SLOVENSKI STANDARD
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Dimensions and output series for rotating electrical machines - Part 1: Frame numbers 56 to 400 and flange numbers 55 to 1080

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Dimensions et séries de puissances des machines électriques tournantes - Partie 1: Désignation des carcasses entre 56 et 400 et des brides entre 55 et 1080

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Dimensions et séries de puissances des machines électriques tournantes

Partie 1:
Désignation des carcasses entre 56 et 400 et des brides entre 55 et 1080

Dimensions and output series for rotating electrical machines

Part 1:
Frame numbers 56 to 400 and flange numbers 55 to 1080

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INTERNATIONAL ELECTROTECHNICAL COMMISSION

DIMENSIONS AND OUTPUT SERIES FOR ROTATING ELECTRICAL MACHINES

Part 1: Frame numbers 56 to 400 and flange numbers 55 to 1080

FOREWORD

1) The formal decisions or agreements of the IEC on technical matters, prepared by Technical Committees on which all the National Committees having a special interest therein are represented, express, as nearly as possible, an international consensus of opinion on the subjets dealt with.

2) They have the form of recommendations for international use and they are accepted by the National Committees in that sense.

3) In order to promote international unification, the IEC expresses the wish that all National Committees should adopt the text of the IEC recommendation for their national rules in so far as national conditions will permit. Any divergence between the IEC recomendation and the corresponding national rules should, as far as possible, be clearly indicated in the latter.

This part of the International Standard IEC 72 has been prepared by Sub-Committee 2B: Mounting dimensions and output series, of IEC Technical Committee No. 2: Rotating machinery.

This sixth edition of IEC 72-1 replaces the fifth edition of IEC 72 (1971) and its Amendments Nos. 1 and 2, issued in 1977 and 1981 respectively.

The text of this part is based on the following documents:

Six Months' Rule	Reports on Voting	Two Months' Procedure	Reports on Voting
2B(CO)51	2B(CO)56	2B(CO)60	2B(CO)65
2B(CO)52	2B(CO)57	—	—
2B(CO)61	2B(CO)66	2B(CO)68A	2B(CO)71
2B(CO)62	2B(CO)67	—	—
2B(CO)70	2B(CO)73	—	—

Full information on the voting for the approval of this can be found in the Voting Reports indicated in the above table.

Annexes A, B and C have the status of a report; annex is informative.

The following publications are quoted in this part of IEC 72:

IEC 34-1: 1983, Rotating electrical machines — Part 1: Rating and performance.

IEC 34-8: 1972, Rotating electrical machines — Part 8: Terminal markings and direction of rotation machines.

IEC 50(411): 1973, International Electrotechnical Vocabulary (IEV) — Chapter 411: Rotating machines.

ISO 273: 1979, Fasteners — Clearance holes for bolts and screws.

ISO 496: 1973, Driving and driven machines — Shaft heights.

ISO/R 773: 1969, Rectangular or square parallel keys and their corresponding keyways (dimensions in millimetres).

ISO/R 775: 1969, Cylindrical and 1/10 conical shaft ends.

ISO 1101: 1983, Technical drawings — geometrical tolerancing — tolerancing of form, orientation, location and run-out — Generalities, definitions, symbols, indications on drawings.

ISO 2768: 1973, Permissible machining variations in dimensions without tolerance indication.

DIMENSIONS AND OUTPUT SERIES FOR ROTATING ELECTRICAL MACHINES

Part 1: Frame numbers 56 to 400 and flange numbers 55 to 1080

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1. Scope

This part of IEC 72 covers the majority of rotating electrical machines for industrial purposes within the dimension range:

Foot-mounted: — shaft-heights: 56 mm to 400 mm

Flange-mounted: — pitch circle diameter of flange: 55 mm to 1080 mm

It gives tables of fixing dimensions, shaft extension dimensions and output powers. Maximum permissible torques for continuous duty on a.c. motors are listed for various shaft diameters.

NOTE — The dimensions for machines with shaft heights 355 mm and 400 mm, given in this standard, are included among the values given in IEC 72-2.

2. Letter-symbols for dimensions

The symbols defined below are illustrated by the dimensional sketches in clause 10.

