

JIS

JAPANESE INDUSTRIAL STANDARD

End suction centrifugal pumps

Ⓔ **JIS B 8313**—1991

Translated and Published

by

Japanese Standards Association

Printed in Japan



Documents

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1. Scope

This Japanese Industrial Standard specifies the general use end suction centrifugal pumps of single suction and single stage which handle water at 0 to 40°C, are used at up to the maximum service pressure of 1 MPa {10.2 kgf/cm²}, have suction bore ⁽¹⁾ of 40 to 200 mm and are connected directly to four-pole or two-pole, three-phase induction motors at 50 Hz or 60 Hz by flexible coupling on a common base (hereafter referred to as the "pumps").

Note ⁽¹⁾ The bore of the pump shall be expressed by the nominal diameter of the flange.

- Remarks 1. The nominal items and principal dimensions of pumps based on ISO 2858 shall be as specified in Annex 1.
2. When these pumps are used at a temperature out of 0 to 40°C, the manufacturer shall show the limit of temperature clearly.
3. The Standards cited in this Standard are shown in Attached Table 1.
4. The units and numerical values given in { } in this Standard are based on the traditional unit system and are appended for informative reference.

2. Size and kind

2.1 Size The nominal size of pump shall be expressed by nominal diameters of suction bore and discharge bore as shown in Table 1, and the nominal diameter of the impeller as shown in Table 2. However, in the case where Annex 1 does not apply, the nominal diameter of the impeller shall be excluded.

Where the suction bore and the discharge bore are equal, one bore shall be expressed and where they are different, both bores shall be expressed.

- Examples 1. Where the pump is based on Annex 1, 100 x 80 - 250 mm
2. Where the pump is not based on Annex 1, 100 mm, 100 x 80 mm

Table 1. Nominal diameters of suction bore and discharge bore

Unit: mm

Nominal diameter	32 ⁽²⁾ , 40, 50, 65, 80, 100, 125, 150, 200
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Note ⁽²⁾ To be used for only discharge bore.

Table 2. Nominal diameter of impeller

Unit: mm

Nominal diameter of impeller	125, 160, 200, 224, 250, 315, 400
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2.2 Kind The kind of pumps shall be expressed by the nominal size, of pump, and the number of poles and frequency of the motor. The relation between the number of poles of motor and the suction bore shall, as a rule, be as given in Table 3.

Table 3. Number of poles of motor and suction bore

Suction bore	mm	40	50	65	80	100	125	150	200
Number of poles of motor	4 poles	○	○	○	○	○	○	○	○
	2 poles	-	○	○	○	○	○	-	-

3. Performances

3.1 Specified discharge quantity ⁽³⁾ The specified discharge quantity of the pump shall be within the range specified in Table 4 in correlation with the suction bore. However, pumps with a suction bore of 40 to 150 mm driven by a 4-pole three-phase induction motor not based on Annex 1 may have the discharge quantity range given in Table 5.

Note ⁽³⁾ The specified discharge quantity means generally the contract value between the parties concerned, but in this standard it means the marked value specified in 11.(1).

Table 4. Discharge quantity range

Unit: m³/min

Suction bore (mm)			40	50	65	80	100	125	150	200
Discharge quantity range	50 Hz	4 poles	0.16 max.	0.10 to 0.32	0.20 to 0.63	0.40 to 1.25	-	0.8 to 2.5 ⁽⁴⁾	1.6 to 5.0 ⁽⁴⁾	3.15 to 10.0 ⁽⁴⁾
							0.63 to 2.0 ⁽⁵⁾	1.0 to 3.15 ⁽⁵⁾	1.6 to 5.0 ⁽⁵⁾	2.5 to 8.0 ⁽⁵⁾
		2 poles	-				0.8 to 2.5 ⁽⁴⁾	1.6 to 5.0 ⁽⁴⁾	-	-
							-	1.25 to 4.0 ⁽⁵⁾ or 2.0 to 6.3 ⁽⁵⁾		
	60 Hz	4 poles	0.20 max.	0.12 to 0.40	0.25 to 0.80	0.50 to 1.60	-	1.0 to 3.15 ⁽⁴⁾	2.0 to 6.3 ⁽⁴⁾	4.0 to 12.5 ⁽⁴⁾
							0.8 to 2.5 ⁽⁵⁾	1.25 to 4.0 ⁽⁵⁾	2.0 to 6.3 ⁽⁵⁾	3.15 to 10.0 ⁽⁵⁾
		2 poles	-				1.0 to 3.15 ⁽⁴⁾	2.0 to 6.3 ⁽⁴⁾	-	-
							-	1.6 to 5.0 ⁽⁵⁾ or 2.5 to 8.0 ⁽⁵⁾		

