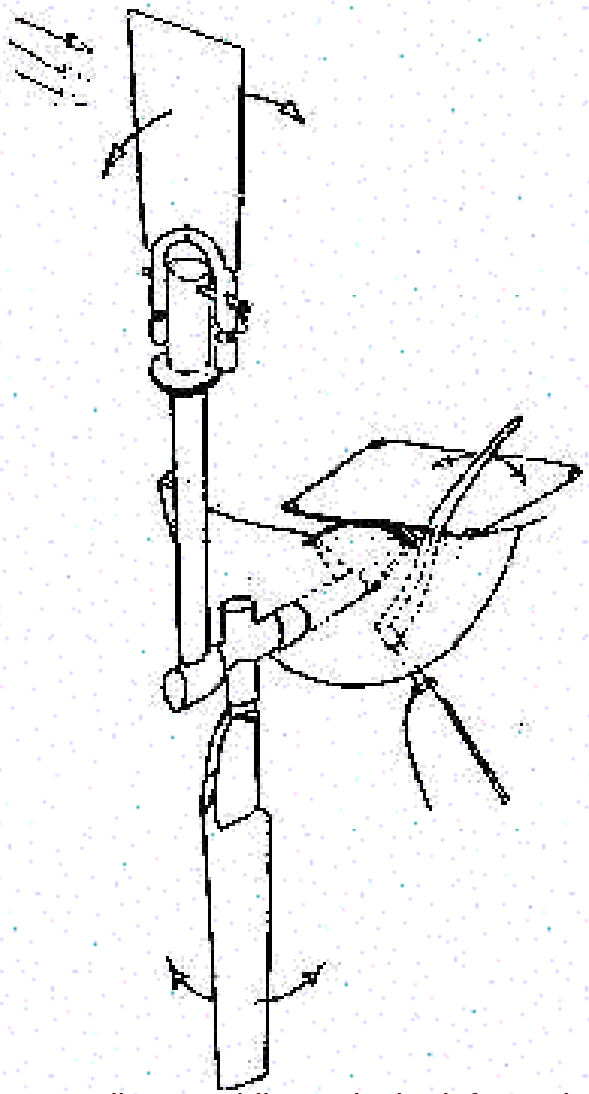
Operation



Operating principle of the Servo-Pendulum Self-Steering

The turret is rotated until the apparent wind hits the windvane on its edge. As long as the boat is on course, the wind pressure on both sides of the vane is equal so that it stays vertical, and the steering oar stays vertical in the water. If the direction of the boat changes in relation to the wind, the vane is tilted by the wind hitting it on one side. This tilt of the vane turns the stock of the steering oar. Because of the forward movement of the boat through the water, this turn of the steering oar (also called " Servo-pendulum ") causes it to be pushed with great force sideways, turning the horizontal shaft that passes through the transom, rotating the quadrant at its forward end and pulling on the control lines attached to the tiller, to the wheel or to the boat's steering quadrant.. As the yacht comes back on course, the tilt of the vane decreases and the steering oar comes back to vertical.

The steering oar (servo-pendulum) can also be controlled by a small electric auto-pilot placed inside the lazarette. The power needed to steer the boat is still provided by the servo-pendulum and the autopilot, providing only the information, uses only a few mille-amperes from the batteries.

Connecting Procedure

1 : Set the Course

The turret is rotated until the apparent wind hits the windvane on the edge. (The higher side of the angled rod at the top of the turret points into the wind and the hook is to leeward.)

2 : Cleat the Control Lines

Cleat the control lines on their marks. If you can not cleat both of them at the same time, first cleat the one that causes the boat to bear away (it is doing most of the work) and take up the slack with the other one.

3 : a) Fine Tune the Course Adjustment.

