IS 8472 : 1998

भारतीय मानक

पम्प — पुनर्योजी स्वच्छ ठंडे पानी के लिए विशिष्टि

(पहला पुनरीक्षण)

Indian Standard

PUMPS — REGENERATIVE FOR CLEAR, COLD WATER — SPECIFICATION

(First Revision)

ICS 23.080

BUREAU OF INDIAN STANDARDS
MANAK BHAVAN, 9 BAHADUR SHAH ZAFAR MARG
NEW DELHI 110002

August 1998

Price Group 7

FOREWORD

This Indian standard (First Revision) was adopted by the Bureau of Indian Standards, after the draft finalized by the Pumps Sectional Committee had been approved by the Heavy Mechanical Engineering Division Council.

This standard was first published in 1977. Since then 2 amendments were issued in 1980 and 1987 respectively.

The present revision has been taken up to align the method of verification of guarantee with the other pump standard like IS 9079, IS 8034 and IS 6595. Also the requirements of self priming characteristics in case of self-priming and semi-self-priming pumps have been incorporated.

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 : 1960 'Rules for rounding off numerical values (*revised*)'. The number of significant places retained in the rounded off value should be the same as that of the specified value in this standard.

Indian Standard

PUMPS — REGENERATIVE FOR CLEAR, COLD WATER — SPECIFICATION

(First Revision)

1 SCOPE

This standard specifies the technical requirements for regenerative, that is, repeated centrifugal action pumps for handling clear, cold water. The pumps may be constructed as bare pumps or monosets in single-or multi-stage construction.

2 REFERENCES

The Indian Standards listed in Annex A are necessary adjuncts to this standard.

3 TYPES

Regenerative pump designs are mainly of two types:

a) Side channel type, and
b) Peripheral type.

In terms of their design capabilities, the pumps may be categorized as:

i) non-self-priming,
ii) semi-self-priming, and
iii) self-priming.

3.1 Non-self-Priming

It is that type of regenerative pump which cannot prime without a foot valve.

3.2 Semi-self-Priming

It is that type of regenerative pump which is capable of priming up to 1.5 m static suction lift without foot valve, at rated head and discharge.

3.3 Self-Priming

It is that type of regenerative pump which is capable of priming up to 3 m static suction lift without a foot valve, at rated head and discharge.

4 PRINCIPLE OF OPERATION

In these pumps, the energy transfer takes place by centrifugal regeneration in series of impeller pockets and the peripheral or side channel casing.

5 UNITS, TERMINOLOGY AND CLASSIFICATION

5.1 Units, terminology and classification relating to pumps shall be as specified in IS 5120 and for motors as specified in IS 996 and IS 7538.

5.2 Manometric Suction Lift

It is the vacuum gauge/suction manometer reading in metre of water column.

5.3 Static Suction Lift

It is the vertical distance between the centre line of the horizontal portion of the suction pipe line and the water level (*see* Fig. 6, 7, 8 and 12).

6 CHARACTERISTICS OF CLEAR, COLD WATER

Characteristics of clear, cold water are specified below:

a) Turbidity	50 ppm (silica scale), *Max*
b) Chlorides	500 ppm, *Max*
c) Total solids	3 000 ppm, *Max*
d) *p*H value	6.5 to 8.5
e) Temperature	33°C, *Max*
f) Specific gravity	1.004, *Max*
g) Hardness (as Ca Co_3) (drinking water)	300 mg, *Max*

NOTES

1 If the range of *p*H value of the water pumped is between 6.5 and 7.5 and also the chloride content is less than 100 ppm, the pump may be made of any bronze. However, if the range of *p*H is between 6.5 and 8.5 and the chloride content exceeds 100 ppm, only zinc-free bronze fitted construction or stainless steel construction shall be permitted.

2 If any other characteristics of the water differ from those specified in 6, the pump details shall have to be agreed between the manufacturer/supplier and the user and shall be specified in the order.

7 NOMENCLATURE

Nomenclature of the pump parts commonly used for regenerative pumps shall be as given in Fig. 1, 2, 3, 4 and 5. Nomenclature of the motor parts shall be as given in IS 1885 (Part 35).

8 MATERIALS OF CONSTRUCTION

It is recognized that a number of materials of construction are available to meet the needs for pumps handling clear, cold water. A few typical materials are indicated below merely for the guidance of the manufacturers and the users.

Component	*Materials of Construction*
Pump Casing/chamber	Casting grade FG200 of IS 210, LTB 2 of IS 318
Impeller	Bronze Grade LTB2 of IS 318, HTB1/HTB2 of IS 304
Shaft	Stainless Steel Grades X04Cr12, X12Cr12 and X20Cr13 of IS 6603

9 DIRECTION OF ROTATION

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

9.2 The direction of rotation shall be clearly marked either by incorporating an arrow in the casting or by a separate metal plate arrow fitted to the pumps at a place clearly visible.

9.3 The direction of inlet and outlet of the pumps shall be marked on the castings.

10 FACTORS AFFECTING PUMP PERFORMANCE

10.1 The degree of compliance of pump components and assembly to the specified requirements affect the pump performance since the dimensional tolerances and clearances required by these pumps are critical.

10.2 Under identical suction conditions with increase in usage of such pumps or wear of impeller and casings, the self-priming time increases; and the head and discharge decrease.

11 DESIGN FEATURES FOR MONOSET

11.1 Voltage and Frequency Variation

Motor of the monoset pump shall be capable of delivering the rated output:

a) With the terminal voltage differing from its rated value by not more than + 6 percent and −15 percent.
b) The frequency differing from its rated value by not more than 3 percent.
c) Any combination of (a) and (b).

12 END CONNECTIONS

The nominal sizes of suction and delivery of the pump shall be as covered in IS 1239 (Part 1), IS 4984, IS 4985 and IS 12231.

NOTE — In case a different bore size of suction pipe other than declared bore pipe size is used for this test, the priming time will be directly proportional to the area ratio.

13 PUMP TESTS

13.1 The testing apparatus, test set-up and observations for the pumps shall be in accordance with IS 11346 except for pumps with vertical axis suction port — the test set-up shall then be as in Fig. 7. In addition hydrostatic and self-priming tests shall also be carried out as specified in **13.3** and **13.5**.

