OPERATING INSTRUCTIONS

12.14 MOTORIZED FOOT VALVE PUMP

Contents

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On these operating instructions

☞ **When the symbol shown on the left is placed before a piece of text, this means that an important instruction follows.**

When the symbol shown on the left is placed before a piece of text, this means that an important warning follows pointing out a risk of injury to the user or damage to the device. The user is always responsible for it own personal protection.

Text **Text in italics means that the actual text is shown on the display screen.**

☞ **For maintenance of the Honda combustion engine please refer to the Honda manual.**

1. General

The foot valve pump (also called inertia pump) is a proven tool to purge and sample monitoring wells with a wide range of diameters. The pump is extremely simple and allows the purging and sampling of wells with a diameter of 10 mm and larger. The foot valve pump itself can be hand-operated purely by a rapid up-down movement. Generally a more ergonomic solution is chosen to allow regular, ergonomic, long-term and professional use. A hand operated actuator exists (12.13.01) and this 4-stroke combustion engine powered actuator (12.14.01). It is light-weight and does not need a separate generator requiring additional safety measures. The supplied removable carrying frame makes it easy to transport the actuator as a rucksack.

2. Characteristics of the combustion engine powered actuator

This actuator can manage 12x16mm, 13x18mm and larger tubings. With a scouring pad wrapped around the tubing smaller dimensions can be grabbed in the clamp. When pumping shallow wells with low friction, two tubings can be actuated at the same time.

2.1 Main advantages

- ❒ Suitable for both well development as well as purging and sampling because of variable speed.
- ❒ For all types of analyses including volatiles and trace metals; no aeration, no suction.
- ❒ Cross-contamination can easily be prevented by cleaning valves in detergent and renewing tubing prior to purging/sampling.
- ❒ Lightweight; can be transported and used anywhere.
- ❒ Very simple operation; no electrical connections.
- ❒ Can be fixed with mounted ratchet on almost any above-ground well casing.
- ❒ Can be used at ground level by strapping the actuator to a ground anchor.
- ❒ Can be used with various sizes of tubing as well as with pipes.
- ❒ 4-stroke engine of high quality that consumes little petrol.
- ❒ 4-stroke engine does not emit oil fumes (like 2-stroke engines do).
- ❒ 4-stroke engine does not require pre-mixed oil containing petrol. Engine runs on regular unleaded (oil-free) petrol (See Honda manual for more detail).
- ❒ 4-stroke engine can run on Aspen or Coleman low-odour (aromatics poor) petrol.
- ❒ 4-stroke engine can be transported in almost any position.

2.2 Main disadvantages

- ❒ Higher turbidity of the water due to the shockwise pumping action (which is an advantage during well development).
- ❒ Sample must be collected windward, at some meters distance from the well to prevent any risk of contaminating sample bottles with exhaust fumes.

❒ Actuator must be stored and transported away from sample tubing to prevent cross contamination due to diffusion of vapours (see in Remarks paragraph).

3. First use

❒ Unpack unit and fill the carter of the Honda engine with required engine oil (see Honda manual) and the reservoir with unleaded petrol.

3.1 Installation

3.1.1 On an above ground well casing

❒ Remove the carrying frame from the actuator (see fig. 1).
❒ Uncap the casing.
❒ Lift actuator, slide strap around casing and hook it on the upper rim of the casing (see fig. 2).
❒ Pull strap, first by hand and then using the ratchet (see fig. 3).

Fig. 1 Removal of carrying frame

Fig. 2 Actuator hooked on the upper rim

Fig. 3 Strap fixed around casing

3.1.2 Installation next to a well, finished at soil level

❒ Remove the carrying frame from the actuator.
❒ Position the actuator next to the well in such a way that the tubing lever is exactly vertical above the well to be pumped.
❒ Mark the place(s) to screw in the ground anchor(s).
❒ If the situation allows, insert one central ground anchor just under the engine (see fig. 4).

Fig. 4 One central ground anchor installed under the engine

❒ If two anchors are needed (see fig. 7), place them at the left and right, next to the actuator.
❒ Now put the actuator in place above or between the anchors.
❒ Pass strap behind electric cables (see fig. 5).
❒ Pull strap between engine and crankcase (see fig. 6). Pass strap through anchor(s). Pull the strap as tight as possible!
❒ Apply force to check if the actuator is well pulled backward (towards the heel of the support frame).

