

GAVIOTAS DOUBLE ACTION TROPICAL WIND MILL

*Installation, Handle
and Maintenance
Handbook Windmill
MV₂E*



United Nations
Development
Programme

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GAVIOTAS DOUBLE ACTION TROPICAL WIND MILL

Science National Prize

Alejandro Angel Escobar 1978

Installation, Handle and
Maintenance Handbook
Windmill MV2E

INTRODUCTION

This is the 7th edition of our HANDBOOK it brings together all the experiences in the installation of our Gaviotas Double Action Tropical Wind Mill in the whole country. It is the result of our successes and failures in the positioning, assembly, installation and operation of it. We have improved all this techniques for using in a rural environment. The first level of this transference technique is a photograph, an illiterate as such that have installed this windmill can understand from a gesture, the force needed to tighten the pump of the cylinder.

The second level is a very fluently conversation supported by images in capital letter by hand for both easy understanding and better comprehension of the graphic. The third level consists of drawings and tables made by hand (for better understanding). These give important but not unavoidable information. In this edition we emphasize the installation model “vertical turn of spheres” although the general information is adequate for all former models.

Though the windmill is been designed for installation by the owner, for regional diffusion plans Gaviotas has trained professional assemblers who have trained a lot of users through community action boards. It is important to note that, the guy trained many years ago for the first edition is now the professional assembler leading the process in this handbook.

Investigation and technological development were made with the sponsorship of the United Nations Development Program, UNDP.



More than hundred years ago there are conventional windmills for extracting water. Its old design offers many disadvantages among others it is too heavy, more than half a ton thus it requires strong wind for working.

Unfortunately our tropical countries are poor in wind but there are many strong and short tempests.



Lately there are many new models, cheaper and simple.

This one made from metal drums for instance, only works few days a year due to the lack of wind and its steel rods cannot support it in a storm.

Scientific's and technicians from Gaviotas decided to create a new type of windmill.

“ A Tropical Wind Mill ”

There were built 58 different windmills in nine years, each of them contributed in some way to the creation of the:

"Gaviotas MV2E Double Action Tropical Wind Mill"



In this one, was tested the high-thrust rotor for the first time, nowadays all the Gaviotas MV2E have it.

800 models 80' and 1,300 models 81' were installed in the country. They are also exported to other countries in Asia, Africa and South America.

Advantages of Gaviotas MV2E, compared with the traditional windmill:

1. A ten-fold lower weight
2. A lower purchase price
3. It needs three times less wind
4. Not need to break in tempest
5. The installation is so simple that you can do it yourself, by following these instructions



Abraham Beltran and Gladys breed chicken and cattle at the bank of Zapata spout on high Vichada, although his closest neighbor lives 4.4 miles away, they consider him very close because Abraham is a the cyclist champion in the region. Since he made a poultry house they drilled a well 7.5 m deep for extracting cleaner water and having it nearer than it from the spout, as well for the house as for the garden and the drinker places for the animals. Last month he went to Gaviotas for enrolling Silvia at school and used the opportunity for buying a windmill with the money he spared since August. He asked the installation service because he wants to be a windmill assembler and maintenance technician for the region.

As you see, we wake very early like chickens! I am Abraham and I am ready to learn



German Moya, assembler from Gaviotas Center, we can start as soon as you wish.

The measure is right Mr. Moya

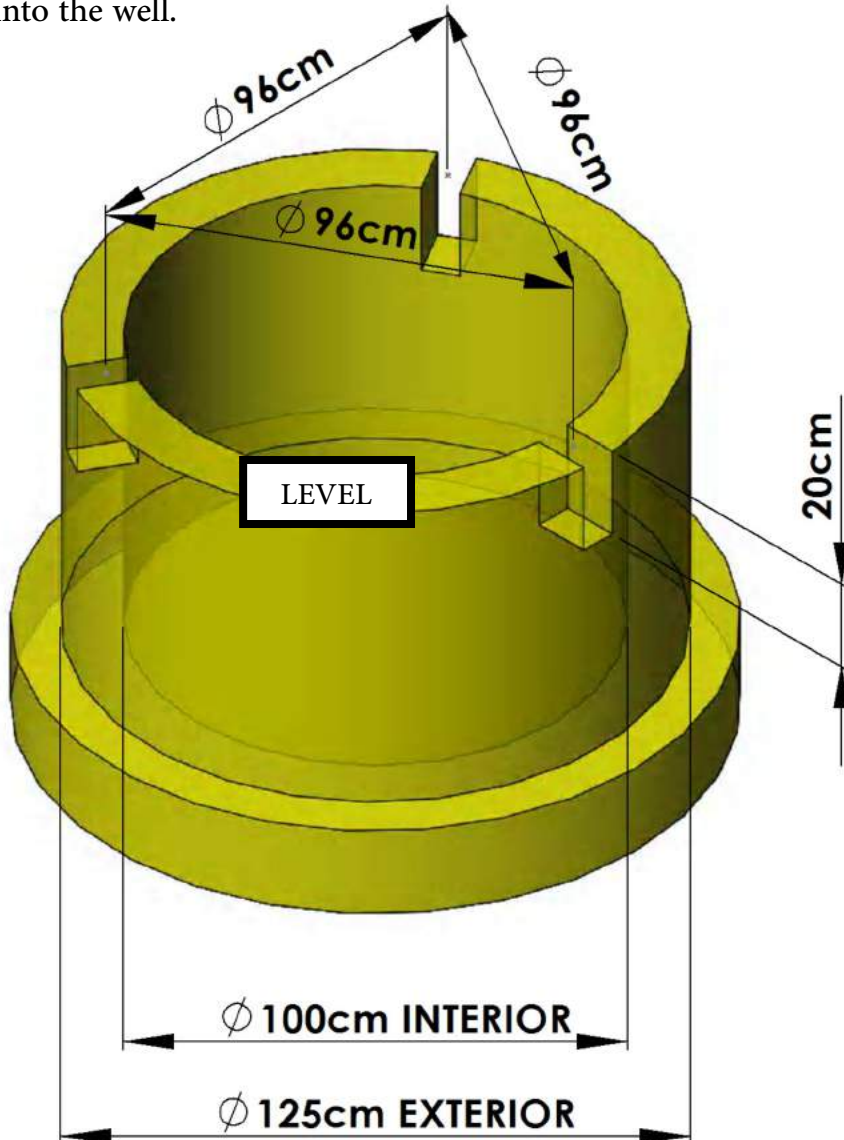


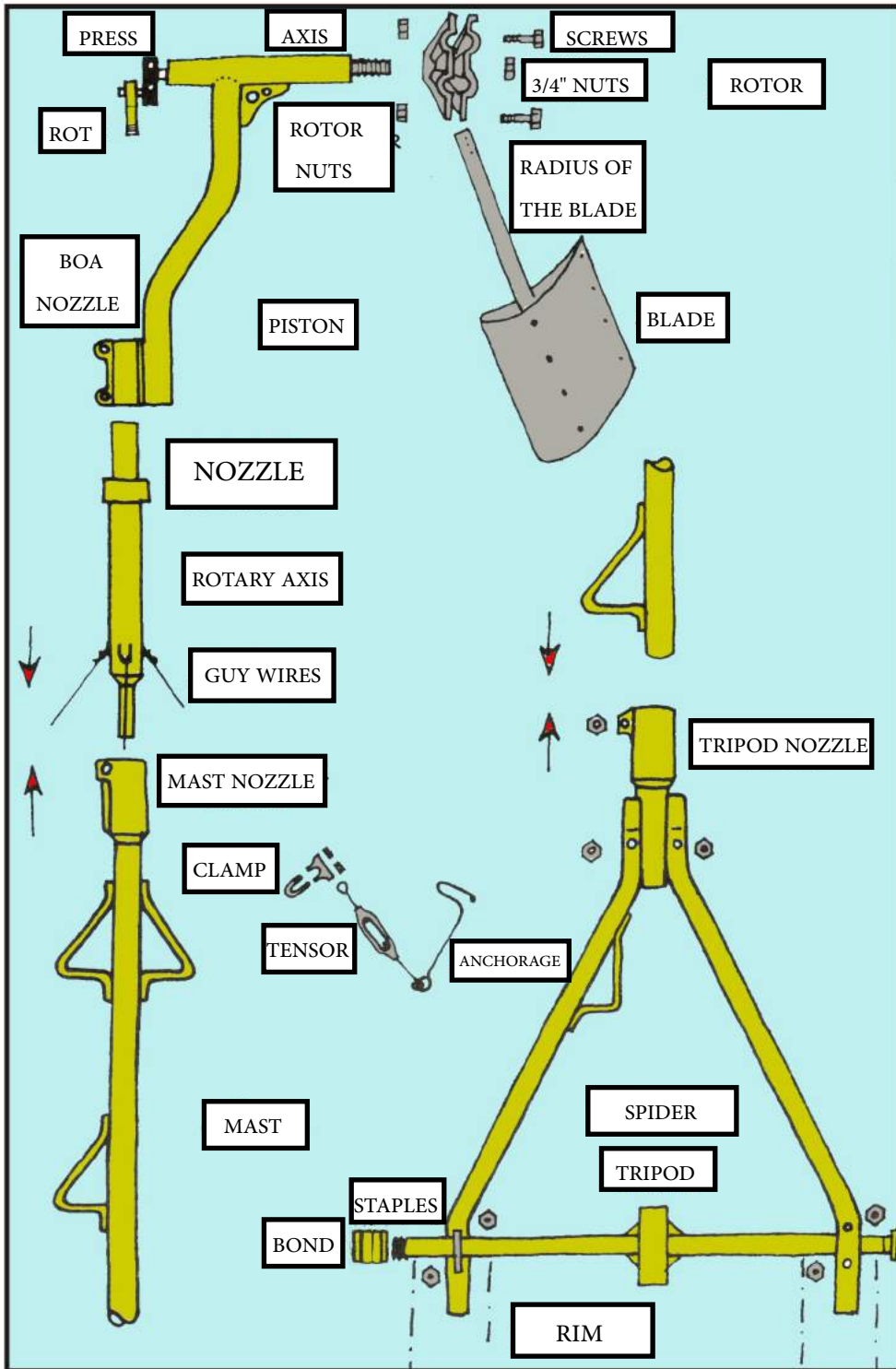
The rim looks great and according to the manual. Let's check all measures though because a misalignment curb is the worst thing when you install a windmill

THE RIGHT RIM

Note: In dug wells by hand (90 cm. to 1,10 m) the best support for the windmill is a rim of 0,7 m to 2 m. height.