A — distance between centre-lines of fixing holes (end view).
AA — width of the end of the foot (end view).
AB — over-all dimension across the feet (end view).
AC — diameter of the machine.
AD — distance from the centre-line of the machine to extreme outside of the terminal box or other most salient part mounted on the side of the machine.
B — distance between the centre-lines of the fixing holes (side view).
BA — length of the foot (side view).
BB — over-all dimension across the feet (side view).
C — distance from the shoulder on the shaft at D-end to the centre-line of the mounting holes in the nearest feet.
CA — distance from the shoulder on the shaft at N-end to the centre-line of the mounting holes in the nearest feet.
D — diameter of the shaft extension at D-end.
DA — diameter of the shaft extension at N-end.
E — length of the shaft extension from the shoulder at D-end.
EA — length of the shaft extension from the shoulder at N-end.
F — width of the keyway of the shaft extension at D-end.
FA — width of the keyway of the shaft extension at N-end.
G — distance from the bottom of the keyway to the opposite surface of the shaft extension at D-end.
GA — distance from the top of the key to the opposite surface of the shaft extension at D-end.
GB — distance from the bottom of the keyway to the opposite surface of the shaft extension at N-end.

GC — distance from the top of the key to the opposite surface of the shaft extension at N-end.
GD — thickness of the key of the shaft extension at D-end.
GE — depth of the keyway at the crown of the shaft extension at D-end.
GF — thickness of the key of the shaft extension at N-end.
GH — depth of the keyway at the crown of the shaft extension at N-end.
H — distance from the centre-line of the shaft to the bottom of the feet (basic dimension).
H' — distance from the centre-line of the shaft to the mounting surface — e.g. the bottom of the feet in the feet-up version.
HA — thickness of the feet.
HC — distance from the top of the horizontal machine to the bottom of the feet.
HD — distance from the top of the lifting eye, the terminal box or other most salient part mounted on the top of the machine to the bottom of the feet.
HE — distance from the mounting surface to the lowest part of the machine in the feet-up version.
K — diameter of the holes or width of the slots in the feet of the machine.
L — overall length of the machine with a single shaft extension.
LA — thickness of the flange.
LB — distance from the mounting surface of the flange to the end of the machine.
LC — overall length of the machine when there is a shaft extension at N-end.
M — pitch circle diameter of the fixing holes.
N — diameter of the spigot.
P — outside diameter of the flange, or in the case of a non-circular outline twice the maximum radial dimension.
R — distance from the mounting surface of the flange to the shoulder on the shaft.
S — diameter of the fixing holes in the mounting flange or nominal diameter of thread.
T — depth of the spigot.

NOTE – The definition of D-end and N-end of a machine is given in IEC 34-8.

3. Designation of machines

Foot-mounted machines may be designated by the frame number followed immediately by the diameter of the shaft extension.

Examples: 112 M 28

Flange-mounted machines may be of three different designs:
– Flange with free holes (clearances holes), denoted: FF flange;
– Flange with tapped holes and with spigot diameter *N* smaller than the pitch circle diameter of the fixing holes *M*, denoted: FT flange;
– Flange with tapped holes and with spigot diameter *N* greater than the pitch circle diameter of the fixing holes *M*, denoted: FI flange.

These symbols shall form part of the respective flange numbers. Machines having only flange mounting may be designated by the diameter of the shaft extension immediately followed by the letters FF, FT or FI and the flange number.

Examples: with free holes: 28 FF 215
with tapped holes: 28 FT 165
or 28 FI 165 as applied

When a foot-mounted machine is also provided with a flange at the drive end (D-end) the letters FF, FT or FI and the flange number may be added immediately after the shaft diameter.

Examples: Flange with free holes: 112 M28 FF 215
Flange with tapped holes: 112 M28 FT 165
or 112 M28 FI 165 as applied

4. Location of the terminal box

4.1 *Machines with feet*

The terminal box on a motor 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 D-end of the motor. No recommendation is decided upon for generators.

It is recommended that unless the terminal box is on the top, motors be so constructed that the terminal box may be located on the left-hand side by the manufacturer, if requested by the user at the time when the motor is ordered.

NOTE — Provision should preferably be made so as to enable the cable entry to the terminal box to be in any one of four directions at right angles.

4.2 *Machines with flange only*

No recommendation.

5. Position of holes in the mounting flange

When a flange-mounted machine also has feet, the holes in the flange shall be spaced from the diameter of the flange perpendicular to the mounting plane of the feet as follows.

