BRITISH STANDARD

BS
4999-141:2004

General requirements for rotating electrical machines —

Part 141: Specification for standard dimensions

ICS 29.160.30

Committees responsible for this British Standard

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Association of Electrical and Mechanical Trades
Association of Manufacturers of Power Generating Systems
Electrical Insulation Association
Electricity Association
GAMBICA Association Limited
Institution of Incorporated Executive Engineers
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Contents

Foreword

This part of BS 4999 has been prepared by Technical Committee PEL/2. Together with BS EN 50347:2001 it supersedes BS 4999-141:1987, which is withdrawn.

The dimensions of general purpose three-phase induction motors with frame sizes up to 315 are now specified in BS EN 50347. This new edition of BS 4999-141 specifies the dimensions of skirt-mounted motors, pad-mounted motors, slide rails, shaft extensions with two tapped holes, and foot-mounted frames for d.c. machines, all of which are outside the scope of BS EN 50347. It also specifies the dimensions of foot-mounted motors, flange-mounted motors, shaft ends and keyways, and shaft extensions with single tapped holes, all of which are above the size range covered by BS EN 50347.

This new edition of BS 4999-141 incorporates changes necessitated by the publication of BS EN 50347. It does not represent a full review or revision of the standard, which will be undertaken in due course.

This publication does not purport to include all the necessary provisions of a contract. Users are responsible for its correct application.

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Summary of pages

This document comprises a front cover, an inside front cover, pages i and ii, pages 1 to 13 and a back cover.

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1 Scope

This part of BS 4999 specifies the dimensions of rotating electrical machines which are outside the scope of BS EN 50347. It specifies the dimensions of skirt-mounted motors, pad-mounted motors, slide rails, shaft extensions with two tapped holes, and foot-mounted frames for d.c. machines. It also specifies the dimensions of foot-mounted motors, flange-mounted motors, shaft ends and keyways, and shaft extensions with single tapped holes, all of which are above the size range covered by BS EN 50347.

2 Normative references

The following referenced documents are indispensable for the application of this document. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

BS EN 50347*, General purpose three-phase induction motors having standard dimensions and outputs — Frame numbers 56 to 315 and flange numbers 65 to 740.*

3 General

3.1 Tolerances

Where tolerance grades are quoted, they have the meanings defined in BS 4500 and BS EN 20286.

3.2 Run-outs

Where appropriate, shaft extension and spigot run-outs and the squareness of the flange face to the shaft shall not exceed the values specified in Table 1, Table 7, Table 8 and Table 9.

Measurements shall be made in accordance with BS EN 50347.

4 Shaft end dimensions

Motors shall have shaft dimensions as specified in the appropriate line in Table 1. The meaning of the symbols is given in BS 4999-103 and BS EN 50347.

Each size of shaft is identified by a shaft number in the second column and the number is the nominal diameter of the shaft in millimetres.

The keyway corner radius, *FB* and/or *FC* shall be in accordance with the dimensions given in Table 2, which were abstracted from BS 4235-1.

When a single tapped hole is required in the shaft extension in a shaft of diameter greater than or equal to 95 mm up to and including 150 mm, the dimensions of the hole shall be in accordance with Table 3. The depth of thread shall be not less than 1.5 diameters, and there shall be a 60° angle at the centre.

If the purchaser specifies two tapped holes in the shaft extension, as an alternative to the single tapped hole, the dimensions of the holes shall be in accordance with Table 4. The depth of thread shall be not less than 1.75 diameters.

NOTE 1 The provision of a tapped hole or holes is primarily for the attachment of shaft fitments including couplings, and is not intended for the attachment of devices for lifting or handling either the motor or the rotor.

NOTE 2 The dimensions *DH* are selected from BS 3643-2 with tolerance class 6H.

