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CA
TESTING
AND
RESEARCH

WAVIN HANDPUMP

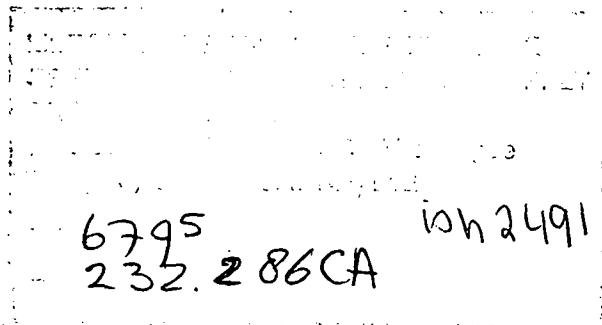
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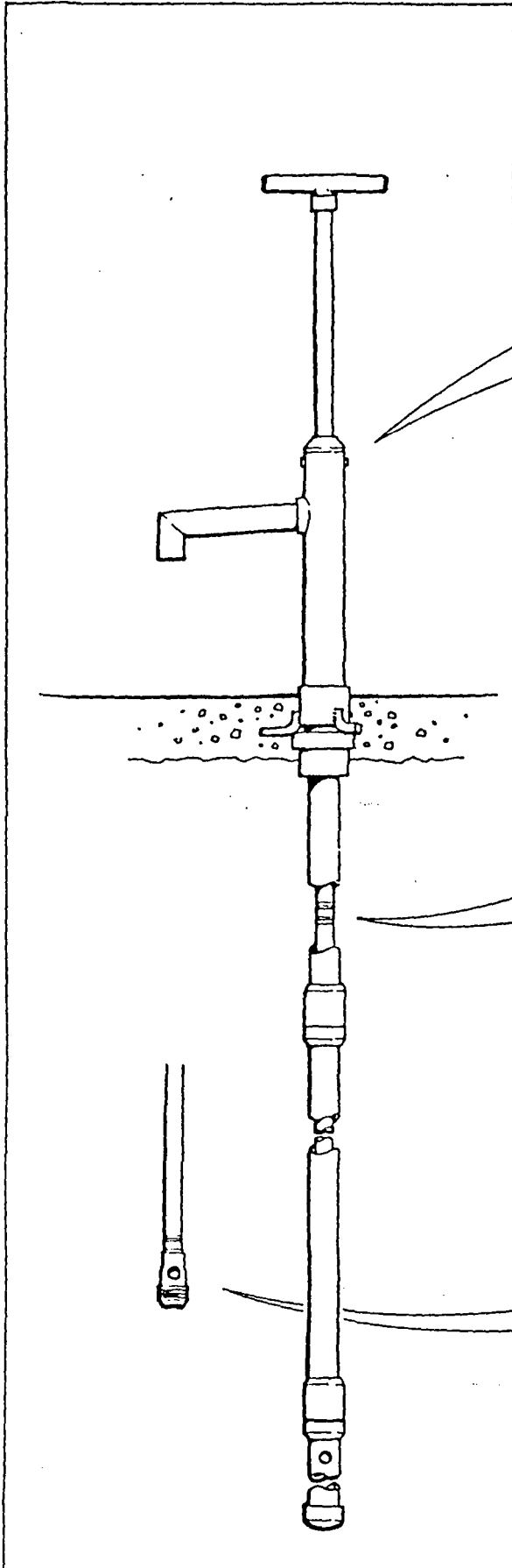
INTRODUCTION

This is the second of two reports on laboratory testing of the Wavin handpump. The earlier report, ref: A9113, dealt with inspection, a design assessment, a series of pump performance tests and a handle bump stop test. This consolidated report incorporates A9113 and also describes the results of a 4000 hour endurance test, followed by tests of pump performance after endurance, side impact tests and an engineering review.

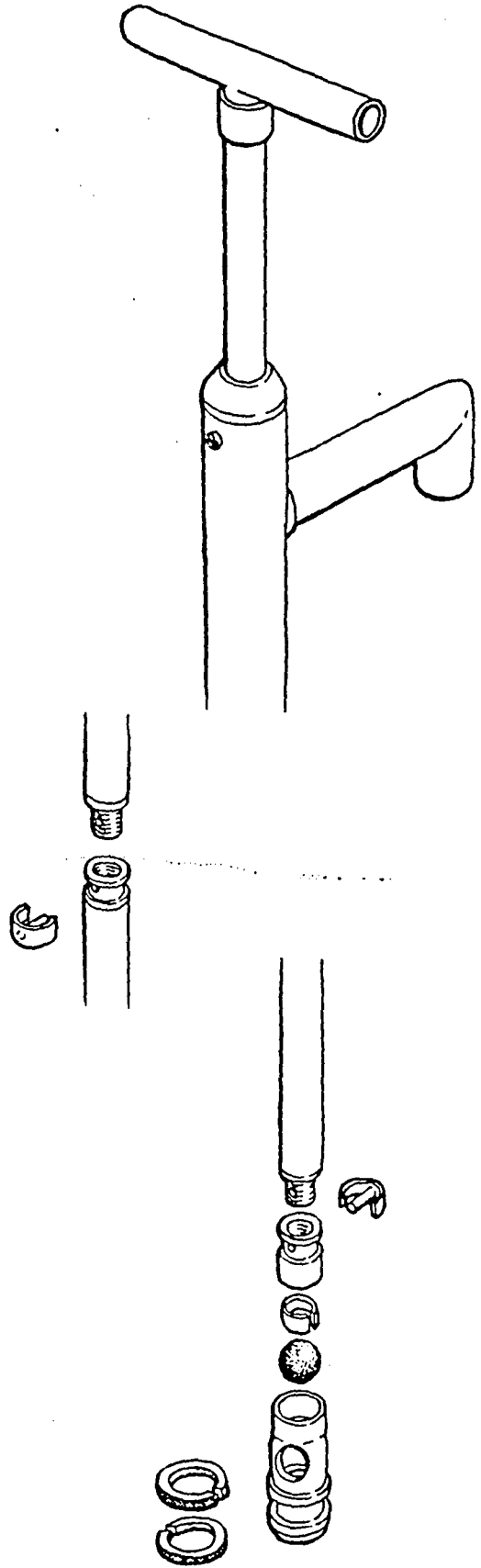
The sample supplied for testing was taken from an initial production batch of the Wavin direct action handpump. The pump incorporates a number of innovations, including the use of ramie cord as a piston seal and of epoxy cement to secure the connectors for the uPVC rising main and tubular pump rod. At the conclusion of the first phase of laboratory testing, the manufacturer provided new pump rods with modified joints for use in the endurance test.