Notes ⁽⁴⁾ The discharge quantities are in the series of common ratio 2.⁽⁵⁾ The discharge quantities are in the series of common ratio 1.6.Table 5. Discharge quantity range
(not based on Annex 1)Unit: m³/min

Suction bore (mm)		40	50	65	80	100	125	150
Discharge quantity range (4 poles)	50 Hz	0.20 max.	0.16 to 0.32	0.25 to 0.50	0.40 to 0.80	0.63 to 1.25	1.00 to 2.00	1.60 to 3.15
	60 Hz	0.22 max.	0.18 to 0.36	0.28 to 0.56	0.45 to 0.90	0.71 to 1.40	1.12 to 2.24	1.80 to 3.55

Remarks: According to agreement between the parties concerned, the specified discharge quantity may be expanded to the range from 63 % of the minimum discharge quantity up to 125 % of the maximum discharge quantity specified in Table 5.

3.2 Total pump head The standard total pump head at the specified discharge quantity shall be in accordance with Attached Fig. 1 and Attached Fig. 2.

Remarks: The head used in this Standard is shown by such an amount that the energy of fluid per unit mass i.e. the specific energy is divided by the acceleration of free fall at that place assumed as 9.80 m/s^2 .

3.3 Maximum suction head The maximum suction head shall be the total suction head ⁽⁶⁾ converted to the pump reference plane [as given in Note ⁽⁷⁾ of 5.2 (total head) of JIS B 8301] at the specified discharge quantity in Table 4, and be as specified in Table 6, and the pump shall be capable of operating under the conditions without abnormalities. However, at the suction head, if the value reduced by 3 m from the total pump head is less than the numerical value in Table 6, the maximum suction head shall be taken as the value reduced by 3 m from the total pump head.

Where the discharge quantity range is based on Table 5, the total suction head ⁽⁶⁾ converted to the pump reference plane at the specified discharge quantity shall be 6 m (5.5 m for suction bore not less than 125 mm) and the pump shall be operated under the conditions without abnormalities. However, where the total pump head is not more than 9.2 m (8.5 m for suction bore not less than 125 mm), the maximum suction head shall be up to 65 % of the total pump head.

Note ⁽⁶⁾ The total suction head is the reading of suction opening vacuum gauge converted to the pump reference plane, minus the velocity head at the section of vacuum gauge fitting opening.

Example: Where the reading of suction opening vacuum gauge is 6 m and the velocity at the section of vacuum gauge fitting opening is 4.4 m/s , i.e. the velocity head is 1 m, total suction head is 5 m.

Table 6. Maximum total suction head

Unit: m

Suction bore (mm)			40	50	65	80	100	125	150	200
Maximum total suction head	50 Hz	4 poles	6	6	6	6	-	5.5 ⁽⁴⁾	5.5 ⁽⁴⁾	3 ⁽⁴⁾
							6 ⁽⁵⁾	5.5 ⁽⁵⁾	5.5 ⁽⁵⁾	3.5 ⁽⁵⁾
		2 poles	-	6	6	5.5	2.5 ⁽⁴⁾	(Forcing 2) ⁽⁴⁾	-	-
							-	(Forcing 0) ⁽⁵⁾ or (Forcing 4) ⁽⁵⁾		
	60 Hz	4 poles	6	6	6	6		5.5 ⁽⁴⁾	3 ⁽⁴⁾	(Forcing 1) ⁽⁴⁾
							6 ⁽⁵⁾	4.5 ⁽⁵⁾	3 ⁽⁵⁾	(Forcing 0) ⁽⁵⁾
		2 poles		6	5.5	3	(Forcing 1) ⁽⁴⁾	(Forcing 8) ⁽⁴⁾	-	-
							-	(Forcing 5) ⁽⁵⁾ or (Forcing 11) ⁽⁵⁾		

Remarks: The indication () in Table 6 means that forcing is necessary and the numerical value expresses the minimum total forcing head.

