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भारतीय मानक **मसौदा**

पम्प अपकेन्द्री स्वतः प्राइमिंग — विशिष्टि

(आई एस 8418 का *दूसरा पुनरीक्षण*)

DRAFT *Indian Standard*

PUMPS — CENTRIFUGAL SELF PRIMING — SPECIFICATION

(*Second Revision* of IS 8418)

ICS 23.080

Pumps Sectional Committee, MED 20	Last date for receipt of comments is **21 July 2024**

FOREWORD

(*Formal Clause will be added later*)

This standard was first published in 1977 and was subsequently revised in 1999.

This revision has been taken up to keep pace with the latest technological developments and the practices followed in pump industry. This revision incorporates the following major changes along with the amendment issued to the earlier version.

a) New clause 11.2 has been added;
b) More grades added for impeller under 7.1; and
c) Other editorial changes have been made.

For the purpose of deciding whether a particular requirement of this standard is complied with, the final value, observed or calculated, expressing the result of a test or analysis, shall be rounded off in accordance with IS 2 : 2022 ‘Rules for rounding off numerical values (*second revision*)’. The number of significant places retained in the rounded off value should be the same as that of the specified value in this standard.

DRAFT *Indian Standard*

PUMPS — CENTRIFUGAL SELF PRIMING — SPECIFICATION

(*Second Revision* of IS 8418)

1 SCOPE

1.1 This standard specifies the technical requirements for horizontal/vertical, single/multi-stage centrifugal self-priming pumps for handling clear cold water.

1.2 Types

The various types of self-priming centrifugal pumps are as follows:

a) Re-circulation in suction (*see* Fig. 2);
b) Re-circulation in delivery (*see* Fig. 3);
c) Auxiliary self-priming pump with main pump (*see* Fig. 4); and
d) Self-priming pump with built-in ejector (*see* Fig. 5).

1.3 Details of types of self-priming pumps and their working principle are given in Annex B and Fig. 2 to Fig. 5.

2 REFERENCES

The standards listed in Annex A contain provisions which, through reference in this text, constitute provisions of this standard. At the time of publication, the editions indicated were valid. All standards are subject to revisions, and parties to agreements based on this standard are encouraged to investigate the possibility of applying the most recent editions of the standards listed in Annex A.

3 UNITS

Units relating to pumps as specified in **2** of IS 5120 shall be applicable.

4 TERMINOLOGY

Terminology relating to pumps as specified in **3** of IS 5120 shall be applicable. In addition, the following shall also apply:

4.1 Static Suction Lift

It is the vertical distance between the pump center line and the water level.

4.2 Manometric Suction Lift

Manometric suction lift is the vacuum gauge/suction manometer readings in meters of water column.

5 Characteristics of Clear, Cold Water

Clear cold water shall mean water having the characteristics specified below:

Sl No. (1)	Characterstic (2)	Value (3)
i)	Turbidity	50 ppm silica scale, max
ii)	Chlorides	500 ppm max
iii)	Total solids	3000 ppm max
iv)	pH	6.5 to 8.5
v)	Temperature	33 °C max
vi)	Specific gravity	1.004 max
vii)	Hardness (Drinking Water)	300 max

NOTE — If any other characteristics of water differ from those specified in 4, the pump details will have to be agreed between the manufacturer/supplier and the user and shall be specified in the order.

6 NOMENCLATURE

Nomenclature of the parts commonly used for the different types of horizontal/vertical, single/multi-stage centrifugal self-priming pumps shall be as given in Fig. 2.

7 CONSTRUCTIONAL FEATURES

7.1 Materials of Construction

It is recognized that a number of materials of construction is available to meet the needs for the horizontal/vertical, single/multi stage centrifugal self-priming pumps handling clear cold water. Typical materials for few parts are indicated in Table 1 for the guidance of the manufacturers and users.

