INDIA MARK II HAND PUMP

REPAIR AND MAINTENANCE DETAILS

PREPARED BY UNICEF WASHE SECTION
FEBRUARY 2005
MAINTENANCE SCHEDULES: WEEKLY & MONTHLY

ONCE EVERY WEEK:

TOOLS AND SUPPLIES REQUIRED - ONE BUCKET

1. COUNT NUMBER OF STROKES TO FILL THE BUCKET WITH WATER:

   - IF NO WATER
   - IF MORE THAN 45 STROKES ARE NEEDED TO FILL BUCKETS
   - IF 15 OR MORE STROKES ARE NEEDED BEFORE WATER STARTS TO FLOW
   - IF THE HANDLE IS LOOSE
   - IF THERE IS MUCH RESISTANCE IN HANDLE

   FOLLOW TROUBLE-SHOOTING GUIDE

ONCE EVERY MONTH:

TOOLS AND SUPPLIES REQUIRED - ONE CRANK SPANNER
- WIRE BRUSH
- GREASE

1. LUBRICATE CHAIN - SEE PAGE 8

   1.1 REMOVE INSPECTION COVER
   1.2 CLEAN CHAIN
   1.3 APPLY GREASE TO CHAIN
   1.4 REFIT INSPECTION COVER

2. CHECK THAT ALL 8 FLANGE BOLTS ARE PRESENT AND TIGHT

   - IF LOOSE: TIGHTEM WITH CRANK SPANNERS
   - IF MISSING: REPLACE WITH NEW BOLTS PROVIDED IN KIT
# MAINTENANCE RECORD SHEET (SAMPLE)

**VILLAGE** __________________________  **MONTH** __________________

**CARETAKER** __________________________

## WEEKLY

<table>
<thead>
<tr>
<th>PUMP No.</th>
<th>WEEK 1</th>
<th>WEEK 2</th>
<th>WEEK 3</th>
<th>WEEK 4</th>
</tr>
</thead>
</table>

**NUMBERS OF STROKES TO FILL THE BUCKET:**

- WEEK 1
- WEEK 2
- WEEK 3
- WEEK 4

- **FILL IN DATA WHEN ANY OF THE FOLLOWING PROBLEMS APPEAR:**
  - NO WATER
  - MORE THAN 45 STROKES ARE NEEDED TO FILL BUCKET
  - 15 OR MORE STROKES ARE NEEDED BEFORE WATER FLOWS
  - THE HANDLE IS LOOSE
  - MUCH RESISTANCE IN HANDLE

## MONTHLY

**CARRIED OUT CLEANING AND GREASING**

**NUMBER OF BOLTS**

- LOOSE
- MISSING

**DATE** __________________  **SIGNATURE** __________________
TOOLS AND SUPPLIES FOR THE VILLAGE CARETAKER

LIFTING SPANNERS

LIFTER PIPE

CRANK SPANNERS 17x19mm

CONNECTING ROD VICE

CONNECTING ROD LIFTER (TEE-LIFTER)

AXLE PUNCH

HEAVY DUTY CLAMP

PIPE WRENCH 93mm

SMALL PIPE WRENCH 91mm

OPEN ENDED SPANNER 17x18mm

OPEN ENDED SPANNER 18x19mm

GARAGE SCREW DRIVER

WIRE BRUSH

PUMP CYLINDER (COMPLETE SET)