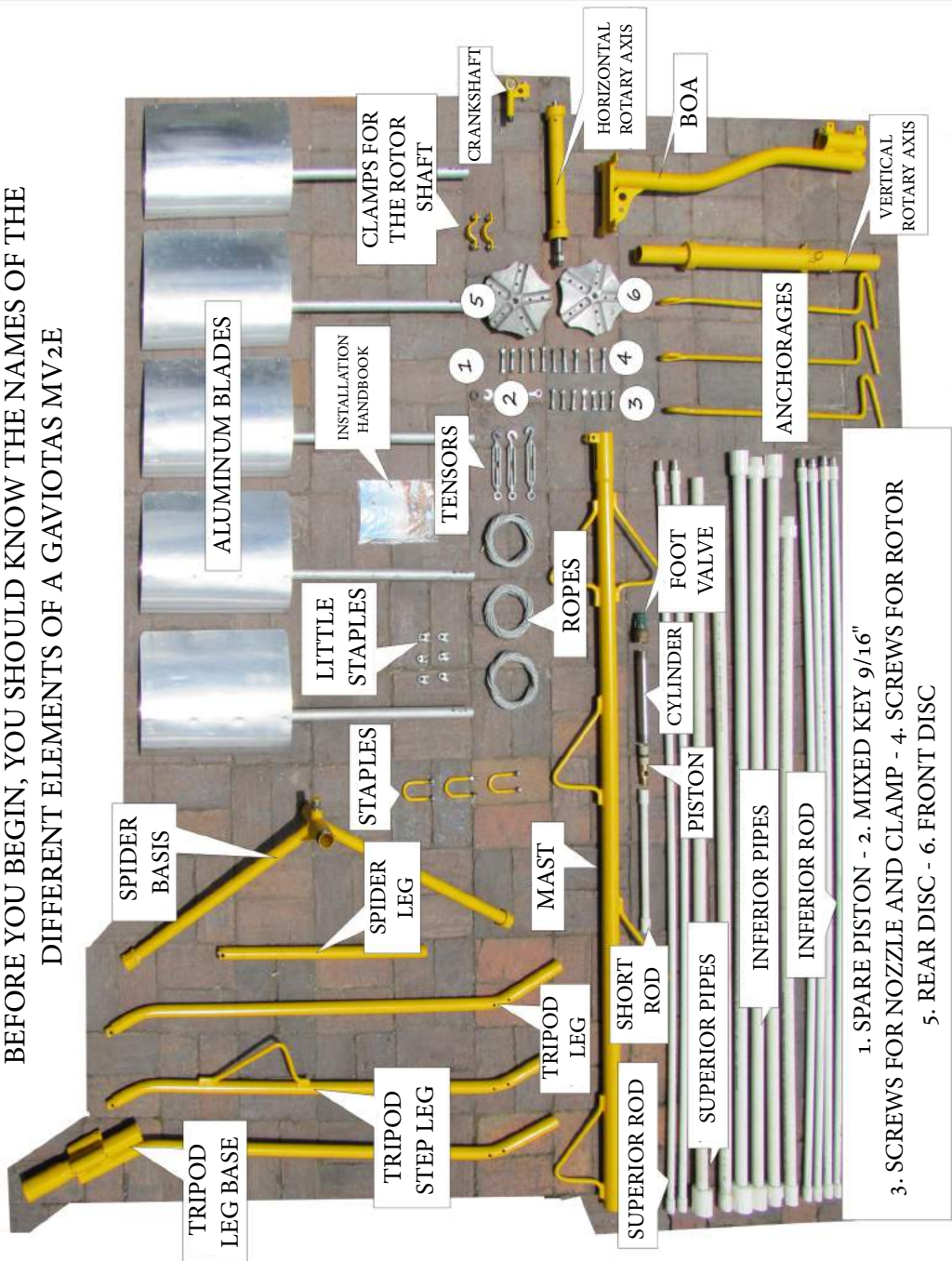
If it is possible you should put a lid to prevent sunlight, animals and even children from falling into the well.





MV2E
 MODEL
 STRUCTURAL
 ASSEMBLY

BEFORE YOU BEGIN, YOU SHOULD KNOW THE NAMES OF THE DIFFERENT ELEMENTS OF A GAVIOTAS MV2E



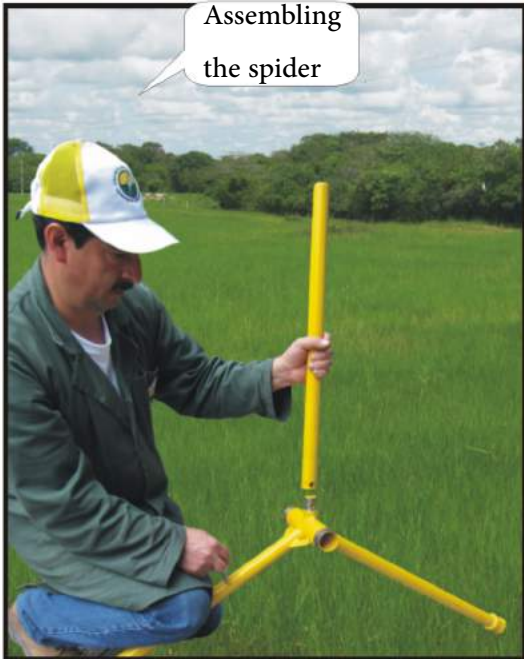


¡Now the last hole is aligned!

Assemble the tripod in the base leg. Straight leg at the left, and the leg with the step at the right side. Hit the Structure on the floor so that the leg would fit perfectly.



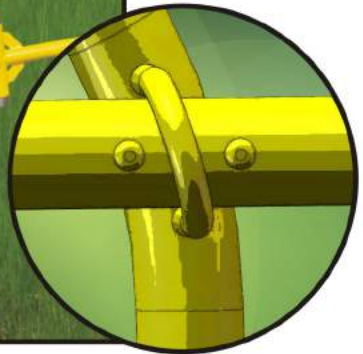
Insert the screws do not tighten them, still when you place the spider they can be tightend



Assembling the spider



Insert each staple to set the spider on the right side of the leg of the tripod.



Those holes indicate the insertion site of the spider leg to the tripod.



Assembly the
mast to the
rotating shaft

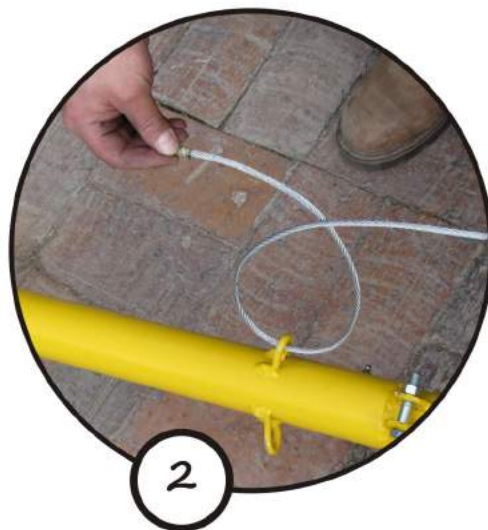
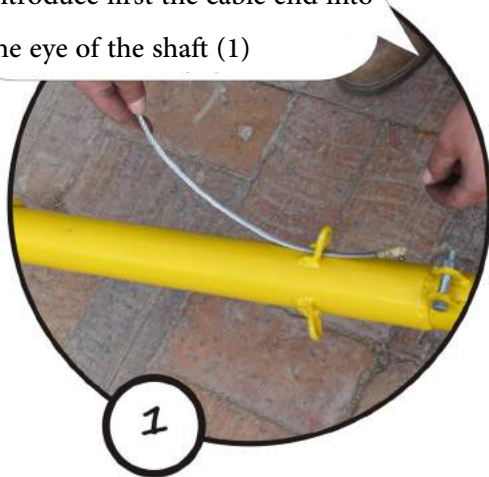
You can hit the mast against
the floor to fit the axis into
the nozzle. Do not hit the
axis.



