

JAPANESE
INDUSTRIAL
STANDARD

Translated and Published by
Japanese Standards Association

JIS C 4210 : 2001
(JEMA)

**Low-voltage three-phase
squirrel-cage induction motors
for general purpose**

ICS 29.160.30

Descriptors : three-phase motors, squirrel-cage motors

Reference number : JIS C 4210 : 2001 (E)

Foreword

This translation has been made based on the original Japanese Industrial Standard revised by the Minister of Economy, Trade and Industry through deliberations at the Japanese Industrial Standards Committee, as the result of proposal for revision of Japanese Industrial Standard submitted by the Japan Electrical Manufacturers' Association (JEMA) with the draft being attached, based on the provision of Article 12 Clause 1 of the Industrial Standardization Law. Consequently **JIS C 4210 : 1983** is replaced with this Standard.

Attention is drawn to the possibility that some parts of this Standard may conflict with a patent right, application for a patent after opening to the public, utility model right or application for registration of utility model after opening to the public which have technical properties. The relevant Minister and the Japanese Industrial Standards Committee are not responsible for identifying the patent right, application for a patent after opening to the public, utility model right or application for registration of utility model after opening to the public which have the said technical properties.

Date of Establishment: 1965-02-01

Date of Revision: 2001-08-20

Date of Public Notice in Official Gazette: 2001-08-20

Investigated by: Standards Board

Technical committee on Electricity
Technology

JIS C 4210 : 2001, First English edition published in 2002-02

Translated and published by: Japanese Standards Association
4-1-24, Akasaka, Minato-ku, Tokyo, 107-8440 JAPAN

In the event of any doubts arising as to the contents,
the original JIS is to be the final authority.

© JSA 2002

All rights reserved. Unless otherwise specified, no part of this publication may be reproduced or utilized in any form or by any means, electronic or mechanical, including photocopying and microfilm, without permission in writing from the publisher.

Printed in Japan

Contents

	Page
Introduction	1
1 Scope	1
2 Normative references	2
3 Ratings	2
3.1 Rated voltages	2
3.2 Rated outputs	2
4 Performances	2
4.1 Temperature rise	2
4.2 Full-load characteristics	3
4.3 Torque characteristics	6
4.4 Locked rotor apparent power	6
4.5 Noise level	7
4.6 Dielectric withstand voltage	9
4.7 Voltage and frequency variations during operation	9
5 Construction	10
5.1 Accessories	10
5.2 Cable entrance	10
5.3 Star-delta starter	10
5.4 Earthing terminal	10
6 Dimensions	10
7 Test methods	16
7.1 Classification of tests	16
7.2 Construction test	17
7.3 Resistance measurement	17
7.4 Lock test	17
7.5 No-load test	17
7.6 Temperature test	17
7.7 Calculation of load characteristics and torque characteristics	18

C 4210 : 2001

7.8	Locked rotor apparent power test	30
7.9	Noise test	31
7.10	Dielectric withstand voltage test	35
8	Marking	35
Annex (informative)	Comparison table between JIS and corresponding International Standards	37

Low-voltage three-phase squirrel-cage induction motors for general purpose

Introduction This Japanese Industrial Standard has been prepared based on **IEC 60034-1 : 1996** *Rotating electrical machines—Part 1 : Rating and performance*, **IEC 60034-2 : 1972** *Rotating electrical machines—Part 2 : Methods for determining losses and efficiency of rotating electrical machinery from tests*, **IEC 60034-9 : 1997** *Rotating electrical machines—Part 9 : Noise limits*, **IEC 60034-12 : 1972** *Rotating electrical machines—Part 12 : Starting performance of single-speed three-phase cage induction motors for voltage up to and including 660 V*, **IEC 60072-1 : 1991** *Dimensions and output series for rotating electrical machines—Part 1 : Frame numbers 56 to 400 and flange numbers 55 to 1080*. However, in this Standard, contents of specifications for products out of the scope of this Standard are deleted and items and contents not specified in the corresponding International Standards are added.

In this Standard, the portions shown by continuous sidelines or dotted underlines mean the matters not stated in or different from those in the corresponding International Standards.

1 Scope This Standard specifies low-voltage three-phase squirrel-cage induction motors for general purpose of continuous rating at a frequency 50 Hz or 60 Hz exclusively or 50 Hz/60 Hz in common, at a voltage not exceeding 600 V with a protection system IP2X (protected type) or IP4X (totally enclosed type) which are used in a place where the coolant temperature is not exceeding 40 °C (hereafter referred to as “motors”).