Table 1 Typical Materials of Main Parts of Pumpset

(*Clause* 7.1)

Sl. No	Name of the Part	Material of Construction
i)	Casing	Cast iron, Grade FG 200 of IS 210
ii)	Impeller	Cast iron grade FG 200 of IS 210 or Bronze grade LTB 2 of IS 318 or stainless steel grade 04Cr13 or 12Cr13 or 20Cr13 of IS 6603 or Bronze, Grade LTB2 of IS 318
iii)	Casing and impeller wearing ring/wear plate (if provided)	Cast iron grade FG 200 of IS 210 or Bronze grade LTB 2 of IS 318
iv)	Shaft	Grade 40 C8 of IS 1570 (Part 2/Sec 1)
v)	Shaft sleeve, where used	Bronze grade LTB 2 of IS 318 or stainless steel grades 04Cr13 or 12Cr13 or 20Cr13 of IS 6603

NOTES

1 The materials listed are to be considered as only typical and indicative of minimum requirements of the material properties. The use of materials having better properties is not prejudiced by the details above provided materials for components in bearing contact with each other do not entail galling, corrosion, magnetic induction, etc.

2 To benefit from the advancement in technology of engineering plastics, thermoplastics materials such as polyphenylene oxide (PPO) polycarbonate, acetal, nylon 6 or 66. PTFE. ABS. polyester PETP, Glass-filled nylon. UHMWPE (Ultra High Molecular Weight Polyethylene) etc may be used for pump parts like bearing sleeve, casing, impeller-wearing ring etc. However, typical materials of the main parts are indicated below for the guidance of the manufacturer and the user.

Sl No.	**Name of the Part**	**Material**		
i)	Impeller	Glass-filled polyphenylene Oxide *(Modified PPO), Glass filled polycarbonate * properties shall be as given below		
		Properties	Modified Polyphenylene Oxide	Polycarbonate
		Hardness (Rockwell)	M90/L106	M91
		Taber abrasion resistance, g	0.035	0.017
		Coefficient of linear, m/m °C thermal expansion	4×10^{-5} Max	3×10^{-5} Max
		Water absorption, 24 h at 23 °C, percent	0.06 Max	0.29 Max
		Notched impact strength Izod, J/m	80 Min	100 Min
		Specific gravity	1021 ± 0.03	1.35 ± 0.03
		Tensile strength at break, N/mm2	90 Min	90 Min
		Elongation at break, percent	4 to 6	3
		Mould shrinkage, percent	0.2 to 0.4	0.2 to 0.5
		Glass content, percent	20 Min	20 Min
ii)	Wearing ring	PTFE, ABS or Nylon 66		
iii)	Bearing sleeve	Polyethylene (LD/HT), Nylon 66, PTFE, polypropylene		
***Glass filling is extremely essential for parts made of plastics in view of abrasion resistance and better life to the end users.*				

7.2 Gaskets, Seals and Packings

Gaskets seals and packing used for clear cold water pumps shall conform to those specified in IS 5120.

8 DIRECTION OF ROTATION

The direction of rotation of pump set is designated clockwise or anti-clockwise as observed when looking at the pump shaft from the driving end.

The direction of rotation shall be clearly marked either by incorporating an arrow in the casting or by a separate metal plate arrow securely fitted to the delivery casing of the pumpset.

9 SUCTION LIMITATIONS

Suction limitations affecting the performance of pumps for clear cold water shall be the same as those specified in IS 5120.

10 FACTORS AFFECTING PUMP PERFORMANCE

Factors affecting pump performance shall be the same as those specified in IS 5120.

11 DESIGN FEATURES

11.1 The pump shall have suitable features designed to ensure satisfactory performance, such as:

a) The pump shall be provided with two bearings;
b) The pump shall be capable to operate without overloading the prime mover in the specified head range. The specified head range shall be as follows:
   1) For guaranteed duty points head up to 20 m + 10 percent to - 20 percent of the guaranteed duty point.
   2) For guaranteed duty point head above 20 m + 5 percent to - 20 percent of the guaranteed duty point.
c) The pump shall be capable of working under static suction lift of 3 m at specified duty point or a manometric suction lift of 4.5 m;
d) The impellers may be of the enclosed or the semi-open type or open type;
e) The inlet passages of the suction casing shall be streamlined to avoid eddies; and
f) The manufacturer shall have a system of controlling dimensional accuracy within a scheme of fits and tolerance limits. The system shall help interchangeability at site of replacement of spares during repair and maintenance.

11.2 The motor for monoset pump shall have suitably designed to ensure satisfactory performance. Monoset motor shall not get overload in the specified operating head range at rated Voltage and supply frequency. The maximum limit for permissible current and minimum nominal efficiency of motor shall be as specified in Table 2 to Table 4.