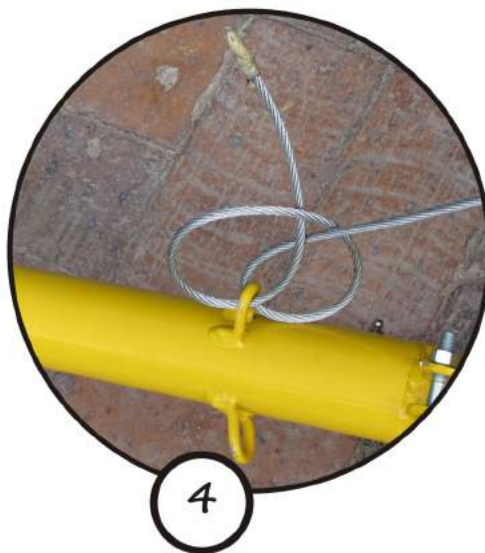
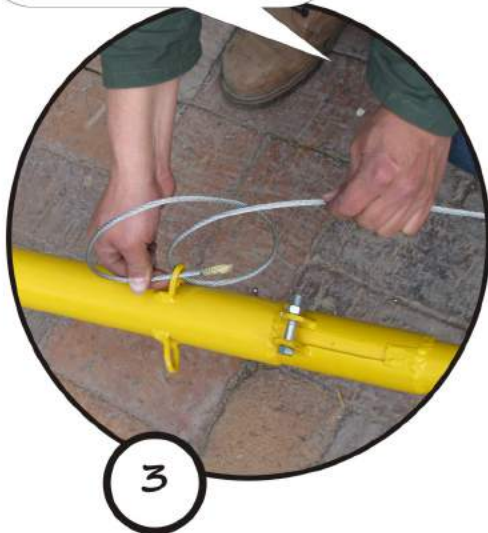
You have to "feel" the shaft
bottomed on the mast before
tightening the screw tip (short
screw)

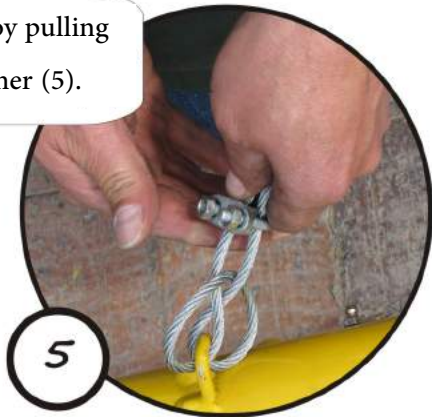
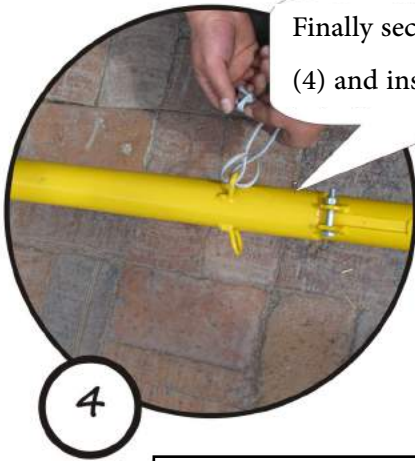


To set the cable tension in the ring of the rotating shaft, introduce first the cable end into the eye of the shaft (1)

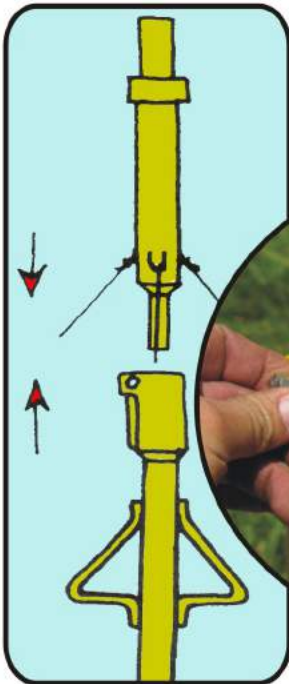


The cable end passes through the eye of the shaft (2), (3) y (4)

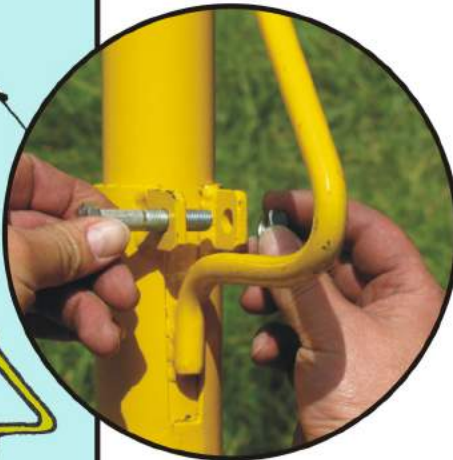




The operation is repeated for the other two wires

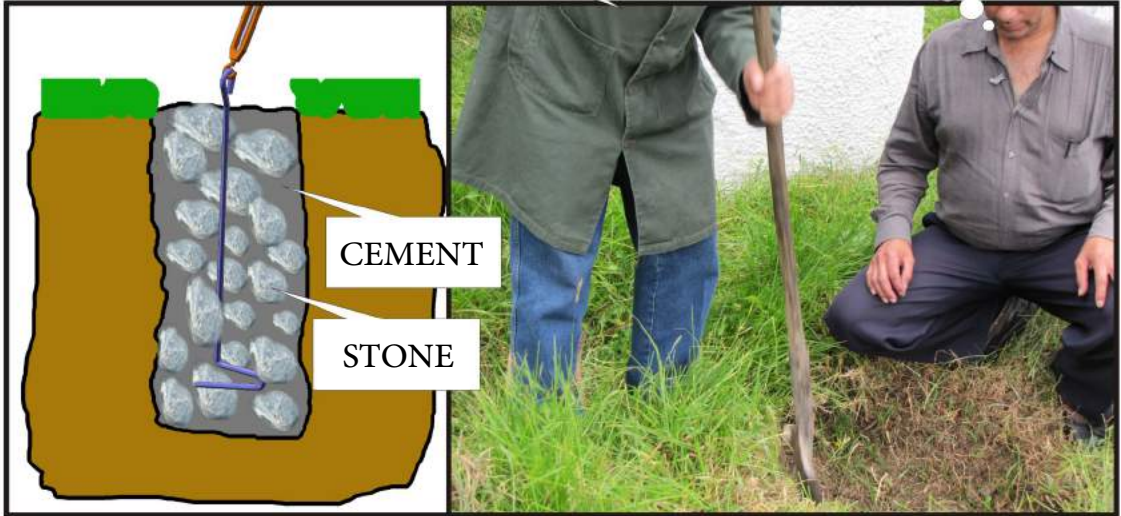


Assembly the tripod and the mast



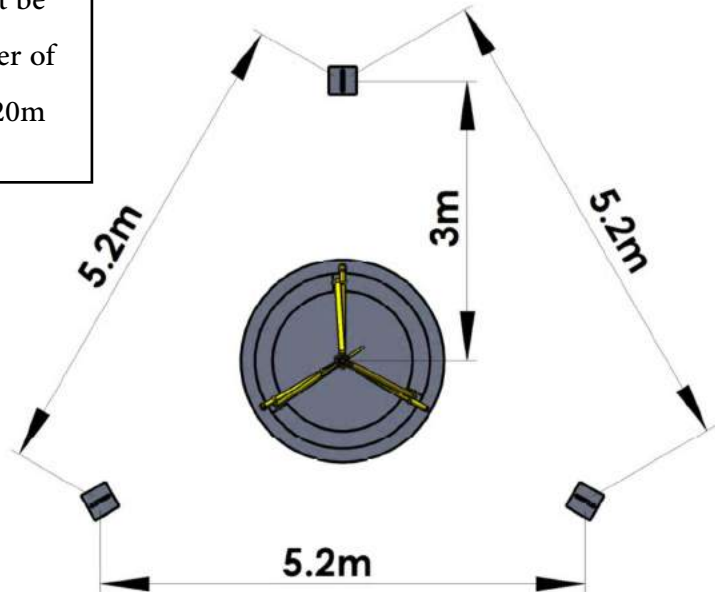
We place the first anchor to three meters of the well

The anchor for the cable



NOTE: For a curb higher than 1m it is necessary having special cables.

The holes for the anchors must be placed 3m away from the center of the well, in a distance from 5,20m each other



Carefully get up the 32 Kilos of the set and placed it over the holes in the rim.



Could we put it first and then fit it into the holes?

Pay attention to the bling leg, it should be placed where no eater is needed



The eye of the hook should be sunk halfway into the cement and the hollow should not point to the tower of the mill so it does not bend when you stretch it

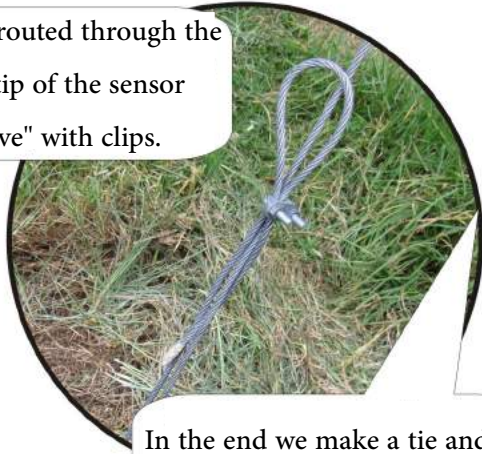
Now we tie the wires to the anchors and secure them with staples



Do I have to stretch the wires?



The cable is routed through the eye and the tip of the sensor ensures "above" with clips.




In the end we make a tie and fasten it with a clip.




The three wires should be ready to level the mill

¡IMPORTANT NOTE!