☞ **Do not allow any movement of the actuator during operation.**

Fig. 5 Pass strap behind electric cables

Fig. 6 Pull strap between engine and crankcase

Fig. 7 Two anchors are used to install the actuator

3.2 Foot valves and tubing

❒ Foot valves are made from inert materials to cope with all sampling situations: Stainless steel 304-type is used for the valves. For the tubing, LDPE or HDPE (disposable) or Teflon (durable but expensive) is commonly used.
❒ Valves are available in 9 mm for 6x8 mm tubing, 12 mm for 8x10 mm tubing, 18 mm for 12x16 mm tubing and 22 mm for 16x20 mm tubing.

☞ **It is essential that the foot valve at depth makes the same up and down movement as the above-ground actuator ! Souple tubing (like transparent PVC or rubber) should therefore not be used.**

☞ **Pumping in open water is not possible with tubing as the tubing will curl. In this case a rigid pipe must be used.**

❒ Depending on the application depth, water level and well diameter, a reasonably stiff tubing or even pipe must be used.
❒ In a 50 mm I(nner) D(iameter) well with shallow water level LDPE tubing can be used until approximately 30 m depth. Deeper water levels, smaller diameters or longer tubing will require stiffer tubing or even pipes.
❒ The 18 mm valve is the standard one and can be combined with 12x16 mm LDPE for pumping depths up to 30 m, or HDPE for larger depths, or Teflon 13x18 mm.
❒ The stiff Teflon 13x18 mm tubing can be used for all depths. Teflon 13x18 mm is expensive but durable and chemically inert. It can be used in chemicals that attack PE. It is also heatt-resistant and can be sterilised.
❒ PE 12x16 mm however, is the basic tubing, cheap and therefore disposable so that cross-contamination can be completely excluded.
❒ Swabbing of the above-well part of the tubing, for instance with the 8, 10 or 16 mm O.D. tubings can be prevented by using the 12.13.09 tube guide. (see fig. 8, how to use this guide).
❒ Large diameter wells (> 100-125 mm I.D.) allow swabbing of the tubing in the well. This will greatly reduce flow. So use straight pipes with threaded connections in large diameter wells. Using straight pipes will also greatly reduce friction in tight small wells as a pipe will not rub.

3.3 Storing tubing

Tubing is sold on coils. When it is uncoiled to slip it in a well, the sides of the tubing will rub against the inner wall of the well.
Stiff tubing like HDPE, Teflon or, even better, rigid straight pipes, will give the best reaction at the valve and the lowest friction and will consequently result in the highest flow. However LDPE, being cheaper and less stubborn in use, can be used up till depths of approx. 25 m. The maximum application depth of the tubing will also depend on the inner diameter of the well. The smaller the well (e.g. 25 mm) the higher the friction to the wall (more contact-rubbing points).

☞ **To reduce friction, store tubing in large diameter coils if tubing is to be re-used.**

A larger diameter hose reel cart allowing rapid winding and unwinding of tubing is sold under article number 12.14.19.

You may also make an even larger reel (see fig. 9) allowing even larger diameter coils. Stiff tubing is preferably stored IN a reel; not ON a reel (see fig. 9). This can be made from a round piece of water-repellent plywood (diameter approx. 1.20 m; thickness 10-12 mm) with threaded rods mounted on it in a circular shape. Ideally this disc can rotate freely on a horizontal or even vertical support. The tube can then be lowered and, later, retrieved by one person without the tube touching the soil!

Fig. 8 Use of the tube guide

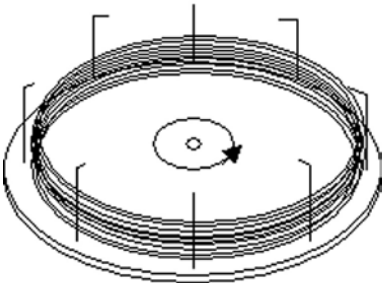

Fig. 9 Storing stiff tubing in a reel

3.4 Waste disposal

- ❒ Teflon tubing contains fluoropolymers and should NOT be burned at low temperatures. Teflon should be incinerated as chemical waste (or re-used for other purposes since it will last for thousands of years). Dumping in an official waste dump is an option too. We suggest that you only use Teflon tubing in cases where LDPE or HDPE cannot be used.
- ❒ PE tubing types can be treated as any household waste, and may therefore be incinerated in a standard waste burner.