Fine tune the course adjustment, so that the boat maintains the precise compass course (or point of sail) required.

b) Limit Yaw

When we have learnt to sail, we were taught to steer with a minimum of rudder angle, in order to maintain boat speed to a maximum. This is also true with self-steering and you want your vane to give just enough rudder angle to stay on course, but not more. The amplitude of the corrections is reduced by limiting the tilt of the windvane. Adjust the tension of the short piece of bungee-cord on the crescent by passing it through the nylon loop on top of the course adjustment disk.

c) Trim the control lines

If a boat is not perfectly balanced under sail and requires some weather or lee helm in order to maintain a given point of sail, the length of the control lines can be adjusted to induce a certain rudder angle so that when the boat is on course, the steering oar is approximately vertical in the water and the amplitude of the correction is roughly equal on both sides.

If the wind varies in strength. the control lines may need to be re-adjusted.

IMPORTANT : When **tacking**, be sure to **invert the trim** of the control lines. Any lack of sail balance that the rudder angle was correcting on the previous tack, is now increased by this rudder angle being inverted. Failure to invert the trim on a new tack, makes the job much more difficult for any self-steerer.

After the vane is connected, it is a good idea to have a look at the windvane quadrant, to ensure the lines are working as they should, and that nothing is fouling them.

Additional Information

Windvanes

Two windvanes are supplied : a smaller one, made of aluminum sheet, for heavy weather, and a larger and lighter one, made of 1/8 in. dia. stainless steel wire and nylon, for added sensitivity in light airs. It is recommended to change over to the small vane after the first or second reef.

The light air vane extends 24 in. (60 cm) above the top of the tower, and the heavy weather vane, 17 in. (43 cm)

The windvane is inserted into a slot cut on the top part of a crescent-shaped tube, and held in place with a thumbscrew.

Windvane Supporting Crescent

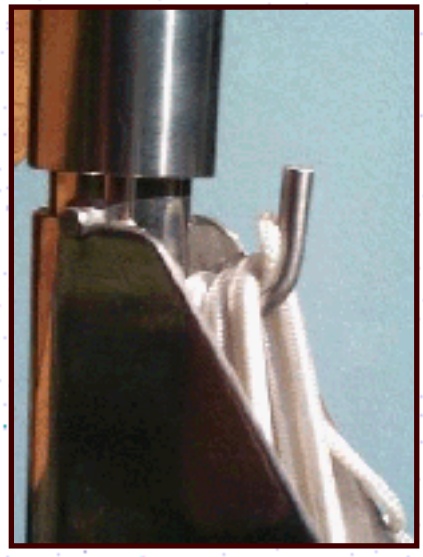
The crescent-shaped piece sits on the angled rod, inserted in a hole on one side, and into a slot on the other, with a concentric sliding collar held in position with a split pin. This pin is also inserted into the hook at the lower end of the angled rod, and transmits the tilting movement of the vane to the rest of the mechanism.

The counterweights have been adjusted before delivery and normally, there should not be any need to change this adjustment, unless some weight is added to the light air vane. They are adjusted so that in calm air, the light air vane just comes back to the vertical after it has been tilted. The heavy weather vane does not need any special adjustment, as there is always plenty of wind when it is in use.

You will notice that this crescent is offset to one side, and the counterweights are sometimes bent to one side : it is because the weight of the crescent is used to counter-balance the weight of the connecting rod inside the windvane tower; the higher the tower, the more the counterweights have to be offset to the side to balance the added weight.

When the gear is out of commission, or when the **Cape Horn** is used in autopilot or remote steering mode, the crescent and vane are removed and stowed.

Steering Oar



The steering oar is linked to its stock with three turns of shock (or bungee) cord between the mounting plate of the oar and the hook on the stock, maintaining the two notches on the plate in contact with the two transverse pins on the stock. This allows the oar to break off if it hits an obstruction, and prevents damage to the stock or to the oar itself.

Tension on the shock cord is adjusted to maintain the oar in place, except when an effort beyond normal is imposed. If it breaks too often, without apparent reason, increase the tension on the shock cord.

The only spare part you really need is a piece of ¼ in. (6 mm) shock cord. Experience has shown that 21 in. for ***Jean-du-Sud*** and 28 for ***Spray*** was the correct length to allow 3 turns, three twists and the length needed for a fisherman's bend and leave sufficient tension to keep the

steering oar in place.