13.2 Sampling

The sampling and criteria of conformity shall be according to IS 10572.

13.3 Hydrostatic Test

Pump casing shall be of robust construction and shall be tested to withstand the shut-off pressure for at least 15 s.

13.4 The pump shall be capable to perform as per guaranteed duty point at the manometric suction lift of 4 m.

13.5 Self-Priming Test (for Self-Priming and Semi- Self-Priming Pumps only)

The pump shall be tested for self-priming time at a minimum static suction lift of 1.5 m for semi-self-priming and minimum static suction lift of 3 m for self-priming pump.

The test procedure shall be as follows:

No check or foot valve or any other external means of priming shall be installed in the suction piping. Fill pump casing with water and start the unit. The priming time shall be the total elapsed time between starting the unit and the time required to obtain a continuous flow through the discharge pipe (Fig. 12).

13.6 The observations of tests shall be recorded in a test record sheet. A specimen sheet is given in Annex B.

13.7 Bare pumps shall be tested using calibrated prime movers.

14 TEST FOR ELECTRICAL PERFORMANCE

The routine and type tests on monoset shall be performed as specified in **14.1** and **14.2**. The general requirements of the motor with regard to types of enclosures, methods of cooling, duty rating and earthing shall be in accordance with IS 996 or IS 7538.

14.1 Single Phase Monoset

14.1.1 *Routine Test*

The routine test shall comprise (a), (g) and (h) of **15.3.1** of IS 996.

14.1.2 *Type Test*

Type test shall comprise (a), (g) and (h) of **15.3.1** of IS 996, the tests for minimum breakway torque and pull-up torque at rated voltage and supply frequency and the temprature rise test given in **14.1.2.1**.

14.1.2.1 *Temperature-rise test*

14.1.2.1.1 Temperature rise test at rated voltage shall be conducted for the maximum current in the operating head range with rated voltage and supply frequency. The temperature rise shall not exceed the limits specified in Table 6 of IS 996.

14.1.2.1.2 Temperature-rise test at reduced voltage shall be conducted at 85 percent of the rated voltage and supply frequency with the same load as in **14.1.2.1.1**. The temperature rise shall not exceed the limits specified in Table 6 of IS 996 by more than 10°C.

14.2 Three-Phase Monoset

14.2.1 *Routine Test*

Shall comprise (a), (c), (e) and (f) of **22.3.2** of IS 7538.

14.2.2 *Type Test*

Shall comprise (b), (c), (d), (e), (m) and (n) of **22.3.1** of IS 7538 and the temperature-rise test given below.

14.2.2.1 *Temperature-rise test*

14.2.2.1.1 Temperature-rise test at rated voltage shall be conducted for maximum current in the operating head range with rated voltage and supply frequency. The temperature rise shall not exceed the limits specified in Table 1 of IS 12802.

14.2.2.1.2 Temperature-rise test at reduced voltage shall be conducted at 85 percent of the rated voltage and supply frequency with the same load as in **14.2.2.1.1**. The temperature rise shall not exceed the limits specified in Table 1 of IS 12802 by more than 10°C.

15 PRIME MOVERS FOR BARE PUMPS

15.1 Engine Drive

The engine shall conform to IS 7347 or IS 11170.

15.2 Electric Motor

The motor shall conform to IS 996 or IS 7538.

16 GUARANTEE ON PUMP PERFORMANCE AND TOLERANCES

16.1 Guarantee of Workmanship and Material

The pumps shall be guaranteed by the manufacturer against defects in material and workmanship. When used under the conditions specified in this standard, for a period of at least 15 months from the date of despatch or 12 months from the date of commissioning whichever is earlier.

16.2 Guarantee of Performance

16.2.1 When tested in accordance with **13** the pumps shall be guaranteed for their performance of:

a) discharge, total head, input power at the guranteed duty point and the full load current in the operating head range. The full load current declared shall be less than or equal to the value of full load current, *Max* specified in IS 996 or IS 7538. Where such values of full load current are not specified, the same shall be declared by the manufacturer.
b) maximum self-priming static suction lift at mean sea level.
c) maximum self-priming time at minimum 1.5 m static suction lift for semiself-priming pumps and minimum 3 m static suction lift for self-priming pumps.

NOTE — The pump performance shall be declared at the rated speed of the prime mover. In case of bare pumps the rated speed shall be declared by the manufacturer.

16.2.2 While carrying out verification of performance as per **13.4**, **16.2.1**(b) and (c), corrections shall be applied for altitude at the test place and water temperature other than 33°C. The corrections to be applied as per IS 11346.

16.3 Tolerances

16.3.1 At rated speed the pump shall give a minimum of 90 percent of rated total head at a minimum of 90 percent of rated discharge. The pump shall not take more than 110 percent of the declared power input at the guaranteed duty point.

16.3.2 The motor shall not get overloaded in the operating head range of ± 25 percent of rated head at rated voltage when the supply frequency is within the limits ± 3 percent of the rated frequency. The maximum allowable current shall be 1.07 times the declared full load current, defined in **16.2.1**(a).

16.4 Verification Procedure

16.4.1 *Discharge (Q)* versus *Total Head (H), Input Power (IP) and Current (I)*

a) Test readings of *Q*, *H* and *IP* corrected for rated speed shall be plotted on a graph and continuous curves drawn. Plot guaranteed duty point *Q*g *H*g on this graph (*see* Fig. 9). If the guaranteed duty point lies below the *Q-H* curve pumps shall be deemed to have conformed to the head and discharge requirements.
b) For verification of input power draw a straight line through the origin and *Q*g *H*g to intersect the *Q-H* curve. Draw a vertical line through the point of intersection so that it intersects the *Q-IP* curve. The value of *IP* at the point of intersection shall be within the limit specified in **16.3.1.**

c) Test readings of Q, H and I shall be plotted on a graph and continuous curves drawn. Horizontal lines shall be drawn at duty point head +25 percent and duty point head −25 percent to intersect the Q-H curve (*see* Fig. 10). Vertical lines shall be drawn through the points of intersection to intersect the Q-I curve. If the maximum value between the points of intersection on the Q-I curve is not more than the value specified in **16.3.2**, the prime mover is not overloaded.

d) If the guaranteed duty point lies above the test Q-H curve then a point 0.90 Qg,0.90 Hg shall be plotted. Then, if this point lies on or below the curve (*see* Fig.11) the guarantee condition in respect of head and discharge shall be deemed to have been met, otherwise not.