3.5 Mounting a valve

- ❒ In LDPE tubing the valve can be pushed in by hand or with a few taps with a plastic or wooden hammer while holding the end of the tubing with your other hand.
- ❒ Teflon has a thicker wall but a larger inner diameter. Grip the tubing with tongs and hammer the valve into the tubing.
- ❒ The best option in the case of HDPE tubing is to first heat the the end of the tubing in a thermos with hot water.

Fig. 10 Mounting a valve

3.6 Removing a valve

- ❒ The barbed part of the foot valve itself is very sharp. This is in order to prevent accidental loosening of the valve. Do not block the water flow (with your thumb to make a spray, or with a clogged filter) as this will overpressurize the tubing which will result in the valve being blown from the tubing. A stainless steel tubing clamp may be used but is in general not necessary.
- ❒ To remove a tube from a valve, take a knife and cut the tubing along the barbed section of the valve. Cut the plastic like you would peel a potato and ease out the valve (see images).

Fig. 11 Removing a valve

4. Use

- ❒ Measure the water level and, if this is unknown, the depth of the well
- ❒ Take a length of tubing long enough to touch the bottom of the well + 5 metres for above ground. For deep wells take a piece of tubing long enough to be submerged 10 m deep. The more the tubing is submerged, the higher the flow will be! Water will also reduce friction. While pumping a small diameter well (e.g. 25 mm) that yields little water, the water level will drop by many metres per minute so use a tubing of sufficient length.
- ❒ Take an 18 mm valve and mount it to a 12x16 mm LDPE tubing (see par. 3.5 Mounting a valve).
- ❒ Lower the tubing until it hits the bottom of the well.
- ❒ Pull up the tubing so that at least 1.5 metres are exposed above ground. Now the valve is positioned in the blind section of the well which will reduce turbidity of the water.
- ❒ Pipes (made from HDPE or PVC) should have strong threaded connections. This means that the couplings are generally thicker than the pipe itself. Use PVC made for the transport of drinking water.
- ❒ Clamp the tubing. With very high frictions + speeds settings + lifts (or tubing with a smaller diameter than the clamp) the tube may start slipping and can get scraped by the clamp. You may prevent this by wrapping a small piece of scouring pad around the tube in the clamp (see fig. 13).
- ❒ Open the upper tubing guide and slip the tube through this opening. Close and fix guide again.
- ❒ Direct the tube in a windward direction and fix it in a stand ("third hand") and position the end of the tubing above a drain, bucket, drum or sample bottle.

Fig. 12 Tubing fixed in upper and lower tube guide

Fig. 13 Piece of scouring pad around tube

- ❒ Switch the red knob on the engine to the *ON* position
- ❒ Push the clear rubber bulb (=petrol priming pump) near the carburettor until it is compeletely filled with petrol (see fig. 14).
- ❒ Put the choke lever in the "*Choke*" |-| position (see fig 15).
- ❒ Pull the starter.
- ❒ When the engine runs, open the choke ||| and allow the engine to idle for at least two full minutes to warm up.
- ❒ Increase the speed. The tube clamp on the gear-box will start moving up and down.
- ❒ Then accelerate and adjust the speed to the required (or possible) flow. If, after some time, air bubbles come up you are surpassing the yield of the well and will need to stop temporarily or adapt the flow to the yield of the well.
- ❒ When ready, slow down and stop engine by switching to the *OFF* position.
- ❒ There is no tank shut-off valve !
- ❒ Pull out the tubing and make an incision on the side near he barbed part of the valve. This allows easy removal of the valve (see "Removing a valve").
- ❒ Place foot-valve in a jar with diluted detergent (minimum exposure time depending on temperature and concentration of the liquid). Rinse valve with water prior to next use.

Fig. 14 Push the clear rubber bulb

Fig. 15 Putting choke in position "Choke"

4.1 Purging a well

- ❒ During well development and purging, measure EC of water in a flow through cell (art. no. 18.55). If you pump with a large flow this will surpass the flow-through capacity of the cell. You will need to divert part of the water. Connect a T-piece upflow of the flow through cell and limit the quantity of water flowing through the cell. A small T piece is supplied with the cell. If needed other sizes can be bought at a hardware shop.
- ❒ Other parameters like pH, O_2 and redox can, if necessary, be measured in the same way.