Table 1 — Dimensions of shaft ends and keyways for shafts greater than 90 mm diameter

Dimensions in millimetres

Shaft number	Diameter *D*			Length *E*	Limit of shaft extension run-out (See Note 1)	Width of keyway *F*			*G*		*EB* and/or *EC* min.	*ED* and/or *EE*
	Nominal	Tolerance				Nominal	Tolerance		Nominal	Tolerance		
95	95	m6	+0.035 +0.013	170	0.07	25	N9	+0 −0.052	86.0	+0 −0.2	140	8
100	100	m6	+0.035 +0.013	210	0.07	28	N9	+0 −0.052	90.0	+0 −0.2	160	8
110	110	m6	+0.035 +0.013	210	0.07	28	N9	+0 −0.052	100	+0 −0.2	160	8
120	120	m6	+0.035 +0.013	210	0.07	32	N9	+0 −0.062	109.0	+0 −0.2	160	10
125[a]	125	m6	+0.040 +0.015	210	0.07	32	N9	+0 −0.062	114.0	+0 −0.2	160	10
130	130	m6	+0.040 +0.015	250	0.07	32	N9	+0 −0.062	119.0	+0 −0.2	200	10
140	140	m6	+0.040 +0.015	250	0.07	36	N9	+0 −0.062	128.0	+0 −0.3	200	10
150	150	m6	+0.040 +0.015	250	0.07	36	N9	+0 −0.062	138.0	+0 −0.3	200	10

NOTE 1 The limits of shaft extension run-out apply only to flange-mounted and skirt-mounted motors and refer to the full indicator measurement at a point mid-way along the shaft extension *E*.

NOTE 2 The parallelism tolerance is the permitted difference in height above the base plane of two points on the axis of the shaft. The difference should be less than 0.1 mm per 100 mm of shaft length between the two points. If it is desired to limit the parallelism tolerance to a lower value, special agreement should be made.

NOTE 3 When using indirect drives such as belts, ropes and pinions to couple motors to their loads, there is a danger that excessive stress may be imposed on the motor shafts and bearings by the side loading inherent in these methods of power transmission. It is advisable to consult the motor manufacturer when such drives are being designed.

NOTE 4 Purchasers may require shafts shorter than those listed in this table. In such cases it is recommended that the length should be in accordance with the short series of Table 1 in BS 4506:1970. *F* and *G* should remain unchanged, but *EB* and/or *EC* reduced as appropriate.

[a] This is a non-preferred ISO size.

Table 2 — Keyway corner radius

Shaft number	Radius max. mm	Radius min. mm
95 to 110 inclusive	0.60	0.40
120 to 150 inclusive	1.0	0.70

Table 3 — Dimensions of single tapped hole in shaft extension

Diameter of shaft *D* mm		Tapped hole diameter *DH*
≥ 95	≤ 150	M24

Table 4 — Dimensions of two tapped holes in shaft extension

Diameter of shaft *D* mm		Tapped hole diameter *DH*	Tapped hole centres *DJ* mm
>43	≤ 55	M12	30
>55	≤ 70	M12	35
>70	≤ 75	M12	45
>75	≤ 80	M16	45
>80	≤ 95	M16	55
>95	≤ 110	M20	65
>110	≤ 125	M20	70
>125	≤ 140	M24	70
>140	≤ 150	M24	80

5 Dimensions of foot-mounted frames

Frames shall conform to the dimensions given in Table 5 or Table 6. The meaning of the symbols is given in BS EN 50347.

Table 5 applies to large, low voltage a.c. induction motors. Table 6 applies to foot-mounted d.c. machines.

The terminal box shall be situated with its centre line within a sector ranging from the top to 10° below the horizontal centre line of the motor, on the right-hand side when looking at the driving end. The preferred position is on or about the horizontal centre line.

Table 5 — Fixing dimensions of large foot-mounted frames, all enclosures

Dimensions in millimetres

Frame number	*H*		*A*	*B*	*C*[b]	*K*[c]	Fixing bolt or screw
	Nominal	Negative tolerance[a]					
355S	355	1.0	610	500	254	28	M24
355L	355	1.0	610	630	254	28	M24
400S	400	1.0	686	560	280	35	M30
400L	400	1.0	686	710	280	35	M30

[a] There are no positive tolerances.
[b] Dimension *C* assumes ball and roller bearings.
[c] The *K* dimensions are selected from the coarse series in BS EN 20273.

Table 6 — Fixing dimensions of foot-mounted frames for d.c. machines

All dimensions are in millimetres

Frame number	*H*		*A*	*B*	*C*[b]	*K*[c]
	Nominal	Negative tolerance[a]				
132	132	0.5	216	No values assigned	89	12
160	160	0.5	254	(see Note)	108	15
180	180	0.5	279		121	15
200	200	0.5	318		133	19
225	225	0.5	356		149	19
250	250	0.5	406		168	24
280	280	1.0	457		190	24
315	315	1.0	508		216	28
355	355	1.0	610		254	28
400	400	1.0	686		280	35
450	450	1.0	750		315	—
500	500	1.0	850		335	—

NOTE Until such time as values for *B* can be specified, it is recommended that figures should be selected from the R20 series listed in BS 2045, or from the values of *B* associated with the particular centre height in Table 5, Table 10 or Table 11.