Remarks 1 The International Standards corresponding to this Standard are as follows.

In addition, symbols which denote the degree of correspondence in the contents between the relevant International Standard and **JIS** are IDT (identical), MOD (modified), and NEQ (not equivalent) according to **ISO/IEC Guide 21**.

IEC 60034-1 : 1996 *Rotating electrical machines—Part 1 : Rating and performance* (MOD)

IEC 60034-2 : 1972 *Rotating electrical machines—Part 2 : Methods for determining losses and efficiency of rotating electrical machinery from tests* (MOD)

IEC 60034-9 : 1997 *Rotating electrical machines—Part 9 : Noise limits* (MOD)

IEC 60034-12 : 1972 *Rotating electrical machines—Part 12 : Starting performance of single-speed three-phase cage induction motors for voltage up to and including 660 V* (MOD)

IEC 60072-1 : 1991 *Dimensions and output series for rotating electrical machines—Part 1 : Frame numbers 56 to 400 and flange numbers 55 to 1080* (MOD)

2 The details of protection systems, IP2X and IP4X are as given in **JIS C 4034-5**.

2 Normative references The following standards contain provisions which, through reference in this Standard, constitute provisions of this Standard. The most recent editions of the standards (including amendments) indicated below shall be applied.

JIS B 0401-1 *ISO system of limits and fits—Part 1 : Bases of tolerances, deviations and fits*

JIS B 0401-2 *ISO system of limits and fits—Part 2 : Tables of standard tolerance grades and limit deviations for holes and shafts*

JIS B 0902 *Shaft heights for driving and driven machines*

JIS B 1001 *Diameter of clearance holes and counterbores for bolts and screws*

JIS B 1301 *Keys and their corresponding keyways*

JIS C 1502 *Sound level meters*

JIS C 4034-5 *Rotating electrical machines—Part 5 : Classification of degrees of protection provided by enclosures of rotating electrical machines (IP code)*

JIS K 6323 *Classical V belts for power transmission*

JIS K 6368 *Narrow V belts for power transmission*

3 Ratings

3.1 Rated voltages The rated voltages shall be as stated in Table 1.

Table 1 Rated voltages

Unit : V

Rated voltage			
200	220	400	440

3.2 Rated outputs The rated output means the mechanical output capable of being used continuously at the shaft and expressed in kilowatt (kW) and the values shall be as stated in Table 2.

Table 2 Rated outputs

Unit : kW

Rated output															
0.2,	0.25,	0.37,	0.4,	0.55,	0.75,	1.1,	1.5,	2.2,	3.7,	5.5,	7.5,	11,	15,	18.5,	22, 30, 37

4 Performances

4.1 Temperature rise The temperature rise shall not exceed the appropriate values stated in Table 3, when the test is carried out in accordance with 7.6.

Table 3 Temperature rise limits

Unit : K

Part of motor	Thermal insulation	Resistance method	
		0.2 to 0.55 kW	0.75 to 37 kW
Stator winding	E	75	75
	B	—	80
	F	—	105
Iron core and all structural components	The temperature rise of these parts shall not adversely affect the insulating material at and the material close to the said parts under any circumstances.		

4.2 Full-load characteristics When the test is carried out in accordance with 7.7, the full-load characteristics of motors with rated voltage 200 V shall be as given in Table 4 for IP2X motors and in Table 5 for IP4X motors.

The values of full load currents and no-load currents in Tables 4 and 5 are those when the rated voltage is 200 V, and in the case of rated voltage E (V), $\frac{200}{E}$ times the respective values shall be taken.

