	94.0	95.0	95.8	96.5	94.0	95.1	96.0	96.7	94.0	95.1	95.8	96.6	92.5	93.5	94.6	95.4
500 to 1000	94.0	95.0	95.8	96.5	94.0	95.1	96.0	96.7	94.0	95.1	95.8	96.6	92.5	93.5	94.6	95.4

7.1.2 Motor efficiencies

Only motors with efficiencies higher than standard efficiency motors (IE1) should be used where operating hours exceed **750 h per year**.
Decisions on motor selection between IE2 (high efficiency), IE3 (premium efficiency), and IE4 (super premium efficiency) should be done on an economic justification basis.

7.2.3.2 Minimum Peak Efficiency Index (PEI) for transformer ratings of more than 3 150 kVA

The minimum peak efficiency for transformer with ratings more than 3 150 kVA shall be calculated by using the following equation.

$$PEI = 1 - \frac{2(P_0 + P_{c0})}{S_r \sqrt{\frac{P_0 + P_{c0}}{P_k}}}$$

where

P_0 is the load losses measured at rated voltage and rated frequency, on the rated tap;

P_{c0} is the electrical power required by the cooling system for no load operation;

P_k is the measured load loss at rated current and rated frequency on the rated tap corrected to the reference temperature;

S_r is the rated power of the transformer or auto-transformer on which P_k is based.

NOTE. The peak efficiency of the transformer occurs at a load factor where the no-load loss equals the total load loss.

7.6 Cogeneration

Cogeneration, which is sequential conversion of a single form of energy (currently natural gas) to other forms of energy, can often achieve high overall primary energy conversion efficiencies, compared to conventional use of electricity and thermal energy (heating or cooling). As such, opportunities for cogeneration within the building complex should be identified and exploited where possible.

The exploitation of the cogen option can still be financially/ economically attractive for consumers who need both electricity and thermal energy, whether for heating or cooling, e.g. through absorption cooling.