OIL CAN

CHAIN COUPLER SUPPORTING TOOL

HAMMER

HEMP

GREASE
<table>
<thead>
<tr>
<th>Problem</th>
<th>Possible Cause</th>
<th>Remedy</th>
<th>Ref.</th>
</tr>
</thead>
<tbody>
<tr>
<td>No water (little resistance in handle)</td>
<td>Chain disconnected</td>
<td>Remove inspection cover refit chain</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Connecting rod disconnected</td>
<td>Disassemble pump - follow job guide until disconnected rod appears</td>
<td>8</td>
</tr>
<tr>
<td></td>
<td>Valve guide or piston disconnected</td>
<td>Disassemble pump - follow job guide exchange old pump cylinder with new provided by MAJI district office</td>
<td>8</td>
</tr>
<tr>
<td>Discharges less than one full bucket of water on 45 strokes</td>
<td>Leather cup worn out</td>
<td>Disassemble pump - follow job guide exchange old pump cylinder with new provided by MAJI district office</td>
<td>8</td>
</tr>
<tr>
<td>15 strokes or more are needed before water flows</td>
<td>Leakage in foot valve</td>
<td>Disassemble pump - follow job guide remove old cylinder clean foot valve test foot valve by filling cylinder with water if water remains in cylinder then:</td>
<td>8</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Fit cylinder to rising main</td>
<td></td>
</tr>
<tr>
<td>Problem</td>
<td>Possible Cause</td>
<td>Remedy</td>
<td></td>
</tr>
<tr>
<td>---------------------------------</td>
<td>----------------------------------------</td>
<td>------------------------------------------------------------------------</td>
<td></td>
</tr>
<tr>
<td>15 strokes or more are needed before water flows (continued)</td>
<td>Leakage in rising main pipe sockets</td>
<td>If water leaks: exchange old cylinder with overhauled cylinder provided by Maji District Office</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Leakage in reducer cap</td>
<td>Disassemble pump</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Handle axle loose</td>
<td>- Follow job guide</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Handle axle dried out</td>
<td>- Remove reducer</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Expansion in leather cups</td>
<td>- Clean threads</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>- Pack threads</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>- Refit reducer</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>- Reinstall cylinder</td>
<td></td>
</tr>
<tr>
<td>Loose handle</td>
<td>Disassemble pump</td>
<td>- Follow job guide</td>
<td></td>
</tr>
<tr>
<td>Resistance in handle</td>
<td>Disassemble axle handle</td>
<td>- Apply grease on axle</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>- Reinstall handle axle</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Disassemble pump</td>
<td>- Follow job guide</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>- Exchange old pump cylinder</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>- With new provided by Maji District Office</td>
<td></td>
</tr>
</tbody>
</table>
3. INSERT CHAIN COUPLER SUPPORTING TOOL

4. REMOVE NYLOC NUT AND BOLT

4.1 LIFT HANDLE IN TOP POSITION
4.2 UNSCREW BOLT AND NUT INDICATED BY ARROWS

TOOLS:
5. REMOVE FLANGE BOLTS FROM HEAD ASSEMBLY

5.1 UNSCREW BOLTS INDICATED BY THE ARROWS

TOOLS:

6. FIT CONNECTING ROD VICE

6.1 INSERT LIFTING SPANNER
6.2 LIFT HEAD ASSEMBLY
6.3 TIGHT VICE FIRMLY

TOOL:
7. REMOVE CHAIN FROM CONNECTING ROD

7.1 Insert screwdriver indicated by the arrow
7.2 Turn in direction

Tool:

8. REMOVE HEAD ASSEMBLY

8.1 Insert lifting spanner
8.2 Lift head assembly
8.3 Place head assembly 5-6 metres from pump

Tool:
MAINTENANCE OF THE PUMP: DISASSEMBLY

9. FIT CONNECTING ROD LIFTER

9.1 SUPPORT ROD
9.2 RELEASE VICE AND LOWER ROD CAREFULLY
9.3 REMOVE CONNECTING ROD VICE

TOOL:  

10. FIT PIPE LIFTER TO WATER TANK

10.1 REMOVE CONNECTING ROD LIFTER
10.2 FIT PIPE LIFTER FIRMLY

TOOL:  
MAINTENANCE OF THE PUMP: DISASSEMBLY

11. REMOVE WATER TANK FLANGE BOLTS

11.1 UNSCREW THE 4 BOLTS ON WATER TANK FLANGE

TOOLS:

12. FIT HEAVY DUTY CLAMP

12.1 LIFT WATER TANK WITH LIFTING SPANNERS
12.2 TIGHTEN CLAMP FIRMLY
12.3 FIT TWO BOLTS FOR CLAMP AS SHOWN BY ARROWS
12.4 REMOVE WATER TANK BY UNSCREWING COUNTERCLOCKWISE (AS SHOWN BY ARROW)