THE CABLE COMES FROM THE MAST, PASSES THROUGH THE EYE OF THE TENSOR, "CURVE" THE TIP AND SECURE WITH THE CLAMP




Make three laps until the drop be horizontally centered



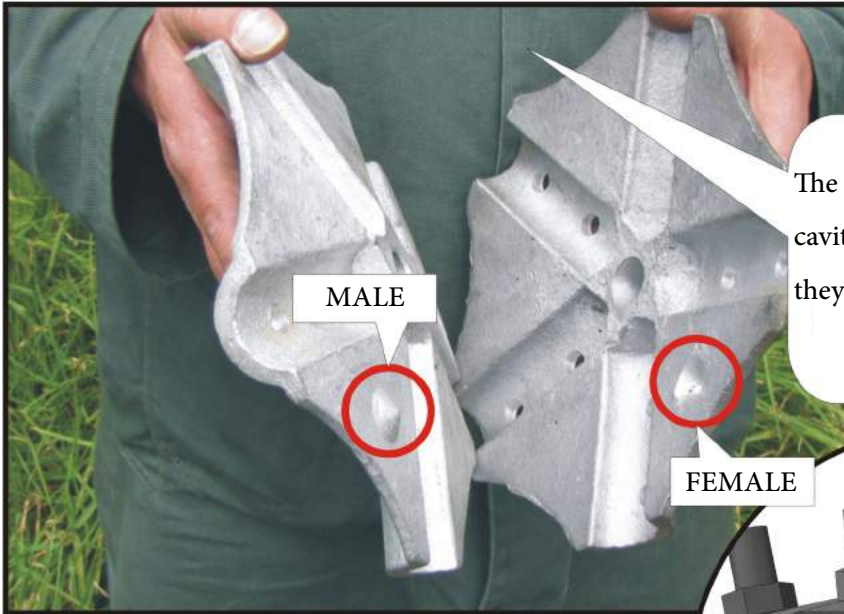
Three laps

Once the tripod is leveled, the legs are fixed with cement*
(A portion of cement and two or three sand)



The spider's legs should be well established in the cement *

* TO GAIN TIME GAVIOTAS INSTALLERS USE A LIQUID THAT HARDEN THE CEMENT IN AN HOUR (ONLY SHORTENS THE INSTALLATION TIME)

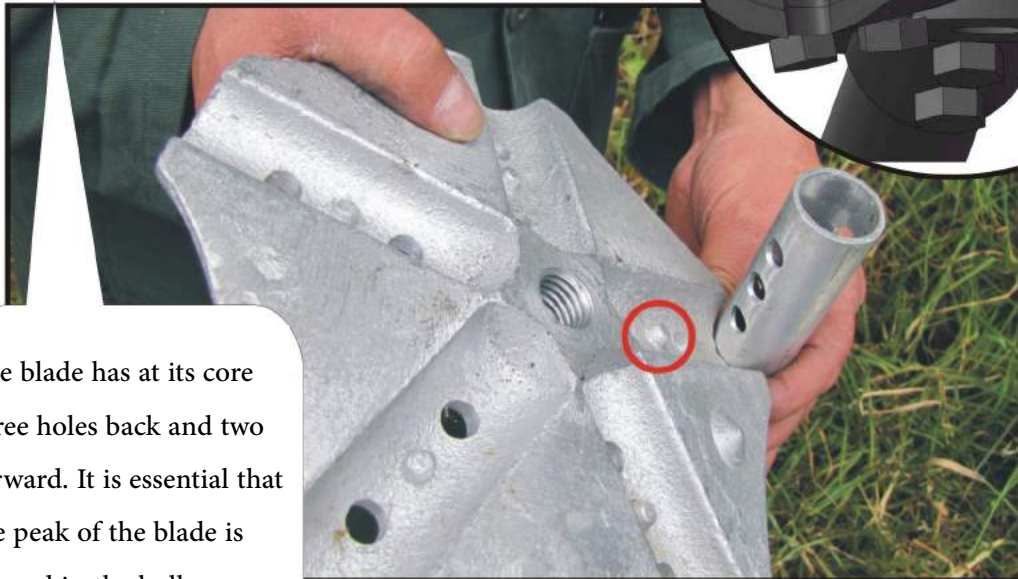
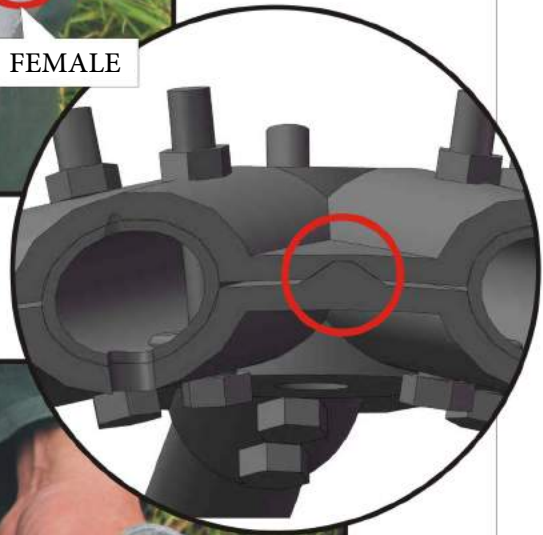


The disk have an internal cavity and a conical peak, they SHOULD be coupled.

MALE

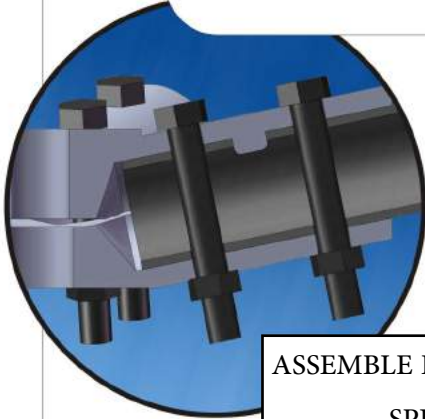
FEMALE

ASSEMBLY CONIC
COUPLE



The blade has at its core three holes back and two forward. It is essential that the peak of the blade is housed in the hollow

Once mated the disks and the central holes in the blades, screws are inserted.

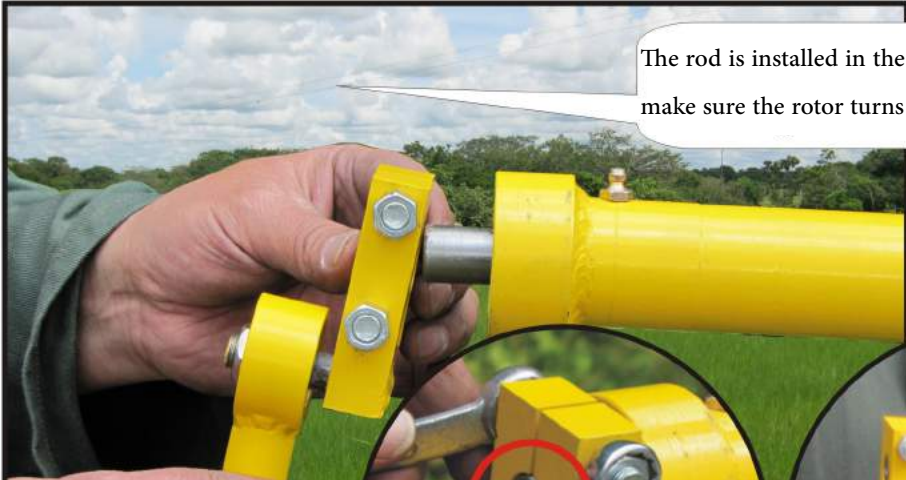


ASSEMBLE BLADE AND SPIKE



Tighten the 10 (long) screws alternating back and forth several times until everyone feels secure. This can take up to 20 minutes





The rod is installed in the rotor shaft; make sure the rotor turns freely.

THE BACK OF THE ROD SHOULD BE FLUSH WITH THE SHAFT FACE

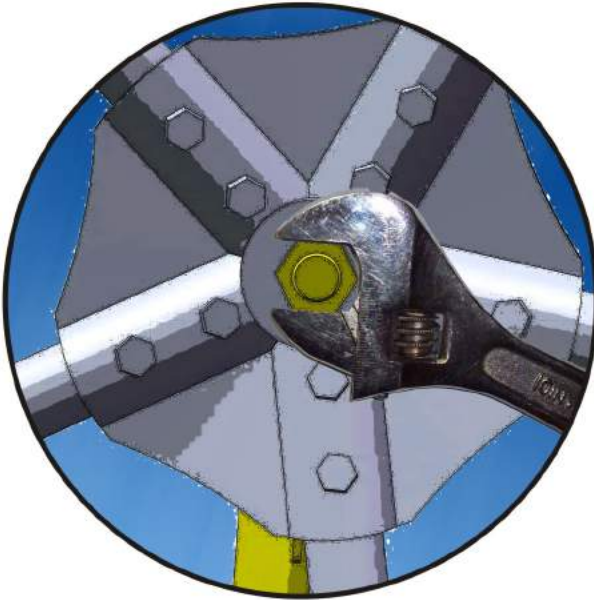


SCREW THE SHAFT TO THE ROTOR



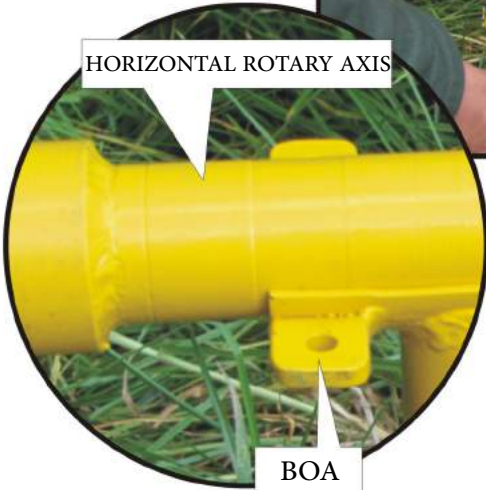
Please hold the rotor to screw it more easily