16.4.2 In the case of bare pumps a calibrated prime mover shall be used. When tested with such prime movers the power consumption by the pump shall not exceed the recommended prime mover rating in the specified operating head range with the tolerance specified in **16.3.1**. Correction shall be made for losses between the driving element and the pump as follows.

Power delivered to the pump shaft when directly connected shall be the power output of the driving element. When not directly connected, correction shall be made for the losses between the driving element and the pump. In the case of flat belt and V-belt drives, the allowances for belt losses may be taken as 6 and 3 percent, respectively.

17 MARKING AND PARAMETERS TO BE DECLARED BY THE MANUFACTURER

17.1 The monoset pump shall be marked with the following parameters, which shall be declared by the manufacturer:

a) Model, size and serial number of the pump;
b) Rated speed, total head and discharge at the guaranteed duty point;
c) Range of head;
d) Motor rating(kW)/Prime mover rating;
e) Rated voltage;
f) Rated frequency;
g) Number of phases;
h) Winding connection;
j) Maximum current in amperes;
k) Class of insulation of motor;
m) Manufacturer's name/trade-mark;
n) Power input in kW;
p) Classification;
q) Number of stages in case of multi stage; and
r) Self-priming time at 1.5 m or 3 m static suction lift.

NOTE—For prime-movers other than electric motor items (e), (f), (g), (h), (j), (k) and (n) shall not be applicable.

17.2 In case of bare pumps the parameters mentioned at **17.1** (a), (b), (c), and (m) and prime mover rating shall be declared by the manufacturer and shall be marked on the pump.

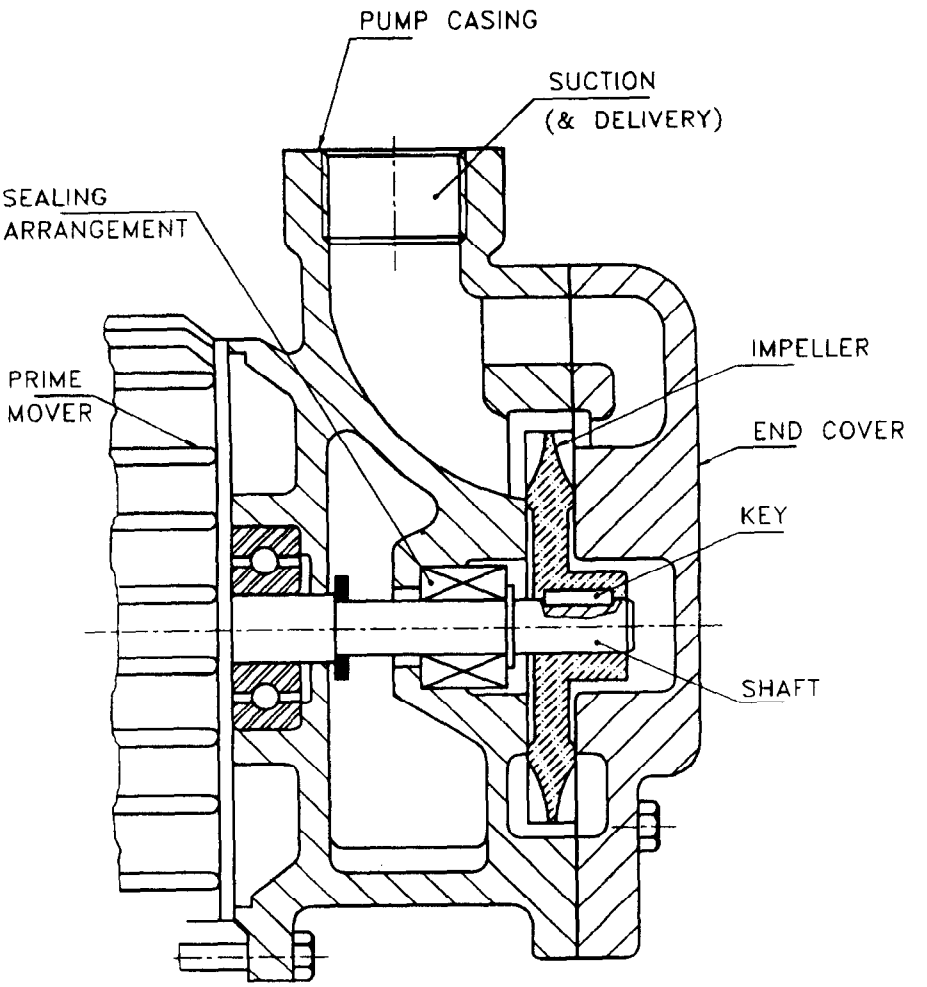

FIG. 1 TYPICAL REGENERATIVE SELF-PRIMING MONOSET PUMP (PERIPHERAL TYPE)