Table 2 Maximum Limit of Permissible Current and Nominal Efficiency in Operating Head Range of Three phases, 415 V Monosets for Checking the Non-overloading Requirements

(*Clause* 11.2)

Sl No.	Rating of Monoset	Rated Current of Motor (Maximum) (*see* IS 7538)	Permissible Limit of Maximum Current at Rated Voltage and Frequency Within ±3 Percent of Rated Frequency	Efficiency Nominal Percent

	kW	2-Pole	4-Pole	2-Pole	4-Pole	2-Pole	4-Pole
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
i)	0.37	1.3	1.5	1.4	1.6	63.0	64
ii)	0.55	1.7	1.8	1.8	1.9	67	69
iii)	0.75	2.1	2.3	2.2	2.45	71	71
iv)	1.1	2.9	3.0	3.1	3.2	73	73
v)	1.5	3.9	4.0	4.2	4.3	76	76
vi)	2.2	5.2	5.3	5.6	5.7	78	79
vii)	3.7	8.3	8.4	8.9	9	81	83
viii)	5.5	11.4	11.9	12.2	12.7	82	84
ix)	7.5	15.6	16.0	16.7	17.0	83	85
x)	9.3	19.5	19.2	20.8	20.5	83.5	85.5
xi)	11	22.4	22.9	24.0	24.5	84	85.5
xii)	15	30.2	31.2	32.3	33.4	85	86

NOTES
1 Values in col 4 and 5 are 1.07 times the values given in col 2 and 3 respectively to take care of voltage and frequency variation.
2 The permissible limit of maximum current above 15 kW shall be as declared by the manufacture.

Table 3 Maximum Limit of Permissible Currents and Nominal Efficiency in Operating Head Range of Single-Phase Monosets for Checking the Over Loading 240 V, Capacitor Start Capacitor Run, and Capacitor Start and Run Motors

(*Clause* 11.2)

Sl No.	**Rating of Monoset**	**Rated Current of Motor (Maximum) (*see* IS 14582)**		**Permissible Limit of Maximum Current at Rated Voltage and Frequency Within ±3 Percent of Rated Frequency**		**Efficiency Nominal Percent**	
	kW	2-Pole	4-Pole	2-Pole	4-Pole	2-Pole	4-Pole
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
i)	0.18	2.1	2.1	2.25	2.25	54.0	54.0
ii)	0.25	2.8	2.8	3.0	3.0	56.0	56.0
iii)	0.37	3.7	3.9	4.0	4.15	59.0	58.5
iv)	0.55	5.0	5.3	5.35	5.65	63.0	62.0
v)	0.75	6.5	7.1	6.6	7.4	67.0	66.0
vi)	1.1	8.8	9.5	9.2	9.7	70.0	69.0
vii)	1.5	12.0	12.5	12.3	13.0	70.0	70.0

NOTES
1 Values in col 4 and 5 are 1.07 times the values given in col 2 and 3 respectively to take care of voltage and frequency variation
2 The permissible limit of maximum current above 1.5 kW shall be as declared by the manufacture

Table 4 Maximum Limit of Permissible Currents and Nominal Efficiency in Operating Head Range of Single-Phase Monosets for Checking the Non-overloading 240 V, Capacitor Start Induction Motors

(*Clause* 11.2)

Sl No.	Rating of Monoset	Rated Current of Motor (Maximum) (*see* IS 14582)		Permissible Limit of Maximum Current at Rated Voltage and Frequency Within ±3 Percent of Rated Frequency		Efficiency Nominal Percent	
	kW	2-Pole	4-Pole	2-Pole	4-Pole	2-Pole	4-Pole
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
i)	0.18	2.9	3.0	3.1	3.2	51.5	51.5
ii)	0.25	3.7	3.9	3.95	4.2	55.0	55.0
iii)	0.37	5.1	5.4	5.45	5.8	57.5	56.5
iv)	0.55	7.3	7.6	7.8	8.1	59.0	58.5
v)	0.75	9.0	9.5	9.6	10.1	63.5	63.0
vi)	1.1	12.5	12.9	13.3	13.8	66.0	64.5
vii)	1.5	16.3	16.8	17.4	17.9	68.0	67.0

NOTES
1 Values in col 4 and 5 are 1.07 times the values given in col 2 and 3 respectively to take care of voltage and frequency variation.
2 The permissible limit of maximum current above 1.5 kW shall be as declared by the manufacture.