[a] There are no positive tolerances.
[b] Dimension *C* assumes ball and roller bearings.
[c] The *K* dimensions are selected from the coarse series in BS EN 20273.

6 Dimensions of large flange-mounted frames

Frames shall conform to the dimensions given in Table 7. The meaning of the symbols is given in BS EN 50347.

Table 7 — Fixing dimensions of large flange-mounted frames, enclosure C[a] and enclosure D[a]

All dimensions are in millimetres

Frame number	*M*	*N*			*P*	Flange holes		Thread[c]	*T* max.	*R*	Limit of spigot run-out and flange face squareness[d]
		Nominal	Tolerance			Number	*S*[b]				
355S and 355L	740	680	h8	+0 −0.125	800	8	24	M20	6	0	0.160
400S and 400L	940	880	h8	+0 −0.140	1 000	8	28	M24	6	0	0.200

[a] See BS 4999-103.
[b] *S* dimensions are selected from the coarse series in BS EN 20273.
[c] Recommended threads for screws used in flange holes *S*.
[d] These limits are by full indicator measurement.

7 Dimensions of skirt-mounted frames

Frames shall conform to the dimensions given in Table 8 or Table 9. The meaning of the symbols is given in BS 4999-103.

Table 8 — Fixing dimensions of skirt-mounted frames, enclosure D[a]

All dimensions are in millimetres

Frame number	*M*	*N*			*P*	Flange holes		*T* max.	*R*	Limit of spigot run-out and flange face squareness[c]
		Nominal	Tolerance			Number	*S*[b]			
80 90S and 90L	165	130	h8	+0 −0.063	200	4	12	3.5	53	0.100
100S and 100L 112S and 112M	215	180	h8	+0 −0.063	250	4	14.5	4	63	0.100
132S and 132M	265	230	h8	+0 −0.072	300	4	14.5	4	83	0.100
160M and 160L 180M and 180L	300	250	h8	+0 −0.072	350	4	18.5	5	113	0.125
200M and 200L	350	300	h8	+0 −0.081	400	4	18.5	5	113	0.125
225S and 225M	400	350	h8	+0 −0.089	450	8	18.5	5	143	0.125
250S and 250M 280S and 280M	500	450	h8	+0 −0.097	550	8	18.5	5	173	0.125
315S, 315M and 315L	600	550	h8	+0 −0.110	660	8	24	6	173	0.160
355S and 355L	740	680	h8	+0 −0.125	800	8	24	6	213	0.160
400S and 400L	940	880	h8	+0 −0.140	1 000	8	28	6	213	0.200

[a] See BS 4999-103.
[b] *S* dimensions are selected from the coarse series in BS EN 20273.
[c] These limits are by full indicator measurement.

Table 9 — Fixing dimensions of skirt-mounted frames, enclosure C[a]

All dimensions are in millimetres

Frame number	*M*	*N*			*P*	Flange holes		*T* max.	*R*	Limit of spigot run-out and flange face squareness[c]
		Nominal	Tolerance			Number	*S*[b]			
160M and 160L 180M and 180L	350	300	h8	+0 −0.081	400	4	19	5	113	0.125
200M and 200L	400	350	h8	+0 −0.089	450	8	19	5	143	0.125
225S and 225M	500	450	h8	+0 −0.097	550	8	19	5	173	0.125
250S and 250M 280S and 280M	600	550	h8	+0 −0.110	660	8	24	6	173	0.160
315S, 315M and 315L	740	680	h8	+0 −0.125	800	8	24	6	173	0.160
355S and 355L	740	680	h8	+0 −0.125	800	8	24	6	213	0.160
400S and 400L	940	880	h8	+0 −0.140	1 000	8	28	6	213	0.200

[a] See BS 4999-103.
[b] *S* dimensions are selected from the coarse series in BS EN 20273.
[c] These limits are by full indicator measurement.

8 Dimensions of large foot-mounted frames

For large motors the range of requirements for design is much wider than for smaller motors whether in speed, output, voltage, enclosure or application. To allow for this and at the same time ensure a degree of standardization, Table 10 and Table 11 have been introduced. With only a few exceptions the values have been selected from the series of preferred numbers listed in BS 2045.

