VACUTUG Manual



OPERATING AND MAINTENANCE MANUAL FOR MK II VACUTUG LATRINE EMPTYING VEHICLE.



OPERATING AND MAINTENANCE MANUAL F OR MK II V ACUTUG L ATRINE E MPTYING VE HICLE.

PROTECTIVE CLOTHING.

The operators should be warned about the hazardous nature of latrine wastes and should be provided with rubber boots, rubber gloves, overalls and disinfectant soap. They should be instructed to wash down the end of the suction hose, any spillage around the latrine and their hands at the end of each pit emptying. The householders should be instructed to provide water for the above operations.

OPERATING INSTRUCTIONS (Key: The numbers in the illustration below appear throughout the manual in parenthesis).



Pre start up check -Ensure that there is oil in the engine & vacuum pump before starting

TUG UNIT. a) E ngine

The engine on the Vacutug can drive either the wheels for moving the machine or the vacuum pump for sucking out the latrine pit and for pressurising the tank. The changeover is made by stopping the engine and moving the "V" belt between the engine and the transmission shaft to the chosen position.

b) Driving

The "V" belt is on the engine pulley groove closest to the engine and the outside pulley on the transmission shaft.



c) P umping

The "V" belt is on the engine pulley groove furthest from the engine and on the inside pulley on the counter shaft.

There are seventeen controls on the V acutug as follows: (Thepicture below illustrates the first 6 controls).



1. Belt tension / clutch lever

The drive from the engine to the wheels and to the vacuum pump is controlled by a lever which slackens or tightens the "V" belt drive to the counter shaft by moving the engine on its hinged base. When the lever is in the rear position the belt is slack. In this position the belt can be moved from the driving position where it drives the Vacutug wheels to the pumping position where it drives the vacuum pump. Moving the control lever forward slowly will engage the drive.

NOTE: The Vacuum pump should only be operated for short periods, maximum 2 minutes, at full speed. As soon as the required vacuum is reached the engine speed should be reduced to tick over.



SAFETY P RECAUTIONS.

ALWAYS ST OP THE E NGINE BEFORE CHANGING BELT

POSITION.

2. E ngine throttle

The "twist grip" motor cycle type throttle on the belt tension lever controls the engine speed. It is sprung to the closed position so that if the twistgrip is released the engine will revert to tick over speed.

3. Brake lever

The brake lever controls the brakes on all four wheels. Pull backwards to apply the brakes.

4. P arking brake

A "flip over" latch is used to lock the brake lever in the parking position.

5. Roller engagement lever (Gear L ever)

This lever applies pressure to the rubber springs which press the drive roller against the two front wheels. The spring pressure can be adjusted by screwing the actuating rod in or out. The roller pressure should be enough to stall the engine when the clutch lever is engaged and the brakes applied.

The roller can be disengaged for pushing the Vacutug by hand for reversing or manoeuvring in tight situations.

6. E ngine cut out switch

The engine cut out switch is used to stop the engine. It should be in the "on" position for starting and is located on the



7. P ump control handle

The pump control handle has three positions as follows.

Forward or S ucking position

The pump sucks the air out of the trailed vacuum tank and the wastes are sucked into the tank. Air from the tank is blown out through the exhaust pipe. For this operation the by-pass valve (14) at the side of the sludge trap (12) must be open (lever in line with the pipes) and the flap valve (15) on the sludge trap should be lifted by hand until it is sucked into place against the trap.

Mid or neutral position

The pump rotates without either sucking or blowing.

Rear or pressurising position.

Air is sucked through the exhaust pipe and blown into the tank



For pressurising the tank the valve lever (14) at the side of the sludge trap (12) must be closed. The flap valve (15) on the sludge trap will fall open and if there are any liquids in the trap they will drain out.

This function can be used for blowing out a blocked suction pipe, for blowing out the suction pipe after filling the tank or for pressurising the tank for discharging wastes up hill. (SEE WARNING BELOW).

The driver can place his hand over the exhaust pipe and feel whether it is blowing (vacuum operation) or sucking (pressurising operation).