3.4 Pump efficiency The maximum value of pump efficiency shall be not less than efficiency A in Attached Fig. 3 at that discharge quantity.

Further, the pump efficiency at the specified discharge quantity shall be not less than efficiency B in Attached Fig. 3.

The allowable value of the efficiency shall be in accordance with 9.3 (pump efficiency) in JIS B 8301.

3.5 Shaft power The shaft power shall be in accordance with 9.2 (shaft power) in JIS B 8301.

3.6 Operating conditions The operating conditions shall be in accordance with 9.4 (operating conditions) in JIS B 8301.

3.7 Resistance to hydraulic pressure The resistance to hydraulic pressure shall be as follows:

- (1) It shall be in accordance with 9.9 (resistance to hydraulic pressure) in JIS B 8301.
- (2) There shall be no abnormality such as water leakage from the fitting surface of pump body or the like other than packing box during operation of pump.

4. Construction

4.1 General The pump shall be composed of body, impeller, shaft, bearing, etc., and an example of the construction is shown in Attached Fig. 4 and Attached Fig. 5.

Remarks: Attached Fig. 4 and Attached Fig. 5 are the explanatory figure of the names of parts, and do not restrict the construction of pump.

4.2 Body The pump body shall be as follows:

- (1) The casing shall have a volute type chamber, the suction opening shall be in the axial direction, and the discharge opening shall, as a rule, be upward.
- (2) The flange shall be those of nominal pressure 10 K or 5 K specified JIS B 2210.

Remarks: Pipe flange of nominal pressure 5 K should, preferably, be used for ship, and pipe flange of nominal pressure 10 K, for land.

- (3) The shaft center height shall, preferably, be in accordance with JIS B 0902.
- (4) The casing shall be provided with the air vent hole, drain hole, priming hole, and discharge pressure taking-out hole. However, for the pump in which the priming hole is set at the top of the volute type chamber and combined with the work of the air vent hole, the air vent hole may be omitted.

These hole threads shall be in accordance with JIS B 0202, however, the threads at the portion fitting plug and pipe may be in accordance with JIS B 0203.

- (5) The water leakage part between the impeller and the pump body shall be provided with a casing ring. The casing ring shall be driving-fit or screwed, and shall not turn during operation.

- (6) Where the impeller is provided with a balancing hole, or in the case of such construction that the pressure inside the packing box might become below the atmospheric pressure during operation, the packing box shall be sealed by providing the sealing part on the box.
- (7) The packing to be used shall be of square type, the number of pieces of packing inserted shall be not less than three, and the point face shall be located alternately.
- (8) The pump shall be so constructed that the packing gland comes out from the packing gland bolt, when the packing gland is kept away from the casing or casing cover, the space from the packing box to the gland removed should, as a rule, be not less than the shaft diameter, and easy exchange of packing is ensured.
- (9) Instead of packing, a mechanical seal may be employed.

4.3 Impeller The impeller shall be as follows:

- (1) The balance quality of an impeller (including testing shaft) shall be the "balance quality of G6.3" specified in JIS B 0905. However, if the mass of the impeller (including testing shaft) is not more than 2 kg the "balance quality of G16" may be accepted.
- (2) It is recommended that the outside diameter, slipping part, shaft hole of hub and both end surfaces of hub of an impeller be machined.

4.4 Pump shaft The pump shaft shall be as follows:

- (1) The thread of pump shaft shall be in such a direction that the nut does not loosen at the time of starting, or whirl-stop shall be applied by means of a washer or the like.
- (2) Water shall be prevented from entering the pump shaft bearing by means of throating grooves, deflector or other adequate method.

4.5 Bearing The bearing shall be as follows:

- (1) The pump shall be provided with total two ball bearings specified in JIS B 1521 or JIS B 1522. The ball bearing shall be greased or oil lubricated.
- (2) The bearing shall be such that the grease or oil does not flow out or spatter during operation. In the case of grease lubrication, the grease replenishing hole shall not be attached.