Using an extensible key give the final laps



USING AN EXTENSIBLE OR FIXED KEY, SCREW NUT 3/4" TO THE ROTOR SHAFT

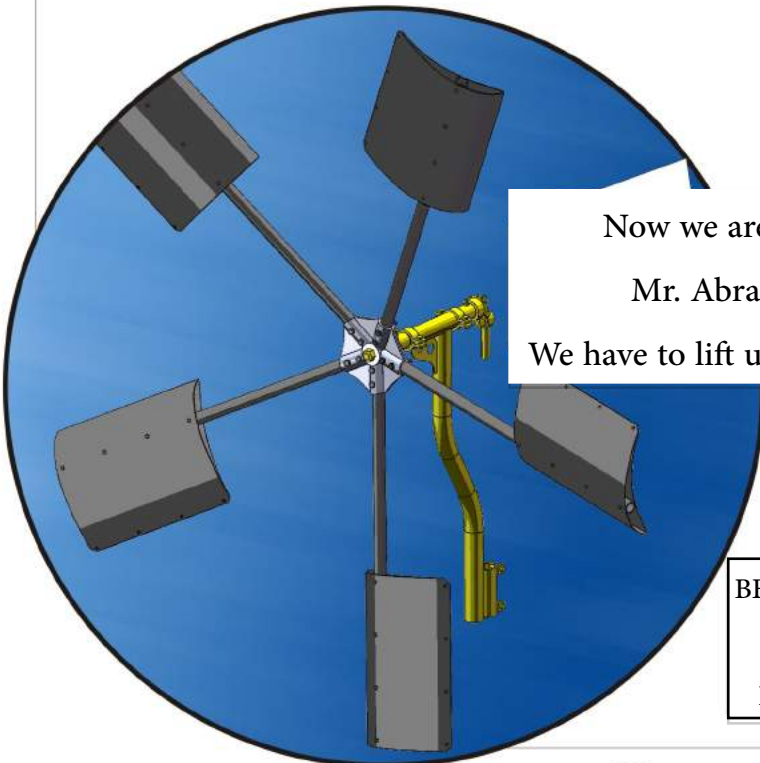
Now assembly the horizontal rotary axis of the boa. Be sure the cradle of the boa fit to the horizontal axis!!!



THE CRADEL OF THE BOA HAVE TO FIT INTO THE SLOT



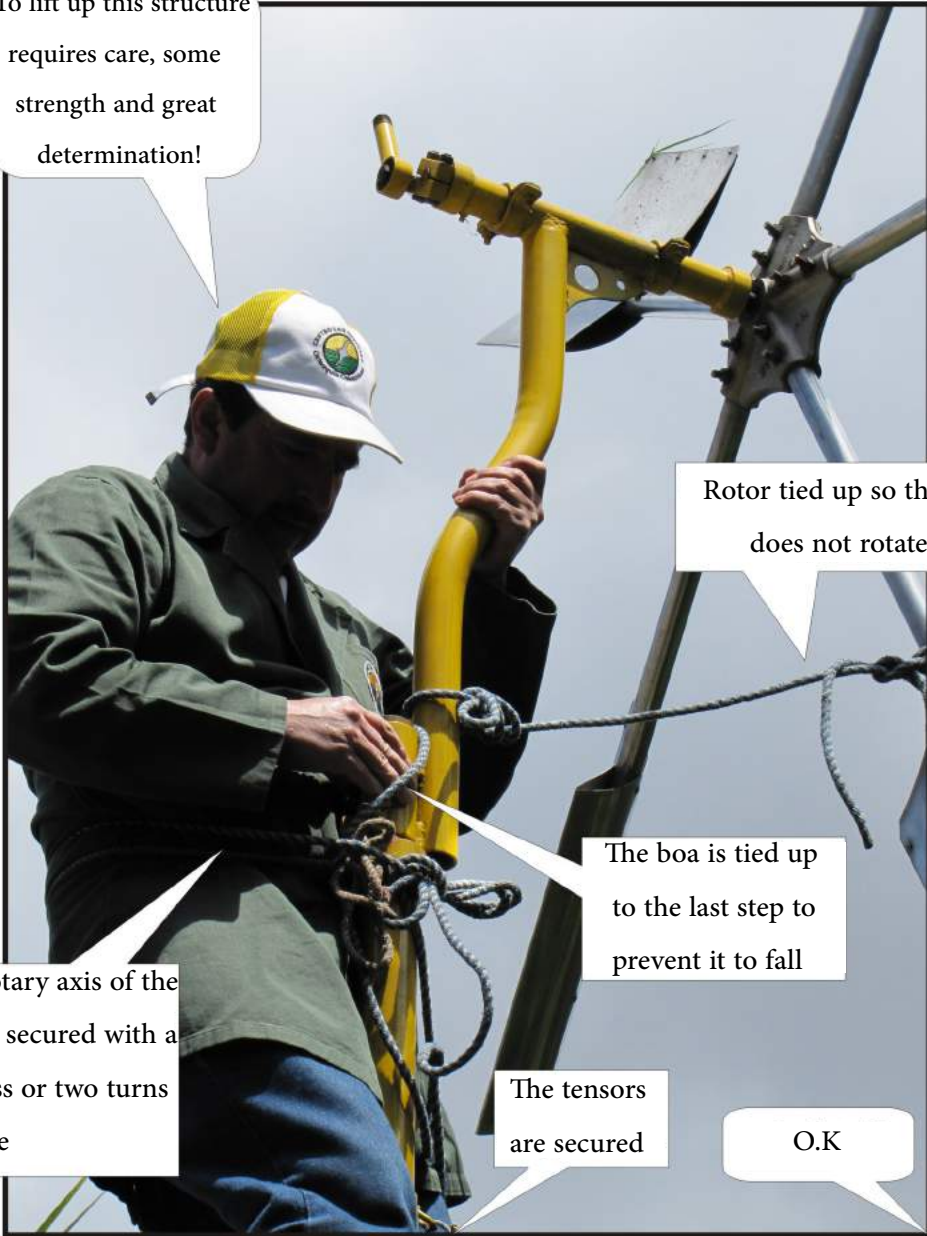
As far as we have the horizontal rotatory axis assembled in the boa, we put the clamps



Now we are ready
Mr. Abraham.
We have to lift up the rotor

BEFORE YOU LIFT UP THE ROTOR,
YOU HAVE TO TIE UP TO
PREVENT IT FROM ROTATING

To lift up this structure requires care, some strength and great determination!



Rotor tied up so that it does not rotate

The boa is tied up to the last step to prevent it to fall

The rotary axis of the mill is secured with a harness or two turns of rope

The tensors are secured

O.K

Introduce the nozzle of the boa in the rotary axis and tighten the screws. Some installers come up with the boa in their arms other ones take it with a rope.



Adjust the short draught with your hands



Stick the two sides of
the tubes...



Insert the upper pipe
bending it a little

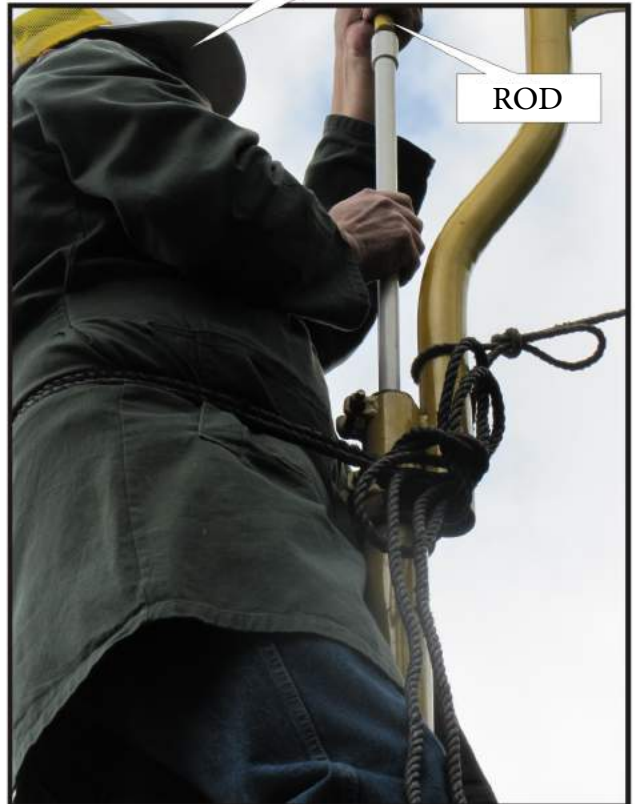
It is ready !