WARNING.

When pressurising the tank for discharge or for blowing out a blocked pipe there will be a gush of air as the last wastes leave the tank or pipe. Always ensure that the outlet end of the discharge pipe is properly secures or that someone is standing on this pipe where it leaves the latrine pit or manhole to prevent this pipe being blown out of position by this gush of air. The hose inlet should be clear of any wastes in the pit while this operation is taking place and the operator holding the hose or standing on it should make sure that he is clear of any spray which might come out.

Always make sure that there are no bystanders within 10 metres of the end of this pipe to avoid any risk of getting accidentally sprayed. E ven when the tank is empty, never open the outlet or inlet valves when there is anyone near the rear of the machine.



8. I nlet valve

The top or inlet valve is used for sucking wastes from a latrine pit into the tank through the 3" hose. Turn off this valve as soon as waste starts to appear in the top sight glass (10).

9. O utlet valve.

Used for emptying the vacuum tank. Make sure that the 3" hose is secure or that someone is standing on the outlet end before opening this valve and then open slowly. This outlet can be used for emptying the wastes by gravity into a manhole or cesspit or for pumping the wastes to a raised transfer tank by pressurising the tank.



10. S ight glasses

Two sight glasses are fitted to enable the level of the wastes in the tank to be seen. Stop sucking as soon as the wastes reach the top sight glass.



11. P rimary check valve

A rubber float valve inside the tank closes off when the tank is full. This should normally require very little maintenance but if liquids are seen at the flap valve (15) this float valve should be cleaned. Undo the quick release clamp at the top of the tank to reach this valve.



12. S ludge trap

If any wastes leak past the primary check valve they will be collected by the sludge trap and released automatically as the flap valve (15) opens when the vacuum stops.



13. Check valves

Two non return valves prevent air from reaching the sludge trap during the pressurising sequence. These should not normally require any maintenance but if air is found to be blowing out of the sludge trap, firstly make sure that the by-pass valve (14) is closed and then if the air is still blowing clean the check valve at the top of the sludge trap by unscrewing the cap on this valve and removing any dirt.



14. By-pass valve

The by-pass valve lever at the side of the sludge trap should be open for sucking and closed when pressurising the tank.



15. V acuum release valve

The vacuum release valve allows cooling air to enter the pump when maximum vacuum is reached.



16. P ressure relief valve (Safety V alve)

The pressure relief valve on the top of the tank prevents the pressure in the tank from exceeding the maximum permitted pressure of 1.0 bar (14psi). This should be checked occasionally to make sure that it is working properly. Pressure can build up in the tank due to fermentation of any wastes which have been left in the tank in a hot climate.

If pressure is set too high the engine will have difficulty in driving the pump at full pressure. To adjust pressure release with hexagon key (Allen key) and rotate spindle.



17. W heel adjustment

The width between the rear trailer wheels can be adjusted for operating in very narrow lanes. To adjust the wheels:-

i) Make sure the tank is empty.

ii) Turn the tug unit at right angles to the tank and press down on the handle. The wheel on the opposite side will lift off the ground.

iii) Remove the locking pin and slide the wheel and stub axle in or out as required.

iv) Replace the locking pin in a new hole position.



WARNING.

The Vacutug should normally be operated with the wheels in the wide position for maximum stability. Only use the narrow wheel position with extreme caution for short periods on level ground to avoid any risk of the machine toppling over.

LEARNING TO OPE RATE T HE V ACUTUG

Make sure that the rear trailer wheels are in the fully out position for maximum stability. See section on wheel adjustment.

Before starting to empty latrine pits the operator should spend two or three hours becoming familiar with the pumping controls and driving the Vacutug around on a flat open area so as to become fully accustomed to the controls and able to respond guickly in an emergency. Make sure that there are no spectators within 10 metres of the Vacutug before operating the pump for the first time or when driving it for the first time.

To operate the V acutug in pumping mode.

¥ Check that the parking brake is on.