45° for 4 holes
22,5° and 67,5° for 8 holes (see clause 10)

6. Fixing dimensions

6.1 *Foot-mounted machines*

Table 1 — Dimensions for machines with shaft-heights from 56 mm to 400 mm

Frame number[1]	*H*		*A*	*B*[4]	*C*	*K*[2]			Bolt or screw
	Nominal	Maximum deviation				Nominal	Tolerance[3]		
	mm	mm	mm	mm	mm	mm	µm	µm	
56 M	56	− 0,5	90	71	36	5,8	+ 300	0	M5
63 M	63	− 0,5	100	80	40	7	+ 360	0	M6
71 M	71	− 0,5	112	90	45	7	+ 360	0	M6
80 M	80	− 0,5	125	100	50	10	+ 360	0	M8
90 S	90	− 0,5	140	100	56	10	+ 360	0	M8
90 L	90	− 0,5	140	125	56	10	+ 360	0	M8
100 S	100	− 0,5	160	112	63	12	+ 430	0	M10
100 L	100	− 0,5	160	140	63	12	+ 430	0	M10
112 S	112	− 0,5	190	114	70	12	+ 430	0	M10
112 M	112	− 0,5	190	140	70	12	+ 430	0	M10
(112 L)	112	− 0,5	190	159	70	12	+ 430	0	M10
132 S	132	− 0,5	216	140	89	12	+ 430	0	M10
132 M	132	− 0,5	216	178	89	12	+ 430	0	M10
(132 L)	132	− 0,5	216	203	89	12	+ 430	0	M10
160 S	160	− 0,5	254	178	108	14,5	+ 430	0	M12
160 M	160	− 0,5	254	210	108	14,5	+ 430	0	M12
160 L	160	− 0,5	254	254	108	14,5	+ 430	0	M12
180 S	180	− 0,5	279	203	121	14,5	+ 430	0	M12
180 M	180	− 0,5	279	241	121	14,5	+ 430	0	M12
180 L	180	− 0,5	279	279	121	14,5	+ 430	0	M12
200 S	200	− 0,5	318	228	133	18,5	+ 520	0	M16
200 M	200	− 0,5	318	267	133	18,5	+ 520	0	M16
200 L	200	− 0,5	318	305	133	18,5	+ 520	0	M16
225 S	225	− 0,5	356	286	149	18,5	+ 520	0	M16
225 M	225	− 0,5	356	311	149	18,5	+ 520	0	M16
(225 L)	225	− 0,5	356	356	149	18,5	+ 520	0	M16
250 S	250	− 0,5	406	311	168	24	+ 520	0	M20
250 M	250	− 0,5	406	349	168	24	+ 520	0	M20
(250 L)	250	− 0,5	406	406	168	24	+ 520	0	M20
280 S	280	− 1	457	368	190	24	+ 520	0	M20
280 M	280	− 1	457	419	190	24	+ 520	0	M20
(280 L)	280	− 1	457	457	190	24	+ 520	0	M20
315 S	315	− 1	508	406	216	28	+ 520	0	M24
315 M	315	− 1	508	457	216	28	+ 520	0	M24
(315 L)	315	− 1	508	508	216	28	+ 520	0	M24
355 S	355	− 1	610	500	254	28	+ 520	0	M24
355 M	355	− 1	610	560	254	28	+ 520	0	M24
355 L	355	− 1	610	630	254	28	+ 520	0	M24
400 S	400	− 1	686	560	280	35	+ 620	0	M30
400 M	400	− 1	686	630	280	35	+ 620	0	M30
400 L	400	− 1	686	710	280	35	+ 620	0	M30

[1] Frame numbers within brackets should be regarded as non-preferred for a.c. induction machines.
[2] Open-ended slots are not permitted.
[3] These tolerances are those given in coarses series H14 of ISO 2768.
[4] Those dimensions are preferred—Additional recommended values for B dimension are given in table 2.

