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SPECIFICATION FOR DEEP-WELL RECIPROCATING HAND PUMPS

Sri Lanka Standards Institution

DRAFTING COMMITTEE ON WATER PUMPS

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FOREWORD

This standard was authorized for adoption and publication as a Sri Lanka Standard by the Council of the Sri Lanka Standards Institution on 91/04/02, after the draft, finalized by the Drafting Committee on Water Pumps, had been approved by the Mechanical Engineering Divisional Committee.

All standard values given in this specification are in SI units.

The type of handpump covered by this specification is the 'deep-well reciprocating' type, which has found wider application in Sri Lanka compared to other types, for example : Direct action, Diaphragm and Progressive - cavity types.

The scope of this standard is limited to pumps operating upto 30 m depth. Pumps for greater depths will be the subject of a subsequent standard.

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 an analysis, shall be rounded off in accordance with CS 102. The number of significant figures to be retained in the rounded off value shall be the same as that of the specified value in this standard.

The assistance derived from the publications of the International Organization for Standardization (ISO) and the British Standards Institution in the preparation of this standard is gratefully acknowledged.

1 SCOPE

This specification lays down minimum requirements of material, dimensions, performance, testing and sampling for deep-well reciprocating hand pumps used in wells upto a maximum depth of 30 metres and bore hole diameters of 100 mm and above.

2 REFERENCES

ISO	630	Structural steels
BS	970	Wrought steel for mechanical and allied engineering purposes
CS	102	Presentation of numerical values
SLS	147	Rigid unplasticized polyvinyl chloride pipes for potable cold water supplies (first revision)
SLS	268	ISO metric screw threads

SLS 428 Random sampling methods
SLS 482 Code of practice for hot-dip galvanizing of iron and steel.

3 DEFINITIONS

For the purpose of this standard the following definitions shall apply (see Fig. 1) :

3.1 connecting rod : The linking member which connects the piston of the cylinder with the reciprocating mechanism of the head assembly.

3.2 cylinder assembly : The cylinder along with its piston, valves and other components.

3.3 head assembly : The mechanism and its housing above the ground level which operates the cylinder piston.

3.4 piston seal : The sealing component of the piston.

3.5 riser pipe : The pipe through which water is transported from the cylinder to the head assembly while housing the connecting rod.

4 REQUIREMENTS

4.1 Materials and construction

Pipes, pipe joints and pipeline parts of unplasticized PVC used in the construction of tank assembly, pump cylinder and riser pipe of the handpump shall satisfy the requirements laid down in **5.1, 5.3** and **5.4** of SLS 147 : 1983. They shall not impart to the water pumped any taste, odour, colour or any substances injurious to health in hygienically undesirable quantities. Materials used for the construction of the pump shall not promote the growth of algae and harmful bacteria in water.

4.1.1 Head assembly

4.1.1.1 Handle and linkages

The handle shall be made out of structural steel conforming to grade Fe 36Ø of ISO 63Ø or any other equivalent or better grade.

If a roller chain is used to couple the connecting rod with the handle, It shall have a minimum pitch of 25 mm and a minimum breaking load of 2Ø kN.

If an alternative linkage is used between the connecting rod and the handle it shall be equal or better in strength and wear resistance when compared with the above chain.

If bearings with rolling elements are used, they shall be of 'pre-lubricated and sealed' type.