The small nylon loop around the three turns of shock cord is a " handle " : it makes it easier to grab the three turns together.

Safety line

Should we mention it? It is essential to have a safety line on the steering oar, to avoid seeing it disappear in the wake, the first time it breaks off.

Flipping the steering oar up when underway

The easiest method of flipping the paddle up when under way is to tilt the windvane crescent, which will cause the servo-pendulum to swing to one side, then pull it up out of the water to " park " it along the tower. Do not pull directly on the safety line, as this will turn the paddle in the wrong direction and the water flow will cause it to move the other way. If you want to use the line, pass it in front of the stock, and pull from that side. This will cause the servo-pendulum to turn in the right direction and the water flow will help it to come out of the water.

Ideal size of the servo-pendulum

Power generated by the servo-pendulum is proportional to its wetted area and to the square of the speed of the boat. From this, we see that servo-pendulum area is critical only at low speed. At higher speeds, the pendulum generates considerably more power than needed to steer the boat.

Experience has shown that the wetted area of servo-pendulum needed to steer at 2-3 kts to be somewhere between 8 and 12 % of the yacht's rudder area. Closer to 8 for a high aspect-ratio, partially balanced rudder steering a well balanced boat, and closer to 12 (or more) for a low aspect ratio rudder, on a boat that is not so well balanced, or has a wheel steering system with a lot of internal friction. We normally take into account the yacht's rudder dimensions and the height of the horizontal axis above the waterline in determining the length of the servo-pendulum for a given boat, but if you find that your pendulum does not generate adequate power to steer your boat at slow speeds, please contact us and we will provide you with a longer one.

A sailor concerned with reducing drag to a minimum could order two steering oars : a longer one for light air or slow speed, and a shorter one for higher speeds.

Balance under sail

With any kind of self-steerer or autopilot the secret to top performance is sail balance.

Do not expect your gear to steer a straight course if the sails constantly pull the boat to one side, and the self-steerer has to correct this tendency before it can do its job of keeping the yacht on course.

The mast should be tuned to render the **helm as neutral as possible** in medium air. When a boat is steered by hand, it is recommended, for safety reasons, to tune the rig with some weather helm so that if the rudder is left free, the boat heads up into the wind and stops. Now that the boat is destined to make passages under self-steerer, this safety feature is no longer desirable: if the helm is left free, the boat should keep sailing in the same direction as much as possible.

When under way, watch the course for a while: if the gear always corrects on the same side, it might be that the sails are not set properly. Trim the sheets until the oscillations are about equal on each side.

Choose sail combinations to favor sail balance. If the wind is aft of the beam, favor sail area forward. On a broad reach, pole out a jib or a genoa as soon as possible (keeping a second jib to leeward if necessary). This improves sail balance and the boat sails a much truer course.

Reef when needed

On a relatively narrow boat, heel is the first sign that indicates that it is over-canvassed. But more recent, beamier boats do not heel; as the wind builds up, they acquire weather helm. Often, the wind freshens gradually and as there is no one at the tiller or wheel, this added weather helm goes unnoticed. Whether it is steered by hand or by a self-steerer, a yacht sails better with a moderate heel and the right amount of sail. A self-steering system does not alleviate the necessity of reefing when necessary.

Connection to electric autopilot

It is possible to connect an electric autopilot to the servo-pendulum of the ***Jean-du-Sud*** and ***Spray*** models. Thus, the energy to turn the rudder comes from the water flowing along the hull, instead of coming from the batteries, and the smallest autopilot can control a large yacht. Placed just in front of the quadrant, inside the lazarette, the autopilot will be protected from spray and since it has a very light duty to perform, its life will be much longer.

At the end of the autopilot ram, there is a hole made for connecting a vertical pin on the tiller. Turn the ram ¼ turn, drill this hole all the way through with a ¼ in. drill, and insert the L-shaped rod through this hole. Insert the dovetail-shaped plastic connector at the other end of this rod into the corresponding piece, at the end of the horizontal control axle.