- ¥ Carry out all pre-start checks on engine and pump. (See separate section on engine) but do not start the engine.
- ¥ Check that roller drive lever (gear lever) is in engaged position.
- ¥ Ensure that belt tension lever (Clutch) is in the loose (rearward) position.
- ¥ Fit the drive belt to the outermost position on the engine pulley and to the inside position on the transmission shaft.
- ¥ Place the pump control in the mid (neutral) position.
- ¥ Put engine choke lever to "starting" position.
- ¥ Turn stop switch to "on".
- ¥ Hold the throttle lever half open with the left hand and pull the starting rope sharply with the right hand. A number of pulls may be required before the engine starts. (See separate section on engine).
- ¥ As soon as the engine has started move the choke lever to the "running" position and wait until the engine has warmed up and is running smoothly.
- ¥ Make sure that the inlet and outlet valves on the tank are closed.



engine on tick over, check that oil can be seen dropping slowly (about 30 drops per minute) through the oiler drip feed sight glass. Adjust drip feed if necessary.

Note: When air is blowing from the vacuum pump exhaust pipe the pump is sucking. When air is sucking through this pipe the pump is blowing.

¥ Make sure that the by-pass valve at the sludge trap is open (lever in direction of pipe) and lift the flap valve at the bottom of the sludge trap. After a few seconds this valve will be sucked into place and will remain closed automatically.

¥ The pressure gauge will then indicate the vacuum in the tank. When maximum vacuum is reached (0.8 bar) some air will be sucked through the vacuum relief valve to prevent overheating of the engine.

¥ Change the pump lever to neutral for three or four seconds to allow the vacuum to be released and than to the pressure position. The pressure gauge will indicate the pressure in the tank.

¥ Before starting to empty any latrine pits the operator should practice sucking water and discharging again a few times from a pond or river until he is completely familiar with all operations.

TO OPERATE T HE V ACUTUG I N DRIVING MODE.

¥ Make sure that the parking brake is on, the belt tension (clutch) lever is in the slack position and the drive roller (gear lever) is engaged.

¥ With the engine stopped change the "V" belt to wheel drive position. The belt should be on the inside groove of the engine pulley and the outside pulley on the transmission shaft.

¥ Release the parking latch on the brake lever and keeping the brake on with the right hand with the left hand increase the engine speed to about one quarter of full engine using the twist grip throttle on the clutch lever and slowly engage the clutch lever. The Vacutug will start to move forward at a slow walking speed.

To stop the Vacutug, release the clutch lever and apply the brake lever simultaneously. Then apply the parking brake latch. Practice a few times releasing the brake and engaging the clutch simultaneously. Synchronised operation of these levers will be required for starting and stopping on hills.

¥ Adjust the speed with the twist grip throttle and steer the Vacutug with the tiller bar.

¥ In an emergency the engine can be stopped using the cutout switch on the tiller bar.

When the operator is fully familiar with the above operations he can gradually experiment with uneven and steep ground becoming familiar with the limitations of where the Vacutug can safely travel.

REVERSING AND MANOEUVRING BY HAND.

To reverse the Vacutug or for manoeuvring in tight spaces the roller drive tension should be released using the roller tension (gear) lever and the machine can be pushed back or manoeuvred by hand as required using the brake where necessary.



WARNING.

Before using the Vacutug on the road or on steep and narrow tracks the operator must become fully familiar with the machine and get to know the limitations of the Vacutug and where it can and cannot travel safely. A new operator should always start by emptying latrine pits which have easy access and then progress to more difficult locations.

