What is a VLOM pump?

A VLOM pump is one which can be operated and sustained using Village Level Operation and Maintenance.

The term VLOMM is also used, meaning Village Level Operation and Management of Maintenance.

This addition emphasizes the role of users as the managers of maintenance – they may choose to use someone from outside the village to assist with more complicated repairs. Not all maintenance and repair needs to be done by the villagers for a pump to be classed as a VLOM pump.

Why are VLOM pumps needed?

Many handpump projects have failed because of:

- the absence of a sustainable system of handpump maintenance and repair;
- the installation of pumps which were not suitable for the heavy usage they received;
- the use of pump components which were damaged by corrosive groundwater; and
- a lack of community involvement in important aspects of the project planning.

The careful choice of a VLOM handpump can help solve the first three of these problems, but unless the community is involved from the beginning in the planning of the pump project and the management of the maintenance, it is unlikely that the handpump will be sustainable.

HOW MOST TYPES OF HANDPUMP CYLINDER WORK

In most handpump cylinders a piston is alternately raised and lowered by a rod (or a string of rods joined together) which is connected to a handle, or sometimes to a flywheel and crank. These pumps are called reciprocating handpumps. The figure above illustrates how most cylinders work.
There are three types of reciprocating handpump.

<table>
<thead>
<tr>
<th>Type of pump</th>
<th>Maximum pumping lift (m)</th>
<th>Cylinder above or below groundwater</th>
</tr>
</thead>
<tbody>
<tr>
<td>Suction</td>
<td>7 - 8.5</td>
<td>Above</td>
</tr>
<tr>
<td>Direct action</td>
<td>15 - 25</td>
<td>Below</td>
</tr>
<tr>
<td>Deep-well</td>
<td>45 - 80+</td>
<td>Below</td>
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</tbody>
</table>

One of the basic aims of a VLOM handpump is to make all the main wearing parts easy to reach and replace, and to reduce the wear and tear on the pump by good design. The main wearing parts of a reciprocating handpump are:

- The piston seal, which rubs against the inside face of the cylinder.
- The piston valve and suction valve (or foot valve), which are constantly opening and closing.
- The bearings in the pump-head, which are subjected to constantly changing loads.

### Suction pumps

#### Traditional design

- Rod hanger bearing
- Handle bearing
- Piston, cup seal, and piston valve
- Suction valve
- Cylinder (often of cast-iron)
- Ground level (concrete)
- Suction pipe (installed in borehole casing or directly in the ground)

VLOM designs are available similar to traditional pumps, but often with these improvements:

- Better suction valves to eliminate priming;
- Smoother cylinder walls to reduce wear on piston seals;
- Wear-resistant seal instead of leather (e.g. nitrile rubber); and
- Better bearings to prevent the pivot pins wearing out the cast-iron (e.g. using hardened bushes around the pivot pins).

#### Rower design

- Plastic cylinder anchored and buried in mound of earth
- Surge chamber, if used, helps to regulate the flow
- Suction valve and seal
- Suction pipe (easily removed)
- Suction pipe from water source (can be flexible pipe)

The rower pump has other VLOM features.

- It allows very easy access to the piston and suction valve.
- It is relatively cheap and easy to manufacture.
- On some versions, the valves can be replaced using discs cut from car inner tubes.

**Important:** If this pump is to be used to draw drinking-water then care must be taken to avoid contaminating the cylinder, for example by using poor-quality priming water.

### The cylinder of a suction pump is usually above ground level.

**Main advantages**

- Easy access to wearing parts because they are usually all above the ground.
- Fast delivery of water because of the large piston diameter (traditional designs), or long piston stroke (rower design).

**Main disadvantages**

- Only suitable for pumping lifts of up to about 7m.
- May need to be ‘primed’ by adding water to the cylinder if the suction valve leaks overnight.
- Villagers will often use polluted water to prime the pump, thereby contaminating it.
- Pump designs are often not suitable for use by more than about 50 people per day unless frequent repairs and replacements are carried out.
### Direct action pumps

- **Section of metal pipe often used below handle, but some designs use plastic**
- **Connector**
- **Plastic pipe rod (usually with special screwed connectors)**
- **GWL: Groundwater level**
- **Cylinder (may be same pipe as rising main)**
- **Fine screen (essential if installed without a borehole casing)**

In most designs of direct action handpumps, the piston is raised and lowered by a 'T' bar handle, which is directly connected to an air-filled plastic pipe 'rod'. This rod floats in the water in the rising main, reducing the force needed on the upstroke. On the down-stroke, as more of the pipe rod enters the water in the rising main, it displaces an equal volume of water, so the pump delivers water on both the up-stroke and the down-stroke.

### Deep-well pumps

#### Traditional design

- **Pump-head:** Most pump-head lever handles work on a similar principle to the handle shown for the traditional suction pump. Some pumps use just one pivot and a chain (or belt) and quadrant system, such as in the India Mk II, shown below.
- **Rising main and cylinder:** Traditionally the rising main is of galvanized steel pipe with a smaller diameter than the piston. The string of pipes and operating rods have to be lifted so that the rod joints (a) and pipe joints (b) can be unscrewed section by section to reach the cylinder (c). This operation needs strong people with appropriate lifting and clamping tools, or a mechanized lifting system. Some manufacturers now supply, therefore, lightweight thin-walled stainless steel pipes joined with 'rope threads', or plastic pipes with special threaded collars to reduce the weight which needs to be lifted. Rubber 'O' rings can be used to make such joints watertight.

