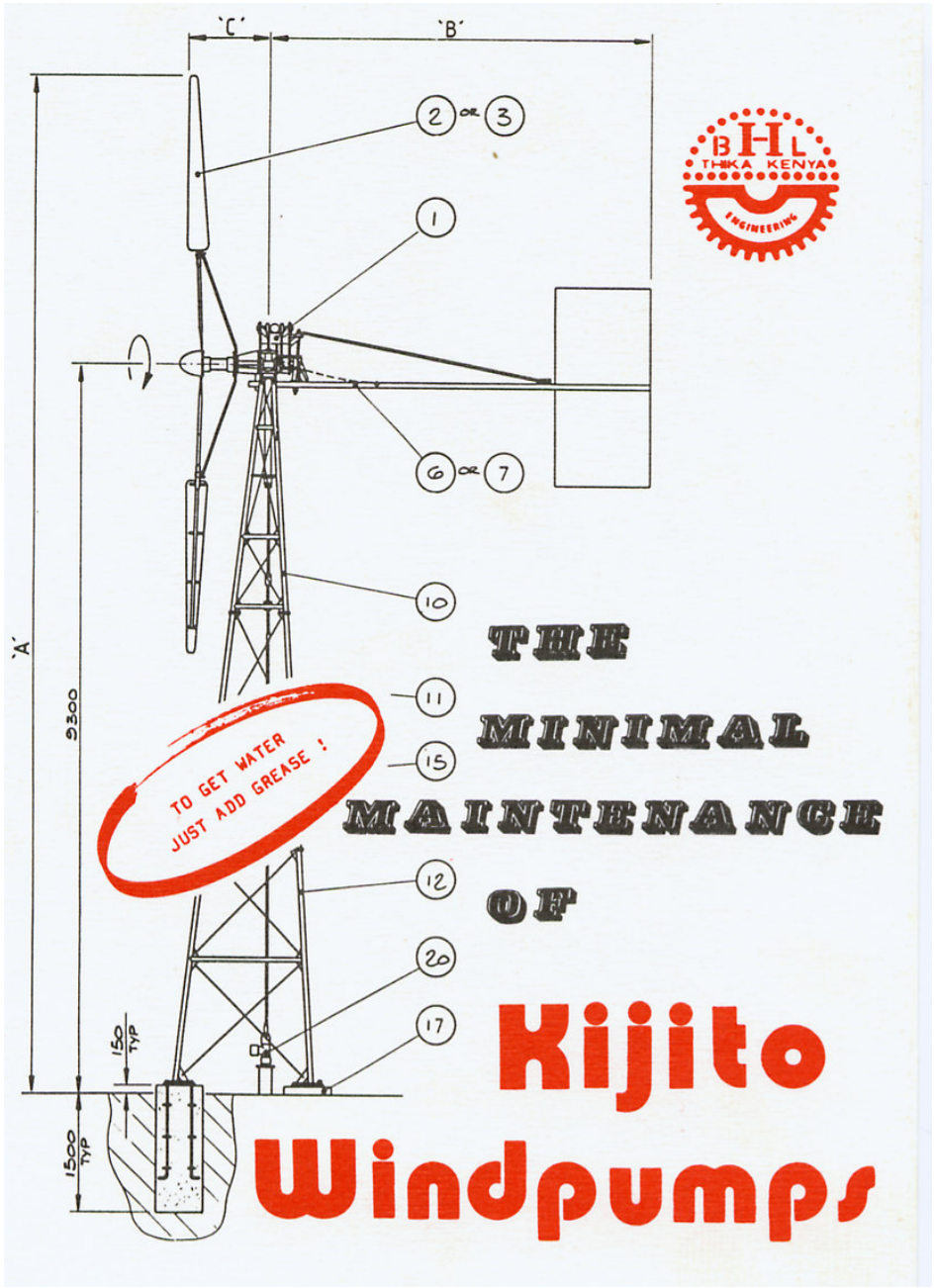


BOBS HARRIES ENGINEERING LIMITED
THE MINIMAL MAINTENANCE OF "KIJITO" WINDPUMPS
CONTENTS

INTRODUCTION

We would like to thank you for purchasing one of our range of KIJITO windpumps, which, after more than twenty years of research, development and field testing in KENYA and other countries, should give you many years of service with a MINIMAL amount of maintenance. However, please remember than minimal maintenance DOES NOT MEAN NO MAINTENANCE AT ALL. Whatever equipment we purchase to help us in our work, the efficiency, economy, safety and length of service we will receive from that equipment will be directly proportional to the standard of our maintenance.

We at KIJITO have designed a machine that needs little attention, but in common with most other equipment we use, a windpump that receives no maintenance at all is not only likely to be costly, because of unnecessary repairs, but can also be extremely dangerous. We would therefore ask you to study this maintenance book carefully and if there is anything you do not understand, then please do not hesitate to contact us. Similarly, should you feel that with your own experiences in working with your KIJITO we have left out any useful information, we would be very happy to hear from you. As you may be aware, we recommend that wherever possible, purchasers of our windpumps should make arrangements to have one of more of their technical staff come to our workshops for a period of training and familiarisation. If we or one of our Agents are actually installing the machine, then sometimes this training can be carried out during the installation process. However, whatever the situation, please remember that the most important aspect of any maintenance schedule is:

MOST PEOPLE DO WHAT YOU INSPECT, NOT WHAT YOU EXPECT

The maintenance of our windpumps can be divided into two main aspects:

1) Above ground components
2) Below ground components

Some of our windpumps are installed BESIDE rivers or dams, so that the actual pump cylinder may be above ground, but for ease of reference these to be covered in our 'below ground' section.

SAFETY

With their tall towers and large spinning rotors, our windpumps can pose a danger, to untrained or careless people, so please ensure that our 'DANGER-HATARI' notices on the tower are taken seriously. Furthermore, please read the section on safety very carefully.

1.0 HOW TO FURL & SECURE YOUR WINDPUMP ROTOR

Before you can begin to do any maintenance work on your windpump, you must understand how to furl your machine AND SECURE YOUR ROTOR, and how to do this correctly and safely.