Table 2 — Recommended values for *B* dimension

Dimensions in millimetres

Frame number numeral	Frame number letter																			
	Z	*Y*	*X*	*W*	*V*	*U*	*T*	*S*	*R*	*M*	*L*	*K*	*J*	*H*	*G*	*F*	*E*	*D*	*C*	*B*	*A*
56					45	50	56	63		*71*	80	90	100	112	125	140					
63					50	56	63	71		*80*	90	100	112	125	140	160					
71					56	63	71	80		*90*	100	112	125	140	160	180					
80					63	71	80	90		*100*	112	125	140	160	180	200					
90					71	80	90	*100*		112	*125*	140	160	180	200	224	250				
100					80	90	100	*112*		125	*140*	160	180	200	224	250	280	315			
112					80	90	100	*114*	125	*140*	*159*	180	200	224	250	280	315	355	400	450	
132					100	112	125	*140*	160	*178*	*203*	224	250	280	315	355	400	450	500	560	
160				112	125	140	160	*178*	200	*210*	*254*	280	315	355	400	450	500	560	630	710	
180				125	140	160	180	*203*	224	*241*	*279*	315	355	400	450	500	560	630	710	800	
200				140	160	180	200	*228*	250	*267*	*305*	355	400	450	500	560	630	710	800	900	
225			160	180	200	224	250	*286*		*311*	*356*	400	450	500	560	630	710	800	900	1000	
250			180	200	224	250	280	*311*		*349*	*406*	450	500	560	630	710	800	900	1000	1120	
280			200	224	250	280	315	*368*		*419*	*457*	500	560	630	710	800	900	1000	1120	1250	
315			224	250	280	315	355	*406*		*457*	*508*	560	630	710	800	900	1000	1120	1250	1400	
355			280	315	355	400	450	*500*		*560*	*630*	710	800	900	1000	1120	1250	1400	1600	1800	
400			315	355	400	450	500	*560*		*630*	*710*	800	900	1000	1120	1250	1400	1600	1800	2000	

NOTES

1 Values printed in italics are repeated from table 1.

2 In special cases, instead of the above values, a value from the R 40 series may be retained.
In this case two adjacent letters of the above table are used, e.g. frame number 225 *DC* for $B = 850$ mm.

6.2 *Flange-mounted machines*

Machines having both feet and flange should preferably have *A, B* and *C* dimensions selected from table 1.

Table 3 — Dimensions for flanges with pitch circle diameters from 55 mm to 1 080 mm.

Flange number FF - FT[1]	*M*	*N*				*P*[2]	*R*	Number of holes	*S* Free holes (FF)				Tapped holes (FT)[3]	*T* Maximum
		Nominal	ISO tolerance						Nominal	ISO tolerance				
	mm	mm		µm	mm	mm	mm		mm		µm	µm	thread	mm
55	55	40	j6	+ 11	− 5	70	0	4	5,8	H14	+ 300	0	M5	2,5
65	65	50	j6	+ 11	− 5	80	0	4	5,8	H14	+ 300	0	M5	2,5
75	75	60	j6	+ 12	− 7	90	0	4	5,8	H14	+ 300	0	M5	2,5
85	85	70	j6	+ 12	− 7	105	0	4	7	H14	+ 360	0	M6	2,5
100	100	80	j6	+ 12	− 7	120	0	4	7	H14	+ 360	0	M6	3
115	115	95	j6	+ 13	− 9	140	0	4	10	H14	+ 360	0	M8	3
130	130	110	j6	+ 13	− 9	160	0	4	10	H14	+ 360	0	M8	3,5
165	165	130	j6	+ 14	− 11	200	0	4	12	H14	+ 430	0	M10	3,5
215	215	180	j6	+ 14	− 11	250	0	4	14,5	H14	+ 430	0	M12	4
265	265	230	j6	+ 16	− 13	300	0	4	14,5	H14	+ 430	0	M12	4
300	300	250	j6	+ 16	− 13	350	0	4	18,5	H14	+ 520	0	M16	5
350	350	300	j6	+ 16	− 16	400	0	4	18,5	H14	+ 520	0	M16	5
400	400	350	j6	+ 18	− 18	450	0	8	18,5	H14	+ 520	0	M16	5
500	500	450	j6	+ 20	− 20	550	0	8	18,5	H14	+ 520	0	M16	5
600	600	550	js6	+ 22	− 22	660	0	8	24	H14	+ 520	0	M20	6
740	740	680	js6	+ 25	− 25	800	0	8	24	H14	+ 520	0	M20	6
940	940	880	js6	+ 28	− 28	1000	0	8	28	H14	+ 520	0	M24	6
1080	1080	1000	js6	+ 28	− 28	1150	0	8	28	H14	+ 520	0	M24	6

[1] This table does not apply to FI flange.

[2] The external outline of mounting flanges up to and including FF 300 and FT 300 may be other than circular. Dimension *P* may deviate from that given in the table only on the minus side.

[3] For FT flange-mounted machines, it is recommended that the free holes in the mounting part should be as shown in column *S* for the corresponding size of FF flange.