All the tests were carried out using test procedures established by agreement with the World Bank, and the results are presented in the format established for World Bank reports.





Wavin Handpump



WAVIN HANDPUMP

1.1 Manufacturer Wavin Overseas b.v.

Address P O Box 158
7700 AD Dedemsvaart
The Netherlands

1.2 Description The sample supplied for testing was taken from an initial production batch of direct action pumps which use standard uPVC pipe for the rising main and as a lightweight pump rod. The pumpstand and handle were fabricated from steel sections, galvanised, with a polyethylene bush for the emerging pump rod.

The same component was used for both the piston and footvalve body, with rubber valve balls. The piston seal was ramie cord. Spare cord and valve balls were supplied attached to the dip tube, so in the event of failure, spares would be readily available when the pump was removed from the borehole.

The rising main sections were joined using threaded connectors epoxy cemented to the pipe, with rubber O-rings to seal the joints. The hollow pump rod sections were sealed, each length of pipe being fitted with one male and one female threaded connector secured by epoxy cement. Each connector was cross-drilled to receive a uPVC locking pin, in turn retained by an external split ring made from the same pipe as the pump rod. The final connector assembly presented a smooth surface of constant diameter. The manufacturer's purpose in using epoxy cement is to avoid local degradation of the parent material which can be a feature of solvent cemented joints.

For the endurance test, the manufacturer supplied new pump rods with modified joints, which are shown on the illustration opposite. These later joints were also flush with the pipe, but the diameter of the locking pins had been increased, and retaining C-clips were attached to the pins.

2. INSPECTION

2.1 Packaging Two test samples were supplied packed in heavy duty corrugated cardboard cartons with wooden ends and wooden protective bands on the ends and at the centre of the carton. The contents were carefully packed to minimise the risks of damage.

The packaging was strong and easy to handle, and therefore was considered suitable for export and for crude overland transportation.

2.2 Condition as Received

In the original samples supplied for testing, the joints for the rising main were found to be out of line with the axis of the uPVC pipe. The manufacturer traced this fault to an error in the machining of the pipe joints. The error was corrected, and the rising main was replaced. All the results in this report refer to the pump with the replacement rising main.

In other respects the samples were received in good working order.

2.3 Installation & Maintenance Information

Comprehensive literature was provided, in English, as follows:

- a) A brief report setting out the design objectives and describing the pump.
- b) A set of engineering drawings.
- c) An installation and maintenance manual.
- d) A set of photographs: "The Wavin Handpump in Pictures".

The manufacturer would normally supply only the installation and maintenance manual with each pump.

All the literature was clearly written, neatly presented and helpful. The installation and maintenance manual was well-illustrated, and included details of the construction of a suitable wellhead apron, followed by comprehensive instructions for installation and maintenance procedures for all the below-ground parts. The latter included various means of renewing the portion of the rising main used as the cylinder, to compensate for wear.

3. WEIGHTS & MEASURES

3.1 Weights

Pumpstand:	7.3 kg
Cylinder assembly:	1.4 kg
Rising main (per metre):	0.6 kg
Pump rod (per metre):	0.2 kg

The pumpstand is simple to make and would therefore be suitable for manufacture in many developing countries. If the production volume were sufficient, it would be appropriate to injection mould the pump handle bush.

Below-ground
assembly

uPVC extrusion and fabrication
Basic machining
Rubber moulding

The major requirement below-ground is for uPVC pipe of consistent high quality. Good quality control is also essential to make satisfactory joints for both the rising main and the pump rod. If the production volume were sufficient, the plastic parts could be injection moulded rather than machined. The below-ground assembly is therefore potentially suitable for manufacture in developing countries with well-established pipe extrusion capabilities, and well-developed skills in either general machining or plastics injection moulding.

4.3 Ease of Installation, Maintenance and Repair

4.3.1 Ease of Installation

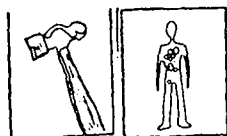


The lightness and simplicity of the pump made it easy to install, with no need for special tools or lifting tackle. Some care was needed to avoid damage to the uPVC pipe and joints.

The uPVC locking pins in the original pump rod joints were weak and could be broken by rough or careless handling. The holes for the pins were awkward to align, and the pins were easily dropped during assembly, with a risk of subsequent damage to the piston.

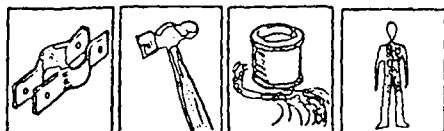
However, in the later rods supplied for endurance testing, the larger pins were more robust, easier to align, and easier to handle because they were attached to the retaining C-clips.

4.3.2 Ease of Pumpstand Maintenance and Repair



Very straightforward. The only maintenance requirement is likely to be replacement of the top bush, which is easily carried out.

4.3.3 Ease of Below-ground Maintenance and Repair



Wavin Handpump

The plunger may be removed very easily; only the top bush in the pumpstand need be removed. Care will be needed to avoid damage to the pump rods, however. The rising main is also easy to extract, with no need of lifting tackle.

4.4 Resistance to Contamination and Abuse

4.4.1 Resistance to Contamination

Generally good; the spout could be easily modified to prevent faecal contamination, if required.

4.4.2 Likely resistance to Abuse

The handle may be susceptible to impacts since it tends to rise to its uppermost position as a result of the buoyancy of the pump rods.

4.5 Potential Safety Hazards

There is a potential finger trap between the pump handle and the top of the pumpstand, but this is not a major hazard since there is no mechanical advantage.

4.6 Suggested Design Improvements

Children would find the pump easier to use if the handle was lower at its lowest point. Moreover, because the handle tends to rise when the pump is unattended, due to the buoyancy of the pump rods, it may be difficult for children to reach. Therefore, it is recommended that the height of the pumpstand should be reduced, and that either the maximum stroke of the handle should be reduced or a retaining device should be incorporated to hold the handle at its lowest position, in the manner of the Tara pump.