PLEASE NOTE ALL MAINTENANCE MUST BE CARRIED OUT BY ATLEAST TWO PEOPLE AND THEY SHOULD WEAR HARD HATS AND SAFETY BELTS

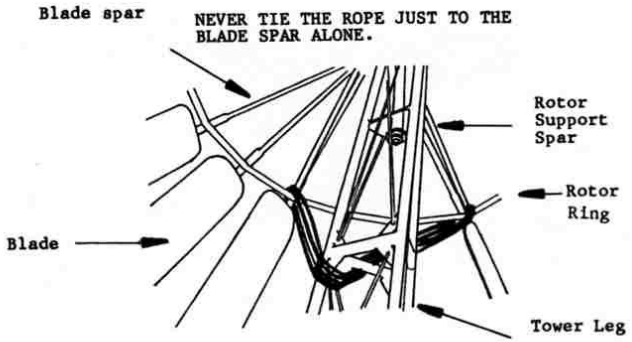
You can furl your KIJITO manually during times of maintenance, or if you wish to stop the machine pumping for any reason. This is done by hooking a rope to the ring on the bottom of the furling chain, and then pulling it from **ground level**. Once it has been furled and while it is being held in that position, someone climbs the tower and locks the tail in position with the chain provided.

Having locked the tail in the furled position with that short chain, the rotor must now be tied with the rope in two different positions. This will prevent the rotor turning even if the wind changes direction while you are up the windpump servicing it.

NOTE: If you merely want to stop the machine pumping, DO NOT tie the rotor to the tower, but leave if free to follow the change in wind direction.

PLEASE NOTE THE FOLLOWING VERY IMPORTANT POINTS:

- Choose an undamaged piece of rope at least 2cum thick and long enough to pass a **double** strand round both anchor points of the rotor.
- Secure the middle of the piece of rope securely underneath one of the lower cross beams just opposite the rotor ring.
- Take one end and loop it round where the blade spar **crosses** the rotor ring, and choose one where the blade is together with a **rotor support spar**. This will reduce the chances of damage to the rotor or blade spar if the wind changes direction very strongly during maintenance.
- Having secured the rotor in this one place, get your assistant to turn the rotor until your rope is tight, and then take the other end of your rope and lash it in the opposite direction to another blade and support spar. (PLEASE SEE SKETCH OVERLEAF TO HELP YOU UNDERSTAND THIS).
- Make sure the knots are tight.
- NEVER LEAVE YOUR WINDPUMP TIED UP LIKE THIS AFTER YOU HAVE LEFT, A STRONG WIND COULD RESULT IN YOUR ROTOR BEING BENT.
- Never try to furl the windpump while you are up the tower, this can be very dangerous.
- Never leave the rope hanging from the furling chain after you have carried out maintenance, as it could get entangled damaging the rotor, or enable unauthorized people to tamper with the machine.



The correct way to tie up your Rotor prior to servicing it

MAINTENANCE OF ABOVE GROUND COMPONENTS

These can be divided into the following sections:

- **1.1** The rotor & tail assemblies
- **1.2** The transmission assembly
- **1.3** The pumprods &guides
- **1.4** The tower structure & foundations
- **1.5** The stuffing box
- **1.6** The suction line
- **1.7** The delivery line

1.1 THE ROTOR & TAIL ASSEMBLIES

The rotor and tail have been designed and manufactured to withstand severe winds and storms, but they are made up of bolted and welded components and so need to be checked from time to time, especially if your area has experienced exceptionally high winds or storms.

A well maintained, correctly installed windpump is a quiet windpump, so any unusual noise should be investigated. Most important is to check the bolts that fasten the individual blade spars to the rotor ring and hub.

The tail has the function of not only keeping the windpump facing into the wind, but is also furls (ie closes up so the windpump rotor faces at 90^{o} degrees to the wind direction, and therefore stops rotating) when the windspeeds gets too high. This is done completely automatically and it will unfurl and put the windpump back to work again when the windspeed slows down, without any action required by the owner.

To slow down or dampen the movement of the tail, we utilise four different methods or a combination, depending on the size or model of your machine.

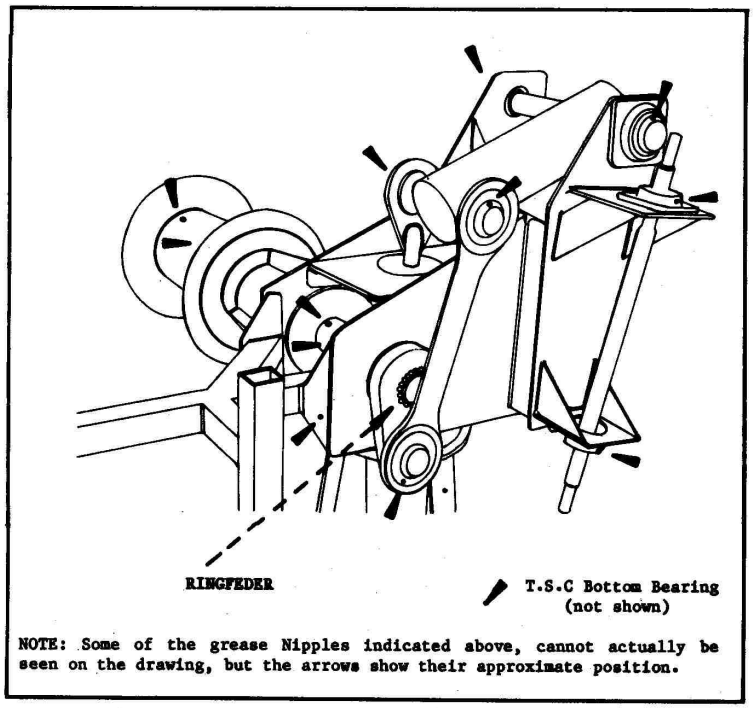
i) Horizontal shock absorbers (motor vehicle type)
ii) Two flat springs mounted on the tail boom which dampen the stops at the tails' open and closed positions.
iii) A coil spring mounted on the furling chain which dampens the movement as the tail returns to the open position.
iv) A thick rubber pad attached to the bumpstop.

Please check that all these are functioning satisfactorily.