INSTRUCTIONS FO R FILLI NG T HE V ACUUM T ANK.



a) Connect the 3" vacuum pipe to the top or ("inlet") valve at the rear of the tank and put the rigid end of the pipe into the latrine pit to be emptied. Two lengths of hose are supplied with the Vacutug and these can be joined together using the quick release couplings on the hoses. If only one hose is required, use the one with the rigid extension pipe. Keep the hoses as short and as straight as possible.

b) Ensure that the pump control on the top of the vacuum pump is in the neutral or middle position and that the V-belt is in the pump drive position (see fig to the right)

- c) Start engine and engage pump drive.
- d) Move pump control lever to vacuum position.





f) Lift the flap valve on the sludge trap. After a few seconds thisflap will remain closed automatically due to the vacuum build up.

g) Allow the vacuum in the tank to build up to around 0.5 bar before opening the inlet valve. Waste will now start to flow



h) Watch the sight glasses on the tank carefull and when wastes reaches the top sight glass immediately close the inlet valve.

i) Return the pump control valve to the neutral (middle) position to release the vacuum in the tank. The flap valve will then fall open automaticlly. Then open the inlet valve again to let any wastes drain out of the suction hose.



j). If required the suction hose can be blown out as follows:

- Close the by-pass valve at the sludge trap (lever at right angles to the pipe).
- Change the pump lever to the pressure position.
- Allow pressure to build up in the tank.
- Make sure that the end of the suction is held securely facing into the pit but not immersed in the sludge.
- Open the inlet valve slowly. After some practice the operator will learn
 - how fast to open this valve to avoid blowing waste.

The above operations can be repeated as required to ensure a clean hose.

INSTRUCTIONS FOR EMPTYING THE VACUUM TANK.

After driving to the discharge point the tank can be emptied by gravity discharge into a manhole or other discharge point or by pressure discharge the wastes can be pushed up to a transfer vehicle or other tank above the level of the Vacutug using the suction hose to deliver the wastes.

For gravity discharge, connect the suction hose to the bottom (outlet) valve at the rear of the tank and open the discharge valve.

For pressure discharge, connect the pipe to the bottom or outlet valve and then pressurise the tank as described in the sequence in (j) above.

After emptying by gravity the pipe can be blown out as described above. After discharging up hill any wastes remaining in the hose pipe can be sucked into the tank before disconnecting the hose pipe.

For discharging into a lagoon the Vacutug can reverse up to the edge of the lagoon and then the tank can be fully pressurised before opening the outlet valve. In this way the wastes can be blown a distance of up to 15 metres spreading the wastes over the lagoon. Take great care when using this process that no person or other vehicle is close to the line of



CAUTION.

When discharging wastes under pressure from the Vacutug there will be a gush of air and sewage spray when the tank empties and the air in the tank is released through the outlet valve. It is important that the outlet end of the discharge pipe is firmly held by putting a foot on the hose pipe to prevent the pipe from being blown out of the discharge access point during blowing.

MAINTENANCE OF T HE V ACUTUG.

The Vacutug Latrine Emptying Vehicle is designed to be operated and maintained with the minimum of servicing and spare parts. However a small amount of PREVENTIVE MAINTENANCE will ensure the optimum life and performance of the vehicle.

Daily pre-start checks and after work clean down procedures are set out below. The pre-start checks will take no more than 5 minutes and the after-work clean down should take no more than 10 minutes.

Weekly checks should be carried out by a service mechanic, preferably outside normal working hours so as not to disrupt work schedules. Typically about one hour should be allowed for this weekly check. The service mechanic should be familiar with small air cooled engines such as are used on lawn mowers, pumps and motorcycles but no other special skills are required.

OPERATORS DAILY CHECK LIST.

The operator must carry out the following daily checks before starting to use the Vacutug. (Daily checklist and corresponding illustrations are on pages 14-16).

A. E NGINE

¥ Check fuel level.

- ¥ Check oil level.
- ¥ Look for oil leaks and report if there are any.

B. V ACUUM P UMP

- ¥ Check oil level in reservoir.
- ¥ Check oil drip feed. (Run the engine with pump on vacuum and view the oil drip through the glass section of the oiler. It should be 30 drops per minute).

C. TY RES

¥ Check front tyre pressure on tug unit (35 psi)

¥ Check rear tyre pressure (25 psi).

D. BRAKES

¥ Check brakes performance. (Should be sufficient to stall the engine).

E. HOSES

¥ Check hoses for damage.