The piston should be modified to remove sharp edges which might damage the cylinder bore. The modification to the test sample during the endurance test, carried out in consultation with the manufacturer, was effective.

Pump rod guides may be required to prevent the formation of PVC debris when the pump rod rubs against the rising main. It is unlikely that guides only at pump rod joints will be sufficient, and it may be necessary to sleeve the entire pump rod in a sacrificial material. The manufacturer is continuing to investigate this aspect of the design, including the use of ribbed pipe for the pump rod.

The ramie cord piston seal seemed to trap PVC debris, causing the piston to seize. There is evidence from other pumps that a nitrile rubber seal may prevent debris lodging between the piston and the rising main. The manufacturer is considering the introduction of a nitrile rubber scraper ring in addition to the ramie cord.

In the later rods supplied for endurance testing, the larger locking pins represented a considerable improvement on the earlier design. However, it is suggested that the pins might be replaced by moulded radial grooves on the mating faces of the connector components, providing a ratchet action as the threads are tightened. This would ensure that the threads are fully

engaged and that the joints are secure, but depends on the joints being injection moulded.

A longer T-bar on the handle would be more comfortable to use, and has subsequently been introduced by the manufacturer. The plastic spacer below the handle has been eliminated in favour of a steel washer welded around the upper section of pump rod below the handle.

5. PUMP PERFORMANCE

The pump was installed in a 48 metre closed borehole. The performance of the pump was measured with the cylinder at approximately 12 metres depth and the static water level at 10 metres, and also with the cylinder at approximately 21 metres depth and the static water level at 15 metres. Initially, no attempt was made to bed-in the pump.

Examples of the force/displacement diagrams may be found in the appendix.

5.1 Pump Performance -- Pump Not Bedded-in

WATER DEPTH below-ground	10 metres				15 metres			
Operating speed (cycles/min)	21	30	40	51	21	30	40	51
Volume/cycle (litres)	0.60	0.59	0.59	0.61	0.68	0.69	0.73	0.78
Flow rate (litres/min)	12.4	17.9	23.4	30.8	14.2	20.9	29.3	39.5
Work input/cycle (joules)	224	215	222	248	244	251	336	384
Work rate (watts)	77	109	147	209	85	126	226	324
Efficiency (per cent)	26	27	26	24	41	41	32	30

The pump was stiff to operate, suggesting excessive friction. In consultation with the manufacturer, it was agreed that this friction was likely to be attributable to the piston seal, which might therefore benefit from bedding-in.

The results at 15 metres depth follow the same general pattern as those at 10 metres. It is normal for the efficiency of a pump to be lower at lesser depths, since friction represents a greater proportion of the total work done on the pump. The differences in volume per stroke are likely to be attributable to variations in the stroke length used by the operator.

The pump was then fitted with a pneumatic drive mechanism and bedded-in by operation over 24 hours at 30 strokes per minute: a total of 43,200 cycles. The pump performance was then re-measured at 15 metres water depth.

5.2 Pump Performance -- Pump Bedded-in over 24 Hours

WATER DEPTH below-ground	15 metres			
Operating speed (cycles/min)	21	30	40	51
Volume/cycle (litres)	0.54	0.54	0.56	0.55
Flow rate (litres/min)	11.1	16.4	22.1	28.1
Work input/cycle (joules)	153	148	173	167
Work rate (watts)	53	74	115	143
Efficiency (per cent)	52	54	47	48

These results clearly show a marked improvement in the efficiency of the pump at all speeds after bedding-in the piston seal.

As before, the differences in volume per stroke are likely to be attributable to variations in the stroke length. It is possible that the piston might have been more susceptible to leakage past the ramie cord after bedding-in, although clearly this has not had a detrimental effect on pump efficiency.

6. USER TRIAL

The manufacturer felt that a laboratory user trial would not be appropriate, since a number of pumps have been installed for assessment in the field. Reports have been received from several sources, including Tim Journey and Ken McLeod of the World Bank.

In a subjective assessment by laboratory staff, it was felt that the distribution of operating forces between the up-stroke and down-stroke made the pump relatively easy to use, although the handle at its lowest point might be uncomfortably high for children. A longer T-bar would also make the pump easier to use.

7. ENDURANCE TESTS

The pump was tested at 40 cycles per minute, over a stroke of approximately 0.4 metres. The driving mechanism was arranged to impose a degree of lateral strain on the operating handle, to represent the out-of-line forces which users have been observed to apply to direct action pumps.

7.1 General Comments on the Endurance Test

The pump did not break during the endurance test. However, there were a number of breakdowns, caused by the pump seizing when particles of uPVC lodged between the piston seal and the cylinder. In the first failure,

between the piston body and the cylinder bore. The piston was modified in accordance with suggestions from the manufacturer, to remove entirely a secondary flange on the lower part of the piston, and a sharp edge on the underside of the flange supporting the seal.

The length of pipe forming the cylinder was replaced, and new sealing cords were fitted to the piston.

Estimated amount of water pumped to breakdown..... 1 million litres

2000 Inspection after 2000 hours:

- (a) Piston and foot valve in good condition. Valve balls marked on surface but not indented.
- (b) Cylinder slightly marked in region swept by piston.

3772 Piston seized in cylinder, due to uPVC debris. Shavings of uPVC were packed around the piston seal, jamming it in the cylinder bore. Shavings generated by pump rod rubbing on rising main.

Stripped, inspected and cleaned. Upper sections of pump rod and rising main replaced. Piston seals replaced by foot valve seals, and vice versa. Fabric mesh filter added to prevent debris being carried in recirculating water.

Estimated additional amount of water pumped to breakdown ... 4 million litres

4014 Piston seized in cylinder, due to uPVC debris packed around piston seal. End of test.

Estimated additional amount of water pumped to breakdown .. 0.3 million litres

4014 FINAL INSPECTION

- (a) 2 metre section of pump rod and rising main beneath pumpstand badly scored by contact between the inner and outer uPVC pipes. Ragged appearance in bore of rising main indicating origin of PVC debris which caused piston to seize.
- (b) Piston and foot valve in good condition. Valve balls marked on surface but not indented.
- (c) Cylinder marked in region swept by piston, but still serviceable.
- (d) Little wear in pumpstand top bush.