12 GENERAL REQUIREMENTS

12.1 The general requirements for the pump shall be as given in IS 5120.

12.2 Pump Casing

The pump casing shall be of robust construction and shall be tested to withstand 1.5 times the maximum discharge pressure for 2 minutes.

12.3 Impeller

The impeller shall be dynamically balanced to grade G6.3 of IS/ISO 21940-11. However, in case the pump speed is less than 1500 rpm and impeller diameter less than 250 mm, the impeller may be statically balanced.

NOTE — Balancing here means the balancing of the unbalanced rotating mass in the impeller and not balancing of the axial hydraulic thrust in the impeller. Impellers made of Engineering Plastic need not be balanced.

12.4 Shaft

The shaft shall be of adequate size to transmit the required power.

12.5 Prime Mover

12.5.1 *Motor*

The motor of monoset pump shall conform to the testing requirements given in IS 9079.

12.5.1.1 *Single-phase motor*

a) *Capacitor start capacitor run (CSCR) (Two-value capacitor motor***) —** This motor has high starting torque and lower starting current than split phase motors and is suitable for frequent starting. This motor has lower noise level, higher efficiency and higher power factor than split phase motors and capacitor start and induction run motors.
b) *Capacitor start and run (CSR) (Permanent split capacitor motor)* — This motor has less starting torque and starting current than Capacitor start capacitor run motor and used where less starting torque are acceptable. In running condition their characteristic are similar to Capacitor start capacitor run motor.
c) *Capacitor Start Induction run (CSIR) (Capacitor Start Motor)* — This motor has higher starting torque and lower starting current than split-phase motors.

NOTE — This is the least preferred type since the load current is higher and efficiency and power factor are lower than other two types.

12.5.1.2 *Three-phase induction motor*

Three-phase induction motor shall meet the general requirements as per IS 7538.

12.5.2 *Engine*

The Engine of monoset pump shall confirm the requirements of IS 7347 or IS 10001 or IS 11170.

12.5.3 *Efficiency*

The pump/overall efficiency of the pumps at duty point shall be declared by the manufacturer.

12.5.4 Cables used shall be as per IS 694.

13 PUMP TEST

13.1 Sampling

The sampling and criteria of conformity shall be as specified in IS 10572.

13.2 Performance Test

The testing of the pump performance shall be in accordance with IS 11346;

a) For Horizontal Centrifugal Pumps and Monosets *see* **5.1** of IS 11346; and

b) For Regenerative Pumps *see* **9** of IS 11346.

13.3 Priming Test

13.3.1 *Priming time*

The self-priming pumps shall be tested to determine the priming time. The pump shall be tested at a static suction lift of 3 m. No check or foot valve shall be installed in the suction piping. The test setup shall be as shown in Fig. 1.

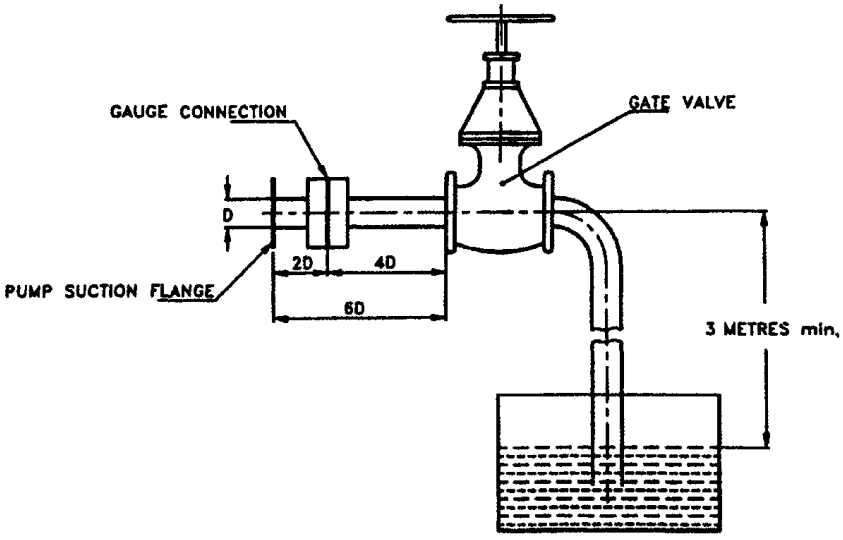

FIG. 1 TEST SET UP

The priming chamber of the pump shall be filled with water before starting of the pump. The priming time shall be the total elapsed time between starting the pump and the time required to obtain a steady delivery gauge reading or full flow through the discharge pipe.