Table 4 Full-load characteristics of IP2X motors

Rated output kW	Number of poles	Synchronous rotating speed min ⁻¹		Thermal insulation class	Full-load characteristics		Informative value		
		50 Hz	60 Hz		Efficiency η %	Power factor P_f %	No-load current I_0 (Average value on every phases) A	Full-load current I (Average value on every phases) A	Full-load slip S %
0.75	2	3 000	3 600	E	68.0 min.	77.0 min.	2.1	3.9	7.5
1.1				E	72.0 min.	79.0 min.	2.8	5.4	7.0
1.5				E	74.5 min.	80.5 min.	3.4	6.9	7.0
2.2				E	77.0 min.	81.5 min.	4.6	9.6	6.5
3.7				E	80.0 min.	82.5 min.	6.9	15.4	6.0
5.5				B	82.0 min.	82.5 min.	11	23	6.0
7.5				B	83.0 min.	82.5 min.	14	31	6.0
11				B	84.0 min.	82.5 min.	18	44	5.5
15				B	85.0 min.	83.0 min.	23	58	5.5
18.5				B	85.5 min.	83.5 min.	28	71	5.5
22				B	86.0 min.	84.0 min.	32	84	5.0
30				B	86.5 min.	84.5 min.	42	113	5.0
37				F	87.0 min.	85.0 min.	50	138	5.0
0.75	4	1 500	1 800	E	69.5 min.	70.0 min.	2.8	4.2	8.0
1.1				E	73.0 min.	73.0 min.	3.6	5.8	7.5
1.5				E	75.5 min.	75.0 min.	4.3	7.3	7.5
2.2				E	78.5 min.	77.0 min.	5.5	10	7.0
3.7				E	81.0 min.	78.0 min.	9.0	16.1	6.5
5.5				B	82.5 min.	78.0 min.	12	24	6.0
7.5				B	83.5 min.	79.0 min.	15	31	6.0
11				B	84.5 min.	80.0 min.	22	45	6.0
15				B	85.5 min.	80.5 min.	28	60	5.5
18.5				B	85.5 min.	80.5 min.	34	74	5.5
22				B	86.0 min.	81.0 min.	40	87	5.5
30				B	86.5 min.	81.5 min.	53	117	5.5
37				F	87.0 min.	82.0 min.	63	143	5.5
0.75	6	1 000	1 200	E	68.0 min.	63.0 min.	3.4	4.8	8.5
1.1				E	72.0 min.	67.0 min.	4.2	6.4	8.0
1.5				E	74.5 min.	69.0 min.	5.2	8.0	8.0
2.2				E	77.0 min.	71.0 min.	6.8	11.1	7.0
3.7				B	80.0 min.	73.0 min.	10	17.4	6.5
5.5				B	82.0 min.	73.0 min.	15	25	6.0
7.5				B	83.0 min.	74.0 min.	19	34	6.0
11				B	84.0 min.	75.5 min.	25	48	6.0
15				B	84.5 min.	76.0 min.	34	64	6.0
18.5				B	85.0 min.	76.5 min.	41	78	5.5
22				F	85.5 min.	77.0 min.	47	92	5.5
30				F	86.0 min.	78.0 min.	61	123	5.5
37				F	86.5 min.	78.5 min.	74	152	5.5