Estimated total amount of water pumped in 4000 hours 5.3 million litres

7.4 Pump Performance after Endurance

Note: all debris was thoroughly removed from the pump before performance was re-measured. As before, the pump was installed on the borehole, with the cylinder at 12 metres and 21 metres depth for water depths of 10 and 15 metres respectively.

Wavin Handpump

WATER DEPTH below-ground	10 metres				15 metres			
	20	30	40	50	20	30	41	50
Operating speed (cycles/min)	20	30	40	50	20	30	41	50
Volume/cycle (litres)	0.54	0.57	0.59	0.68	0.56	0.57	0.61	0.67
Flow rate (litres/min)	10.8	17.4	23.6	33.7	11.4	16.9	25.1	33.3
Work input/cycle (joules)	89	102	133	189	119	133	181	222
Work rate (watts)	30	52	89	156	40	66	124	184
Efficiency (per cent)	59	55	43	35	70	63	50	44

These results suggest a considerable improvement over the performance of the pump when new, even after 24 hours bedding-in. However, the results are not strictly comparable, because the major parts of the below-ground assembly were replaced during the endurance test.

8. ABUSE TESTS

8.1 Side Impact Tests

Because of the tendency of the handle to rise while unattended, a side impact test was carried out on the protruding handle. The handle was slightly bent by an impact of 150 joules, and rather more by an impact of 200 joules. However, it could readily be straightened by hand and continued to be serviceable.

In the test on the side of the pumpstand body, the pumpstand undamaged by impacts of up to 500 joules.

8.2 Handle Bump Stop Test

The pump was tested by applying controlled shocks to the handle at the lower limit of handle movement. A similar test of the upper limit of handle movement was not carried out, since in this position the handle is very high in relation to the operator, and it was considered most unlikely that the handle would ever impact the upper stop in actual use.

The pump completed the allotted 96,000 cycles without failure. Some distortion of the lower limit stop was apparent where the handle had impacted it, but the distortion would be unlikely to effect the endurance or performance of the pump.

7. VERDICT

The Wavin pump incorporates some interesting innovations, principally the use of epoxy cement for joints in uPVC pipes and of ramie cord as a piston seal. The manufacturer's research has indicated that epoxy cement is likely

to be stronger and more durable than solvent cementing. This comparison has not been independently assessed, but the pump completed the endurance test with no failures in the rods or rising main. Ramie cord appears to be an efficient and durable seal. However, it needs bedding-in and appears to be susceptible to contamination by debris, which can cause the piston to seize.

The manufacturer should be encouraged to continue to develop this handpump design. The pump has the potential to be easy to operate, install, maintain and repair, and therefore to satisfy the requirements for village level operation and maintenance in developing countries. Some developing countries would also have the capability to manufacture the pump.

WAVIN HANDPUMP

FIELD TESTS

CONSULTING ENGINEERS, ARCHITECTS AND ECONOMISTS

Telex :
Denmark :
15508 Kampsax DK
27033 Kruger DK
Sri Lanka :
Via Scan Shipping
21677 LSCAN CE for KK Kandy

Consultants to the Sri Lanka National Water
Supply and Drainage Board

Kandy Address :
532/8, Siebel Place,
Kandy.
Telephone : 08-23156

10th April 1986.

ATTN: MR E Sjørnslev Jensen.

Head Danida Mission to Sri Lanka,
2 ASIATISK PLADS,
DK-1448, Copenhagen K,
Denmark.

Dear Sir,

SUBJECT : PERFORMANCE OF THE WAVIN HANDPUMP

Upon request of the Danida, two Wavin handpumps have been installed during the implementation programme of 1200 boreholes with handpumps in Matale and Polonnaruwa Districts Sri Lanka by KAMPSAX-KRUGER.

The Wavin handpumps were installed on 6th February 1986, in borehole number NA 37 and NA 38, close to the main-road Matale - Dambulla approximately 2 respectively 3km North of Naula. Criteria for selection of the boreholes fitted with the Wavin handpumps were:

- a. Close to the Matale Workshop, this to facilitate easy monitoring of the pump performance.
- b. The anticipated dynamic water level in the borehole was never to exceed 15 meters, as the total length of the supplied and installed risermain was 15 meters for each pump.

It should be mentioned that this performance report is based upon a relatively short, two months, operational period.

1. Crating and Packing

The two pumps arrived in good order and were properly packed in cardboard. Attached to the pulling rod of each pump a small number of spare parts were attached.

Contd/.....2

2. Installation

The pumps were installed by two adults in less than one hour and no problems were encountered.

3. Operation

In contrary to previously published reports regarding complains of "the odd up-and-down movement" no negative feedback from users were received. (The sociologists have made 3 field surveys).

Children from an age of 4 - 5 years can operate the pump.

Due to the height of the outlet, people cannot directly bath or wash on the concrete pedestal, which is an advantage from sanitary point of view. User acceptability is very high.

4. Yield

A significant difference is the high yield per stroke compared with the other handpumps in boreholes with similar groundwater conditions.

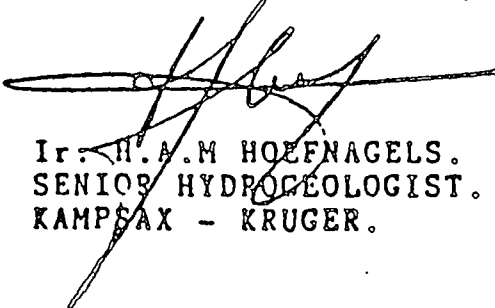
5. Maintenance

Up to now no breakdowns have been experienced, however several "simulated maintenance experiments" have been carried out by the mechanical section.

It is anticipated that, in case minor breakdowns will occur, these can be carried out by two adults without any special heavy tools.

6. Durability

As the period of installation is only a fraction of the total expected life time no comments regarding this matter can be given.



Ir. H.A.M. HOEFNAGELS.
SENIOR HYDROGEOLOGIST.
KAMPSAX - KRUGER.

TEST RESULTS INDONESIA

WAVIN PVC Handpump

The first of the two WAVIN PVC handpumps has been installed on a new, hand dug well at Dusun Pare, Desa Semoyang. The pump has been installed as per the WAVIN installation manual, using 2 x 2.5 metre lengths of riser pipe and the shorter 1.6 metre length supplied. The piston is set at the lowest possible setting, that is, with the 600 mm length of pump rod included. Water is being lifted from about 3.5 metres below the outlet in the morning after overnight recovery, and from the total depth of the pump after about 4 hours of heavy usage. The village which built the well has about 150 families, and the well is their sole potable water source at present. The total number of beneficiaries is difficult to estimate, as people are coming from 3 or 4 other hamlets to obtain water from the pump.