Now we introduce the upper draught through the guide. Be sure this point could be see over there

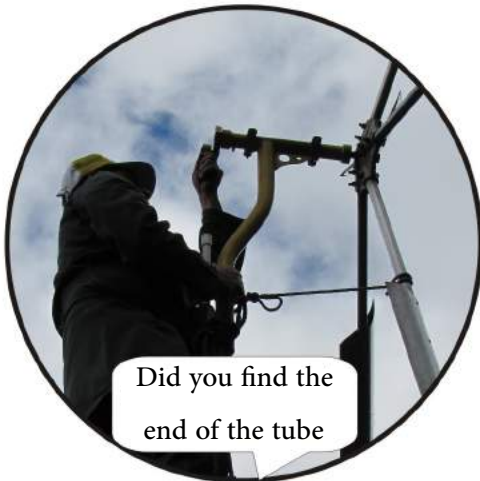


Help me to screw the tube

MOUNTING THE UPPER TUBE...



ROD



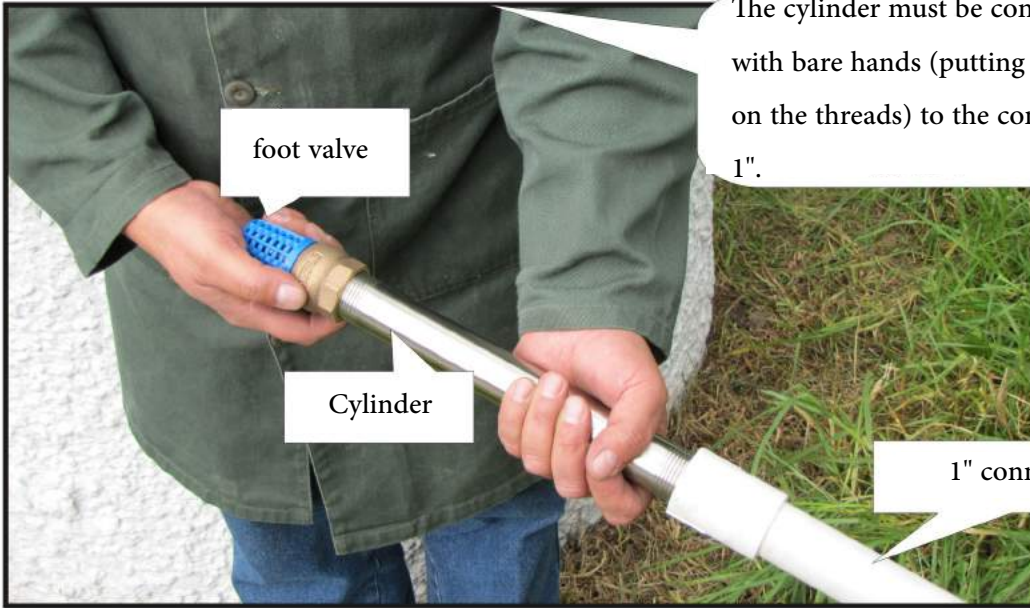
Did you find the end of the tube

THE LENGHT OF THE PUMP

Beltran's well is 7.5 meters from the floor and 8.6 meters from the top edge of the curb
in the hot summer it drops to 7.6 meters of the cup

THE PUMP SHOULD BE AS LOW AS POSSIBLE

	DEPTH M
◦ From the upper edge of the rim	0.0
◦ Union of the tripod of 1½" about 8cm below the rim	0.08
◦ PVC 1" light with connector 1½" has a length of 2.08m	2.16
◦ PVC 1" light has a length of 2.06m	4.22
◦ Other PVC 1" light of 2.06m	6.28
◦ PVC 1" light with connector 1" for the cylinder 1.84m	8.12
◦ Cylinder and foot valve have a length of 0,28m	8.40
◦ There are 20cm at the bottom and 80cm of water effective in the hard summer	
◦ You could change the depth (see page 39) from: $0.08+2.08+1.84+0.28=4.28$ from the rim until: $0.08+2.08+10+2.06+1.84+0.28=24.88$ m with 10 extensions.	



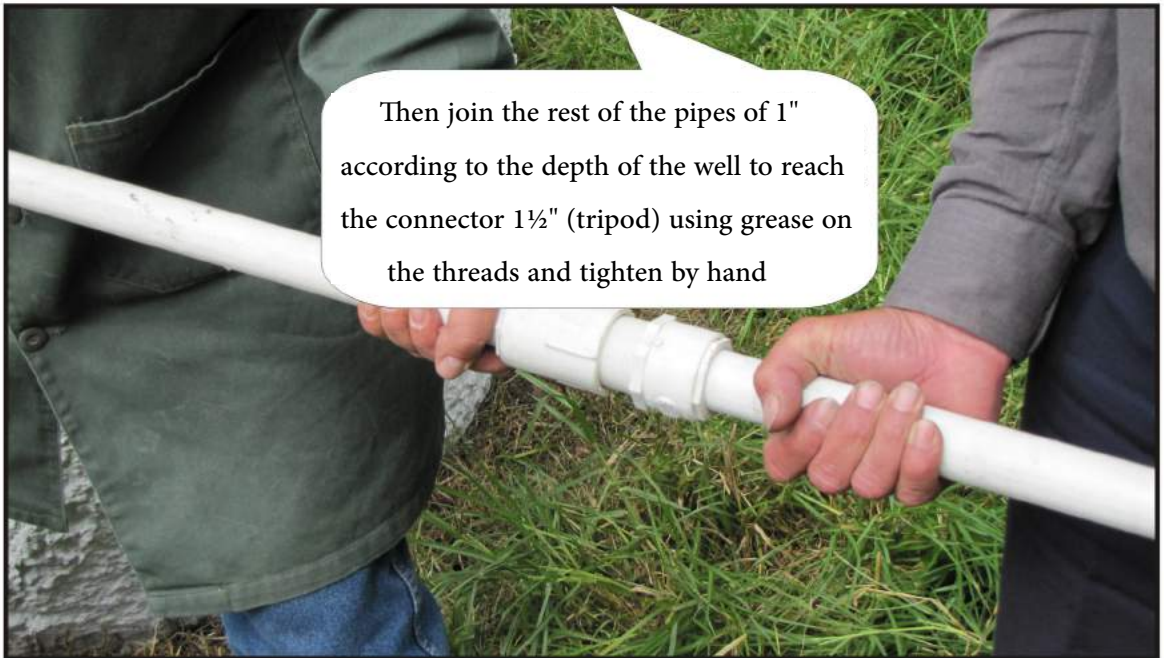
foot valve

Cylinder

1" connector

The cylinder must be connected with bare hands (putting grease on the threads) to the connector 1".

NOTE: NEVER PUT A KEY OR PRESS ON THE CYLINDER. (TRY WINDING A STRING, FOR EXAMPLE).



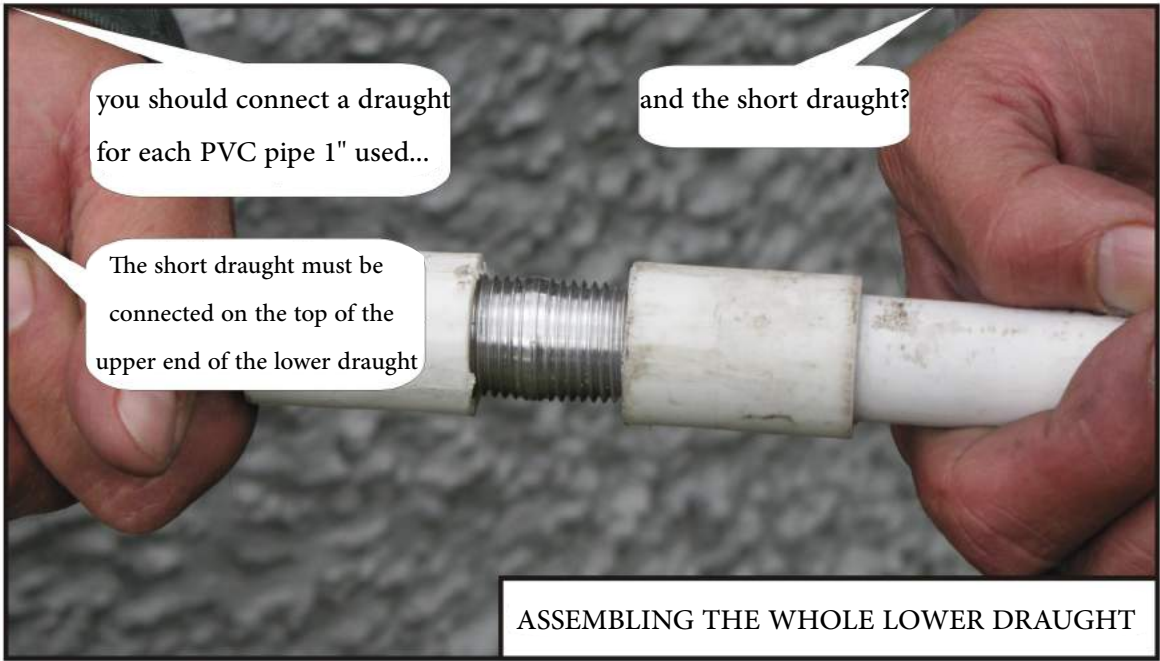
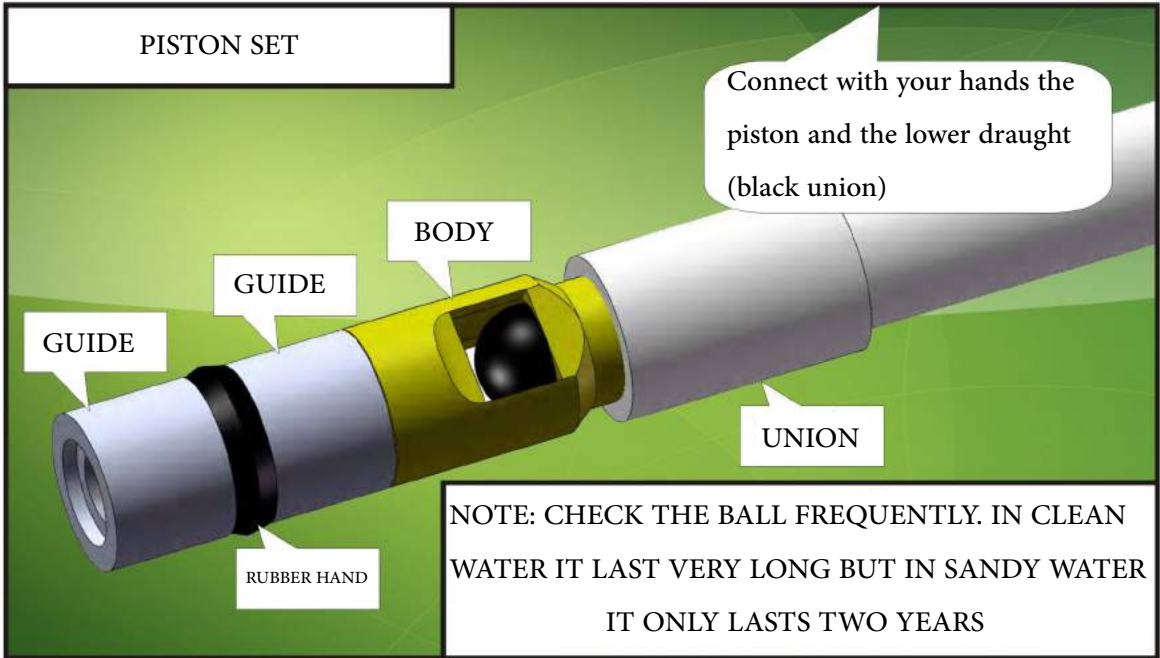
Then join the rest of the pipes of 1" according to the depth of the well to reach the connector 1½" (tripod) using grease on the threads and tighten by hand