Two arrangements are given for the feet of large motors:

a) motors with a high shaft centre (approximately the radius of the motor carcase);

b) motors with a low shaft centre.

In the case of high shaft centre motors, only one value of *A* and two values of *C* are allocated to each shaft height. Corresponding frames with low shaft centres also have one (but different) value of *A* and the same two values of *C*. Of the frames provided with the low shaft centre arrangement, the larger ones have two alternative low shaft centre heights.

(This makes a total of three possible centre heights for each of these frames.) However, the low shaft centre heights are the same for all these larger frames.

Table 10 and Table 11 give a number of alternative values from which the dimension *B* can be selected.

No further selection of dimensions of standard frames for large motors is visualized at the time of publication.

The symbols have the same meaning as given for smaller foot-mounted frames in BS EN 50347.

Table 10 — Preferred fixing dimensions for large horizontal shaft motors with high shaft centres

All dimensions are in millimetres

Frame	*H*	*A*	Series of *B* dimensions													*C* Ball and roller	*C* Sleeve
355	355	610	280	315	355	400	450	500	560	630	710	800	900	1 000	1 120	254	450
400	400	686	315	355	400	450	500	560	630	710	800	900	1 000	1 120	1 250	280	475
450	450	750	355	400	450	500	560	630	710	800	900	1 000	1 120	1 250	1 400	315	500
500	500	850	400	450	500	560	630	710	800	900	1 000	1 120	1 250	1 400	1 600	335	530
560	560	950	450	500	560	630	710	800	900	1 000	1 120	1 250	1 400	1 600	1 800	355	560
630	630	1 060	500	560	630	710	800	900	1 000	1 120	1 250	1 400	1 600	1 800	2 000	375	600
710	710	1 180	560	630	710	800	900	1 000	1 120	1 250	1 400	1 600	1 800	2 000	2 240	400	630
800	800	1 320	630	710	800	900	1 000	1 120	1 250	1 400	1 600	1 800	2 000	2 240	2 500	425	670
900	900	1 500	710	800	900	1 000	1 120	1 250	1 400	1 600	1 800	2 000	2 240	2 500	2 800	450	710
1 000	1 000	1 700	800	900	1 000	1 120	1 250	1 400	1 600	1 800	2 000	2 240	2 500	2 800	3 150	475	750

Table 11 — Preferred fixing dimensions for large horizontal shaft motors with low shaft centres

All dimensions are in millimetres

Frames	*H′*	*A*	Series of *B* dimensions													*C* Ball and roller	*C* Sleeve
560/500	500	1 120	450	500	560	630	710	800	900	1 000	1 120	1 250	1 400	1 600	1 800	355	560
630/500	500	1 250	500	560	630	710	800	900	1 000	1 120	1 250	1 400	1 600	1 800	2 000	375	600
710/500	500	1 400	560	630	710	800	900	1 000	1 120	1 250	1 400	1 600	1 800	2 000	2 240	400	630
710/630	630																
800/500	500	1 600	630	710	800	900	1 000	1 120	1 250	1 400	1 600	1 800	2 000	2 240	2 500	425	670
800/630	630																
900/500	500	1 800	710	800	900	1 000	1 120	1 250	1 400	1 600	1 800	2 000	2 240	2 500	2 800	450	710
900/630	630																
1 000/500	500	2 000	800	900	1 000	1 120	1 250	1 400	1 600	1 800	2 000	2 240	2 500	2 800	3 150	475	750
1 000/630	630																

9 Dimensions of pad-mounted or rod-mounted frames

Frames shall conform to the dimensions given in Table 12. The meaning of the symbols is given in BS 4999-103.

Where a terminal box is fitted, there is no specified position for the cable or wiring entry.

In Table 12 it has not been possible for motor manufacturers to adopt single values of *J* for each frame; the figures in the table are maximum values and are two steps greater (in the R40 series) than the *H* value for the particular frame (see Table 5) plus an allowance of 5 mm. In practice the value of *J* will lie between the maximum figure (as in Table 12) and *H* – 5 mm. Makers of driven machines are recommended to provide this degree of adjustment in the mounting.

For the convenience of both motor manufacturers and users, it is usual in this specialized design to build only the longer frame of each diameter. If circumstances justify the introduction of a shorter frame, it is recommended that the dimension *B* should be reduced by the same amount as for the foot-mounted version of the particular frame number (see Table 5).