7. Shaft extension, keys and keyways dimensions. Greatest permissible torques on continuous duty for a.c. motors

Table 4

Diameter D[1] (DA)				E (EA)[2]	Key						Keyway								GA (GC) Nominal[4]	Greatest permissible torque on continuous duty for a.c. motor[5]
					F (FA)			GD (GF)			F (FA)					GE (GH)				
Nominal	Tolerance				Nominal	Tolerance h9		Nominal	Tolerance		Nominal	Tolerance N9[3]		Tolerance P9[3]		Nominal	Tolerance			
	Designation ISO								Designation ISO											
mm		µm	µm	mm	mm	µm	µm	mm		µm	µm	mm	µm	µm	µm	µm	mm	µm	µm	mm	Nm
7	j6	+ 7	- 2	16	2	0	-25	2	h9	0	- 25	2	-4	-29	- 6	-31	1,2	+100	0	7,8	0,25
9	j6	+ 7	- 2	20	3	0	-25	3	h9	0	- 25	3	-4	-29	- 6	-31	1,8	+100	0	10,2	0,63
11	j6	+ 8	- 3	23	4	0	-30	4	h9	0	- 30	4	0	-30	-12	-42	2,5	+100	0	12,5	1,25
14	j6	+ 8	- 3	30	5	0	-30	5	h9	0	- 30	5	0	-30	-12	-42	3	+100	0	16	2,8
16	j6	+ 8	- 3	40	5	0	-30	5	h9	0	- 30	5	0	-30	-12	-42	3	+100	0	18	4,1
18	j6	+ 8	- 3	40	6	0	-30	6	h9	0	- 30	6	0	-30	-12	-42	3,5	+100	0	20,5	7,1
19	j6	+ 9	- 4	40	6	0	-30	6	h9	0	- 30	6	0	-30	-12	-42	3,5	+100	0	21,5	8,25
22	j6	+ 9	- 4	50	6	0	-30	6	h9	0	- 30	6	0	-30	-12	-42	3,5	+100	0	24,5	14
24	j6	+ 9	- 4	50	8	0	-36	7	h11	0	- 90	8	0	-36	-15	-51	4	+200	0	27	18
28	j6	+ 9	- 4	60	8	0	-36	7	h11	0	- 90	8	0	-36	-15	-51	4	+200	0	31	31,5
32	k6	+18	+ 2	80	10	0	-36	8	h11	0	- 90	10	0	-36	-15	-51	5	+200	0	35	50
38	k6	+18	+ 2	80	10	0	-36	8	h11	0	- 90	10	0	-36	-15	-51	5	+200	0	41	90
42	k6	+18	+ 2	110	12	0	-43	8	h11	0	- 90	12	0	-43	-18	-61	5	+200	0	45	125
48	k6	+18	+ 2	110	14	0	-43	9	h11	0	- 90	14	0	-43	-18	-61	5,5	+200	0	51,5	200
55	m6	+30	+11	110	16	0	-43	10	h11	0	- 90	16	0	-43	-18	-61	6	+200	0	59	355
60	m6	+30	+11	140	18	0	-43	11	h11	0	-110	18	0	-43	-18	-61	7	+200	0	64	450
65	m6	+30	+11	140	18	0	-43	11	h11	0	-110	18	0	-43	-18	-61	7	+200	0	69	630
70	m6	+30	+11	140	20	0	-52	12	h11	0	-110	20	0	-52	-22	-74	7,5	+200	0	74,5	800
75	m6	+30	+11	140	20	0	-52	12	h11	0	-110	20	0	-52	-22	-74	7,5	+200	0	79,5	1 000
80	m6	+30	+11	170	22	0	-52	14	h11	0	-110	22	0	-52	-22	-74	9	+200	0	85	1 250
85	m6	+35	+13	170	22	0	-52	14	h11	0	-110	22	0	-52	-22	-74	9	+200	0	90	1 600
90	m6	+35	+13	170	25	0	-52	14	h11	0	-110	25	0	-52	-22	-74	9	+200	0	95	1 900
95	m6	+35	+13	170	25	0	-52	14	h11	0	-110	25	0	-52	-22	-74	9	+200	0	100	2 300
100	m6	+35	+13	210	28	0	-52	16	h11	0	-110	28	0	-52	-22	-74	10	+200	0	106	2 800
110	m6	+35	+13	210	28	0	-52	16	h11	0	-110	28	0	-52	-22	-74	10	+200	0	116	4 000

[1] For diameters up to 25 mm, a shoulder of 0,5 mm is considered sufficient.
[2] In cases where the service conditions are well defined, shaft extensions might also be selected in accordance with existing ISO standards.
[3] The keyway tolerance N9 applies for normal keys and P9 for fitted keys.
[4] Tolerances for *GA* can be calculated from values of the other dimensions given in the table.
[5] The torque values are chosen from the R 40 series. In cases where the operating conditions are well defined, torque values might also be selected in accordance with existing ISO standards.