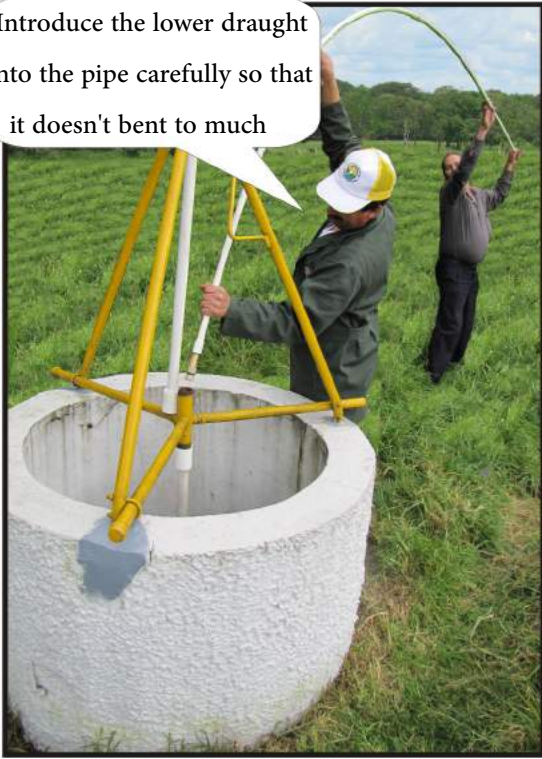
Gently curving the lower tube insert into the well the set formed by:

- * **1" tube with 1½" connector (tripod)**
- * **1" tube - tube 1"**
- * **1" tube connector 1" (cylinder)**
- * **Stainless steel cylinder**
- * **Bronze foot valve**

ONCE INSIDE SCREW CAREFULLY THE CONNECTOR 1½" TO THE TRIPOD



Introduce the lower draught into the pipe carefully so that it doesn't bent to much



CONNECTING BOTH THE UPPER
AND THE LOWER DRAUGHT

Screw it down while
I hold it here



The draught is factory calibrated,
still, if the rod is on the bottom and
the piston touch the soil, there must
be about 7cm distance between them



Wipe the rim of the thread
of the tripod to fit perfectly

Be careful with the threads
that connect the tube with
the tripod

WHENEVER YOU NEED STOP THE WINDMILL
TURN THE BOA TO PLACE THE ROTOR
TOWARDS THE WIND. ¡NEVER TRY TO STOP
THE ROTARY AXIS WITH YOUR HANDS!, ¡THAT
IS VERY DANGEROUS!.



Here you have the rope



¡That's great! You will see what I'm going to do with this water

¡So sweet!

How do you like it? It has such a big water jet even with so little wind

IN 4 HOURS THE INSTALLATION IS COMPLETED.

GAVIOTAS MILL MV2E CHARACTERISTICS

Rotor Diameter:	2.05m
Rotor Type:	5 aluminum blades high thrust
Speed Control:	Passive aerodynamic can run storms of 130Km/h
Delivery Height:	4.2m (over rim)
Delivery Depth:	4.3m to 24.9m
Minimum wind speed for pumping from 6m depth	1.5m/s

Typical pumping:	(6m depth)
Weak and sporadic wind:	1 to 2½ m ³ /day
Mean wind during the day:	4 to 5 m ³ /day
Strong wind 24 hours a day:	10 - 15 m ³ /day

Typical distance delivery through horizontal smooth pipe of 3/4 (polyethylene or PVC): 1,2Km

APPENDIX

APPENDIX 1 MAINTENANCE - OPERATION

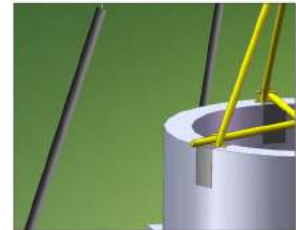
IN OPEN SPACE THE WINDMILL SHOULD BE:



FENCED SO THAT CATTLE DO NOT KNOCK IT OVER WHEN SCRATCHING

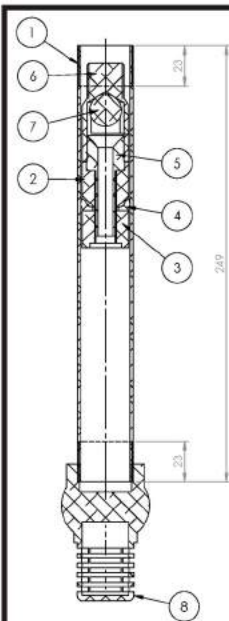


THE TENSOR CAN BE WRAPPED IN BARBED WIRE (WATCH OUT FOR CHILDREN).



THE TENSOR CAN BE INSIDE A TUBE SO AS NOT TO TEAR THE CABLE

- YOU MUST REVIEW EVERY 6 MONTHS THE WIRES TENSION.
- YOU MUST REVIEW EVERY YEAR THAT THE MILL IS VERTICAL.
- YOU MUST REVIEW EVERY 2 YEARS:



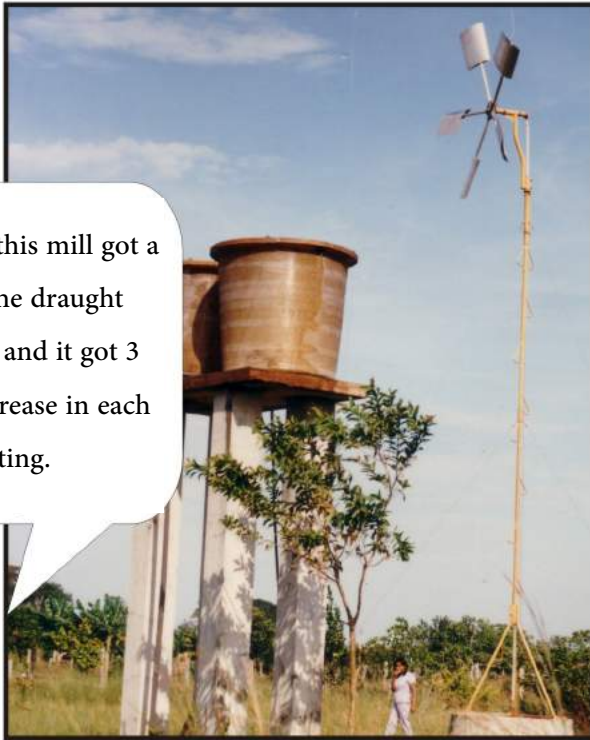
8	FOOT VALVE 1"
7	NEOPRENE SPHERE D18mm
6	BRASS ROD D27mm
5	BRASS ROD D7/8mm
4	RUBBER BAND
3	TEFLON ROD D27mm
2	TEFLON ROD D27mm
1	STEEL PIPE SCH 40 D1"
ITEM	MATERIAL

THE RUBBER BALL OF THE FOOT VALVE MUST HAVE MORE THAN 15 MM IN DIAMETER. IF YOU SEE IT IS TOO SMALL PULL THE PIN WITH SMALL TAPS. WHEN ASSEMBLING PUT A PLASTIC STRIP ON THE THREAD. DO NOT USE KEYS OR PRESSES IN THE CYLINDER.