Table 5 Full-load characteristics of IP4X motors

Rated output kW	Number of poles	Synchronous rotating speed min ⁻¹		Thermal insulation class	Full-load characteristics		Informative value		
		50 Hz	60 Hz		Efficiency η %	Power factor P_f %	No-load current I_0 (Average value on every phases) A	Full-load current I (Average value on every phases) A	Full-load slip S %
0.2 0.25 0.37 0.4 0.55 0.75 1.1 1.5 2.2 3.7 5.5 7.5 11 15 18.5 22 30 37	2	3 000	3 600	E E E E E E E E E E B B B B B B F F	54.5 min. 57.0 min. 61.0 min. 62.0 min. 65.5 min. 68.0 min. 71.5 min. 74.5 min. 77.0 min. 80.0 min. 82.0 min. 83.0 min. 84.0 min. 85.0 min. 85.5 min. 86.0 min. 86.5 min. 87.0 min.	65.0 min. 67.5 min. 71.5 min. 72.0 min. 74.5 min. 77.0 min. 79.0 min. 80.5 min. 81.5 min. 82.5 min. 82.5 min. 82.5 min. 82.5 min. 82.5 min. 83.0 min. 83.5 min. 84.0 min. 84.5 min.	1.1 1.2 1.4 1.5 1.8 2.1 2.7 3.4 4.6 6.9 11 14 18 24 29 32 43 51	1.6 1.9 2.4 2.5 3.2 3.9 5.3 6.9 9.6 15.4 23 31 44 59 72 84 114 139	10 9.5 8.5 8.5 8.0 7.5 7.0 7.0 6.5 6.0 6.0 6.0 5.5 5.5 5.0 5.0 5.0
0.2 0.25 0.37 0.4 0.55 0.75 1.1 1.5 2.2 3.7 5.5 7.5 11 15 18.5 22 30 37	4	1 500	1 800	E E E E E E E E E E B B B B B B F F	56.0 min. 58.5 min. 62.5 min. 63.5 min. 66.5 min. 69.5 min. 73.0 min. 75.5 min. 78.5 min. 81.0 min. 82.5 min. 83.5 min. 84.5 min. 85.5 min. 86.0 min. 86.5 min. 87.0 min. 87.5 min.	53.0 min. 56.5 min. 62.0 min. 63.0 min. 67.0 min. 70.0 min. 73.0 min. 75.0 min. 77.0 min. 78.0 min. 78.0 min. 78.0 min. 79.0 min. 79.5 min. 80.0 min. 80.5 min. 81.0 min. 81.5 min.	1.5 1.6 1.9 2.0 2.3 2.8 3.5 4.3 5.5 9.0 13 16 23 29 35 40 53 64	1.8 2.1 2.6 2.8 3.4 4.2 5.6 7.3 10 16.1 24 32 45 61 74 87 117 143	10.5 10.0 9.0 9.0 8.5 8.0 7.5 7.5 7.0 6.5 6.0 6.0 6.0 5.5 5.5 5.5 5.5 5.5
0.4 0.55 0.75 1.1 1.5 2.2 3.7 5.5 7.5 11 15 18.5 22 30 37	6	1 000	1 200	E E E E E E B B B B B B F F F F	62.0 min. 65.0 min. 68.0 min. 72.0 min. 74.5 min. 77.0 min. 80.0 min. 82.0 min. 83.0 min. 84.0 min. 84.5 min. 85.0 min. 85.5 min. 86.0 min. 86.5 min.	55.0 min. 59.5 min. 63.0 min. 66.5 min. 69.0 min. 71.0 min. 73.0 min. 73.0 min. 73.0 min. 74.5 min. 75.0 min. 76.0 min. 76.5 min. 77.5 min. 78.0 min.	2.5 2.9 3.4 4.3 5.2 6.8 10 15 19 26 35 41 47 61 74	3.2 3.9 4.8 6.2 8.0 11.1 17.4 26 34 48 65 79 93 124 152	10 9.0 8.5 8.0 8.0 7.0 6.5 6.0 6.0 6.0 6.0 5.5 5.5 5.5 5.5

4.3 Torque characteristics The locked rotor torque, pull-up torque and break down torque shall show at least the appropriate values given in Table 6, when the tests are carried out in accordance with 7.7.

Table 6 Torque characteristics of motors

Rated output kW	Ratio to rated torque								
	Two-pole motors			Four-pole motors			Six-pole motors		
	Locked rotor torque	Pull-up torque	Break down torque	Locked rotor torque	Pull-up torque	Break down torque	Locked rotor torque	Pull-up torque	Break down torque
0.2	1.9	1.3	2.0	2.0	1.4	2.0	—	—	—
0.25	1.9	1.3	2.0	2.0	1.4	2.0	—	—	—
0.37	1.9	1.3	2.0	2.0	1.4	2.0	—	—	—
0.4	1.9	1.3	2.0	2.0	1.4	2.0	1.7	1.2	1.7
0.55	1.9	1.3	2.0	2.0	1.4	2.0	1.7	1.2	1.7
0.75	1.8	1.2	2.0	1.9	1.3	2.0	1.7	1.2	1.8
1.1	1.8	1.2	2.0	1.9	1.3	2.0	1.6	1.1	1.9
1.5	1.8	1.2	2.0	1.9	1.3	2.0	1.6	1.1	1.9
2.2	1.7	1.1	2.0	1.8	1.2	2.0	1.6	1.1	1.9
3.7	1.6	1.1	2.0	1.7	1.2	2.0	1.5	1.1	1.9
5.5	1.5	1.0	2.0	1.6	1.1	2.0	1.5	1.1	1.9
7.5	1.5	1.0	2.0	1.6	1.1	2.0	1.5	1.1	1.8
11	1.4	1.0	2.0	1.5	1.1	2.0	1.4	1.0	1.8
15	1.4	1.0	2.0	1.5	1.1	2.0	1.4	1.0	1.8
18.5	1.3	0.9	1.9	1.4	1.0	1.9	1.4	1.0	1.8
22	1.3	0.9	1.9	1.4	1.0	1.9	1.4	1.0	1.8
30	1.2	0.9	1.9	1.3	1.0	1.9	1.3	1.0	1.8
37	1.2	0.9	1.9	1.3	1.0	1.9	1.3	1.0	1.8

Remarks : The rated outputs 0.2 kW, 0.25 kW, 0.37 kW, 0.4 kW and 0.55 kW are applicable for IP4X motors only.