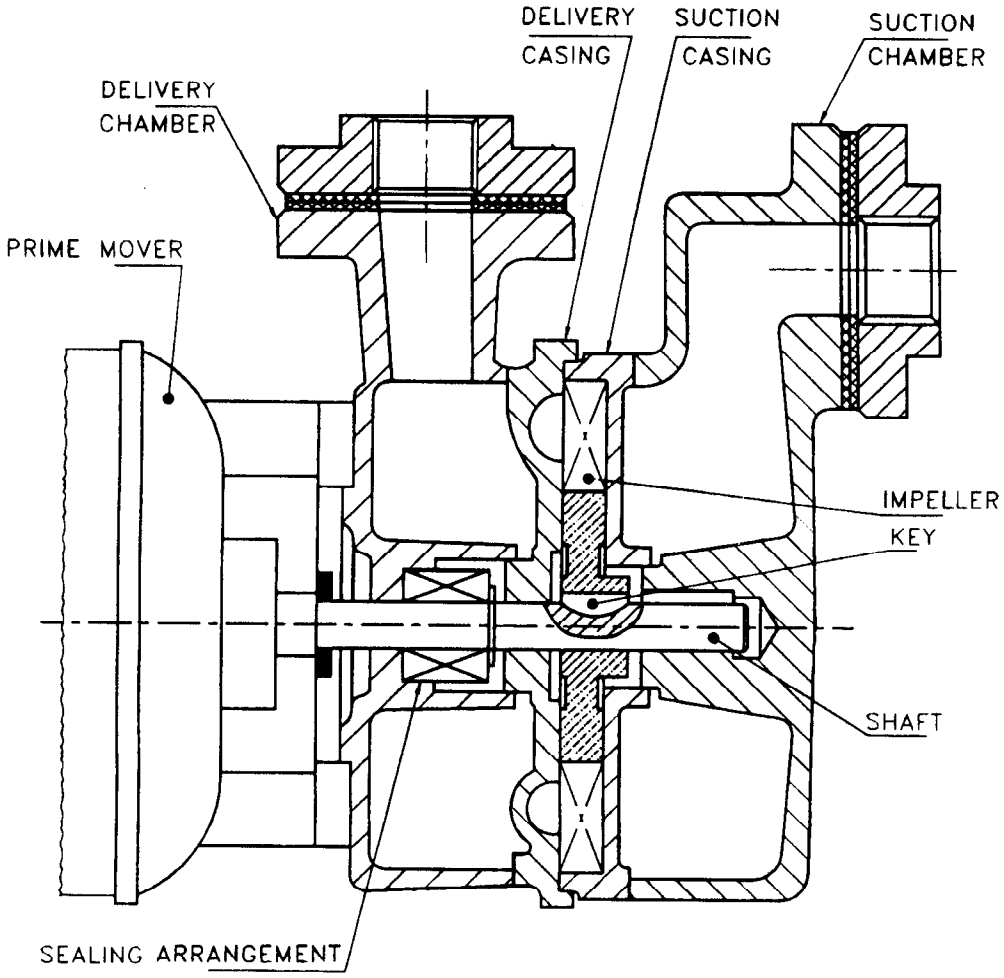

FIG. 2 TYPICAL REGENERATIVE SELF-PRIMING MONOSET PUMP (SIDE CHANNEL TYPE)

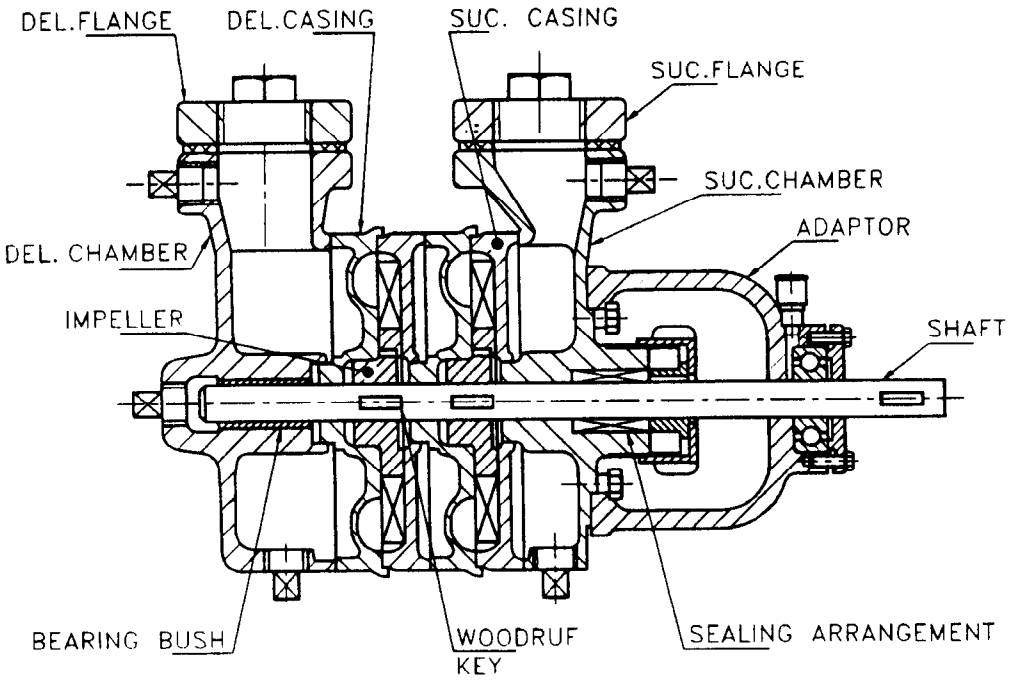

FIG. 3 REGENERATIVE PUMP (SIDE CHANNEL MULTI-STAGE TYPE)