Installation was not difficult, except that careful selection of the first "cylinder" section was required. Three pipes were tried before the action was considered light enough to overcome any possible user resistance at first "trial" of the pump. The new piston moving in a slightly undersized section of pipe can make a considerable difference in the effort required to operate the pump. After 6 days of heavy usage, the action was found to be very "light", and there appears to be high user acceptance of the pump.

The users have overcome their initial reluctance to dismantling the pump, and a number of users have learnt the procedures for dismantling and re-installation. This was not as a result of any formal training session, but as a consequence of having to remove the pump to allow final location and fixing of the well cover (which had been cast off-site).

Even small children can operate the pump now that the piston seals have "worn in", and the smallest children can operate it in pairs.

The water delivery spout is a little too low set for the traditional clay water collection pots used by the rural population, and no allowance had been made for this during installation. Subsequent installations will allow for the height of the local water pot. In this first instance, a length of high strength plastic (ribbed suction) hose has been attached to the spout to allow water deliver at a lower level outside the well cover.

The bag of spare parts has been removed temporarily, as the high and constant usage in the first few days of operation caused the bag to be drawn tightly into the intake pipe where it eventually tore. The spare balls and seals did not come free from the bag but it was noticed that the ends of the greased hemp seals were frayed by the flow of water. It may be that two balls and the spare seals place too high a restriction on the flow of water, and a less bulky set of parts comprising one ball and the seals may be more suitable.

As this pump was designed primarily for borehole installation, there is difficulty in watching the depth of a dug well to the lengths of pipe and pump rod provided. For dug well installations, there is a need for one length of riser pipe and one length of pump rod to be left unfinished so that the final length adjustment can be performed by the installer. It is recognized that this would introduce a potential weak point in the pump, but the need for full-depth installation in a dug well also has to be considered.

The pump will be removed for inspection late in May, and a report of the inspection will be included in the May Non-piped Systems report.

The Installation Manual is simple and an adequate guide to pump installation. The use of photographs in any later edition is recommended, as many rural villagers have difficulty in understanding even simple line drawings. The section on the well slab is oversimplified, and does not take into account the fact that many wells are constructed in areas with expansive surface clays. The well apron as described is felt, to be an inadequate design, and far less durable than the pump itself. This section should be either confined to a description of the actual installation on the well casing, or should be expanded to include a design similar to that in the Richardson & Cruddas Installation Manual for the INDIA Mk.II handpump. Thought could also be given to the design of a surface fitting more suited to dug well installation, although the well casing fitting as supplied was able to be securely tied to the reinforcing rods in the well cover.

People from outside the user community who have tried the pump have commented on its ease of operation, simplicity, apparent durability, and the "trickery" which allows the pump to produce an apparently continuous flow of water. There is some resistance to acceptance by people whose only experience with PVC has been with low cost, low quality piping.

Trials of the pump before installation produced flows of about 30 litres/minute with both rapid short stroke and slower long stroke operation. In the field, the estimated average flow is of the order of 16 litres/minute over a 4 hours' period. This is based on the removal of a calculated volume of water stored in the well, and does not take inflow into account. This estimated flow rate is in line with the flows produced during trials when the "changeover" times between users are considered.

Proyek Penyediaan Air Bersih Dan Penyehatan Lingkungan Pedesaan
Kab. Lombok Tengah
N.T.B. - Indonesia

RURAL WATER SUPPLY & SANITATION PROJECT
LOMBOK TENGAH

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Project Manager Team Leader

' 'tlx 4466
Lilongwe/malawi (ibrd) 64 01 1709

wavin overseas b.v.
netherlands

misc 1467 wavin overseas b.v. from liyanage unv int/81/026 re your
telex nr. 9538 of 21.03.86 testing on wavin handpump started in
march 1986 due to delayed installation.

- very easy to instal, operate and maintain.
- accepted by users specially because of good volume flow and easiness of operation.
- so far ne weak points to be found on the pump.