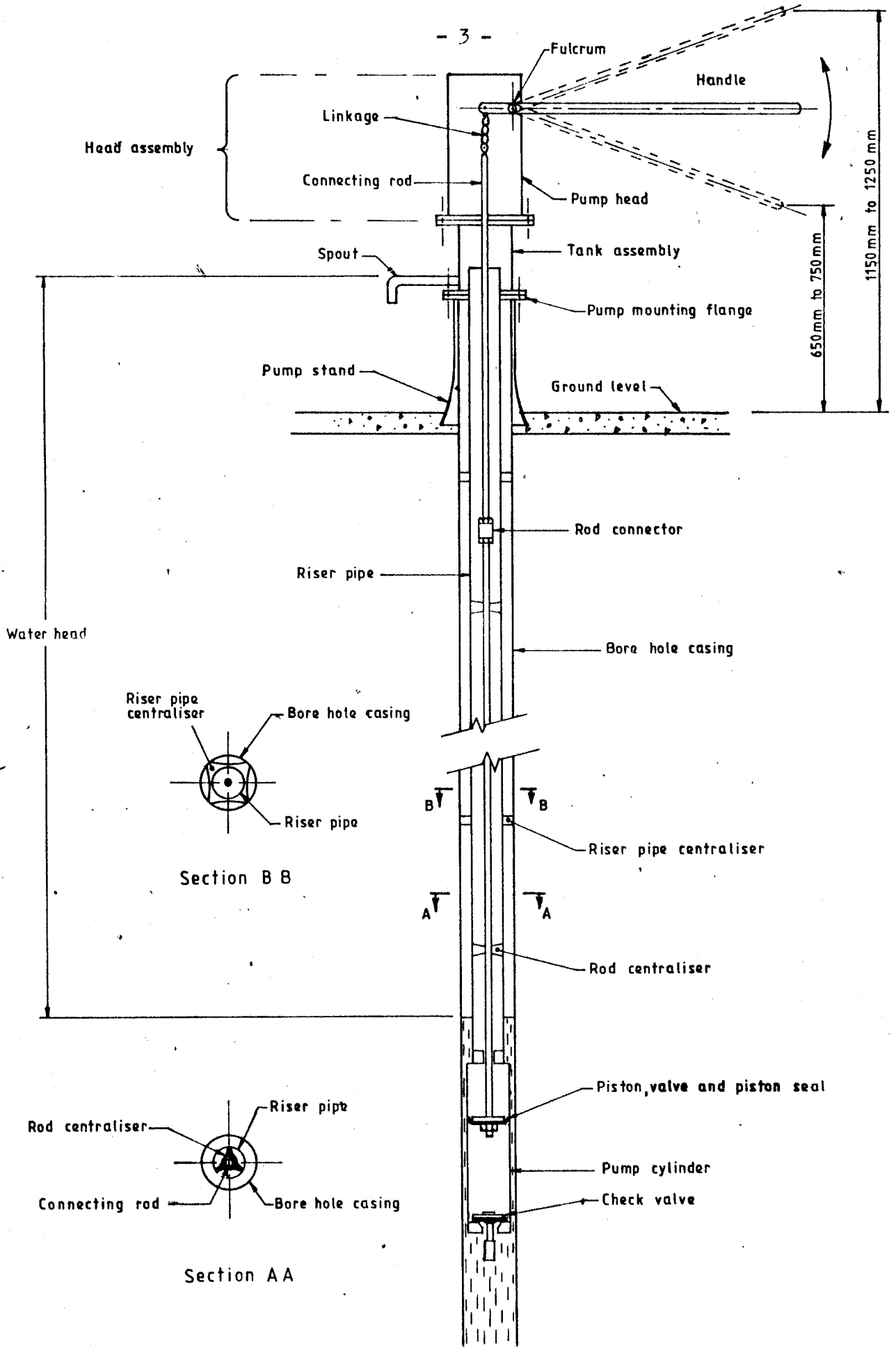

FIGURE 1 - Typical arrangement of deep-well reciprocating hand pump

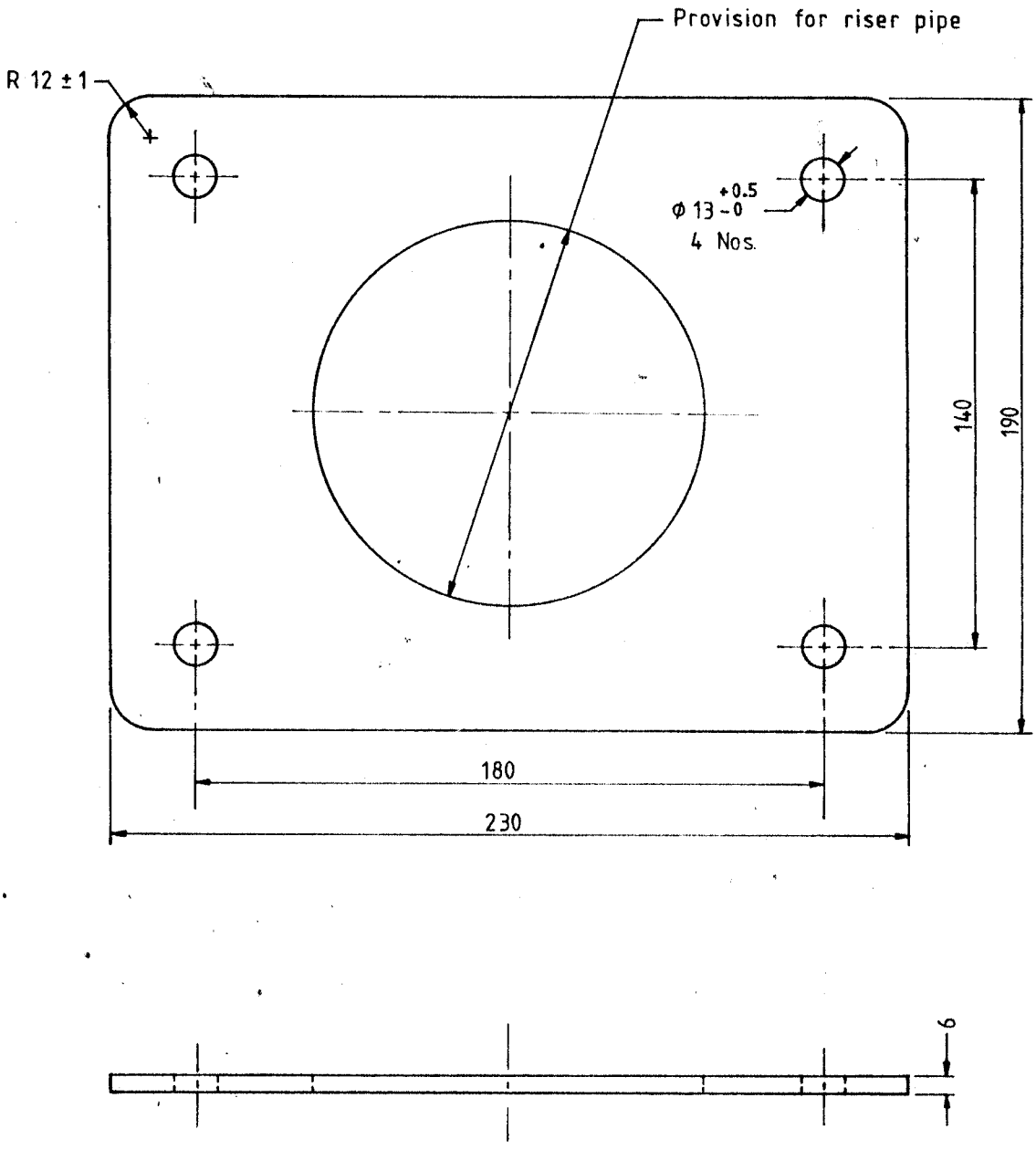

FIGURE 2 – Pump mounting flange

Through the range of the stroke the lowest point of the end of the handle shall be 650 mm to 750 mm and the highest point shall be 1150 mm to 1250 mm from the operating ground level. (see Fig.1).

4.1.1.2 Axle (Fulcrum)
The axle shall be made of carbon steel conforming to grade 080M36 of BS 970 : Part 1.

Alternatively a corrosion proof material such as stainless steel having strength equivalent to or better than that of grade 080M36 of BS 970 : Part 1 shall be used.

4.1.1.3 Head
The head shall be made out of non-corrosive material or if made of steel it shall be hot dipped galvanized conforming to SLS 482 after fabrication.

4.1.1.4 Tank assembly
The Tank assembly shall be made out of non-corrosive material or if made of steel it shall be hot dipped galvanized conforming to SLS 482 after fabrication. The tank shall be enclosed as far as possible to avoid ingress of foreign material.

4.1.1.5 Pump stand & pedestals
The pump stand and pedestal shall be constructed out of non corrosive material or if made of steel it should be hot dipped galvanized conforming to SLS 482.

It is recommended that the mounting flange of the handpump should conform to Fig.2

4.1.1.6 Fasteners in head assembly
The fasteners in the head assembly shall be of steel hot dipped galvanized conforming to SLS 482 or stainless steel conforming to grade 304 of BS 970 : Part 1 throughout. All screw threads used shall comply with SLS 268. Any fasteners used other than screws shall conform to the relevant Sri Lanka Standards.

Bolts and nuts of the head assembly, as far as possible, shall be of one size (preferably M12).

4.1.1.7 User abuse
Head assembly including the handle shall be capable of withstanding the user abuse test specified in 6.3.

4.1.2 Pump cylinder and piston mechanism

The pump cylinder and piston mechanism shall be of stainless steel or equivalent non-corrosive material throughout. Fasteners, when used, shall be of stainless steel or of equivalent non-corrosive material.

The pump cylinder, if lined with metal, shall have a minimum wall thickness of 1 mm.

Stainless steel, when used, shall conform to grade 304 of BS 970 : Part 1.