Table 12 — Fixing dimensions of pad-mounted or rod-mounted frames, enclosure D[a]

All dimensions are in millimetres

Frame number	*J*[b]	*B*	*C*[c]	*K*[d]
80	95	90	55	M12
90L	105	90	73.5	M12
100L	117	100	83	M12
112M	130	100	90	M12
132M	155	140	108	M16
160L	185	200	135	M20
180L	205	200	160.5	M20
200L	229	224	173.5	M24
225M	255	224	192.5	M24
250M	285	224	230.5	M24

[a] See BS 4999-103.
[b] These are maximum dimensions (see text above).
[c] Dimension *C* assumes ball and/or roller bearings.
[d] The dimensions for *K* are selected from BS 3643-2.

10 Dimensions of slide rails

10.1 General

The dimensions apply to slide rails for use with foot-mounted motors having frame sizes in accordance with Table 5.

10.2 Mounting

The slide rails are intended for use mounted horizontally on a rigid structure, with the motor above.

NOTE If wall or ceiling mounting is required, the advice of the manufacturer should be sought.

10.3 Accessories

A set of suitable motor holding-down bolts and washers and adjusting screws, but not foundation bolts, shall be included with each set of slide rails.

10.4 Nomenclature

The nomenclature for slide rail size given in column 1 of Table 13 is designed to indicate the motor frames with which it can be used and is built up as follows.

The slide rail reference has been given the prefix “M” (metric). With the exception of rail size M 0809 (which is numbered thus for convenience of maintaining the numerical sequence in ascending order of rail size), the first pair of numerals are the first two numerals in the frame references of the smallest motor frames for which the slide rails are designed, and the second pair of numerals are the first two numerals in the frame references of the largest motor frames for which the slide rails are designed, e.g. slide rail M 1013 is suitable for use with frames:

100S, 100L, 112S, 112M, 132S and 132M.

If the first pair or the second pair of numerals are “00”, it means that the slide rail is suitable for one set of frames only; for example, slide rail M 3100 is suitable for use with frames 315S, 315M and 315L.

10.5 Dimensions

The dimensions of slide rails shall be as given in Table 13 and Table 14. The meaning of the symbols is given in BS 4999-103.

Table 13 — Standard dimensions of slide rails

All dimensions are in millimetres

Slide rail size	*AL*	*AT*[a]	*AU*	*AX*[b]	*AY* max.	*AZ*	*XA* max.	*XB*	*XC*	*XD*[c]	*XE*	*XF*	Motor centre height	*BT* min.
M 0809	355	12	10	30	105	35	45	30	8	6	325	15	80 90	95 80
M 1013	470	16	12	38 or 44	170	50	50	45	10	6	430	20	100 112 132	160 125 100
M 1618	615	19	15	45 or 64	170	75	67	57	12	10	565	25	160 180	155 125
M 2022	785	25	19	57 or 82	210	100	80	82	16	12	725	30	200 225	190 140
M 2528	965	30	24	75 or 100	275	100	86	82	20	16	885	40	250 280	250 190
M 3100	1 215	40	28	100 or 125	355	120	110	95	24	20	1 115	50	315	330

[a] The proportions of these rails are based on the use of grey iron castings. It may be convenient in some cases to manufacture the rails as steel fabrications and the dimension *AT* can be modified to the figures in Table 14 in such cases, but all other dimensions remain unaltered.

[b] The smaller value for dimension *AX* is adequate for a grey cast iron rail in normal service and supported over its length. If such support is not provided, the larger dimension or a higher grade of material is necessary. Manufacturers may elect to supply the deeper rail in all cases.

[c] Tolerance on *XD* is ±2 mm.

Table 14 — Dimension *AT* for fabrication

Slide rail size	*AT* mm
M 0809	10
M 1013	14
M 1618	14
M 2022	16
M 2528	16
M 3100	20

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BS 4235-1:1972, *Specification for metric keys and keyways — Part 1: Parallel and taper keys.*

BS 4500 (all parts), *ISO limits and fits.*

BS 4506:1970, *Specification for shaft ends.*

BS 4999-103:2004, *General requirements for rotating electrical machines — Part 103: Specification for symbols.*

BS EN 20273:1992, *Fasteners — Clearance holes for bolts and screws.*

BS EN 20286 (all parts), *ISO system of limits and fits.*

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