8. Tolerances for flange-mounted machines

8.1 *Shaft extension run-out*

Table 5

D	Shaft extension run-out	
	Normal class	Precision class (only on request)
mm	µm	µm
$D \leq 10$	30	15
$10 < D \leq 18$	35	18
$18 < D \leq 30$	40	21
$30 < D \leq 50$	50	25
$50 < D \leq 80$	60	30
$80 < D \leq 120$	70	35

8.2 *Concentricity of spigot diameter and perpendicularity of mounting face of flange to shaft*

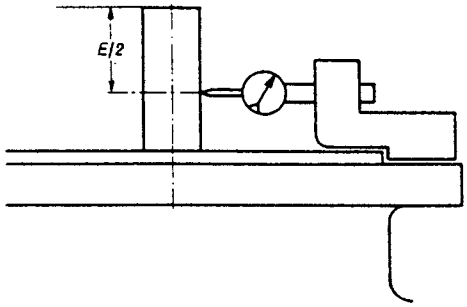
Table 6

Flange number FF - FT	*N* mm	*P* mm	Maximum permissible change in indicator reading	
			Normal class µm	Precision class (only on request) µm
55	40	70	80	40
65	50	80	80	40
75	60	90	80	40
85	70	105	80	40
100	80	120	80	40
115	95	140	80	40
130	110	160	100	50
165	130	200	100	50
215	180	250	100	50
265	230	300	100	50
300	250	350	125	63
350	300	400	125	63
400	350	450	125	63
500	450	550	125	63
600	550	660	160	80
740	680	800	160	80
940	880	1000	200	100
1080	1000	1150	200	100

8.3 *Methods of measurement*

8.3.1 *Shaft extension run-out*

Apply the point of the indicator to the shaft, midway along its length. Read the maximum and minimum values on the indicator through one slow revolution of the shaft. The difference between the readings shall not exceed the value given in table 5.

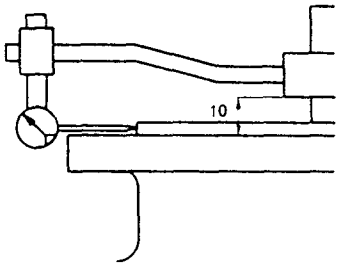


8.3.2 *Concentricity of spigot and shaft*

Fix the indicator rigidly on the shaft extension, by means of a device similar to that shown in the figure, at a distance of about 10 mm from the mounting face of the flange. Read the maximum and minimum values on the indicator through one slow revolution of the shaft.

The difference betwen the extreme readings of the concentricity test indicator shall not exceed the values given in table 6.

It is recommended that the test be carried out on the machine set up with shaft vertical so as to make the measurement free from the effect of gravity.

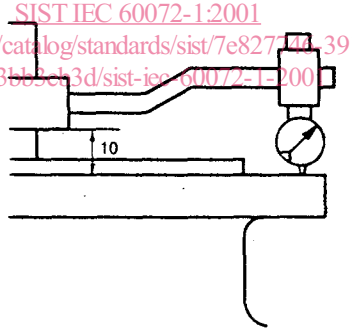


8.3.3 *Perpendicularity of mounting face of flange to shaft*

Fix the indicator rigidly on the shaft extension, by means of a device similar to that shown in the figure, at a distance of about 10 mm from the mounting face of the flange. Read the maximum and minimum values on the indicator through one slow revolution of the shaft.

The difference between the extreme readings of the perpendicularity indicator shall not exceed the values given in table 6.

It is recommended that the test be carried out on the machine set up with shaft vertical so as to eliminate the axial clearance in the bearing.



8.4 *Tolerances for machines other than flange-mounted machines*

The shaft extension run-out for machines other than flange-mounted machines shall not exceed the value specified in table 5 when measured as specified in 8.3.1.