4.1.2.1 Piston seal
The piston seal shall be made of natural rubber to hardness not exceeding IRHD 75. The maximum water absorption of the piston seal shall be 1 per cent in 48h at 30 °C.

Any other elastomer, if used for the piston seal, shall conform to the hardness and water absorption requirements specified above for seals made of natural rubber. Such elastomers shall not constitute a toxic hazard and shall not foster microbiological growth nor give rise to taste or odour, cloudiness or discoloration of the water being pumped.

4.1.2.2 Other sealing components
All other sealing components in contact with the water being pumped, for example : valve seats, O-rings, shall be of natural rubber or any other elastomer as specified in 4.1.2.1.

4.1.3 Connecting rod
The connecting rod and connectors shall be made out of stainless steel or equivalent non-corrosive material and shall have a minimum diameter of 10 mm.

The spacing spiders/centralisers between the connecting rod and the riser pipe shall be of natural rubber or equivalent elastomer of comparable strength and corrosion resistance. These elastomers shall satisfy the water potable requirements specified in 4.1.2.1.

4.1.4 Riser pipe
The riser pipe shall be of unplasticized polyvinyl chloride conforming to 5.1, 5.3 and 5.4 of SLS 147 : 1983 with minimum wall thickness of 6 mm (if threaded) or 4 mm if alternative non threaded joints are used or non-corrosive material of equivalent strength.

The riser pipe shall be supplied in standard lengths of minimum 3 m and provided with suitable connections of adequate flexibility.

The spacing spiders/centraliser between the bore hole casing and the riser pipe shall be of natural rubber or equivalent elastomeric material.

4.2 Dimensions and duty ratings

4.2.1 Bore of the cylinder
The bore of the cylinder shall be either 50 mm or 64 mm measured as the inside diameter of the cylinder wall.

4.2.2 Minimum flow rate
The minimum flow rate shall be 0.25 litres per full stroke at 30 m depth at the pumping rate of 40 full strokes per minute.

4.3 Workmanship and finish

4.3.1 Above ground level components

Components above the ground level shall be of operator safe design, free of finger traps and have no sharp edges or corners. The edges shall be rounded and /or smoothed and free of burrs. The grip of the handle in particular should be rounded, comfortable and smooth to the touch.

4.4 Performance

4.4.1 Energy input

When the pump is tested according to the method described in 6.2.1 the energy input to the pump shall not exceed 100 joules at 40 full strokes per minute at 30 m waterhead.

4.4.2 Efficiency

The mechanical efficiency of the pump shall be not less than 75 per cent and the volumetric efficiency not less than 80 per cent at 40 full strokes per minute and 30 m waterhead.

4.4.3 Performance after endurance test

When the pump is tested according to the methods described in 6.2.2 the volumetric efficiency of the pump shall not fall below 70 per cent and energy input shall not exceed 105 joules at 40 full strokes per minute.During the period of these tests there shall be no structural or mechanical failure of any part of the pump.

4.5 Information to be provided by the supplier

4.5.1 An adequately illustrated manual shall be provided by the supplier. The manual shall include a complete list of regular and optional parts, instructions for dismantling, cleaning and assembly, instructions for routine inspection, adjustments and replacement of parts, and instructions for handling and using the pump.

4.5.2 The following information shall be provided by the supplier on request to the purchaser:

a) Dimensions of pump components with descriptive drawings for illustrations;
b) Unit weight of the connecting rod and riser pipe of the pump;
c) Material specification of components;
d) Complete parts list with part numbers;
e) Maximum recommended depth of installation or water-head;
f) Installation instructions;
g) Maintenance instructions;
h) List of tools required to install and maintain the pump with mention of special tools, if required;
i) List of all the parts which need regular replacement; and
j) Pump performance characteristics.

5 MARKING

Pumps shall be marked legibly and indelibly with the following :
a) Name and address of the manufacturer and/or registered trade mark ;
b) Country of manufacture ;
c) Minimum discharge at the recommended water-head ;
d) Model number and serial number.
e) Maximum discharge at the recommended water-head; and
f) Date of manufacture.

6 METHODS OF TEST

6.1 Verification of specification

The pump specifications provided by the manufacturer as per 4.5.2 shall be verified using appropriate methods of test. Chemical analysis may be carried out to verify the material whenever the identification of material is in doubt.

6.2 Performance tests

The performance tests are carried out to determine the performance characteristics of the pumps. For example the inter-relationship between discharge water head, energy and efficiency. Clean water at atmospheric temperature shall be used for the performance tests.
The testing of pumps shall be conducted under field conditions or simulated conditions in the laboratory.