DURING OPE RATION CHECKS

F. BELT DRIVE

¥ Look out for belt slip. (Call the mechanic if adjustment is required. A slipping belt will wear out very quickly)

G. CHAIN DRIVE

¥ If chain slip occurs call the mechanic to adjust.

H. ROLLER DRIVE SLIPPI NG

¥ Check for a build up of clay on the drive roller.

¥ Scrape clean if required using the special tool provided.

¥ Check tyre pressures. A low tyre pressure can cause slip. If there is still a problem ask the mechanic to adjust the roller pressure.

I. V ACUUM P UMP

If the pump is not reaching the correct vacuum (0.8 bar): ¥ Look for air leaks.

¥ Ask mechanic to flush out pump. (see pump manual).

¥ Ask mechanic to replace vanes in pump.

J. HOSES AND FITTI NGS

¥ Check for air or liquid leaks in the hoses, fittings and quick release couplings.

OPERATORS FI NAL CHECKS AT T HE E ND OF E ACH DAYS WO RK.

- ¥ Wash out hoses and tank by sucking clean water through the hoses and discharging.
- ¥ Wash down the outside of the machine.
- ¥ Clean the drive roller with the special tool provided
- ¥ Ensure than engine fuel tap is turned off.

MECHANICS WEE KLY CHECK LIST.

¥ Once every week the following checks should be carried out by a mechanic. (Maintenance check sheet is provided at the end of this manual)

1. BELTS

¥ Check belt tension and adjust or replace belts as necessary.

2. CHAIN

¥ Check chain adjustment and adjust or replace chain as necessary.

¥ Check chain drive sprocket for wear and replace as necessary.

Table level may need readjusting after any adjustments have been made to the chain drive.

3. E NGINE. (See separate engine manual)

Check engine oil level and quality of oil on dip stick.

Change oil periodically as recommended in engine manual.

Check for easy starting and tick over.

Adjust plug points and carburettor when necessary. Clean air filter.

4. V ACUUM P UMP (see separate pump manual).

¥ Check oil level.

¥ Rotate pump by hand and listen for clicking sound that shows that vanes are sliding freely.

If no sound is heard refer to pump manual for cleaning proceedure.

¥ Check oiler drip feed.

5. TY RES

- ¥ Check tyre pressures.
- ¥ Check tyre condition.
- ¥ Change over tyres (front to rear) when front tyres are half worn.

6. DRIVE ROLLER

- ¥ Check that there is no build up of clay on the drive roller and clean with the special tool provided.
- ¥ Check that the drive roller is capable of stalling the engine on fast tick over and adjust the roller pressure if necessary.
- ¥ Check that the table is level and does not touch the tiller arm when the roller is under pressure.
- ¥ When the drive roller shows about 3mm wear on the rectangular ribs these can be reconditioned by building up the ribs on the roller with hand facing welding rods, then grind off any weld projections that could cause tyre damage.

7. GE NERAL

- ¥ Check all bolts for tightness.
- ¥ Check that belt pulleys and sprocket are tight on their shafts.
- ¥ Grease all grease nipples.
- ¥ Oil the chain and control linkages.
- ¥ Check engine and pump for oil leaks and rectify.
- ¥ Check hoses and fittings.
- ¥ Check brakes and look for excessive wear on wheel and roller bearings.

VACUTUG SPE CIFICATION

| ENGINE. | HONDA Model GX 250. 8.0hp (5.96 kw) @ 3,600 RPM. (See attached separate manual for this engine). |
|---------------|--|
| VACUUM PUMP. | BATTIONI & PAGANI Model MEC 2000 P sliding vane pump. (See attached separate manual for this pump. |
| "V" BELTS. | Type SPB 1580. (Note:- If type SPB are not available "B 62" belts may be fitted but these will have a shorter life). |
| CHAIN. | 3/4" pitch type BS 60 roller chain. (This is a common type used on medium powered motorcycles). |
| BEARINGS. | Type 6206 2RS. (It is important that type 2RS bearings are used for maximum sealing and long life.) |
| TYRES. | 155 R15 or 5.50 x 15 car tyres. |
| BRAKES. | 200mm x 40mm expanding shoe brakes on all wheels. |
| AXLE HUBS. | 4 stud 130pcd x 12mm studs. |
| SUCTION HOSE. | 3" "ITANIFLEX" or equivalent heavy duty reinforced PVC vacuum hose. |