1.2 THE TRANSMISION ASSEMBLY

This is the "heart" of your machine and much has gone into it's design and manufacture.

LOCATION OF GREASE NIPPLES AND RINGFEDER JOINT



NOTE: Some of the grease Nipples indicated above, cannot actually be seen on the drawing, but the arrows show their approximate position.

All we are asking you to do is acquaint yourself with the number and position of the various grease nipples (painted red) on your machine and make sure they are greased EVERY SIX MONTHS. Depending which model of windpump you have, the grease nipples can vary from 12 to 16 in number. To facilitate greasing, it is better to use a good quality grease gun with a flexible coupling. All new machines are now provided with one of these at the time of purchase.

We recommend you use Shell Retinax A grease or similar.

NOTE: To assist you, we have included overleaf a detailed drawing showing the positions of all the grease nipples on one of our 20ft of 24ft rotor machines, as well as a close up view of the actual transmission grease points you have seen on the previous page.

PLEASE DO NOT:

- Try to grease the windpump without furling and securing it first (see Page 2)

PLEASE DO:

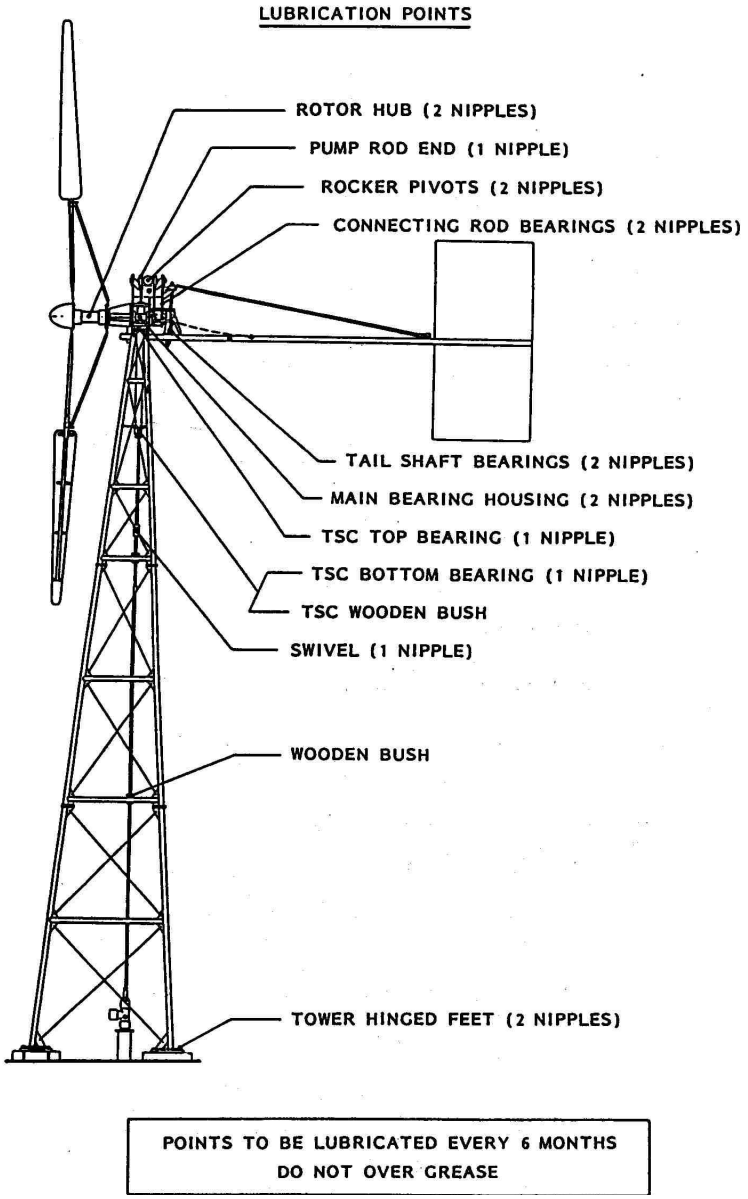
- Check the operation of your grease gun BEFORE climbing up the tower.
- Always use 2 people for greasing the transmission; 1 to locate the grease nipple and the other to operate the grease gun.
- Treat all moving parts with great respect as they can move with tremendous force. Keep fingers, hands etc well clear.

LUBRICATION REQUIREMENTS FOR ALL OUR KIJITO WINDPUMPS

(To be carried out every 6 months)

GREASE NIPPLE POSITIONS & THE STROKES REQUIRED FROM A STANDARD GREASE GUN

ASSEMBLY	LOCATION	NO OF NIPPLES	NO OF STROKES
TRANSMISSION	Rotor hub	2	6
	Drive shaft	2	3
The rotors of our 12' & 16' machines turn on 2 large flange mounted bearings only:		2	2
	Connecting rod	2	3
	Pumprod end	1	3
	Rocker pivots (flange brgs)	2	3
	Tail shaft (flange brgs)	2	3
TRANSMISSION SUPORT COLUMN	TSC (bottom brg)	1	6
PUMPROD	Swivel	1	3
BOTTOM TOWER	Tower feet	2	3



IMPORTANT
DO NOT EXCEED THE RECOMMENDED NUMBER OF STROKES!

Unfortunately it is NOT TRUE that if a little grease is good, then more grease must be better! Too much grease applied with a grease gun can result in an increase in pressure in the bearing or the oil seal being damaged or forced out.

WOODEN BUSH LUBRICATION

All pumprod wooden bushes should also be greased regularly. How frequently will depend on your local conditions. So please check them visually and grease as required. Do not forget the wooden bush at the bottom of the transmission support column (TSC). ANY WORN OR DAMAGED WOODEN BUSHES MUST BE REPLACED. You can either make your own to fit, or purchase the oil soaked ones machined and supplied by us.

1.3 THE PUMPRODS & GUIDES

These come down the centre of your tower and are the connecting link from the transmission to the single acting pump cylinder, which can be situated either at the base of the tower or deep in the borehole, depending on the type of installation.

You will note that just below the transmission there is a swivel joint. This allows the windpump transmission to change direction without rotating the pump plunger, preventing undue wear of the pump washers. This has its own grease nipple and should be greased regularly.