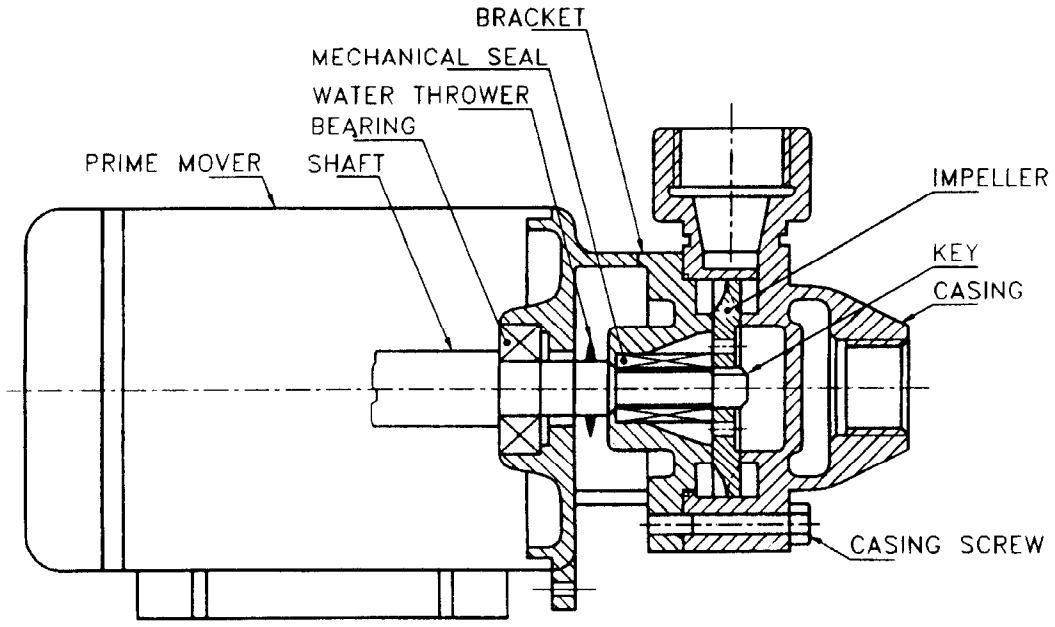

FIG. 4 TYPICAL REGENERATIVE PUMP

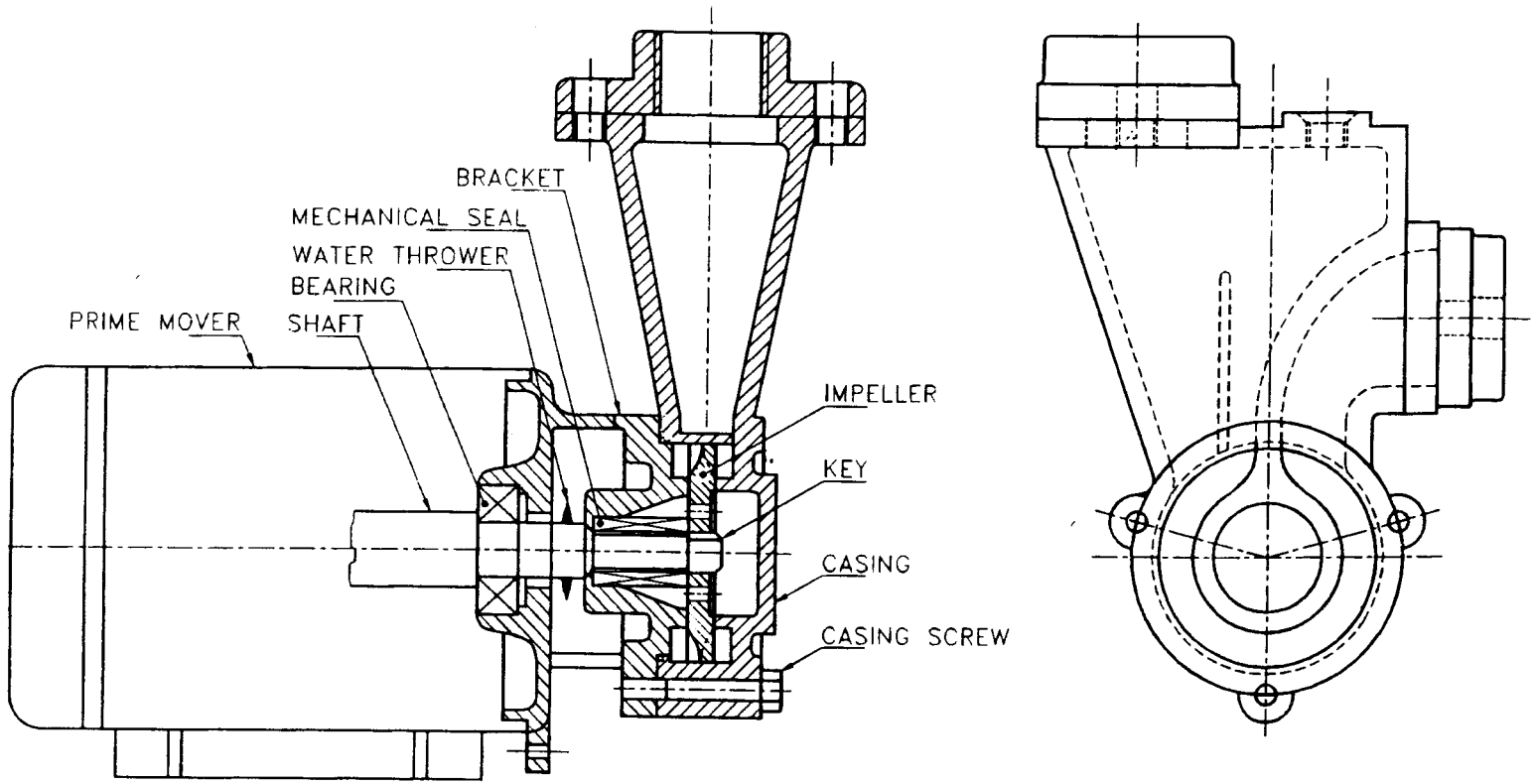

FIG. 5 TYPICAL REGENERATIVE PUMP

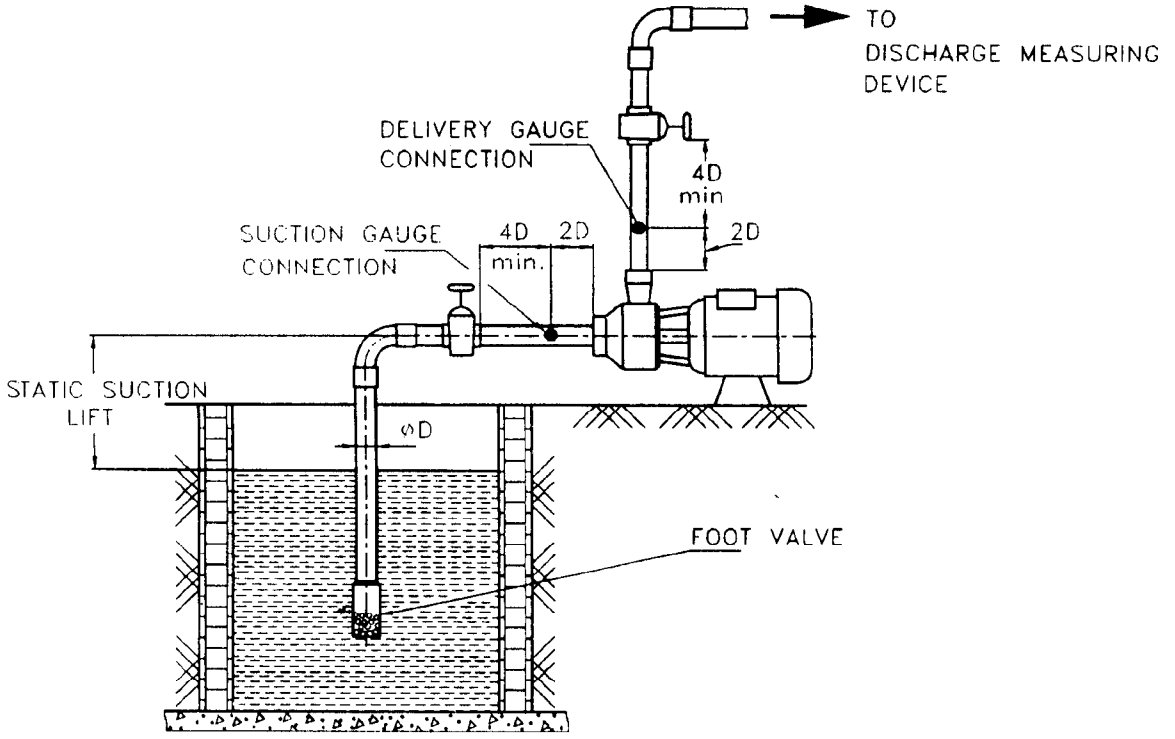

FIG. 6 NON-SELF-PRIMING MONOSET TEST SET-UP

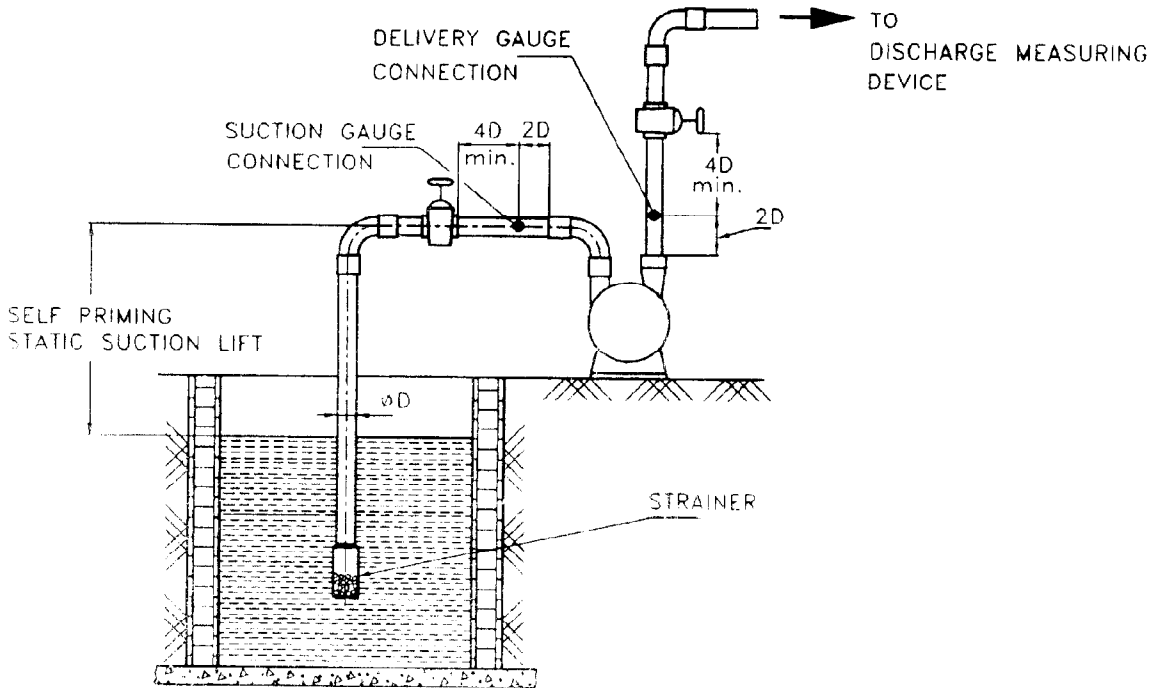