13.3.2 *Primary Time Conversion Factor*

If a pump is connected to a larger pipe than the nominal pipe size of the pump on the suction side, it is necessary to compute the performance for the nominal pipe size of the pump. For ease of reference, the conversion factors are given in Table 5.

The method of finding the conversion factor is as explained below:

a) Select the size of the suction pipe actually used in the test;
b) Follow this line horizontally right to the vertical column under the heading size of nominal pipe;
c) The figure shown at the intersection is the conversion factor; and
d) Divide the test time (in seconds) by this factor and then divide the resultant by the total vertical length of suction pipe above water level in meters. This gives the average time in seconds for air removed from a suction line of nominal size per meter of length.

Table 5 Priming time conversion factor

(*Clause* 13.3.2)

Sl No.	**Suction pipe size Used For testing, mm**	**Nominal Suction Pipe Size, mm**												
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)
		10	15	20	25	32	40	50	65	80	90	100	125	150
i)	15	168	-	-	-	-	-	-	-	-	-	-	-	-
ii)	20	3 23	19 2	-	-	-	-	-	-	-	-	-	-	-
iii)	25	5 1	3 0	1 57	-	-	-	-	-	-	-	-	-	-
iv)	32	9 05	5 36	2 8	1 78	-	-	-	-	-	-	-	-	-
v)	40	12 4	7 4	3 85	2 45	1 37	-	-	-	-	-	-	-	-
vi)	50	20 2	12 0	6 25	4 0	2 23	1 62	-	-	-	-	-	-	-
vii)	65	34 6	20 6	10 7	6 8	3 82	2 78	1 72	-	-	-	-	-	-
viii)	80	48 2	28 5	14 9	9 5	5 32	3 88	2 38	1 34	-	-	-	-	-
ix)	90	-	38 4	20 0	12 8	7 15	5 2	3 2	1 87	1 34	-	-	-	-
x)	100	-	49 0	25 5	1 62	9 1	6 62	4 06	2 37	1 71	1 27	-	-	-
xi)	125	-	95 5	39 4	25 1	14 1	10 3	6 3	3 68	2 65	1 97	1 55	-	-
xii)	150	-	-	56 5	36 0	20 2	14 7	9 05	5 3	4 0	2 82	2 22	1 44	-
xiii)	200	-	-	94 5	60 8	34 0	24 7	15 3	8 9	6 4	4 75	3 74	2 44	1 68
xiv)	250	-	-	-	95 2	53 6	39 0	22 9	14 0	10 05	7 46	5 90	3 8	2 65
xv)	100	-	-	-	-	75 8	55 0	33 8	19 8	14 2	10 35	8 32	5 4	3 8

14 GUARANTEE

14.1 Guarantee of Workmanship and Material

The pumps shall be guaranteed by the manufacturer against defects in material and workmanship, under normal use and service, for a period of at least 15 months from date of dispatch or 12 months from the date of commissioning whichever is less.

14.2 Guarantee of Performance

14.2.1 The pumps shall be guaranteed for their performance of:

a) The volume rate of flow and the head at the guaranteed duty point;
b) The efficiency of the pumps shall be guaranteed at the declared duty point only; and
c) Maximum self-priming time at minimum 3 m static suction lift.

14.2.2 The guarantee shall be deemed to have been met with, if:

a) The measured values of head and volume rate of flow are within the limits indicated in IS 11346;
b) Power consumption by the pump does not exceed the recommended prime-mover rating in the specified head range; and
c) The requirements of self-priming time and self-priming static suction lift are complied.

15 PERMISSIBLE INACCURACIES IN MEASUREMENTS

In all commercial acceptance tests for pumps a certain tolerance shall be allowed to the manufacturer on his guarantee to cover the inaccuracies of the equations for volume rate of flow, errors of observation and unavoidable errors of the instruments employed.