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| Super Date : Time (Time (| visor: of departure: of arrival: | | | | Checklist: | ST ARI Check el Check Fl Check Fl Check B Check fc Check fc Check fc | r ngine an uel Level ACK tyre r loose b r hose d ak perf | d Vacuum c e pressure pressure 2 olts amage ortmance | 11 135 psi | | | END Clean drive Ensure no Clean brea Wash dowr Tum engine | e roller: wheels obst k cable path h hoses and e tap off | ruction: s: tank | | | | UN-HABITAT |
| | | | Area/ | | | | | ə. | | | LATRINE | | SEW TRANSFER | /ER/ ST ATION | | | | |
| реод | Name | Owner/ Tenant | Village/ House | Date requested | Date serviced | Sum Paid | Balance | iutengi2 | Arrival time | Start Exhausting | Finish Exhausting | Exhausting time | Start emptying | Finish emptying | Description of pit | No. of users | Weather condition | Comments |
| eg | Maria Gonzalez | Owner | Soweto | 15/12/2003 | 18/12/2003 | 500 | | | 9:00AM | 9:15AM | 10:00AM | 0:45 | 10:30AM | 10:45AM | Concrete Sanplat | 5 | Rainy | Liquid waste easy to remove |
| | John Erustus | Tenant | Soweto | 18/12/2003 | 18/12/2003 | 400 | 100 | | 11:30AM | 11:45AM | 1:00PM | 1:15 | 1:30PM | 2:00PM | Access hole too small | 17 | Rainy | Had to remove plastic bags & rags from pit |
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| | UN-HABITAT | | | |
|---------------------|-------------------------|--|--|--|
| | | | END of MONTH Date Name of Operator | Clean outside of machine Clean Inside of wheels Clean Brakes and oil Clean Brakes and oil Clean Brake cables Clean Brake cables Clean Tank inside Check pump operation Check pump inside Check Engine operation Check Engine operation Check Engine operation Check Engine on adjust Plug points Check Belt tension adjust/replace Check tyre pressure/condition Clean air filter Check tyre pressure/condition Clean all nipples Check hoses and fittings |
| MAINTENANCE CHECKS | MONTHYEAR | ek and once at the end of the month | EK 3 WEEK 4 | |
| | | J (X) each item at the end of every we | 1 WEEK2 WE | |
| UN-HABITAT V ACUTUG | Name of supervisor:City | * Please fill out the form by checking | WEEK Date | Outside machine cleaning Inside wheels cleaning Brakes cleaning & oil Brake cables cleaning & oil Check pump operation Top up engine oil Check engine operation |

ILLUSTRATION - OPERATORS DAILY CHECKLIST



- Key:-
- A Engine
- B Vacuum Pump
- C Tyres
- D Brakes
- E Hoses
- F Belt Tension
- G Chain Drive
- H Roller Driver
- I Pressure gauge
- J Inlet (top) outlet (bottom)

ILLUSTRATION - WEEKLY AND MONTHLY OPERATIONS



Key:-

- I Belts
- II Chain
- III Engine
- IV Vacuum Pump

UN-HABITAT V ACUTUG MARK II

| Serial No | | Chassis No | |
|------------|---|--|------|
| Engine No | | Year of Manufacture | |
| | Manufactured in Banglac Mirpur Agricultural W E-mail : mawts@bdonlin | desh by: orkshop and T raining S chool (MA ne.com | WTS) |
| UN-HABITAT | Designed and Developed UN-HABITAT, Water, P.O. BOX 30030, Nairobi E-mail : <i>graham.alabaste</i> For project details contact | d for: S anitation and I nfrastructure Bran i, Kenya. er@unhabitat.org ict: iole.issaias@unhabitat.org | ch, |
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United Nations Human Settlement Programme

SEPTEMBER 2002.