4.2 Sampling without filtration

- ❒ Most sampling pumps are lowered half-way down the screened part of the well. This is not ideal when working with a foot valve pump. A moving part in the screened section of the well will in most cases results in very turbid samples. Preferably position the ball valve just above the screen so that it will be moving in the blind section of the well. Slow down the flow if air is pumped up. Take samples for volatiles with 100-300 ml/min or according to the local standards enforced.

4.3 Sampling with filtration

Fig. 16 Measuring the flow

- ❒ Certain samples, like samples for (trace or other))metals, need to be field-filtered under anaerobe conditions on a 0.45 micron filter. To this end a large capacity filter (above 300 cm^2) can be connected straight to the end of the tubing. A small filter or a plugged large one will block the water flow! This will simply blow off the valve at the bottom of the tubing! So set the pump at the lowest speed or actuate the tube purely by hand.
- ❒ As an alternative you may connect a T-piece at the end of the tubing. Connect a filter on one outlet. On the remaining outlet limit the outflow of water so that pressure will build up for proper filtration.
- ❒ If the water is too turbid or if you only have small filters, collect water in a bottle and overfill the bottle from the bottom a number of times (this will expel the initial oxygen-rich water from the bottle). Then use a peristaltic pump to filter the water from the bottle.
- ❒ Also consult our manuals on filtration equipment.

4.4 Decontamination of the valves and tubing

- ❒ Decontamination of the valves in diluted detergent. A warm detergent will greatly reduce the required exposure time.
- ❒ Rinse valves with drinking water prior to next use or rinse, allow to dry and store the valves free from dust and dirt.
- ❒ Decontamination of tubing is risky. If you insist or work with Teflon tubing, pump warm detergent through tubing for 15-30 minutes for instance with a peristaltic pump or a 12 V booster pump 12.12.08. At the same time spray diluted detergent on outside of tubing. Later rinse in- and outside of tubing with drinking water. Teflon tubing is heat resistant and can be treated with a steam cleaner.
- ❒ If you use PVC pipes instead of PE or Teflon tubing be careful to only select pipes produced for drinking water transport. Other PVC pipes will contain phthalates (plasticizers) which will contaminate your samples for these analyses. Also you will need to know how the PVC was stabilised. This is always (except for Eijkelkamp PVC well pipes) lead, tin or zinc-calcium. In this case the metal, due to friction, may be found back in the samples.
- ❒ Since volatiles (like BTEX) dissolve in plastic tubing or piping, they cannot be washed off. They will slowly come out in time (weeks) in a warm well ventilated area.
- ❒ Always store and transport tubing away from petrol cans and the petrol reservoir of this engine; especially if using normal petrol instead of Aspen or Coleman. Volatiles will pass through plastic bags and adhere to the plastic of the tubing. You may transport either the dirty equipment or the tubing that needs to be kept clean in a separate gas-tight (=metal) cabin trunk. Fit the trunk with a charcoal (gas mask) filter.
- ❒ Take blank samples to check success of decontamination procedure on tubing. (LD or HD)PE tubing is cheap and can be changed prior to next sampling to prevent costs (and insecurities) of cleaning process and taking and analysing field blanks. So generally renew tubing when PE was used in combination with volatiles sampling.

5. Remarks

5.1 Well development

Due to its motion this pump is perfect for well development. If the valve is positioned within the screened area the turbulence will wash fine silt and sand particles from the screened zone and pump them up. If later the valve is located higher, the turbidity will become much lower; especially if the pumping action is slowed down.

5.2 Wells filled with sand

If a monitoring well is silted up with sand or mud, the foot valve pump can be used for cleaning. Start positioning the foot valve (in lowest position) just above the sand. Start pumping until the water pump holds little sand. Lower the valve for a few centimetres and repeat. Repeat until most of the sand has been removed. Do not allow the foot valve to knock on the bottom of the well. This may dislocate the bottom plug. Do not stop the pump when a lot of sand is in the tubing as this may block it.

5.3 Narrow wells, slowly recovering wells

If a narrow well is located in a slowly recovering layer (like clay) the water level will drop very rapidly within seconds by ten or more metres. If this is expected or noticed, always take a length of tubing that is long enough to prevent air from entering the foot valve. If this happens anyway, slow down the pumping action. You may notice this in two ways: the pumping is supple and smooth initially (water table still high) but after a few minutes the tubing starts jumping, making more noise (water table at valve level with water shock as result). Air bubbles will be pumped up.