A tiller autopilot that is designed to be mounted to **port** will also go to port if it is placed **below** the control axle. It can also be placed above and be mounted to starboard. However, the autopilot can be connected with equal effectiveness above or below the horizontal axle, placed to port or to starboard. If the correction of the autopilot is on the wrong side, flip the changeover switch on the unit.

The 1/4" rod is held by friction inside the dovetail-shaped plastic piece; it can be pulled out and inserted from the other end. The amplitude of the correction given by the autopilot can be increased by shortening the rod.

It is possible to mount the autopilot elsewhere and link it to the steering mechanism with light control lines.

When the autopilot is used, the windvane and crescent on the top of the turret are removed. Conversely, when the unit is controlled by the windvane, the autopilot rod is disconnected, in order to reduce the inertia of the mechanism.

Note: rigging steering lines to the control rod also renders remote power steering possible.

Stowage

For short periods, the steering oar can be swung 180° to rest along the windvane tower.

For longer periods, the steering oar and windvane (with crescent) are easily removed and stowed below.

Maintenance

After the gear has steered half way around the world, or after two or three seasons, it is prudent to make sure there is some waterproof grease left in the slot in the pendulum stock, to prevent wear of the bent rod passing through it. Remove the cap at top of the tube and insert grease through the hollow top part of the stock, using a stick or a piece of wire.

Do not use grease or WD40 (or equivalent) to lubricate the plastic bushings. The Teflon bushings need no lubrication, however, an occasional squirt of silicone spray on the Teflon bushings of the windvane, connecting rod and steering oar will contribute to maintain top performance in light air.

As with other stainless steel equipment, a regular polish will maintain its bright finish.

Installation of Integrated Units

If installation of your Cape Horn is done according to the instructions below, we guarantee that

it will steer to your satisfaction. Most problems with the Cape Horn are caused by an improper installation.

You will most probably gain time by reading the instructions below : they may prevent many time-consuming mistakes.

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Installation of Integrated Models

Installation of the models *Jean-du-Sud* and *Spray* is done in 5 steps :

1 : a) Position the Gear
b) Trace the center of the Mounting Tube hole

2 : Drill the hole and fasten the Mounting Tube

3 : Insert the Control Axle and fasten the quadrant to it

4 : Install the Windvane Tower

5 : a) Connect the control lines to Yacht's Steering system

b) Rig Lines for Remote Course Setting

It is possible (and even easier) to install afloat, provided the boat floats in its lines, water is quiet and the stern can be brought to a dock. If the boat is on the hard, ensuring that waterline is level allows the use of a level on the horizontal axle and vertical windvane tower; otherwise, you will have to rely on your eye.

1 : a) Position the Gear

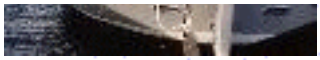
It is the mounting tube that passes through the transom, and through which pivots the horizontal axis between the servo-pendulum and the quadrant, which determines the position of the gear. Hence, positioning the mounting tube is positioning the entire gear.

The mounting tube should be in a line parallel to the fore-and-aft centerline of the boat (the keel)

However, it can be mounted **off-center**, in order to avoid cutting or moving the backstay chainplate gusset. Performance of the gear will not be affected if it is offset to one side (provided it is kept parallel to the keel).

It can even be offset enough to allow a transom-mounted rudder to pivot.

Height Above Water

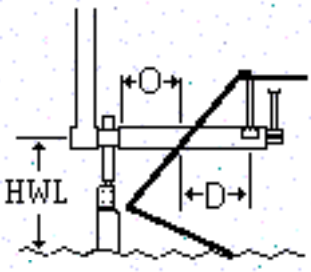


Drag of the servo-pendulum is kept to a minimum when the metal plate that links the servo-pendulum to its stock is out of the water. Therefore, the height of the mounting tube above the waterline (HWL) should be at least

13.5 in. (34 cm) for the ***Jean-du-Sud***
21.5 in. (55 cm) for the ***Spray.***

If the horizontal axle must be lower, it is possible to shorten the stock of the servo-pendulum. Conversely, if it must be much higher, it is possible to provide either a longer paddle or a longer stock.