FIG. 7 SEMI-SELF-PRIMING TEST SET-UP

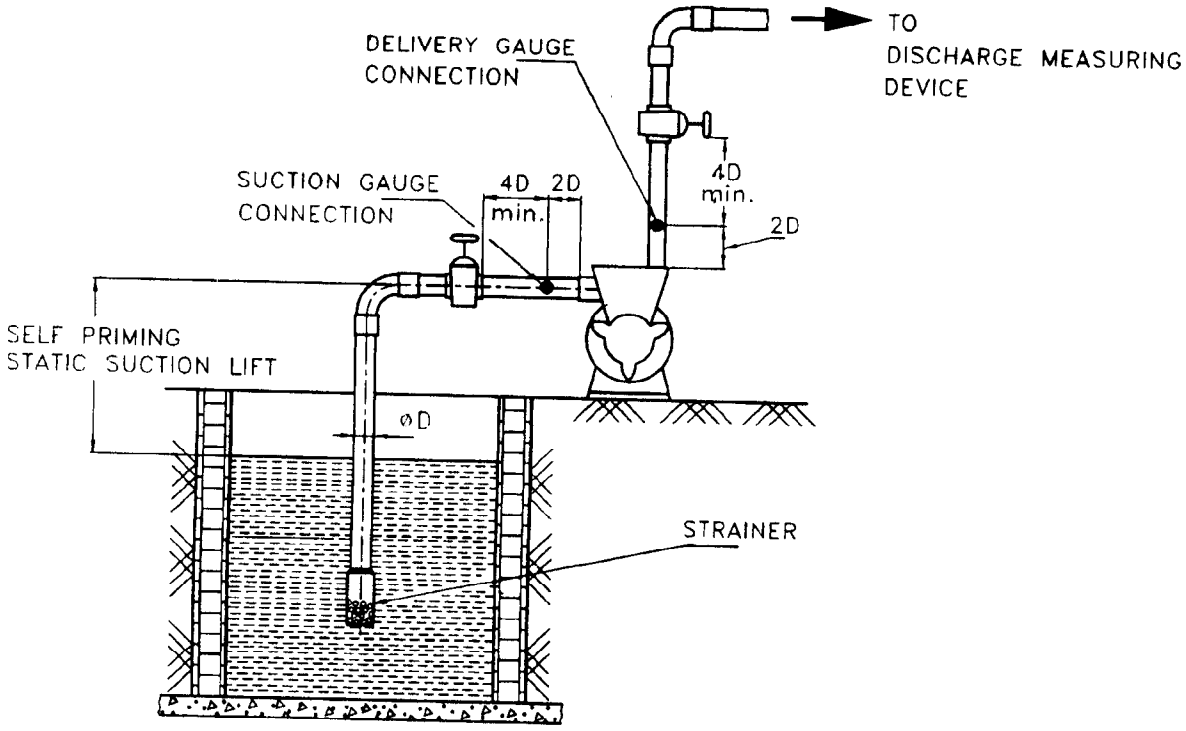

FIG. 8 SELF-PRIMING MONOSET TEST SET-UP

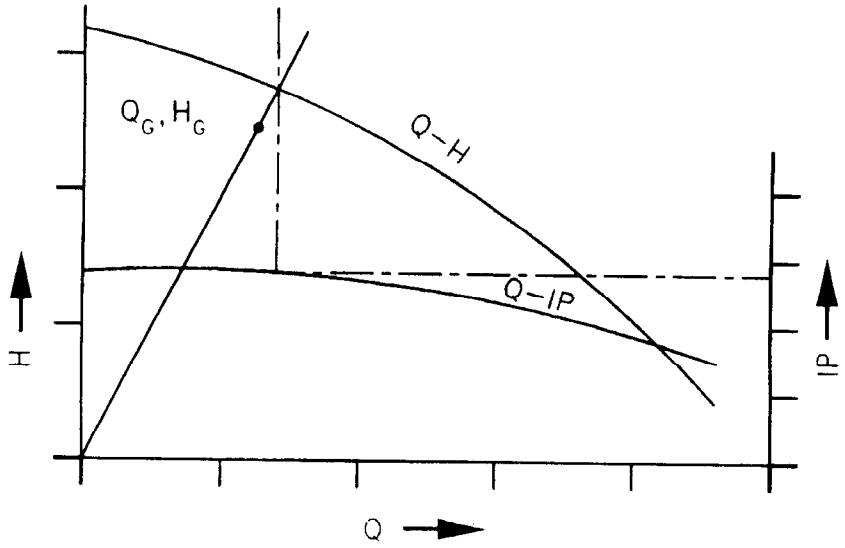

FIG. 9 CURVES FOR VERIFICATION OF GUARANTEE *Q-H*, *Q-IP* AT RATED SPEED

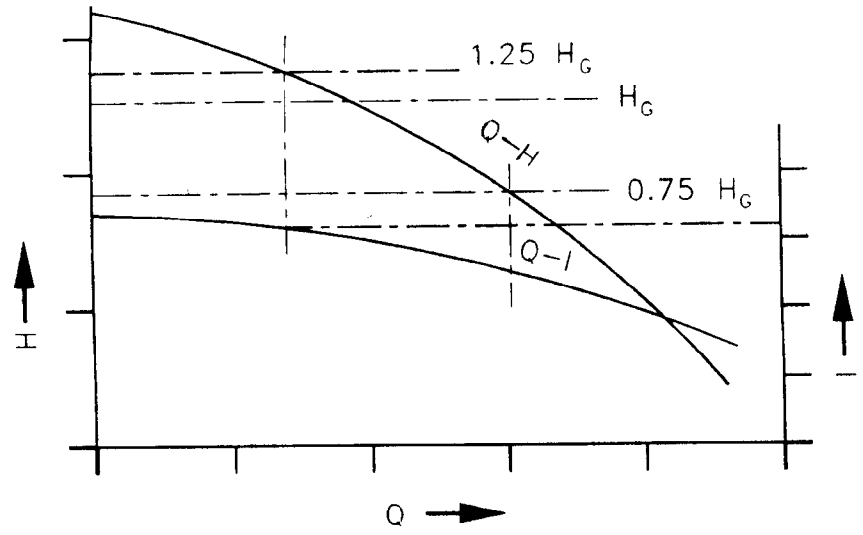