TOOLS:
MAINTENANCE OF THE PUMP: DISASSEMBLY

13. FIT PIPE LIFTER TO RISING MAIN

13.1 TIGHTEN FIRMLY

TOOLS:

14. LIFT RISING MAIN

14.1 SUPPORT RISING MAIN WITH LIFTING SPANNERS
14.2 RELEASE HEAVY DUTY CLAMP CAREFULLY
14.3 LIFT RISING MAIN*
14.4 TIGHTEN HEAVY DUTY CLAMP FIRMLY
14.5 REPEAT UNTIL NEXT SOCKET APPEARS

TOOLS:

* THE WEIGHT OF THE RISING MAIN WILL OVERWHELM THE LIFTER IF NOT SECURED CLEVERLY
MAINTENANCE OF THE PUMP: DISASSEMBLY

15. DISCONNECT RISING MAIN AND CONNECTING RODS

15.1 SUPPORT SOCKET (INDICATED BY WHITE ARROW) WITH PIPE SPANNER
15.2 TURN PIPE (INDICATED BY BLACK ARROW) WITH ANOTHER PIPE SPANNER COUNTERCLOCKWISE
15.3 LIFT PIPE UNTIL ROD CONNECTION APPEARS
15.4 SUPPORT CHECK NUT WITH OPEN ENDED SPANNER
15.5 TURN CONNECTION WITH ANOTHER OPEN ENDED SPANNER
15.6 REMOVE PIPE AND CONNECTING ROD
15.7 REPEAT UNTIL CYLINDER APPEARS

TOOLS:

16. REMOVE HEAVY DUTY CLAMP

16.1 TIGHTEN CLAMP FIRMLY ON LAST PIPE
16.2 REMOVE BOLTS FROM CLAMP INDICATED BY THE ARROWS
16.3 REMOVE CLAMP WITH PIPE AND CYLINDER
16.4 RELEASE CLAMP
16.5 DISCONNECT CYLINDER

TOOLS:
MAINTENANCE OF THE PUMP: PREPARATION OF RISING MAIN PIPES & CONNECTING RODS

1. PREPARATION OF RISING MAIN PIPES & CONNECTING RODS FOR ASSEMBLY

TOOLS REQUIRED:  - WIRE BRUSH
                 - OIL CAN
                 - HEMP

2. ARRANGEPIPES, TOOLS AND TOOL BOX
MAINTENANCE OF THE PUMP: PREPARATION OF RISING MAIN PIPES & CONNECTING RODS

3. SUPPORT PIPE ACROSS YOUR LEGS

3.1 CLEAN THREADS WITH WIRE BRUSH
3.2 KEEP LONG END OF PIPE TO YOUR LEFT SIDE

4. APPLY HEMP ON THREADS

4.1 KEEP THE END OF THE HEMP BETWEEN YOUR LEFT HAND THUMB AND THE PIPE THREADS
4.2 WRAP THE HEMP CAREFULLY WITH YOUR RIGHT HAND IN DIRECTION OF ARROWS
4.3 CAREFULLY PULL THE HEMP TIGHT AFTER EACH TURN
5. APPLY 4-5 DROPS OIL ON HEMP

6. TURN CHECK NUT ON CONNECTING ROD TO THE END OF THREADS
1. REMOVE INSPECTION COVER

1.1 UNSCREW BOLT AS INDICATED BY THE ARROW

TOOL:

2. INSERT CHAIN COUPLER SUPPORTING TOOL

TOOL:
MAINTENANCE OF THE PUMP: REMOVAL OF THE PUMP HANDLE

3. REMOVE NYLOC NUT AND BOLT

3.1 LIFT HANDLE IN TOP POSITION

3.2 UNSCREW BOLT AND NUT INDICATED BY THE ARROWS

TOOLS:

4. REMOVE AXLE BOLT

4.1 SUPPORT HANDLE

4.2 UNSCREW WASHER NUT AND CHECK NUT (SHOWN BY WHITE ARROW)

4.3 PLACE AXLE PUNCH ON BOLT (SHOWN BY BLACK ARROW)

4.4 USE THE HAMMER CAREFULLY TO REMOVE THE AXLE BOLT

4.5 REMOVE THE HANDLE

TOOLS:
INDIA MARK II HAND PUMP

INSTALLATION
OF
THE PUMP HEAD, CYLINDER, RISER PIPES AND RODS

PREPARED BY UNICEF WASHE SECTION
FEBRUARY 2005
SEVEN DAYS LATER

Lay out pipes and connecting rods.
Check that pipes and rods are threaded properly
Check that all threads are good and clean
Ensure that all pipes have socket at one end
CHECK CYLINDER OPERATION

Step 11

1. Open Cylinder and check that piston Assembly and check valve Assembly are tight and properly assembled.
2. Re-assemble cylinder.
3. Test cylinder in a bucket of water. If Check valve Assembly leaks replace it.

Step 12

1. Remove metal cover of Stand Assembly.
2. Join first connecting rod to Plunger rod.
4. Wipe off excess jointing compound.

FIX CYLINDER TO FIRST ROD AND PIPE
Step 13
Cylinder should be installed at a minimum depth of 24 metres.

Lower cylinder, first pipe and connecting rod into tube well.

Step 14

Never install a cylinder less than 6 Metres from the bottom of the tube well.

Insert the self locking clamp to clamp the riser pipe as shown.
**FIX SUCCESSIVE PIPE AND RODS**

1. Fit bolts and nuts as shown.
2. Join connecting rods together. Tighten fully by using coupling spanner.
3. Put jointing compound on pipe threads.

**Step 15**

**Step 16**

1. Lock the bottom pipe with help of self locking clamp, lifting spanner and a pipe wrench as shown.
2. Tighten pipes as shown.
3. Wipe off excess jointing compound or it will spoil the water in the tube well.
Lower down gently the rising main with the help of lifting spanners.

The self locking clamp jaws to be kept in open condition. Only while lowering the rising main as shown.

Keep on lowering the pipe and connecting rod into tube well till the last pipe.

Lock the pipe with the help of lifting spanner and a pipe wrench as shown.

Screw water tank to last pipe. Tighten fully.

Cylinder should be installed at a minimum depth of 24 Metres for maximum efficiency.
Step 19

1. Screw tank pipe lifter onto Water tank coupling.

2. Remove bolts and nuts holding the self locking clamp.

3. Withdraw self locking clamp as shown.

4. Use lifting spanners to lever down the water tank gently as shown till it is placed on stand flange.

Step 20

1. After water tank is placed on the stand flange, fix up bolts and nuts as shown.

2. Push rod down gently as far as possible.

3. Mark rod here in Level with top of water tank.
Step 21

1. Lift rod as far as possible with help of connecting rod lifter as shown.

SET PISTON STROKE LENGTH

Step 22

1. Tighten the rod as shown.

2. Cut rod at mark.

3. Put cloth around top of Connecting Rod Vice so that cuttings do not fall in.

4. File top of rod smooth.

Insert connecting rod vice as shown.
Cut thread on the rod for at least 45 mm. length. Make sure the threads are clean and true.

Check thread with check nut. You must be able to screw the nut all the way down by hand.

Lubricate rod with oil while cutting thread.

Step 23

Step 24

Fix head assembly

Remove the cloth and lower pump head on to the connecting rod vice.

Rod goes through guide bush.

Fix check nut as shown.
Step 25

1. Screw chain on to rod upto two threads by hand.

2. Keep the chain as shown.

3. Rotate the head as shown till the chain coupler gets tightened fully.

Step 26

1. Insert the chain coupler supporting tool.

2. Loosen the connecting rod vice and allow the connecting rod to go down till it sits on the chain coupler supporting tool as shown.
Step 27

PLACE HEAD ON WATER TANK

1. Insert lifting spanner as shown and lift the pump head gently.
2. Withdraw connecting rod vice as shown.
3. Lower the head till it sits on water tank.