4.4 Locked rotor apparent power The ratio of locked rotor apparent power (kVA) to the rated output (kW) shall not exceed the appropriate value shown in Table 7, when the test is carried out in accordance with 7.8.

Table 7 Ratio of locked rotor apparent power (kVA) to rated output (kW)

Rated output kW	Ratio of locked rotor apparent power (kVA) to rated output (kW) kVA/kW
0.2 to 5.5	13
7.5 to 22	12
30 to 37	11

Remarks : The rated outputs 0.2 kW, 0.25 kW, 0.37 kW, 0.4 kW and 0.55 kW are applicable for IP4X motors only.

4.5 Noise level When the test is carried out in accordance with 7.9, the sound level shall show a value not exceeding the appropriate value shown in Table 8-1 in the case where the level is expressed by sound power level of characteristic A, and the appropriate value shown in Table 8-2 where the level is expressed by sound pressure level of characteristic A.

Table 8-1 Sound power level of characteristic A

Unit : dB (A)

Rated output kW	IP2X motor						IP4X motor					
	of two poles		of four poles		of six poles		of two poles		of four poles		of six poles	
	50 Hz	60 Hz	50 Hz	60 Hz	50 Hz	60 Hz	50 Hz	60 Hz	50 Hz	60 Hz	50 Hz	60 Hz
0.2	—	—	—	—	—	—	77	81	74	74	—	—
0.25	—	—	—	—	—	—	77	81	74	74	—	—
0.37	—	—	—	—	—	—	80	84	76	76	—	—
0.4	—	—	—	—	—	—	80	84	76	76	75	75
0.55	—	—	—	—	—	—	82	86	77	77	76	76
0.75	81	82	77	77	76	76	84	88	78	78	76	76
1.1	81	82	77	77	76	76	84	88	78	78	76	76
1.5	85	86	81	81	78	78	88	91	82	82	78	78
2.2	85	86	81	81	78	78	88	91	82	82	78	78
3.7	89	93	85	85	81	81	93	95	86	86	82	82
5.5	89	93	85	85	81	81	93	95	86	86	82	82
7.5	93	97	88	88	85	85	97	98	90	90	85	85
11	93	97	88	88	85	85	97	98	90	90	85	85
15	96	97	91	91	88	88	100	100	94	94	88	88
18.5	96	97	91	91	88	88	100	100	94	94	88	88
22	96	97	91	91	88	88	100	100	94	94	88	88
30	99	101	94	94	91	91	102	102	98	98	91	91
37	99	101	94	94	91	91	102	102	98	98	91	91

Table 8-2 Sound pressure level of characteristic A

Unit : dB (A)

Rated output kW	IP2X motor						IP4X motor					
	of two poles		of four poles		of six poles		of two poles		of four poles		of six poles	
	50 Hz	60 Hz	50 Hz	60 Hz	50 Hz	60 Hz	50 Hz	60 Hz	50 Hz	60 Hz	50 Hz	60 Hz
0.2	—	—	—	—	—	—	72	76	69	69	—	—
0.25	—	—	—	—	—	—	72	76	69	69	—	—
0.37	—	—	—	—	—	—	75	79	71	71	—	—
0.4	—	—	—	—	—	—	75	79	71	71	70	70
0.55	—	—	—	—	—	—	77	81	72	72	71	71
0.75	76	77	72	72	71	71	79	83	73	73	71	71
1.1	70	71	66	66	65	65	73	77	67	67	65	65
1.5	74	75	70	70	67	67	77	80	71	71	67	67
2.2	74	75	70	70	67	67	77	80	71	71	67	67
3.7	78	82	74	74	70	70	82	84	75	75	71	71
5.5	78	82	74	74	70	70	82	84	75	75	71	71
7.5	82	86	77	77	74	74	86	87	79	79	74	74
11	82	86	77	77	74	74	86	87	79	79	74	74
15	85	86	80	80	77	77	89	89	83	83	77	77
18.5	85	86	80	80	77	77	89	89	83	83	77	77
22	85	86	80	80	77	77	89	89	83	83	77	77
30	88	90	83	83	80	80	91	91	87	87	80	80
37	88	90	83	83	80	80	91	91	87	87	80	80

Remarks : Distance to microphone 0.5 m for motors less than 1 kW in output
1.0 m for motors 1 kW or more in output

4.6 Dielectric withstand voltage When the dielectric withstand voltage test is carried out in accordance with 7.10, the sample shall withstand the test voltage.