The permissible inaccuracy in the measurement of various quantities shall be as indicated in IS 11346.

16 INFORMATION TO BE FURNISHED BY THE PURCHASER

When inquiring or ordering pumps to this standard, the user shall furnish the following information to the supplier:

a) Total capacity required in lps;
b) Total head in meters;
c) Operational speed rpm; and
d) Prime mover rating kW.

17 PARAMETERS TO BE DECLARED BY MANUFACTURER

17.1 The following parameters shall be declared by the manufacturer:

a) Pipe size (suction and delivery);
b) Speed;
c) Duty point head and discharge rate;
d) Pump efficiency at duty point;
e) Head range for overloading requirement;
f) Recommended primemover rating;
g) Maximum permissible static suction lift; and
h) Maximum self-priming time at 3 m static suction lift.

17.2 An operating and maintenance manual shall be supplied along with each pump. Such manual shall contain the following details in addition to the information mentioned in **17 and 18**:

a) Plan and cross-sectional view of the pump showing various components;
b) Spare parts list;
c) Routine maintenance and lubrication guidelines;
d) Troubleshooting tips; and
e) Warranty card.

18 MARKING

18.1 The self-priming centrifugal pump shall be marked with the following:

a) Manufacturer's name and/or recognized trademark;
b) Type, size, and serial No. of pump;
c) Pipe size (suction and delivery) mm;
d) Speed rpm;
e) Duty point head (m) and discharge rate LPS;
f) Pump efficiency at duty point percent;
g) Head range m;
h) Recommended prime mover rating kW; and
j) Arrow indicating direction of rotation.

18.2 BIS Certification Marking

18.2.1 The pumps may also be marked with the Standard Mark.

18.2.1 The product(s) conforming to the requirements of this standard may be certified as per the conformity assessment schemes under the provisions of the *Bureau of Indian Standards Act, 2016* and the Rules and Regulations framed thereunder, and the products may be marked with the Standard Mark.

ANNEX A

(*Clause* 2)

LIST OF REFERRED INDIAN STANDARDS

IS No.	*Title*
IS 210 : 2009	Grey iron castings — Specification (*fifth revision*)
IS 318 : 1981	Specification for leaded tin bronze ingots and castings (*second revision*)
IS 694 : 2010	Polyvinyl chloride insulated unsheathed and sheathed cables/cords with rigid and flexible conductor for rated voltages up to and including 450/750 v (*fourth revision*)
IS 1570 (Part 2/Sec 1) : 1979	Schedule for wrought steels: Part 2 Carbon steels (unalloyed steel), Section 1 Wrought products (other than wire) with specified chemical composition and related properties (*first revision*)
IS 5120 : 1977	Technical requirements for rotodynamic special purpose pumps (*first revision*)
IS 6603 : 2024	Stainless Steel Semi-Finished Products, Bars, Wire Rods and Bright Bars — Specification (*second revision*)
IS 7347 : 1974	Specification for performance of small size spark ignition engines for agricultural water pumps, sprayers, tillers, reapers and other similar applications
IS 7538 : 1996	Three phase Squirrel cage induction motors for centrifugal pumps for agricultural application - Specification
IS 9079 : 2018	Monoset pumps for clear, cold water for agricultural and water supply purposes — Specification (*third revision*)
IS 10001 : 1981	Performance requirements for constant speed compression ignition (diesel) engines for general purposes (up to 20 kW)
IS 10572 : 1983	Methods of sampling pumps
IS 11170 : 1985	Specification for 1 performance requirements for constant speed compression ignition (Diesel) engines for agricultural purposes (Up To 20 KW)
IS 11346 : 2002	Tests for agricultural and water supply pumps — Code of acceptance (*first revision*)
IS 14582: 2021	Single-phase small ac electric motors for centrifugal pumps for agricultural applications
IS/ISO 21940-11:2016	Mechanical vibration – Rotor balancing: Part 11 procedures and tolerances for rotors with rigid behaviour

ANNEX - B

(*Clause* 1.3)

TYPES OF SELF-PRIMING CENTRIFUGAL PUMPS AND THEIR WORKING PRINCIPLE

A -1 TYPES

a) Re-circulation in suction;
b) Re-circulation in delivery;
c) Auxiliary self-priming pump with main pump; and
d) Self-priming pump with built-in ejectors.