Below the swivel joint the pumprod becomes square or flat, depending on your model, and it passes through a special wooden bush that prevents that pumprod rotating as mentioned above. It is most important to grease this wooden bush as necessary, and to make sure the pumprod cannot rotate inside it. If this happens then replace the wooden bush immediately.

Our pumprod bushes are soaked in oil before they leave the factory but occasional greasing will still help to reduce wear. Apart form wearing the pump washers, if the rods do start to rotate, then a pumprod could become unscrewed deep down in the borehole rising main and then a tricky 'fishing' job is required to retrieve it.

While you are disconnecting the pumprods for whatever reason, please make sure all the wooden bushes are removed before you start.

PLEASE DO:

- Change any wooden bush that has started to ear out, this costs little and it if is not done it can cause unnecessary problems to your machine, especially the stuffing box (see 1.5)
- Whenever you are reconnecting the pumprods after maintenance of the pump cylinder ALWAYS put a black bituminous paint on the threads of the connectors. This helps prevent rust and makes them easier to undo next time.

1.4 THE TOWER & FOUNDATIONS

Our towers come in 2 types:

- BOLTED TYPE: These are usually for export
- WELDED TYPE: These are made in 10ft modules, up to a maximum of 40ft.
-

Both these different types require inspection occasionally, to check all bolts are tight, and should be repainted as necessary to prevent corrosion.

As you may know, one of the things all our towers have in common, is that they are hinged at the foundation level. This greatly simplifies initial installation and if you windpump is over a borehole, it also facilitates borehole maintenance as by swinging the windpump away from a borehole, a drilling rig can be used for cleaning or other borehole work. This can be quite a difficult operation with our larger machines, and therefore needs to be done by experienced staff. Our KIJITO installation manual, which is available on request, has some useful information on this.

PLEASE DO:

- Make sure at all times that the bolts & nuts that attach the windpump foundations are tight.
- Once of twice a year, pour old engine oil over the hinge pins, so that they do not seize up with rust, especially in coastal areas. Our new models have grease nipples in the actual hinge which makes lubrication easier.
- Use steps that we have welded into our tower structure, when you are climbing up or down the windpump.
- If you have one of our Export models (with bolted rather than welded towers) make sure that none of the cross bracing has been removed. (**Important Note**: It is our recommendation that with these towers, that all the bolts that attach the cross bracing should be either welded or riveted, prior to standing the machine up, to prevent theft)
- Beware of bees or hornets nesting in the structure. We have found a few moth balls tied up inside the transmission, will usually keep them away!

PLEASE DO NOT:

- Attempt to pull up a long and heavy rising main using the tower as a gantry, without checking with us first. Where necessary, a special gin pole can be supplied on request.

SOME SHOTS OF THE ACTUAL INSTALLATION OF A KIJITO

Above: Our Kijito towers are hinged so they can be assembled at ground level and then winched into position. Below: Pumping water for elephants in Tsavo Park

1.5 THE STUFFING BOX

This is the joint that enables your windpump to push water away from itself, to a total head not exceeding 60m. It is a water proof slide just above the water outlet, which uses a stainless steel rod and normal pump gland packing.

As this is a component that can cause problems with wear, we have made the brass guides for the stainless steel rod replaceable. If the stuffing box starts to leak too much then the first action is to loosen the locknut that locks the main centre guide. This guide should than be tightened a few turns with a pipe spanner until the water is just very slightly oozing out every time the pumprod goes up. **IMPORTANT**: you should never tighten the guide SO much that water stops leaking completely, as this is needed to keep the slide lubricated.

Don't forget to tighten the locknut up again when you have finished.

If you later need to insert more packing, please follow the steps outlined overleaf.

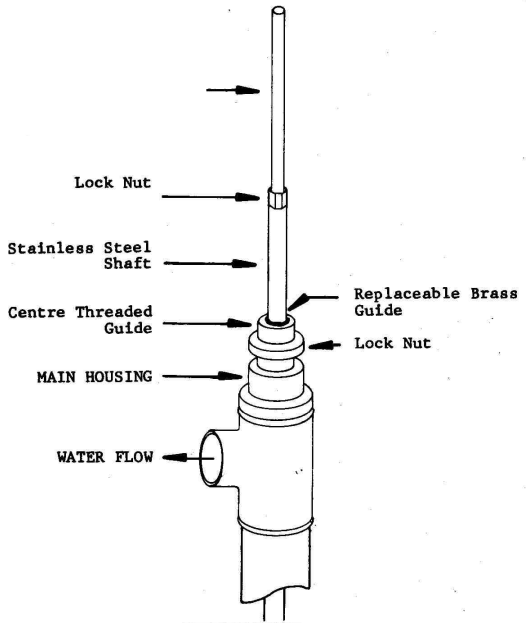
PLEASE DO:

- Check your pumprod wooden bush guides regularly, as excessive wear in these areas can cause unnecessary wear in your stuffing box.
- Make sure you only tighten the stuffing box when the windpump is actually working, so you can make sure you do not over-tighten it.
- Make sure you add extra gland packing when required. If your windpump is pushing water up quite a high head, the amount of water leaking through a stuffing box with worn out packing can be excessive. This can cause corrosion to the tower structure, and in extreme cases, start to undermine the foundations.
- If you are doing work on the delivery or suction lines of your windpump, after installation, please make sure your new plumbing has not effected the alignment of the stuffing box.
- Check your stuffing box regularly, as a leaky stuffing box can casue problems (see below).

PLEASE DO NOT:

- Use any grease on the gland packing or shaft, as the graphite impregnated into the packing is sufficient. We have found that extra grease can break down the strength of the gland packing. This has resulted in parts of it being stripped off by the stainless steel rod. These pieces then sink down to the bottom of the pump, and clog up the valves, which then has to be removed and cleaned to get the windpump working again – an unnecessary expense.