THE RUBBER BAND (4) MUST HAVE MORE THAN 28.3 AND THE BALL (7) MORE THAN 15MM. IF THEY ARE WORN OUT USE THE SPARE PARTS. PUT A PLASTIC STRIP ON THE THREAD OF THE GUIDE WHEN SCREWING DOWN. DO NOT TIGHT OR GREASE THE RUBBER BAND, LET IT A LITTLE LOOSE.

◦ ANNUALLY LUBRICATION

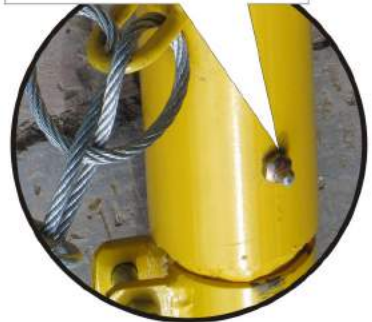
After a year this mill got a check of the draught (it was fine) and it got 3 servings of grease in each fitting.



HORIZONTAL
GREASE FITTING



VERTICAL
GREASE FITTING



◦ REVIEW EVERY TWO YEARS

IT IS CONVENIENT TO ADJUST THE NUTS OF THE PRESS, THE ROD AND THE MAIN NUT ON THE ROTOR. THE WINDMILL DEPENDS ON THEM LITERALLY.



APPENDIX 2 SPECIAL INSTRUCTIONS FOR INSTALLATION



THIS MILL COMPLETELY CLEARED
AREA SUPPLIES WATER TO 100
COWS IN SUMMER



THIS MILL ENCLOSED BY TREES
SCARCELY REACHES TO 15 ANIMALS
ALTHOUGH IS JUST 10 MILES AWAY
FROM THE OTHER

WINDMILL ON THE RIGHT TAKES MORE WATER THAN THE LEFT ONE ON
EQUAL TERMS

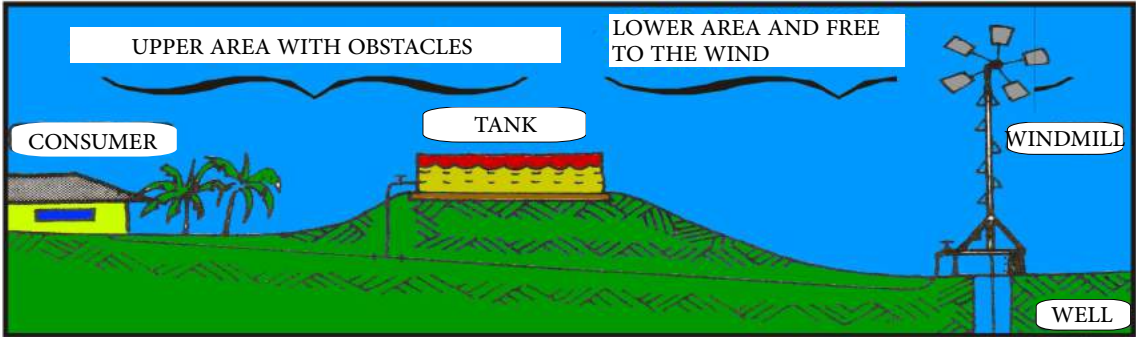


WITHOUT
EXTENSIONS
(DRAUGHTS 5M)

WITH
EXTENSIONS
(DRAUGHTS 9M)



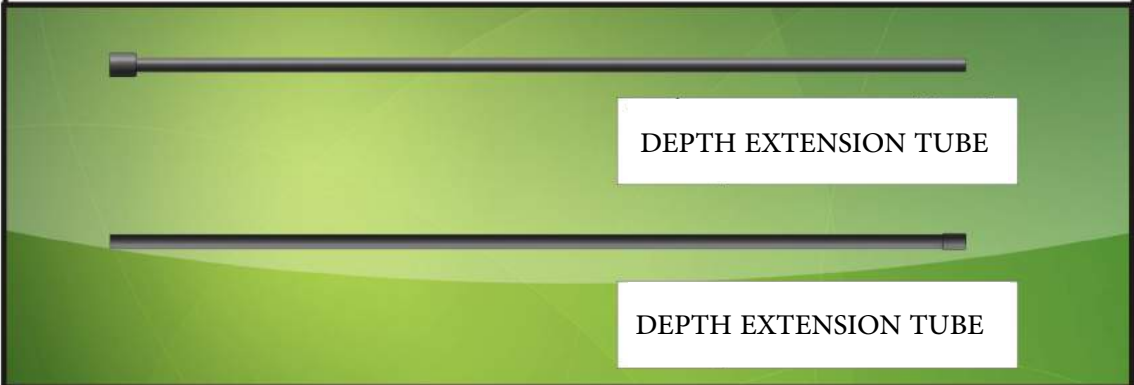
THE WINDMILL DOES NOT HAVE TO BE CLOSE TO THE CONSUMER; REMEMBER THAT:



- 1KM OF 1" HOSE BURIED COST LESS THAN ANOTHER MILL.
- A GOOD PLACED MILL REGARDING WATER AND WIND YIELDS EVEN 7 TIMES MORE
- IT IS CHEAPER TO PLACE THE WINDMILL IN A HILL, WHERE IT COULD DRAUGHT WITH EXTENSIONS OR WITHOUT THEM, THAN PLACING IT ON A TOWER. $5M^3$ TO $10M^3$ ARE A GOOD STORE CAPACITY.
- THE WINDMILLS CAN ONLY DRAUGHT 4.2M HEIGHT OVER THE RIM OR THE PILLAR WITHOUT EXTENSIONS



IF THE WATER IS MORE THAN 8.4M DEEP..



GAVIOTAS DISTRIBUTE EXTENSIONS FOR WELLS WITH A DEPTH OF 25M IN UNITS OF 2.06M WITH PVC UNIONS IN 1" AND ½", AND FOLLOWING THE INSTRUCTIONS FOR ATTACHING THE PVC IT CAN BE SHORTENED TO AN EVEN SMALLER SIZE

WHEN THERE ARE OBSTACLES OR AREAS OF LITTLE WIND OR WHEN YOU HAVE TO LIFT WATER MORE THAN 4.2M ABOVE THE CURB, GAVIOTAS DISTRIBUTED THE UPPER EXTENSION. IT IS INSTALLED IMMEDIATELY AFTER THE TRIPOD MAST BETWEEN IT AND THE ROTATING SHAFT. IN EXCEPTIONAL CASES UP TO 2 EXTENSIONS CAN BE INSTALLED IN SERIES.

(SEE PAGE 38)



HELPFUL HINTS FOR
INSTALLATION AND OPERATION

MV2E

1. TIE THE REMAINING ENDS OF THE CABLES THROUGH THE CLAMPS TO PREVENT FROM SOMEONE ACCIDENTALLY UPSET THE MILL

2. IN SCHOOLS OR WITH CHILDREN AROUND, ROLL BARBED PAINTED IN RED ON A SECTION OF THE MAST. A ROTOR WITH A GOOD WIND CUTS LIKE AN AXE

3. IF THE MILL DOES NOT RAISE WATER TO A TANK OF 3M OR MORE IN HEIGHT LIMIT A BIT THE WAY OUT OF THE WATER SO THAT IN THE STORM IT GOES OVER AND YOU AVOID THE WEAR DOWN OF THE DRAUGHT

4. THE CURB IS HIGH SO THAT THE WINDMILL IS IN A HIGHER PLACE AND YOU AVOID CHILDREN AND ANIMALS TO FALL DOWN INTO THE WELL

5. DO NOT LET CHICKEN TO SLEEP ON THE WINDMILL BECAUSE THE WATER THAT IS BENEATH THEM IS FOR YOUR BASKET. COVER THE WELL!

6. DO NOT BUILD THE WELL NEAR A SEPTIC TANK OR LATRINE BECAUSE THEY POLLUTE, REMEMBER THAT IN FLAT AREAS GROUNDWATER GENERALLY MOVES AS ON THE SURFACE

7. WATER PUMPED THROUGH A MILL IS CHEAPER THEN THE GASOLINE PUMP OR HAND-LADEN WATER

CURVED PIPES AND DRAUGHTS

◦ THE MAIN ENEMIES OF THE WINDMILL ARE A CURVED PIPE OR A CURVED DRAUGHT

◦ WHEN A PIPE OR DRAUGHT STAYED TOO LONG IN THE SUN THEY CURVED DOWN. THIS IS ALMOST ALWAYS THE ONLY CAUSE OF WORN OUT OF THE WINDMILL

◦ IF ONE OF YOUR DRAUGHTS OR TUBES IS ACCIDENTALLY CURVED, IT SHOULD BE PUT IN THE MIDDAY SUN WITH THE CURLED ENDS UP. WITH THE HEAT THE CURVE WILL BE GRADUALLY STRIGHTENING

◦ ONCE THEY ARE STRAIGHT YOU SHOULD PUT THEM INTO A PLAN AND SHADED AREA TO COOL SLOWLY IN THE SAME POSITION

◦ IF YOU DO NOT HAVE A SHADED AREA AVAILABLE, HANG IT INSIDE THE WELL



Las Gaviotas

Gaviotas, this world over there emerged spontaneously from chaos to cosmos always believing in freedom, without a predetermined pattern different from that of sustainability. The human race originated in the tropics and in the tropics must be reborn another homo sapiens, to stop the extinction, to be lively, first of all who fall in love with life, capable of illuminating the future.

“Maturity is to make the dreams come true”

Paolo Lugari

For more information about our projects see our web page

www.centrolasgaviotas.org



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