In the case of oil lubrication, the oil surface shall be able to be checked from outside, and an oil drain hole shall be provided. In the case of using an oil ring, a peep hole for the oil ring shall be provided.

- (3) The oil ring shall have a broad contact surface and a sufficient oil feeding capacity.
- (4) The water drain hole and overflow hole shall be provided in the mounting part of the bearing so as the leaking water from the packing box does not enter the inside of the bearing.

4.6 Other parts The construction of other parts shall be as follows:

- (1) The rotating direction of the pump shall, as a rule, be clockwise, viewed from the motor side.
- (2) The legs of the pump may be fitted to either the casing or the bearing, provided that the fitting bolts shall be not less than 4 pieces, and the foundation bolts of the common base, not less than 3 pieces.
- (3) The shift in axial direction of rotary part shall be stopped securely by a ball bearing.
- (4) The seats on the common base for the pump side and the motor side shall be in the same plane. In direct coupling, liners of the same thickness may be inserted in either side, in inevitable cases.
- (5) The size of the seat on a common base should preferably be equal to or larger than the leg of the pump or motor to be mounted thereon.
- (6) The coupling shall be provided with a coupling guard on its outside.

5. Dimensions and fits

5.1 Nominal diameter and actual bore The relation between the nominal diameter and actual bore of the pump shall be in accordance with Table 7.

Table 7. Actual bore

Unit: mm

Nominal diameter	32	40	50	65	80	100	125	150	200
Actual bore	32 ± 3	40 ± 3	50 ± 3	65 ± 4	80 ± 4	100 ± 4	125 ± 4	150 ± 5	200 ± 5

5.2 Body The body shall be as follows:

- (1) Even if there is a deviation in thickness, the minimum value of thickness of pressure resistant part of the casing shall be as given in Table 8.

Table 8. Minimum thickness of casing

Unit: mm

Suction bore	Minimum thickness
40 to 80	5
100 to 200	6

- (2) The tolerances on flange thickness are + 15 % and -5 %.
- (3) The dimension of packing box shall be as annex 2. If there is any dimension not specified in the annex 2, the space between the bore of packing box and the shaft diameter shall be not less than $\frac{1}{6}$ of the shaft diameter, and, as a rule, be 6 mm, 8 mm, 10 mm or 12.5 mm.

5.3 Impeller The impeller shall be as follows:

- (1) The impeller shall be of closed type and its thickness shall comply with Table 9. However, the thicknesses of tips of impeller at inlet and outlet are optional.

Table 9. Minimum thickness of impeller

Unit: mm

Outside diameter of impeller	Minimum thickness		
	Casting		Stainless steel sheet
	Both side plates	Impeller	
Not exceeding 200	2.5	2.0	0.8
Exceeding 200	3.0	2.5	-

- (2) The length of hub shall be not less than the hole diameter.

5.4 Diameter of pump shaft The diameter of pump shaft d (7) shall be not less than the value calculated from the following formula:

$$d = k \sqrt[3]{\frac{L}{n}} \text{ (mm)}$$

where,

L : shaft power (kW)

n : revolving speed (min^{-1})

k : coefficient specific for material obtained from the following formula.

$$k = 125^3 \sqrt{\frac{\text{tensile strength of S30C (470 MPa)}}{\text{tensile strength of the material (MPa)}}}$$

$$\left\{ k = 125^3 \sqrt{\frac{\text{tensile strength of S30C (48 kgf/mm}^2\text{)}}{\text{tensile strength of the material (kgf/mm}^2\text{)}}} \right\}$$

Example: $k=125$ for S30C in JIS G 4051

$k=116$ for SUS403 in JIS G 4303

The dimensions of shaft end shall, preferably, be in accordance with JIS B 0903.

Note (7) The d is the diameter of the part relating to power transmission, and that of other part may be finer than this diameter.

5.5 Coupling The coupling shall be as follows:

- (1) The coupling shall preferably be in accordance with JIS B 1452.
- (2) In the case where the flexible flanged coupling is used, the clearance between the couplings during operation shall preferably be 3 to 5 mm, the finishing and mounting accuracy of the coupling shall comply with Table 10.