regards

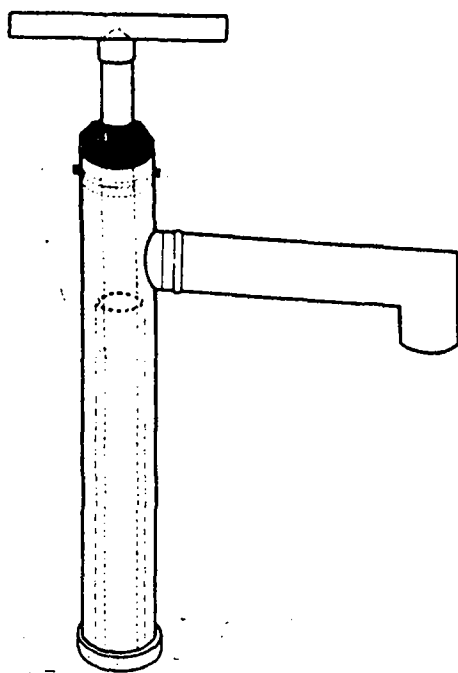
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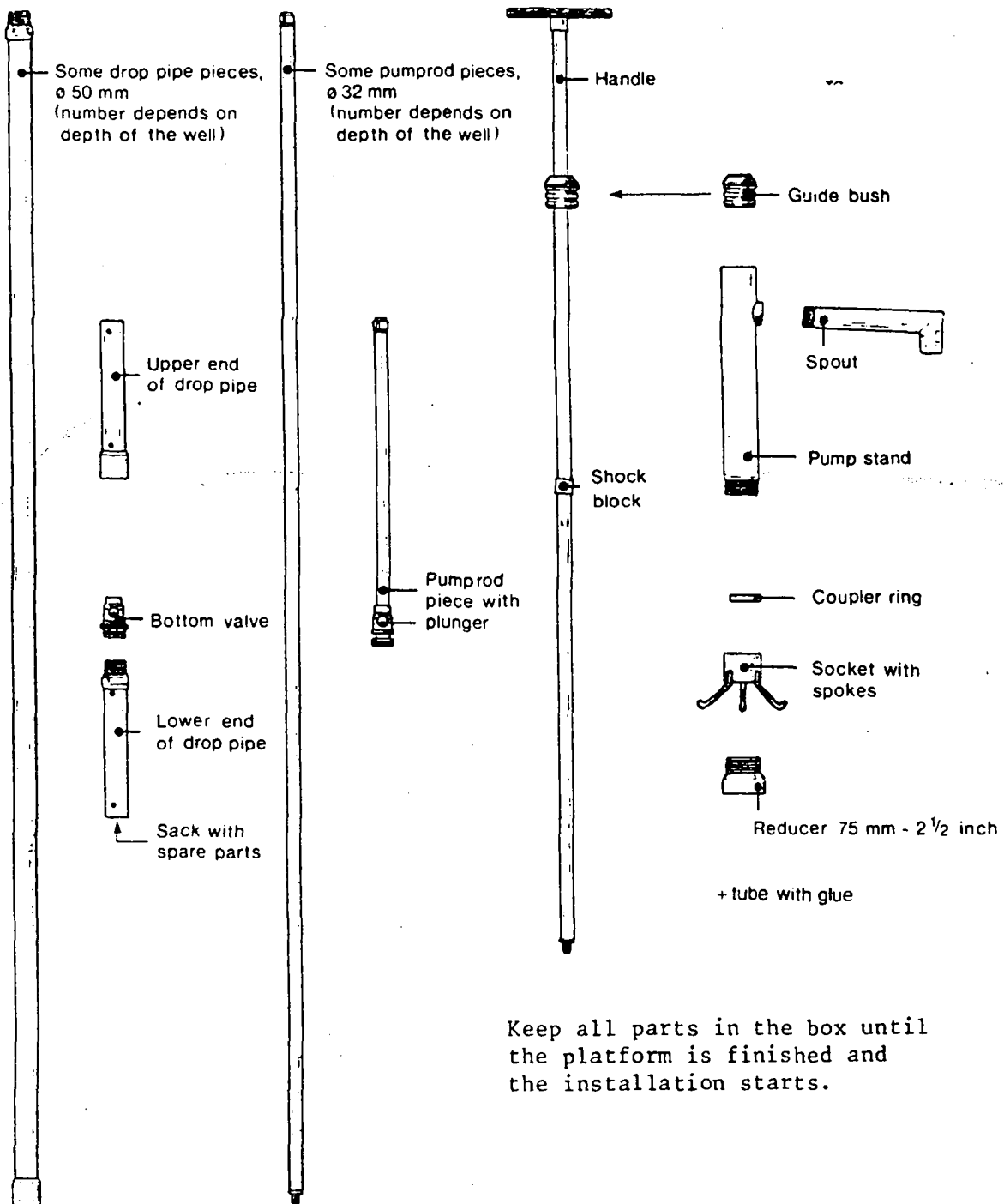
Wavin handpump

Instruction manual
for installation
and maintenance



GENERAL

The following parts are in the box:



Keep all parts in the box until the platform is finished and the installation starts.

The pump is suited for casings ø 75 mm or ø 2" BSP Whitworth (reducer enclosed). If other sizes are met, an appropriate reduction piece shall be applied.

INSTALLATION

Before the actual installation of the pump can take place, a tapping platform has to be constructed.
If a platform is already available, the following actions can of course be omitted.

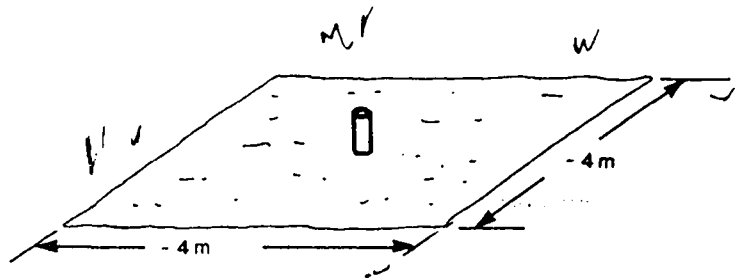
Construction of the platform

Approximately 1,500 l of concrete has to be poured.

- Components: 250 l cement
- 600 l clean sand
- 900 l clean gravel and water

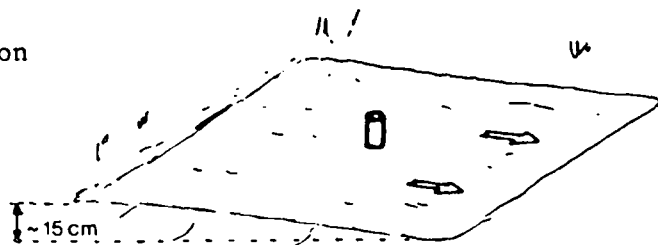
- Action 1

Clean and flatten an area of approx. 4 x 4 metres around the casing. Remove grass, bushes, stones, etc.



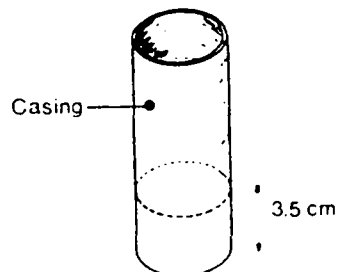
- Action 2

Make a decision in what direction the waste water shall flow.
Add sand until a slope of 1:30 is reached. (The lowest side of the treated area shall not be more than 5 cm below normal surface).



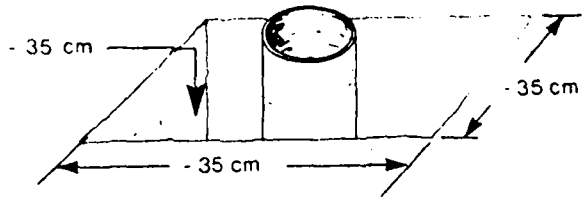
- Action 3

Cut the casing 3.5 cm above level of the treated area.
Close the casing with a wooden stop or e.g. old clothing.



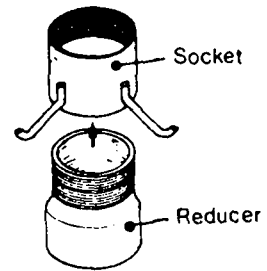
- Action 4

Dig a hole of 35 x 35 cm around the casing.