DETAILS OF THE KIJITO STUFFING BOX



DETAILED STEPS FOR REPLACING GLAND PACKING:

- Furl windpump, and secure the rotor (see Pg 2 & 3)
- Slacken large locknut and unscrew centre threaded guide (CTG) – It is easier to slide this up the pumprod and secure with a piece of string, while you are working with the packing.
- Tap gland packing with a hammer so it is the right width to fit round the stainless steel shaft. Cut about 15cms and wrap it round the shaft, at the same time tapping it down into the main housing. Make sure you do not put in so much as a time that you cannot replace the CTG.
- Screw down CTG, once the threads catch, unfurl the windpump and tighten down WHILE THE WINDPUMP IS TURNING, until only a small amount of water SEEPS through.
- Replace and tighten locknut.

1.6 THE SUCTION LINE

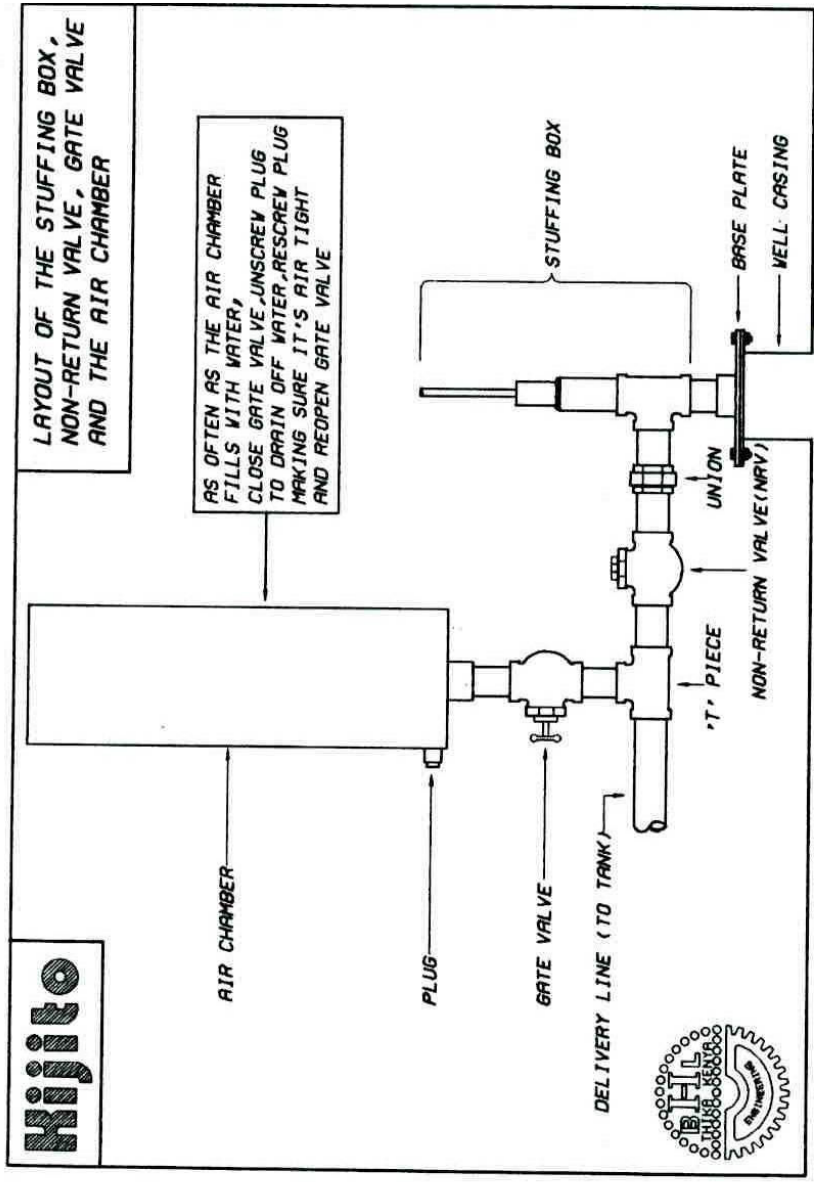
This is referred to briefly here, as sometime in installations beside lakes, rivers or dams, it can exceed 50m in length and this can cause problems, especially with airlocks. Ideally the suction line should be in a straight line and have:

- An internal diameter of approximately 75% of the pump cylinder, and certainly not less than 50%. If a suction line is of a smaller diameter than recommended, then the speed of the water through the line will be too fast, which can cause 'water hammer' and friction.
- As few sharp bends as possible, and an actual suction lift not exceeding 4 to 7 m. DEPENDING ON YOUR ALTITUDE.
- Any suction line that exceeds 50m would benefit from having an airchamber (vacuum bottle) on it, as near to the pump cylinder as possible. This will again help reduce 'water hammer' and to be effective should be checked and bled regularly.

1.7 THE DELIVERY LINE

One might think that this is an area that would have very few problems, but this has not been our experience:

- Where a long delivery line has been installed before (or after) the windpump was connected, especially if it is PVC pipe, the whole line should be checked for leaks. There have been times when a customer has complained about insufficient water reaching the storeage tank, only to find the pipe was leaking.
- Again, if the delivery line is PVC, then please make sure that it is buried deep enough to protect it from sunshine, animals and erosion during times of high rain.
- There is another good reason for burying your pipe, as a pipe on the surface of the ground can expand and contract up to as much as 10cms or more, between the extremes of temperature. Obviously if one end is fixed into a concrete tank, the only direction the pipe can expand is towards the windpump, and this can cause sever problems to your stuffing box, and pumprods. If you cannot bury your pipe due to the presence of rocks etc, then please make sure than any movement of the pipe can be taken up in an expansion joint, or insert a horizontal "U" bend to take up the movement. This can be made of rubber suction pipe if necessary.
- **NEVER HAVE A DELIVERY LINE THAT CAN BE COMPLETE CLOSED OFF BY SOMEONE CLOSING A GATEVALVE** Severe damage can be caused to your windpump if at a time of high wind it is suddenly trying to pump against a totally closed head. If you do have gatevalves in your system, or are pumping to animal troughs or tanks that use a ball cock to close them off when they are full, then **ALWAYS** fit a **PRESSURE RELEASE VALVE** near the windpump, so that if everything is closed off, then there is still somewhere for the water to be released, and your windpump will not be damaged.