6.2.1 Test for efficiency

6.2.1.1 Procedure

The pump shall be tested at minimum of three different water heads starting from a minimum of 15 m through 30 m up to a maximum water head of 36 m. At each head the pump performance shall be tested for a maximum of three different pumping rates commencing from a minimum of 30 full strokes per minute through 40 up to the maximum rate of 50 full strokes per minute.

6.2.1.2 Measurements

The following data shall be gathered at each setting :
a) Depth measured from water surface to the level of water at the discharge ;
b) Number of strokes per minute ; and
c) Discharge.

6.2.1.3 Calculations

The following shall be calculated from the data collected :
a) Energy input to the pump ;
b) Pump mechanical efficiency ; and
c) Volumetric efficiency.

6.2.2 Test for endurance

6.2.2.1 Procedure

6.2.2.1 a) For type test referred to in 7.1 the endurance test shall be conducted at 30 m waterhead for 10,000,000 strokes at a pumping rate of 40 full strokes per minute.

6.2.2.1 b) For acceptance test referred to in 7.3 the endurance test shall be conducted at 30 m waterhead for 2,500,000 strokes at a pumping rate of 40 full strokes per minute.

6.2.2.2 Performance evaluation after endurance test

The performance of the pump shall be evaluated by repeating the efficiency test as described in 6.2.1.

6.2.2.3 Calculations
The following shall be calculated from the data collected :
a) Change in volumetric efficiency ; and
b) Change in energy input.

6.3 User abuse test

The above ground components of the pump shall be tested for user abuse. The following test shall be included in these tests :

The head,the handle and the spout shall withstand a lateral impact of not less than 500 joules.

7 SAMPLING

7.1 Type test

7.1.1 The type test is conducted to determine whether a particular manufacturer can be considered to be able to produce hand pumps in compliance with the performance requirements of the specification.

7.1.2 One hand pump conforming to the requirements of 4.1, 4.2,4.3, 5 and 6.1 shall be selected and tested for efficiency in accordance with 6.2.1, for endurance in accordance with 6.2.2.1 a) and for performance evaluation after endurance in accordance with 6.2.2.2.

NOTE
This should be done for every 1000 hand pumps of the model tested or each years production whichever is less.

7.1.3 If the handpump tested as in 7.1.2 satisfies the requirements of 4.4 the model is considered to conform to the specification for efficiency, endurance and performance after endurance.

7.2 Routine tests

7.2.1 Batch : All handpumps of the same model manufactured under conditons which are presumed uniform shall constitute a batch.

7.2.2 All batches of deep-well reciprocating handpumps shall be subjected to routine inspection by the manufacturer in accordance with this standard.

7.2.3 Each handpump of a batch shall be inspected for requirements under 4.1, 4.2, 4.3, 5 and 6.1.

7.2.3.1 Only those complying with the above requirements shall be accepted.

7.2.3.2 Each batch shall also satisfy the type test requirements as specified in 7.1.

7.3 Acceptance test

7.3.1 Lot : In any consignment all handpumps of the same model belonging to one batch of manufacture shall constitute a lot.

7.3.2 Samples shall be tested from each lot for ascertaining the conformity of the lot to the requirements of this specification.

7.3.3 Scale of sampling

7.3.3.1 The number of handpumps to be selected from a lot shall be in accordance with Table 1.

TABLE 1 - Scale of sampling

Number of handpumps in the lot	Number of handpumps to be selected
Up to 150	5
151 - 500	8
501 - 1200	13
1201 and above	20

7.3.3.2 The handpumps shall be selected at random. In order to ensure randomness of selection the random number tables as given in SLS 428 shall be used.

7.3.4 Number of tests

Each handpump selected as in 7.3.3.1 shall be examined as required under 4.1, 4.2, 4.3, 5 and 6.1.

7.3.5 One handpump tested and satisfying the requirements of 7.3.4 shall be selected and tested for efficiency in accordance with 6.2.1, for endurance in accordance with 6.2.2.1 b) and for performance after endurance in accordance with 6.2.2.2.

8 CRITERIA FOR CONFORMITY

8.1 A lot shall be declared as conforming to the requirements of this specification if the following conditions are satisfied :

8.1.1 Each handpump examined as in 7.3.4 satisfies the relevant requirements.

8.1.2 Each handpump tested as given in 7.3.5 satisfies the requirements of 4.4.

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