# **CONSTRUCTION MANUAL MARBLE PUMP**

#### For demonstration purposes

The marble pump is a type of water pump made of PVC pipe and two marbles. Because of its simplicity and because PVC is readily available all over the world, this pump is very suitable for developing countries.

The marble pump essentially consists of two parts: The pump cylinder with foot valve and the head pipe with discharge valve. This document describes step by step how to make the parts. The drawing shows the exposed construction of the pump.

#### **Required materials and tools**

Materials needed:

- 25 mm thin-walled PVC pipe, approx. 960 mm long (\*)
- 19 mm (3/4") electrical tube 1000 mm long + 50 mm
- 16 mm (5/8") electrical tube 50 mm long
- 3/4" long sleeve (\*)
- 2 marbles Ø16 mm
- rubber, about 5 mm thick

Required tools:

- hacksaw
- smooth file
- sandpaper
- tape measure
- scissors
- punches: 16 mm & 22 (23) mm
- heavy hammer
- pencil
- fire (small spirit burner)
- lighter
- gap-filling PVC glue

(\*) The 25 mm thin-walled tube and the long 3/4" sleeve are available from Dyka plastics.

# **Modeling PVC**

The marble pump is made from standard tube sizes. Some parts are different in size or are specially shaped. These parts are made by modeling the tube into the desired shape.

PVC is a thermoplastic. This means that the plastic can be deformed in a warm state. In order to deform PVC, the material must be heated to well above 80°C. A small fire is used. Hold the part of the pipe to be heated in the flame while continuously rotating the pipe.



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Keep the tube briefly in the flame and feel whether the tube becomes plastic. If the material gets too hot it will char and can no longer be used.

When forming a part, use a longer piece of tube and only cut it off after forming. This is because a longer piece of tube is more manageable. The dimensions are also easier to check.

#### Fill the burner with only a small layer of fuel!

Before forming the PVC pipe, remove all burrs created by sawing with sandpaper. After forming, there may be a raised edge, this should be filed away.

# Gluing

With this pump, various parts need to be glued. For this purpose, special gap-filling

PVC adhesive is used. Before bonding, the surfaces must be sanded. The edges must be well deburred and slightly chamfered. Coat both parts to be glued with glue and press them together. Do not wait too long because the glue hardens fairly quickly.



# Valve seats

The pump contains two valve seats: one in the foot valve and one in the discharge valve.

If the marble rests on the seat, it must block the flow of water. Therefore, it is important that the valve seat is cut off properly at right angles on the marble side and then flattened. To do this, sandpaper is placed on a flat surface and the valve seat is moved over the sandpaper while turning under slight pressure. The rough side of the valve seat is marked beforehand making notches by here with a file.





#### **Rubber ring**

The rubber ring ensures a good seal of the piston in the cylinder. For smooth movement of the piston, it is important that the ring be properly sized.



Using the 22 mm punch, punch a disc out of the rubber plate. Alternatively, mark and cut out a 23 mm circle using scissors.



Then make a hole in the disc with the 16 mm punch

Cut the sharp edges on the outside at an angle with scissors.



Four sizes of tube are used in the pump:

5/8" electrical tube

3/4" electrical tube

**3/4" long sleeve** Called "sleeve" for short in this document.

25 mm PVC pipe, thinwalled









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The cylinder with the foot valve at the bottom is the fixed part of the pump.

#### Valve Body



Make the following two parts for the foot valve.



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#### Stroke limitation

To prevent the valves from being broken, a stroke restrictor is necessary.





# Testing the pump

Once the glue has had about half an hour to cure, the pump can be carefully tested. The stopper has probably not had as long to dry. Therefore, do not bump it into anything.

After 24 hours for the adhesive to harden, the pump can be used.