#### Open-top cylinder design

- **Cylinder:** Recent designs of deep-well pumps have 'open top cylinders' (OTC). These allow the piston (d) to be pulled up through the rising main (e) which is of the same, or preferably a slightly larger, diameter than that of the cylinder. With these pumps, the piston can be pulled to the surface by pulling out the string of rods.
- **Rods:** Most rod strings are joined by threaded couplings, but some pumps use special rod joints (f) which can be easily disassembled without tools.
- **Foot valve:** The best designs of OTC allow the foot valve (g) to be removed through the rising main, either with the piston, or by using a fishing tool which is lowered down inside the rising main on a piece of rope after the piston has been removed.
- **Rising main removal:** In OTC pumps with extractable foot valves, the rising main should never need removing unless the pipe or the lining to the cylinder becomes damaged. Mains with screwed couplings are easily removed.
- **Should the removal of a solvent-cemented plastic rising main be necessary, the whole length can be removed by supporting it with tall poles so that it can bend to a large radius curve as it leaves the borehole.**
# Technical Brief No. 41: VLOM pumps

<table>
<thead>
<tr>
<th><strong>Direct action pumps</strong></th>
<th><strong>Deep-well pumps</strong></th>
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<tbody>
<tr>
<td><strong>Main advantages</strong></td>
<td><strong>Traditional design</strong></td>
</tr>
<tr>
<td>• Easy access to piston (and sometimes the foot valve), which can be pulled through the rising main.</td>
<td>• Pump is suitable for a wide range of pumping lifts.</td>
</tr>
<tr>
<td>• Relatively cheap, and easy to manufacture.</td>
<td>• Design can be strong enough to cope with intensive use.</td>
</tr>
<tr>
<td><strong>Main disadvantages</strong></td>
<td><strong>Open-top cylinder design</strong></td>
</tr>
<tr>
<td>• Lack of lever handle makes it difficult to operate at pumping lifts much above 12m.</td>
<td>• Easy access to piston, and often to the foot valve.</td>
</tr>
<tr>
<td>• Pump design is often not rugged enough for use by more than about 50 people per day unless it is frequently repaired.</td>
<td>• Use of solvent-cemented plastic rising main is feasible.</td>
</tr>
<tr>
<td>• Main wearing parts (in the upper cylinder) are easily accessible.</td>
<td>• Same advantages as for traditional design.</td>
</tr>
<tr>
<td><strong>Special VLOM features:</strong></td>
<td><strong>Main disadvantages</strong></td>
</tr>
<tr>
<td>• identical body for piston and foot valve housing; and</td>
<td>• Large diameter rising main (to allow piston extraction) can be expensive.</td>
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<tr>
<td>• identical bearings for the rod hanger and handle (can be moulded from engineering plastics).</td>
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<tr>
<td><strong>Other good features to look for in VLOM pumps:</strong></td>
<td><strong>Important notes about sustainable maintenance:</strong></td>
</tr>
<tr>
<td><strong>Corrosion resistance by using:</strong></td>
<td><strong>Affordability and availability of spares</strong></td>
</tr>
<tr>
<td>• stainless steel rods (with direct-well pumps);</td>
<td>It is vital that there is a reliable distribution system of essential, affordable spares. Standardizing on one particular pump in a region, or country, can make this, and local technical support for repairs, more feasible.</td>
</tr>
<tr>
<td>• plastic pipe ‘rods’ (with direct action pumps);</td>
<td><strong>In-country manufacture</strong></td>
</tr>
<tr>
<td>• brass, plastic, and/or rubber for valves and pistons; and</td>
<td>Standardization on one pump in any country can also make the in-country production of a handpump, or at least the spares it commonly requires, a more attractive proposition because of the resulting high level of demand.</td>
</tr>
<tr>
<td>• plastic or stainless steel for the rising main.</td>
<td><strong>Quality control</strong></td>
</tr>
<tr>
<td><strong>Reduction of both production costs and number of different spare parts required by using:</strong></td>
<td>To give good performance, handpumps and spares need to be produced by manufacturers who carry out stringent quality control checks.</td>
</tr>
<tr>
<td>• identical designs for the piston valve and foot valve;</td>
<td></td>
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<td>• identical body for piston and foot valve housing; and</td>
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<tr>
<td>• identical bearings for the rod hanger and handle (can be moulded from engineering plastics).</td>
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<tr>
<td><strong>Few tools necessary for normal maintenance work.</strong></td>
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<td><strong>Easily replaceable bearings.</strong></td>
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<tr>
<td>Facility to use ‘T’ bar end to lever handles to reduce sideways forces on bearings. Handle ideally of adjustable length to suit leverage required.</td>
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<td>Theft-resistant parts and ‘captive nuts’ where possible, so that they cannot be dropped or lost.</td>
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**Vergnet diaphragm pump**

This is a deep-well pump which works without rods; instead it uses hydraulic pressure from a small cylinder just under the baseplate of the pump to cause the alternate expansion and contraction of a cylindrical diaphragm in a larger cylinder at the bottom of the borehole. Models for operation by foot or by hand (lever or ‘direct action’) are available. The reinforced rubber diaphragm can only usually be manufactured in countries with a high level of industrial development.

**Special VLOM features:**

- Main wearing parts (in the upper cylinder) are easily accessible.
- When necessary the main cylinder can reached by pulling it up using the two flexible plastic pipes attached to it.

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**Further information:**


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