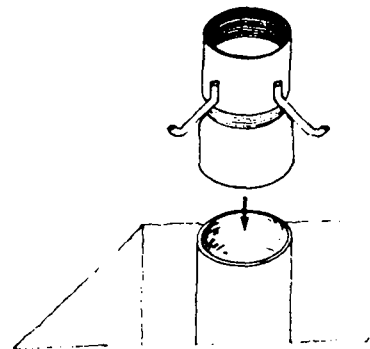
- Action 5

Screw socket with spokes and reducer together, if required (depends on the size of the casing). The reducer shall fit in at least 2 cm.



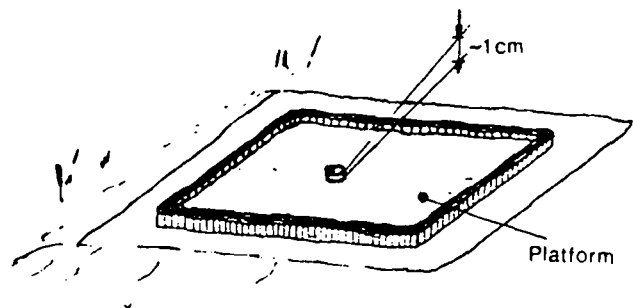
- Action 6

Cement socket + reducer (or socket alone) onto the casing (glue is in the box).



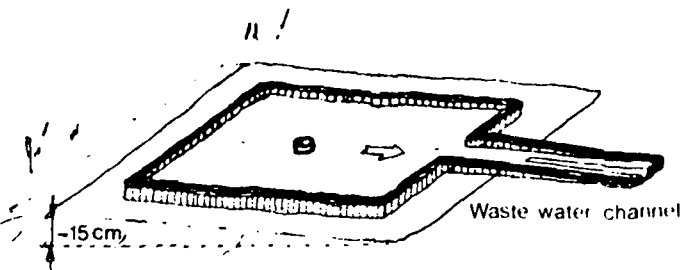
- Action 7

Surround the area to be poured with concrete with bricks or soil. Mix the concrete and pour it. The socket shall remain ± 1 cm above the concrete. Keep the prepared slope intact.



- Action 8

The next day the waste water channel shall be made. Provide a small gutter in the middle (use bricks and concrete mortar).



- Action 9

Protect the platform against damaging. Let it rest for approximately 8 days.

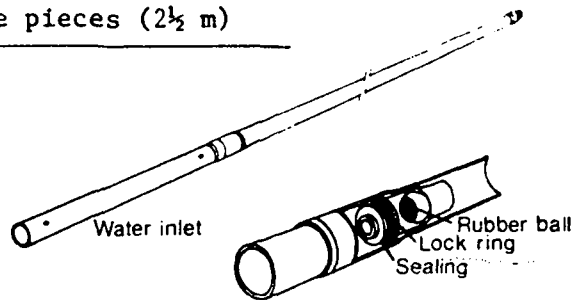
Pump installation

From now on it takes about one hour to have the pump ready.

- Action 10

-
- Assemble:
- . lower end of drop pipe (water inlet)
 - . bottom valve
 - . one or two drop pipe pieces (2½ m)
-

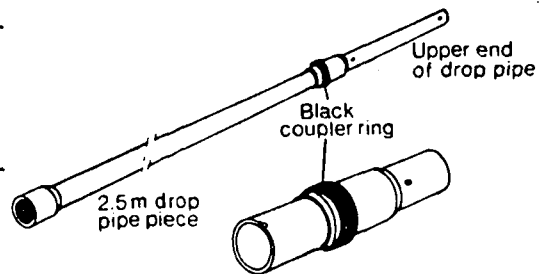
In the box, the valve is fitted in between the upper end and the lower end of the drop pipe. The upper end shall be removed and replaced by a 2½ m drop pipe piece.



Note: Leave the sack with spare parts where it is.

- Action 11

-
- Assemble:
- . a (2½ m) drop pipe piece
 - . coupler ring (black)
 - . upper end of drop pipe
-

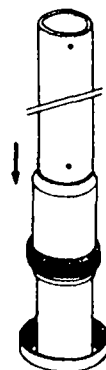


(Later on the ring will be clamped in between the casing reducer and the pump stand).

- Action 12

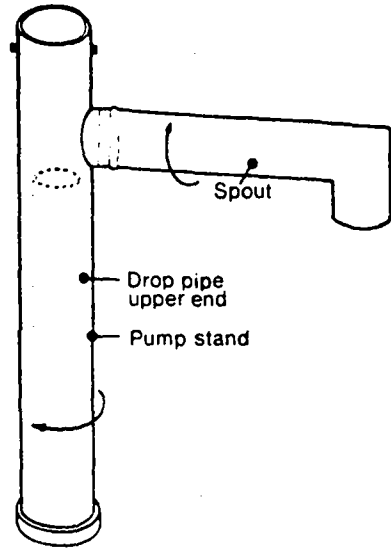
Lower the drop pipe pieces in the casing one by one after connecting the piece to the previous one. Start with the assembly from action 10 and end with the assembly from action 11.

The drop pipe is installed now.



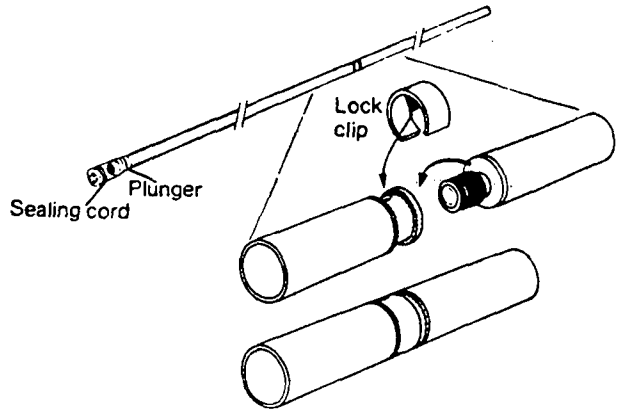
- Action 13

Screw spout in pump stand.
Screw pump stand in steel socket (use the spout as a grip; do not use other tools). The pump stand shall be screwed in until the black coupler ring is clamped.