FIG. 10 CURVES FOR VERIFICATION OF GUARANTEE *Q-H*, *Q-I*—OBSERVED TEST READING

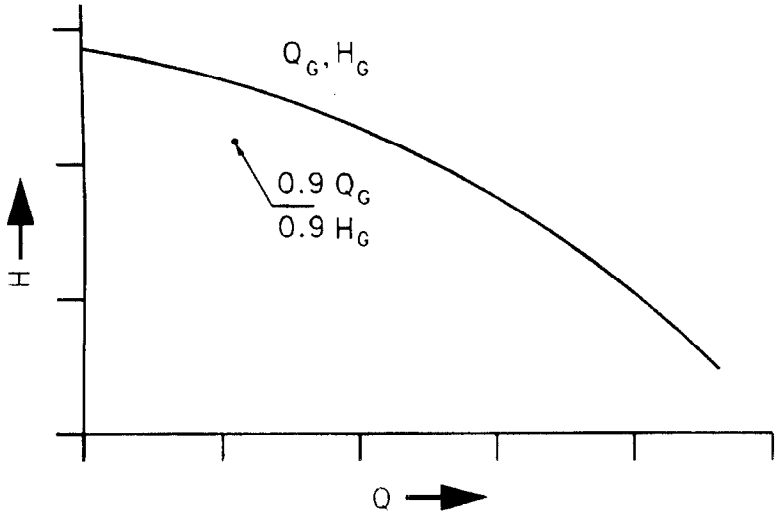

FIG. 11 CURVE FOR VERIFICATION OF GUARANTEE *Q-H* AT RATED SPEED— WHERE THE CURVE IS BELOW Q_G, H_G

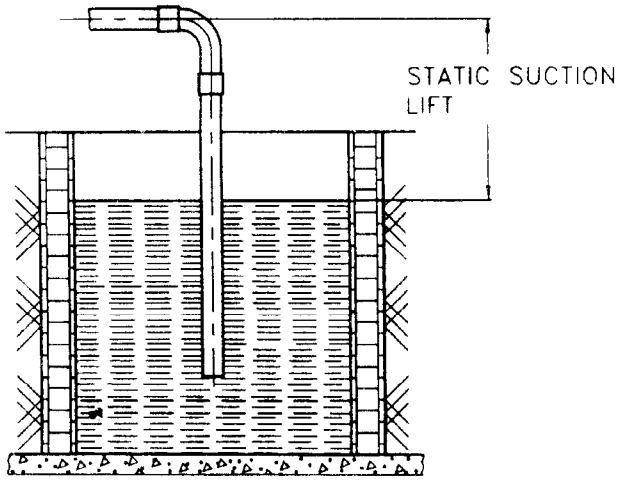

FIG. 12 TEST SET-UP FOR SELF-PRIMING TEST

ANNEX A

(*Clause* 2)