4.7 Voltage and frequency variations during operation Combinations of voltage variation and frequency variation are classified as being either in zone A or zone B as illustrated in Fig. 1. A motor shall operate continuously at its rated torque without trouble to practical service, for the voltage and frequency variations in zone A, and shall operate at its rated torque without trouble to practical service in zone B.

Long time operation in zone B is not desirable.

Remarks : "Without trouble to practical service" means that the life of motor is not remarkably shortened, and the characteristics, temperature rise, etc. do not necessarily have to meet the values stated in this Standard.

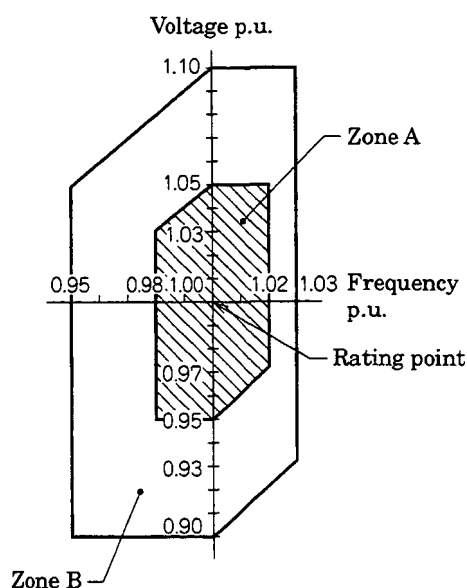


Fig. 1 Voltage and frequency limits of motor

5 Construction

5.1 Accessories The base, foundation bolts, etc. shall be appended to a motor as required.

5.2 Cable entrance Unless otherwise specified a cable entrance shall be provided on right side of motor as viewed from the opposite side of coupling.

If a terminal box is provided, its mounting center shall be located within an angular range from the top to 110° on right side when viewed from the opposite side of coupling.

5.3 Star-delta starter Motors with rated output 11 kW or more shall be so constructed that an appropriate star-delta starter can be used.

5.4 Earthing terminal A motor shall be provided with a terminal capable of connecting an earthing conductor. The earthing terminal shall be identified by a symbol or letter ($\perp$ or E).

6 Dimensions The dimensions of various parts and bases of motors and application of frame number shall be as stated in Fig. 2 and Tables 9 and 10. The dimensions and application of V pulleys shall be as stated in Table 11 and Fig. 3.

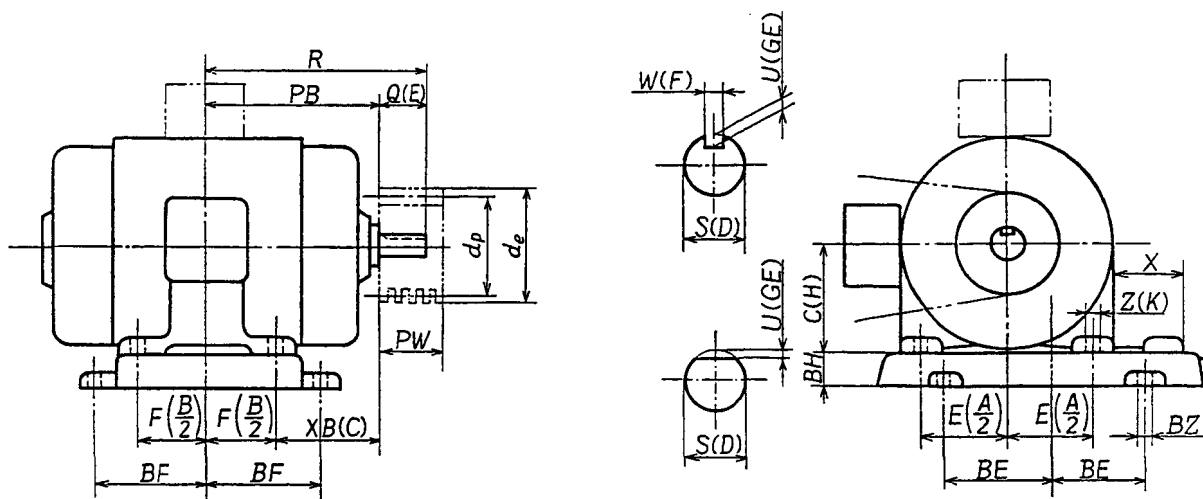


Fig. 2 Dimensional symbols of motors