A-1.1 Re-circulation in Suction

Self-priming pump of this type contains water reservoir either attached to or built in the casing. Before starting the pump for the first time, reservoir should be filled with water. Re-circulating port provided in the reservoir communicates with the suction side of the impeller. When the pump is started, the impeller sucks the water from the re-circulating port and certain amount of air from suction side. This mixture of water and air reaches the reservoir. Here the air gets separated and escapes through discharge pipe. The water enters the suction of the impeller through the re-circulating port. This operation continues until all the air has been removed from the suction line. The vacuum thus created sucks the water from the water source and supplies it to the impeller. The reservoir should remain filled with water when the pump is stopped. This is accomplished by incorporating either a non-return valve or some form of trap between the suction line and the impeller. This type of pump is shown in Fig. 2.

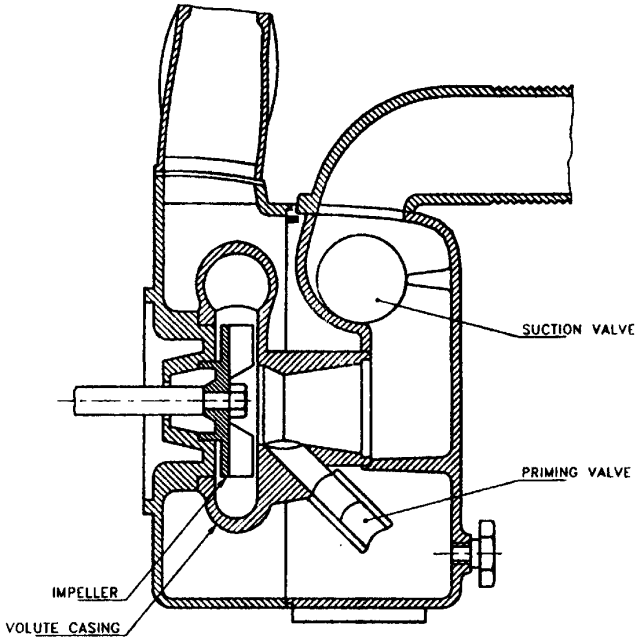

FIG. 2 SELF PRIMING PUMP RE-CIRCULATION IN SUCTION

A-1.2 Re-circulation in Delivery

It may be distinguished from the preceding pump by the fact that the priming liquid is not returned to the suction of the pump but mixes with the air either within the impeller itself or at its periphery. Its principal advantage therefore is that it eliminates the complexity of internal valve mechanisms. This type of pump is shown in Fig. 3.