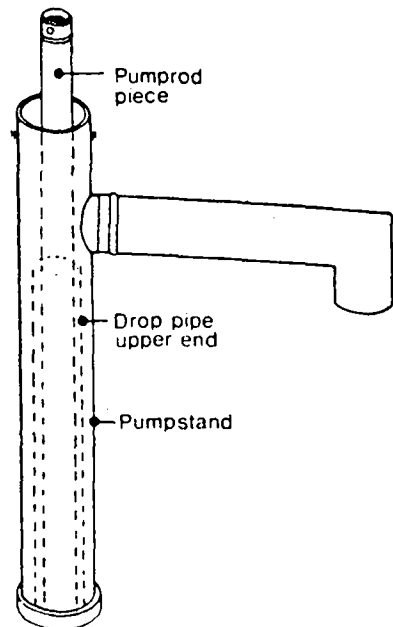
- Action 14

Connect the pump rod piece supplied with the plunger to another (2½ m) piece. Lock the connection by lock clip. Push these carefully in the drop pipe. The sealing shall not be damaged. (If necessary, press the sealing firmly in its groove; within some hours it will expand again).



- Action 15

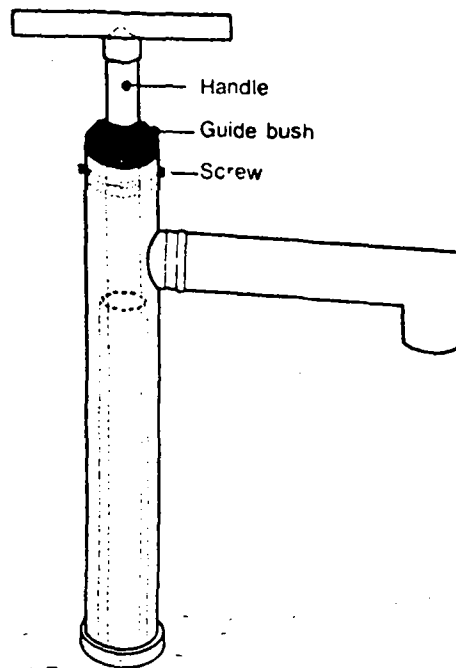
Lower all pump rod pieces, connecting to the previous one using lock clip



- Action 16

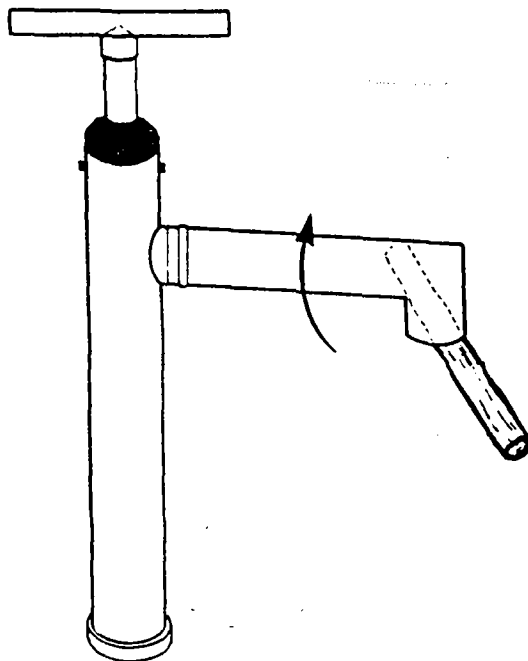
The handle, with the (black) guide bush already on it, has to be connected to the last pump rod piece (again by lock pin/bush), after which it is lowered also.

Press the guide bush in the pump stand and lock it with the two screws.



- Action 17

Turn the spout in the correct position (outlet downwards). Use a piece of wood as tool.



The pump is ready now

Pump approximately 100 strokes. Let the water flow away. After this the water can be used.

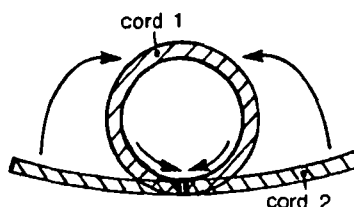
MAINTENANCE

The pump can become out of order by the following reasons:

1. Wearing of the sealing in the plunger

Remedy is:

- a. Lift the pump rod (see "Installation Manual").
- b. Lift the drop pipe (see "Installation Manual").
- c. The lowest piece (water inlet) contains some spare parts.
Take as much as required and replace the remaining parts in the pipe.
- d. Replace the worn sealing (see sketch).
Control other parts, being:
 - Foot valve
 - Plunger ball, etc.
 - Clean if necessary
- e. Install the pump again.



2. Wearing of the ball in plunger or bottom valve

- The renewing of the ball in the plunger

- . Lift the pump rod.
On the end the plunger is mounted.
- . The ball is held on its place by a small plastic spring.
- . Remove the spring through one of the side holes.
- . The ball is free now and can be renewed.
- . Lock the ball with the spring.
- . Re-install again.

- The renewing of the ball in the bottom valve

- . Lift the pump rod.
- . Lift the drop pipe.
- . Unscrew the lowest piece (water inlet).
The entire valve is loose now.
- . The damaged ball can be renewed via one of the side holes.
- . Re-install again.

3. Leaking plunger or bottom valve

Reasons can be:

- a. Worn-off balls; remedy: replace the balls (spare balls available in the pump).
- b. Dirt; remedy: clean carefully.
- c. Damaging of valve seat (occurs hardly ever); remedy: order a new valve at your supplier.

Note 1: Generally speaking the pump can work at least for two years without any maintenance. Check the pump every 6 months, it will only take half an hour. If needed, new parts can be ordered before they are needed.

Note 2: As you will have noticed no tools are necessary.
So, do not use them.

4. Wearing of the cylinder wall (= part of the drop pipe)

- Renewing of the cylinder .

After approximately 2 years the cylinder wall shall be renewed.
This has to be done as follows:

- a. Every drop pipe piece can be used as a cylinder.
The first change can be made by an interchange with one of the other pipes.
- b. Having used all pipes once, the following series of cylinder can be used by turning over the whole drop pipe construction. So, the higher pieces become the lower pieces and reversibly. Now all drop pipe pieces can be used again (see a.).
- c. The next series of cylinder walls can be obtained by reducing the length of the pump rod.
A 60 cm piece of the pump rod is included in the pump rod.
By taking away this piece the plunger will rise 60 cm.
So, the drop pipes can be used twice for cylinder purposes (see a. and b.).

In total every drop pipe can be used 4 times.

A 12.5 m pump includes 5 drop pipe pieces.

So, the whole drop pipe construction can be used 20 times as a cylinder wall.