- If you are pumping with a stuffing box down a fairly long delivery line, then it is always beneficial to insert an airchamber (see facing page). This chamber has a drain plug on it, that should be removed from time to time, to see that all the air in the chamber has not been absorbed by water. As in the section on the suction line this airchamber acts as a 'shock absorber' to prevent water hammer.
- Where the windpump is pumping into a closed system that might stretch quite long distances, it might not be easy to see just how much water your windpump is actually pumping when you are beside it. By inserting a 'T' piece with a gatevalve as shown on the sketch on the facing page, it is then possible to see just how much water your windpump is actually producing. A reduction in the normal flow could mean your pump washers will soon need replacing.
- To reduce extra head due to pipe friction, always make sure your delivery line is adequate for the quantity of water being pumped. As a rule of thumb it should not be less than 50% of the diameter of your pump cylinder. We once installed one large windpump and when we later came back found they had connected it to a long delivery line of ¾" pipe. The result was not very satisfactory!

1.8 THE STORAGE TANK

In most installations, you will get more efficient use of your windpump if you can supply adequate storeage.

We suggest as a normal guide, a storage capacity **3 times** what the windpump could deliver over a 24 hour period. Even if you cannot provide adequate storage, then under most circumstances, especially if your windpump is in a remote area, we suggest that you allow the excess water pumped to be used for small scale irrigation. We feel that this is putting the windpump to better use than furling it every time the tank is full, but please keep the water away from the foundations of the tank and the windpump.

If your storeage tank is near to the windpump and at ground level, then you will not need a stuffing box, but can just extend the rising mail up into the tower.

One last word on storage: under some circumstances it is possible that a windpump in an arid area where there are not other sources of water for a considerable distance might lead to damage to the environment if too many people are allowed to bring their animals for watering. One way to reduce this problem is to **limit** the size of the storage tank, and to again use the 'overflow' to irrigate a tree nursery or small afforestation project.

2.0 THE MAINTENANCE OF BELOW GROUND COMPONENTS

As mentioned at the beginning, our windpumps can pump water from many different types of water source, but let us start with the one that is probably the commonest and unfortunately, the most complicated.

2.1 BOREHOLES

Before you can even start to think of the installation or maintenance of your below ground components, you have got to know the following details of the borehole itself:

- Total drilled depth, date of drilling and diameter of borehole.
- How much casing was put into your borehole, and was it plain or slotted?
- What is the water rest level?
- What is the pumping water level, and the recommended depth at which the pump cylinder should be, or has been installed?
- What is it's tested yield, and the recommended maximum extraction rate? (The latter is usually about half the former)
- When was it last checked or cleaned by a professional driller?

If this sounds all rather complicated, then be encouraged that all this information, together with your borehole reference No should be available on the original completion report, furnished to the ministry of Water Development, by the Drilling Contractor.

Assuming that you have all this information, and that your windpump has been correctly installed, then what possible problems do you need to be aware of?

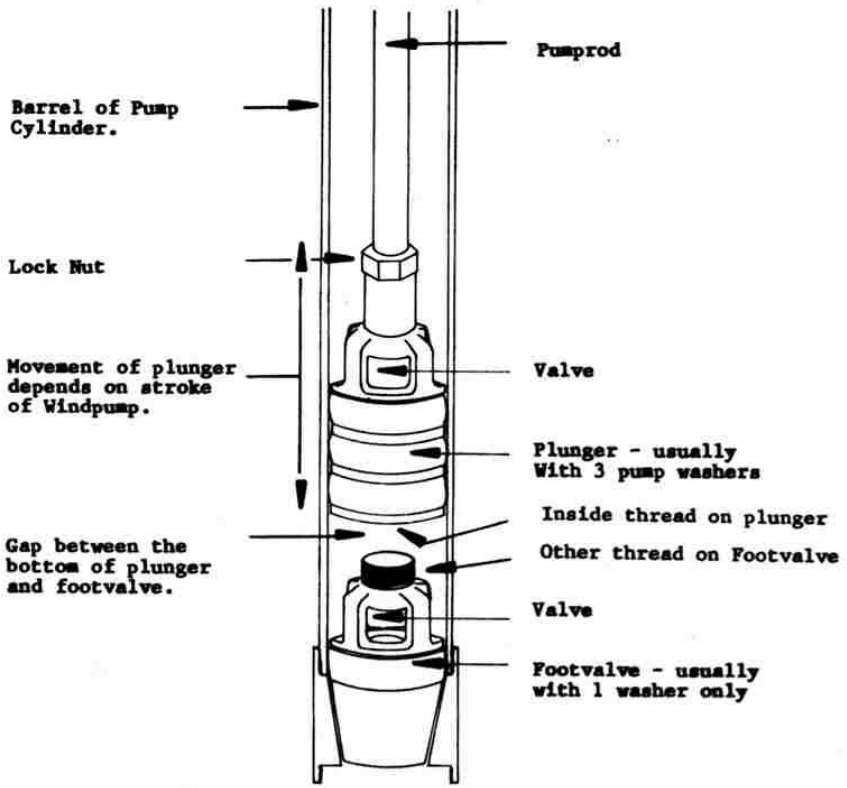
Most pump cylinders used in boreholes are the 'open topped' or 'deepwell' type. This means that for ease of maintenance, the plunger and footvalve can be moved from the borehole WITHOUT removing the rising main. Hence if you have a 2¾" deepwell cylinder you will need a 3" rising main, so that the plunger and footvalve can be raised to the surface by pulling up the pumprods only, through the rising main. (please see diagram on facing page)

BASIC TROUBLE SHOOTING

If your windpump starts pumping less water than before, or stops pumping water altogether, even though it is still turning, then this could have been caused by one of more of the following:

- Your pump washers have worn out, and need to be replaced.
- Your pumprods have become unscrewed
- A valve has jammed open in either the plunger of footvalve
- The footvalve has worn and is not seating properly
- The water rest level in your borehole has dropped

DETAILS OF A TYPICAL DEEPWELL PUMP CYLINDER



To change the washers the pumprods are disconnected up above ground and then the plunger is gently lowered onto the thread on top of the footvalve, which is then 'caught' by turning the pumprods. Both units can then be bought to the surface for maintenance. This is a skilled operation and needs, if possible, someone who has done it before to assist he first time.