LIST OF REFERRED INDIAN STANDARDS

IS No.	*Title*
210 : 1993	Grey iron castings (*fourth revision*)
304 : 1981	High tensile brass ingots and castings (*second revision*)
318 : 1981	Leaded tin bronze ingots and castings (*second revision*)
996 : 1979	Single-phase small ac and universal electric motors (*second revision*)
1239 (Part 1) : 1990	Mild steel tubes, tubulars and other wrought steel fittings: Part 1 Mild steel tubes (*fifth revision*)
1885 (Part 35) : 1993	Electrotechnical vocabulary: Part 35 Rotating machinery (*first revision*)
4984 : 1995	Specification for high density polyethylene pipes for potable water supplies (*fourth revision*)
4985 : 1988	Unplasticized PVC pipes for potable water supplies (*second revision*)
5120 : 1977	Technical requirements for rotodynamic special purpose pumps (*first revision*)
6603 : 1972	Stainless steel bars and flats
7347 : 1974	Performance of small size spark ignition engines for agricultural sprayers and similar applications
7538 : 1996	Three phase squirrel cage induction motors for centrifugal pumps for agricultural applications (*first revision*)
10572 : 1983	Methods of sampling pumps
10805 : 1986	Footvalves, reflux valves or non-return valves and bore valves to be used in suction lines of agricultural pumping systems (*first revision*)
11170 : 1985	Performance requirements for constant speed compression ignition (diesel) engines for agricultural purposes (up to 20 kW)
11346 : 1985	Testing set-up for agricultural pumps
12231 : 1987	UPVC (rigid) pipes for use in suction and delivery lines of agricultural pumps
12802 : 1989	Temperature rise measurement of rotating electrical machines

ANNEX B

(*Clause* 13.6)

Name of Manufacturer:

PUMP TEST RECORD SHEET (TYPICAL)

Sheet No.....
Refer Graph No.....

Pump Type .....
Suction .....mm
Imp. dia .....mm
Capacity Measured by
Suction lift measured by: Hg manometer/Vaccum Gauge
Delivery head measured by: Hg manometer/ Pressure Gauge
Motor Eff. Reference : Performance Curve at Full Load, rpm

Pump No. .....
Delivery .....mm
Material .....

Motor Make .....
Motor Rating .....kW
Motor Frame .....
Motor Sl No. .....

FULL LOAD
Current .....Amps
Speed .....Rpm
Motor Efficiency .....%

Voltage .....Volts
Phase .....
Frequency .....Hz

Nature of Test — Performance test as per IS:

Sl. No.	Speed of Pump rev/min	Suction Guage Reading, m	Delivery Gauge Reading, m	Guage Distance, Z m	Velocity Head Correction, m	Total Head, m	Discharge Measurement	Discharge in l/s	Current, A	Voltage, V	Watt Meter Reading		Watt Meter Reading (IP) kW	Pump Input (BP) kW	Pump Output (LP) kW	Preformance of Rated Speed		
											W1	W2				H m	Q l/s	BP kW

Pump Certified for
i) Head Range.....m
ii) *Max.* Self-Priming Time.....s
iii) *Max.* Self-Priming Static Suction Head .....m (at mean sea level)

i) Total Head in m
ii) Discharge in l/s..... rev/min..... Pump Input kW

Date.....
Tested by.....
Set started at.....
Set stopped at.....

Remarks.....
.....
.....
.....

General Requirements — Satisfactory/ Unsatisfactory

Bureau of Indian Standards

BIS is a statutory institution established under the *Bureau of Indian Standards Act*, 1986 to promote harmonious development of the activities of standardization, marking and quality certification of goods and attending to connected matters in the country.

Review of Indian Standards

Amendments are issued to standards as the need arises on the basis of comments. Standards are also reviewed periodically; a standard along with amendments is reaffirmed when such review indicates that no changes are needed; if the review indicates that changes are needed, it is taken up for revision. Users of Indian Standards should ascertain that they are in possession of the latest amendments or edition by referring to the latest issue of 'BIS Handbook' and 'Standards Monthly Additions'.

This Indian Standard has been developed from Doc: No. HMD 20 (0276).

Amendments Issued Since Publication

Amend No.	Date of Issue	Text Affected

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AMENDMENT NO. 1 OCTOBER 2000
TO
IS 8472 : 1998 PUMPS — REGENERATIVE FOR CLEAR, COLD WATER — SPECIFICATION

(First Revision)

(*Front cover page and page* 1, *Title*) — Substitute the following for the existing title:

'Indian Standard

CENTRIFUGAL REGENERATIVE PUMP FOR CLEAR, COLD WATER — SPECIFICATION

(First Revision)'

(*Page* 1, *clause* 1) — Substitute the following for the first sentence:

'This standard specifies the technical requirements for centrifugal regenerative pump that is, repeated centrifugal action pumps for handling clear, cold water.'

(*Page* 4, *add new clause* 17.3) — Insert the following new clause 17.3 after 17.2:

'17.3 Standard Mark

17.3.1 The centrifugal regenerative pump may also be marked with the Standard Mark.

17.3.2 The use of Standard Mark is covered by the provisions of the *Bureau of Indian Standards Act*, 1986 and the Rules and Regulations made thereunder. The details of conditions under which a license for the use of Standard Mark may be granted to manufacturers or producers, may be obtained from the Bureau of Indian Standards.'

Reprography Unit, BIS, New Delhi, India