Step 28

FIX HANDLE

1. Insert handle assembly from front opening.
2. Tighten all bolts and nuts as shown.
3. Insert handle punch as shown.
Step 29

1. Insert the handle axle as shown. Tap gently.

2. Drive the handle axle till the threaded portion comes out.

3. Remove handle axle punch.

Step 30

1. Hold the handle axle with the help of Coupling Spanner as shown.

2. Insert 4 mm washer.

3. Tighten nuts by using crank spanner as shown.
**CONNECT CHAIN WITH HANDLE**

1. Lift the handle for fixing chain.
2. Lift the chain and insert high tensile bolt and washer.
3. Tighten the nylock nut with the help of crank spanners.

**LUBRICATE CHAIN**

1. Lower down handle and Remove chain coupler supporting tool.
2. Tighten the check nut against the chain coupler.
3. Lift handle up and apply 'Graphite Grease on Chain.'
Now make sure that:

- When you pump, the handle touches the top stop and bottom stop of Bracket. If it does not, then remove head and check the setting of the top connecting rod. Refer Page 31.

- Connecting rod moves up and down freely in guide bush. If it does not, then the rod must have got bent while threading.

- You have threaded chain coupling fully on to connecting rod, and you have tightened the lock nut fully.

- You have tightened axle nut and lock nut fully and the handle axle is firmly retained.

- You have tightened chain anchor bolt and nyloc nut fully.

- All the flange bolts & nuts are tight, and you have also tightened the lock nuts fully.

- You have left nothing inside the head.

2. Tighten cover bolt fully by Crank Spanner.

1. Fix inspection cover.
INDIA MARK II HAND PUMP

INSTALLATION
OF
THE PUMP PEDESTAL
AND
CONSTRUCTION OF THE APRON

PREPARED BY UNICEF WASHE SECTION
FEBRUARY 2005
STEP 1  PLATFORM CONSTRUCTION

DIG PIT FOR PUMP PEDESTAL

REMOVE TUBEWELL CASING PIPE COVER, MEASURE DEPTH OF TUBEWELL STATIC WATER LEVEL AND ENSURE THAT IT IS FREE FROM OBSTRUCTIONS

CHLORINATE TUBEWELL

MIX 300 GMS OF BLEACHING POWDER IN 15 LITRES OF WATER IN A BUCKET, STIR WELL AND POUR INTO THE TUBE WELL FOR CHLORINATION.

COVER TUBE WELL CASING PIPE
DIG A SQUARE PIT 75 CM BY 76 CM AROUND CASING PIPE AND 40 CM DEEP FROM GROUND LEVEL.
STEP 3 Platform Construction

PREPARE CEMENT CONCRETE MIX

1 PART CEMENT
2 PARTS SAND
4 PARTS 20 MM METAL

MIX THOROUGHLY

POUR CEMENT CONCRETE 8 CM DEEP INTO PIT

STEP 4 Platform Construction

DECIDE NOW WHERE YOU WILL MAKE THE DRAIN

LOOK AT HOW THE LAND SLOPES.
DRAIN MUST SLOPE DOWNHILL.

THIS LEG AND THE PUMP SPOUT MUST FACE DRAIN AND BE IN THE CENTRE OF PLATFORM.

STAND ASSEMBLY.
STEP 5  Platform Construction

**PLACEMENT OF STAND ASSEMBLY**

1. REMOVE TUBE WELL COVER

2. PLACE STAND ASSEMBLY OVER CASING PIPE SO THAT...

3. MAKE SURE THAT STAND ASSEMBLY IS VERTICAL. USE A SPIRIT LEVEL.

WHEN YOU FIT WATER TANK, SPOUT WILL BE OVER THIS LEG IN THE CENTRE OF PLATFORM.

CASINGPIPE

STEP 6  Platform Construction

**LEVEL STAND ASSEMBLY**

1. FILL PIT WITH CONCRETE AND RAM TO GET AIR BUBBLES OUT OF CONCRETE

2. CHECK THAT TOP FLANGE IS LEVEL. USE SPIRIT LEVEL.

3. CONSTRUCT PLATFORM TO TOP OF LEGS WHILE CONCRETE IS STILL WET.
STEP 7 Platform Construction

COVER STAND ASSEMBLY

1. COVER STAND ASSEMBLY SO THAT CHILDREN DO NOT PUT STONES IN THE TUBE WELL.
   - IF YOU HAVE A COVER PLATE, USE IT.
   - IF YOU DON'T HAVE A COVER PLATE

   PLACE MIDDLE FLANGE OVER WATER TANK AND BOLT IT.