- Due to corrosion, or in some areas “iron bacteria”, your rising main has sprung a leak, down inside the borehole.
- If your water is slightly saline or dirty, your filter (if fitted) could become blocked.
- Mud or silt cold have entered the borehole and blocked your pump.
- If your borehole is bent, this will result in pumprods being worn on one side and the washers wearing out quicker.

One way of reducing these problems is to try and filter the water before it reaches the pump cylinder. In areas where sand or ‘fines’ could be a problem, an experience driller will either recommend the fitting of a Johnson Screen, which can be quite expensive, or a ‘gravel pack’ filter, which when done well is very effective. In areas where sand etc can be a problem, it is false economy not to ask the driller to insert some kind of filtering device. Coming back alter to re-clean and redevelop the borehole is a very expensive operation.

Whatever your type of installation, **FILTERING** will always help to increase the working life of your pump components.

PLEASE DO NOT:

- EVER use grease to lubricate leather pump washers during installation or replacement. This softens the leather considerably and greatly reduces the working life of the washers. Some type of soap solution should be used instead.

IMPORTANT NOTE

Care must be taken when fitting new washers that they correspond with the internal diameter of the pump cylinder and the depth of the individual washer spacers **very accurately** after the plunger components have been tightened up. The operation of tightening the plunger can sometimes increase the diameter of the washers, so that when you try to re-insert them into the cylinder, usually deep down underground, they are so tight that will not fit, and you then have to bring the plunger back up to the surface, and gently file off some of the leather until it will fit easily.

REMEMBER leather will swell a little bit after it has been under water for a time, so the washers do not have to be very tight when they are originally being fitted.

2.2 OTHER TYPES OF INSTALLATIONS

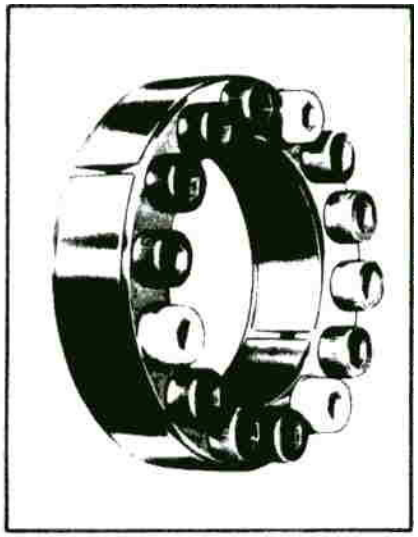
These are usually surface or shallow well installations, and the same principles apply, except that they would usually use a ‘closed top’ or ‘shallow well’ cylinder which means the rising main has to be removed as well as the pumprods to enable you to service the cylinder.

3.1 THE RINGFEDER PRESSURE JOINT

The pressure/friction joint connects the crank of our windpumps to the rear of the drive shaft. Originally we used them only on our larger models, but we are now using them on all our windpumps, except the newer 12ft models and our ‘2008’ models. They come in two different sizes.

Using these joins makes assembly/disassembly much easier, and also allows us to change the stroke of your windpump, if it becomes necessary, by merely fitting another crank. This can be done without laying the windpump down.

If you reassembled this joint incorrectly then it might slip when your windpump comes under heavy load, and damage your shaft. It is therefore VERY IMPORTANT that owners of KIJITOS understand the correct procedure. The position of the ringfeder in relation to the crank,, drive shaft and connecting rod can be seen very clearly in the photograph overleaf.



As can be seen in the diagram opposite, the device is circular with 15 x 8mm allen screws. 10 of which are black and 5 either painted red or silver. When these screws are tightened the whole device expands and grips the shaft and the crank, without using any keyways keys. The smaller size has a total of 12 allen screws, 8 of which are black and 4 silver.

These screws must be tightened gradually in a diametrically opposite sequence using a TORQUE WRENCH, going round the sequence **several times**, until all the torque settings come to the figures shown below:

BLACK SCREWS – 41Nm (29.6ft lbs), SILVER/RED SCREWS 35Nm (25.3ft lbs)

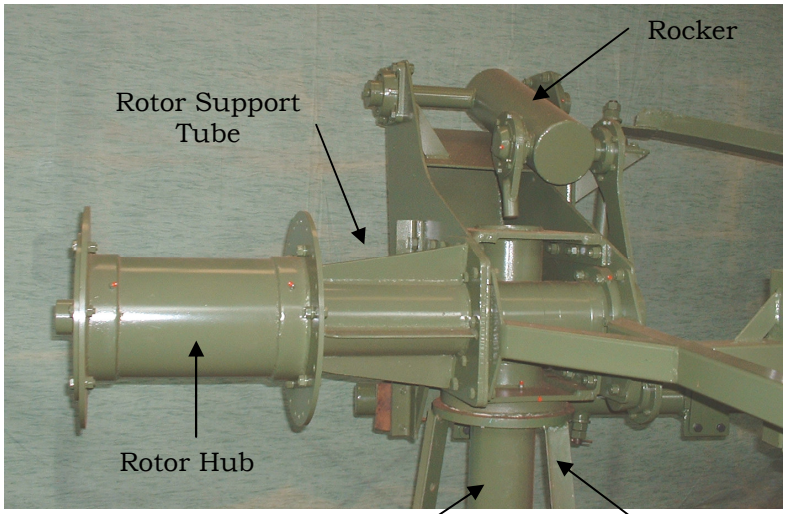
If you have to remove your ringfeder for any reason, and after loosening all the screws you still find it tight on the shaft, then REMOVE the silver/red screws and replace them with 10mm bolts. As you tighten these **gently**, they will loosen the ringfeder so it can be removed by hand. **NEVER, EVER strike the ringfeder with a hammer to remove it.**