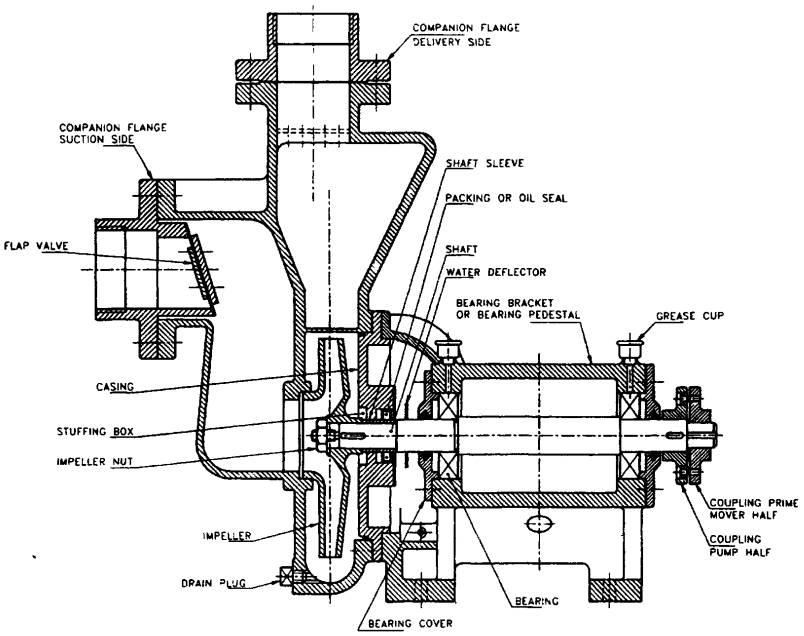

FIG. 3 SELF-PRIMING PUMP RE-CIRCULATION IN DELIVERY

A-1.3 Using an Auxiliary Self-priming Pump with the Main Pump

In this type, an air pump is attached on the suction side of the pump, whose impeller is driven by the extension of the pump shaft. The air pump runs in parallel with the water pump, removes the air from the suction line and discharges it into open air (or into the discharge pipe, if it is an open line). After priming, the air pump discharges the water, generally back into the suction line. The two kinds of air pumps used commonly are side channel type and water ring type. These are shown in Fig. 4.

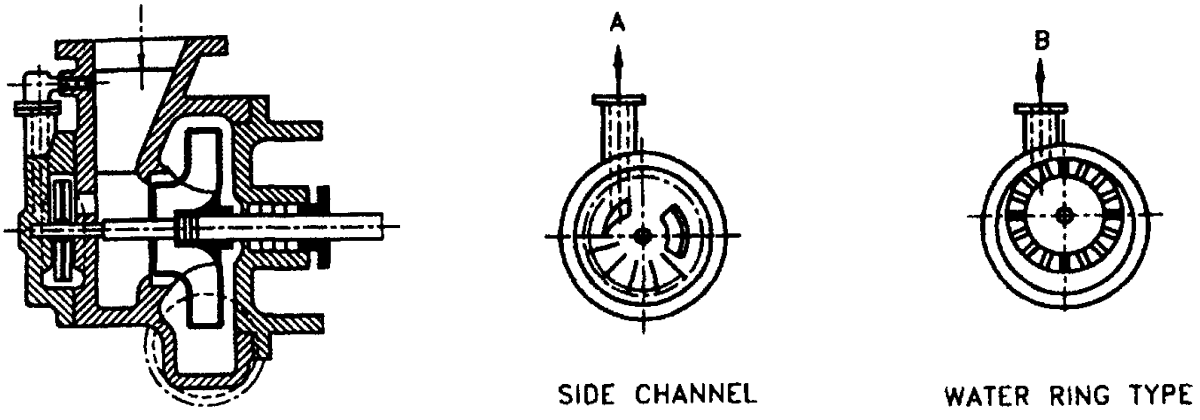

FIG. 4 AUXILIARY SELF PRIMING PUMP WITH MAIN PUMP

A-1.4 Self-priming Pump with Built-in Ejectors

Ejectors devices have been used for a considerable time to create a vacuum. They have also found application in self-priming centrifugal pumps. Ejector pumps or jet pumps are distinguished by their high suction lift capability (up to 9 m). They are less sensitive to impurities in the water than side channel pumps or peripheral pumps. This type of pumps is shown in Fig. 5.

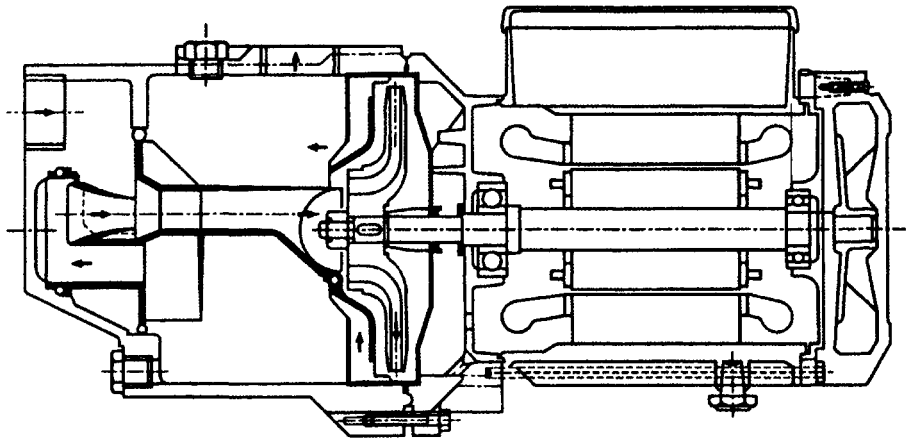

FIG. 5 SELF PRIMING PUMP WITH BUILT-IN EJECTOR