2. WRAP CLOTH AROUND AS SHOWN.

STEP 8 Platform Construction

PLACEMENT OF PLATFORM SHUTTERING

LAY THE MILD STEEL PLATE OVER THE PUMP AND PREPARE THE GROUND FOR CONSTRUCTING THE PLATFORM AS PER DESIGN.
STEP 9 Platform Construction

POUR CONCRETE PARTIALLY.

STEP 10 Platform Construction

APPROXIMATE MATERIAL REQUIREMENT FOR CONSTRUCTION OF ONE PLATFORM.

- a) CEMENT ... 6 BAGS.
- b) SAND ... 0.40 M³
- c) METAL (20 MM SIZE) ... 0.80 M³

COMPLETE PLATFORM
**STEP 11 Platform Construction**

1. **CURE PLATFORM**
   - TO CUBE CONCRETE
   - BLOCK DRAIN AND FILL PLATFORM WITH WATER
   - ASK VILLAGERS TO KEEP AWAY FROM PLATFORM
   - ALLOW CONCRETE TO SET FOR SEVEN DAYS
   - SPREAD THORNY BUSHES AND COVER THE PLATFORM TO AVOID PEOPLE OR ANIMALS STEPPING ON IT

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**How to Cure Cholesterol (Triglycerides)**

- Send the sample for biochemical examination.
- Collect samples of the water. Use a sterile bottle. Seal.
- No bubbles in the water.
- Place day pump at the base of choline is just pump until next day.
- 6 hours or more. Soak people not to use the hot. But it is better if the hand pump is not used for a long time.

- The hand pump must not be used for at least one day of choline.
- PUMP: Stop pumping when the water smells strongly.
- Tighten the hose bolts and nuts firmly.
- Send the water tank and bolt to pedestal.
- Pour Choline solution into open end of pedestal
- The side pedestal above water tank with water pump assembly to:
  - Lift it properly.
  - Water in a bucket:
    - 300 grams of bleeding powder in 15 liters of
      - Occassionally when the dye well gets polluted.
    - Pour the mixture into the dye well.
    - Mix it thoroughly.
    - Water in 3 buckets:
      - Pour 300 grams of bleeding powder in 15 liters of water in a bucket.

- Initiate during the installation of hand pump.
THE INDIA MARK II HAND PUMP

Background Information

The India Mark II hand pump was a result of efforts initiated by UNICEF in co-operation with the Government of India (GoI) in the late 1970's to develop a sturdy and reliable deep well hand pump. In the year 1979 this pump design was adopted on a national scale in India. To overcome certain design weaknesses such as poor service life of leather cup seals and bearings and frequent failure of upper valve assembly, the UNDP/World Bank Water and Sanitation Program in co-operation with GOI and UNICEF initiated in the early 1980's, further experiments and field testing of this pump. As a result of these efforts and close field monitoring over a four and half year period (1983-88) some design improvements to the India Mark II were carried out. These improvements have enhanced the serviceability and reliability of the Mark II. Currently, over 1.8 million Mark II hand pumps are believed to be in operation in more than thirty countries.

WORKING PRINCIPLE

This is a positive displacement reciprocating type hand pump and consists of: a head assembly mounted on a pedestal fixed in cement concrete, pump rods to connect the handle and the plunger assembly; a riser pipes which carries water from the cylinder to the water tank; and a cylinder assembly normally placed 3-6 meters below the dynamic water level. For construction details see figure overleaf.

When a user operates the handle, the plunger moves up and down. With each upstroke of the plunger, a certain quantity of water is pushed upwards and ultimately it emerges out of the water tank spout and the same quantity of water enters the cylinder through the foot-valve.

DESIGN FEATURES

The design features of the hand pump are briefly described below:

Above-ground Assembly

The above-ground assemblies are fabricated from carbon steel plates and rods and hot dip galvanized for corrosion resistance. Two ball bearings are fired in an accurately machined bearing housing welded on the handle. The weight of the handle balances the weight of connecting rods and this makes for the easier operation of the hand pump. The handle and the connecting rods are connected through a chain link which keeps the pump rods in constant tension, thus minimizing the chances of bending of rods due to buckling. The above-ground structure is designed to withstand abuse and vandalism.