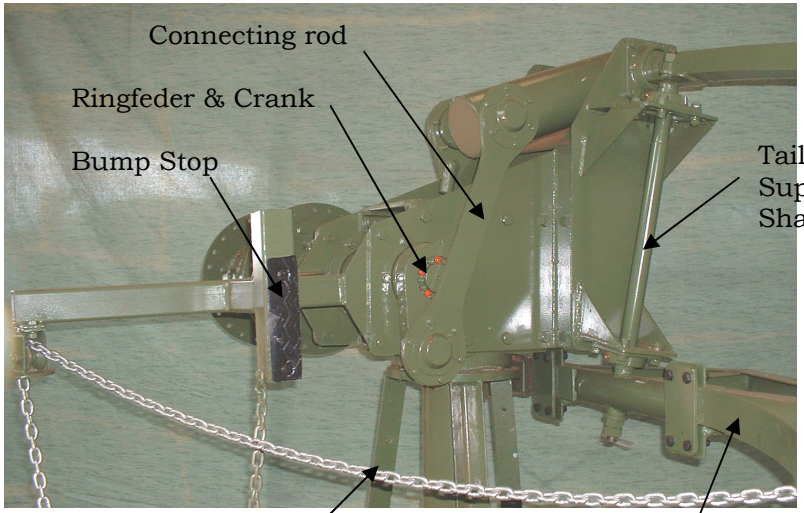
IMPORTANT NOTE:

- Always check the torque setting after a week or operation, following installation or refitting.

- Do not allow oil or grease on the friction surfaces at any time.

TWO VIEWS OF OUR SERIES III TRANSMISSION





3.2 HOW MUCH WATER WILL YOUR KIJITO PUMP?

This is rather a difficult question to answer exactly, as windspeeds can be quite variable. It must also be noted that local topography and trees and buildings within the vicinity of the windpump can reduce its performance.

However, there is a measurement of wind that can give us quite an accurate estimate of the performance of our pumps, and it is called MEAN WINDSPEED. This is calculated by measuring with an anemometer the kms of wind passing a given point during a specific period (a week, month or year_ and then expressing that in metres per second. (m/s).

In the tables below, the pumping capability of five sizes of our KIJITO windpumps are indicated for three types of wind regimes.

'light' mean windspeed	2-3m/s (4-7mph)
'medium'	3-4m/s (7-9mph)
'strong'	4-5m/s (9-11mph)

This will give you a guide to the pumping capacity of these machines for a wide range of pumping heads.

NOTE: These details have been verified by computerized 'data loggers' that measure windspeed, water pumped, number of pump strokes and the power in the wind (which is basically windspeed cubed). However, they assume an optimum wind site, matched pump cylinder (not always possible down narrow boreholes) and counterbalancing on deeper wells.

KIJITO PERFORMANCE DATA (CuM/24hrs)

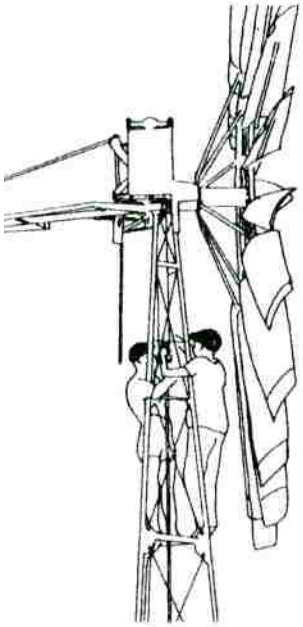
Model	12ft (3.7m) Rotor			16' (4.9m) Rotor			20' (6.1m) Rotor			24' (7.3m) Rotor			26' (7.9m) Rotor		
Total Head	Light	Medium	Strong	Light	Medium	Strong	Light	Medium	Strong	Light	Medium	Strong	Light	Medium	Strong
20m	5	14	29	10	35	75	19	53	113	30	83	177	35	95	204
40m	2.5	7	15	5	18	37	10	27	57	15	42	89	17	48	102
60m		5	11	4	14	28	7	20	43	11	31	66	13	36	76
80m		3	7	3	9	19	5	13	28	8	21	44	9	24	51
100m		2	6		7	16	4	10	24	7	18	36	8	21	41
120m			5		6	12	3	9	19	5	14	29	6	16	33

WINDSPEEDS: Light = 2-3 M/sec, Medium = 3-4 M/sec, Strong = 4-5 M/sec

4 SAFETY PROCEDURES

As already mentioned on page1, in common with all powerful mechanical devices, our KIJITO windpumps can be dangerous if they are not approached with the correct attitude and experience. Adherence to the following simple rules will help prevent accidents.

- Always work on your KIJITO with at least **2 PEOPLE**, never work on a windpump **ALONE**.
- Keep fingers well clear of any moving parts.
- When climbing the windpump keep your feet clear of the moving pumprods, and **CHECK** you are not coming up directly under the rotor.
- If possible, do not stand or work underneath the windpump when someone is working on it, unless you are wearing a hard hat.
- It is good practice to wear a hard hat at all times, even if you are just climbing the KIJITO to check its operation. It is quite easy to get distracted and this could result in the crank striking your head, as it rotates.
- Our towers have steps on of the tripod legs, **PLEASE** use them.
- The rotor is designed with sufficient clearance between it and the tower legs, to allow you a safe clearance should the rotor change direction while you are up on the KIJITO.
- Even if you are experienced with working up on the KIJITO, it is still a good idea to use a simple quick release harness, to attach yourself to the tower. This also allows you to use both hands when necessary.
- **NEVER** allow children to play on or near the KIJITO.
- Experienced people actually sit on top of the transmission while checking or servicing it. No matter how experienced you get, **NEVER** do this without securing the rotor first. (see Page 2)
- While servicing your KIJITO, it is easy to leave grease on the tower. Please make sure it is wiped off before you leave, as it could cause someone to slip.



KIJITO WINDPUMP MAINTENANCE RECORD

DATE	WORK CARRIED OUT	SIGN

MAINTENANCE CHECK LIST **Page**

Thank you for taking the trouble to read through this Maintenance Manual. We trust you have found it helpful and informative.

As we have already said, if there is anything in it that you do not understand, or you have any comments or suggestions to make, we would be very pleased to hear from you.

If you are taking continual recordings of how much water your KIJTO is pumping, this would also be very useful information for us. We would very much appreciate it if you could send us these details from time to time.

Please contact any of the personnel below at:

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BHL THIKA KENYA ENGINEERING

Kijito Windpumps