Riser Main

The 32 mm galvanized iron tube (medium class) of 3 m length with heavy duty socket is used as a riser pipe. The pipe sockets are of seamless construction.
**Pump rod**

This consists of a 12 mm diameter of 3 m long electro-galvanized carbon steel rods with male threads on one end and a coupler with female threads welded on to the other end. For corrosive water stainless steel pump rod option is available.

**Cylinder assembly**

This consists of a cast iron body with a brass liner fitted snugly inside. The brass liner provides smooth surface for the seal to function and the hard cast iron outer surface helps in minimizing damage due to abrasion between the cylinder and the inside of a borewell in rock formation. The plunger and foot-valve assemblies are made of brass. One of the special features of the cylinder is the use of piston seal and valve seatings made of acrylonitrile butadiene rubber. The field trials have conclusively proved that NBR is highly abrasion resistant material.

The use of stainless steel plunger rod eliminates the galvanic corrosion between the plunger and plunger rod.

**APPLICATION**

The India Mark II Deep well Hand pump is recommended for community use (150-200) in borewells of diameter 100 mm (N.B.) and above with static water level (SWL) up to 45 meters. It can be used both in lined as well as unlined borewells. The rated discharge of this pump is 15 liters per minute (0.25 l/sec.). This pump is not suitable in corrosive water as its hot dip galvanized steel rising main is susceptible to corrosive water.

**COST**

The approximate ex-works price of this pump, for a 30-meter cylinder setting and inclusive of 32 mm NB GI rising main is U.S.$200.00.

**OPERATION & MAINTENANCE**

The pump is comparatively easy to operate in wells with SWL up to 20 meters. The above-ground repairs can be attended by a village-level mechanic with a few simple tools. To carry out below-ground repairs it is necessary to lift the entire below-ground assembly which means lifting over 150kg of weight and dismantling and making of at least eight threaded joints each in rising main and pump rod. This requires a team of four semi skilled persons, a motorised transport and heavy tools. Special tools have been developed which make the below-ground repairs easier but not easy enough to facilitate repairs at village level without outside assistance. The average frequency of below-ground repairs is one per year and the average spare parts cost U.S.$20 per pump per year.
The average life span recorded for wearing pump components in a hand pump field testing project is:

- Piston seal - 2 years.
- Ball bearing - 5 years.
- Pump rod - 8 years.
- Chain - 4 years.
- Valves - 4 years.
- Rising main - 6 years.

**INDIA MARK III DEEP WELL HAND PUMP**

**BACKGROUND INFORMATION**

The United Nations Development Program and the World Bank initiated a global/interregional project for Field and Technological Development of Community Water Supply hand pumps. From the beginning, the project promoted VLOM hand pump designs as a means of overcoming some of the major obstacles to establishing and maintaining a sustainable water supply system. The Coimbatore Hand pump Field Testing Project in India (1983-88) undertaken in collaboration with the Government of India, and UNICEF formed part of this global efforts.

Even though the India Mark II hand pump was regarded as a reliable and sturdy deep well hand pump, the maintenance of its below-ground components, especially fast wearing components like the piston seal etc., at the village level was not feasible as it needed heavy tools, tackles and four semi skilled persons. To overcome this deficiency, further field testing on this pump was undertaken in the coimbatore project. Intensive work and close field monitoring over a four and half year period resulted in the development of a VLOM derivative of the India Mark II pump, known as the India Mark III deep well hand pump.

To assess its performance in various geological and usage conditions and its acceptability by implementors and users, four hand pump demonstration projects were initiated by UNICEF and UNDP/World Bank Water and Sanitation program. Two and half years of monitoring proved that the procedure for below-ground repairs in the India Mark III hand pump has been simplified substantially and that it is now feasible to promote a village based maintenance system.

**WORKING PRINCIPLE**

The India Mark III is a positive displacement reciprocating type hand pump and consists of:

- a head assembly mounted on a pedestal fixed in cement concrete;
- connecting rods connecting the handle and the plunger in the cylinder;
- a riser main which carries water from the cylinder to the water tank; and a cylinder assembly normally placed 3-6 meters below the dynamic water level. (For construction details see figure overleaf). When a user operates the handle, the plunger moves up and down. During each upstroke of the plunger, a certain quantity of water is pushed upwards and ultimately emerges from the water tank spout. Simultaneously, the same quantity of water enters the cylinder through the foot valve.
DESIGN FEATURES

The pump has design features such as open top cylinder with a withdrawable plunger and foot valve, and a riser main with it’s internal diameter (I.D.) higher than the I.D. of the cylinder. The main pump assemblies are briefly described below.

Above-ground assembly

The above-ground assemblies are fabricated from carbon steel plates and rods and hot dip galvanized for corrosion resistance. Two ball bearings are fixed in an accurately machined bearing housing welded on the handle. The weight of the handle balances the weight of connecting rods and this makes the operation of the hand pump easier. The handle and connecting rod are connected through a chain link which keeps the pump rod always in tension, thus minimizing the bending of rods due to buckling. The above-ground structure is designed to withstand abuse and vandalism.

Riser Main

A 65 mm galvanized iron pipe of 3 m length with heavy duty socket is used as a riser pipe. As the annular space between the pump rod coupler and the rising main is more, the abrasion between them is considerably reduced.

Pump Rod

This consists of a 12 mm diameter and 3 m long electro-galvanized carbon steel rods with male threads on one end and a coupler with female threads welded on the other end. The option of using a 12 mm diameter stainless steel pump rod for corrosive water is also available.

Cylinder Assembly

It consists of cast iron body with a brass liner fitted snugly inside. The brass liner provides a smooth surface for the seal to function and the hard cast iron outer surface helps in minimizing the damage due to abrasion between the cylinder and the inside of a borewell in rocky areas. The foot valve assembly is seated in a conical receiver of the bottom cap. The plunger and foot valve assemblies can be engaged together by resting the plunger on the foot-valve and rotating the connecting rods clockwise from the ground level. When the plunger and foot-valve assemblies are engaged, the push rod in the foot-valve assembly lifts the piston valve and as soon the foot-valve is lifted by a few mm, the water column in the rising main is dumped. This makes the lifting of the connecting rods and pumping elements a lot easier. The piston seal and valve seatings made of nitrile rubber and are durable.
Application

The India Mark III hand pump is recommended for communities of 150 - 200 persons, and for installation in boreholes of 125 mm and above diameter with static Water Level (SWL) up to 45 meters. The rated discharge of this pump is 15 liters per minute, and can be used in both lined as well as unlined borewells. This pump is not suitable for corrosive water as its hot dip galvanized steel rising main is prone to corrosion in corrosive water.

Cost

The approximate ex-works cost for the pump for a 30 meter cylinder setting, and inclusive of 65 mm GI riser pipes $325.00

Maintenance

All above and below-ground repairs, except the repairs of the rising main, cylinder body and cap can be carried out by village level mechanic with a few simple tools. However, to attend to the repairs on the rising main and cylinder body which are not frequent, 4-5 semi-skilled persons with heavy tools and tackies are required. As the rising main is not removed frequently, the average life of the rising main is much high than in the India Mark II. The average spare parts cost recorded in various demonstration projects over a period of three years, is U.S. $10.00 per pump per year.

The average life span for wearing pump components is estimated as:

<table>
<thead>
<tr>
<th>Component</th>
<th>Life Span</th>
</tr>
</thead>
<tbody>
<tr>
<td>Piston seals</td>
<td>5 years</td>
</tr>
<tr>
<td>Handle bearings</td>
<td>5 years</td>
</tr>
<tr>
<td>Pump rod</td>
<td>10 years</td>
</tr>
<tr>
<td>Chain</td>
<td>4 years</td>
</tr>
<tr>
<td>Valves</td>
<td>4 years</td>
</tr>
<tr>
<td>Riser pipes</td>
<td>12 years</td>
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</tbody>
</table>