Positioning the tube fore and aft



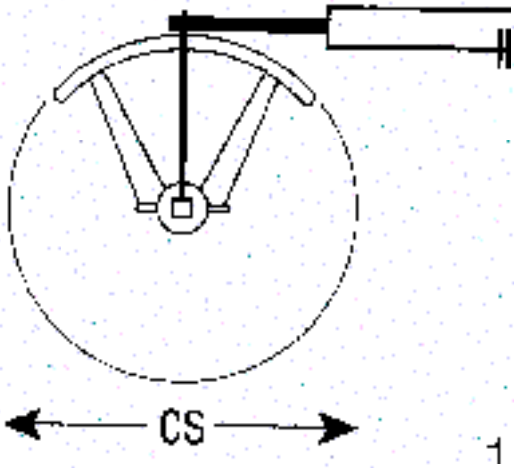
Aft : The aft end of the tube must clear the aftermost part of the transom or stern. It must also clear the trailing edge of the rudder by at least one inch (25 mm) if it extends past the hull.

Forward : A reasonable distance between the transom and the struts supporting the forward end ensures a strong installation. This distance (D) should not be much shorter than the overhang (O) between the transom and the outboard end of the mounting tube

Provision for 360° Quadrant Movement

The radius of the quadrant is
- 8.25" (210 mm) for ***Jean-du-Sud***
- 11" (280 mm) for ***Spray***

Consequently, at the forward end of the tube, a circular space (CS) of a diameter
- 16.5" (420mm) for ***Jean-du-Sud***
- 22" (560 mm) for ***Spray***.



Quadrant thickness is
- 1" (25 mm) for ***Jean-du-Sud***
- 1 1/4" (32 mm) for ***Spray***.

If space is restricted, it is possible to provide a quadrant with a shorter radius.

Provision for connecting an autopilot to the steering oar

The co-axial control rod that steers the servo-pendulum extends in front of the horizontal axis, in front of the quadrant.

In front of the quadrant, there should also be enough space for the autopilot itself, unless it is located elsewhere and connected through light control lines.

1 : b) Trace the Center of the Mounting Tube Hole

Transferring various measures to points on the transom, inside or out, is much easier when the boat is floating in its lines; if the boat is on the hard, ensure the waterline is level, both fore-and-aft and athwartships. In this case, a line can be strung above the rail, made perfectly level and parallel to the keel, and used as a baseline. In most cases, From it, you can drop a plumbline through an opening in the lazarette to transfer measures inside.

Make good use of the level and the square. If the yacht is stable, also use the plumbline (it is easy to improvise one); use it in particular to materialize both ends of the mounting tube and to determine the position of the quadrant..

Carefully mark the center of the hole on the transom or hull, both inside and out.

When this is done, do not grab the drill yet. Repeat each step of the whole measuring operation, to double-check. Remember this is the most critical part of the installation process and has to be done with greatest care.

If you arrive at the same results twice, you can go ahead with a clear conscience and drill the center guiding hole.

2 : Drill the Hole and Fasten the Mounting Tube

2 : a) Drill the Hole

Drill a hole 1/8 in. (3 mm) or smaller first. If you are satisfied with its position, drill 1/4 in. If not. Drill an other smaller hole in the right position. Drilling a small hole first makes changing its position easier. Do not worry about drilling more than one hole, as this section of the transom will be removed when you drill the large hole.

Cutting the Mounting Tube hole through the transom is easier than it appears, with a good quality hole saw :

- **2 1/2** in. (63 mm) for ***Jean-du-Sud***
- **3 1/2** in. (89 mm) ***Spray***

The secret is to maintain the tool very steady, level and parallel to the centerline. This way, you will eaily cut through the transom, even if it is at an angle, or if it is a canoe stern. If the drill is held very steady, the

hole-saw will not bind.

To make it easier to drill perfectly level and parallel with the keel, you can replace the center 1/4 in. drill bit of the hole-saw
holder by one that is 18 inches long (easily found in most hardware stores). It then becomes possible to place a small level on the drill. It also allows placing a straight batten on deck, extending past the transom, parallel to the keel and having an assistant looking above, guiding your hand left or right.

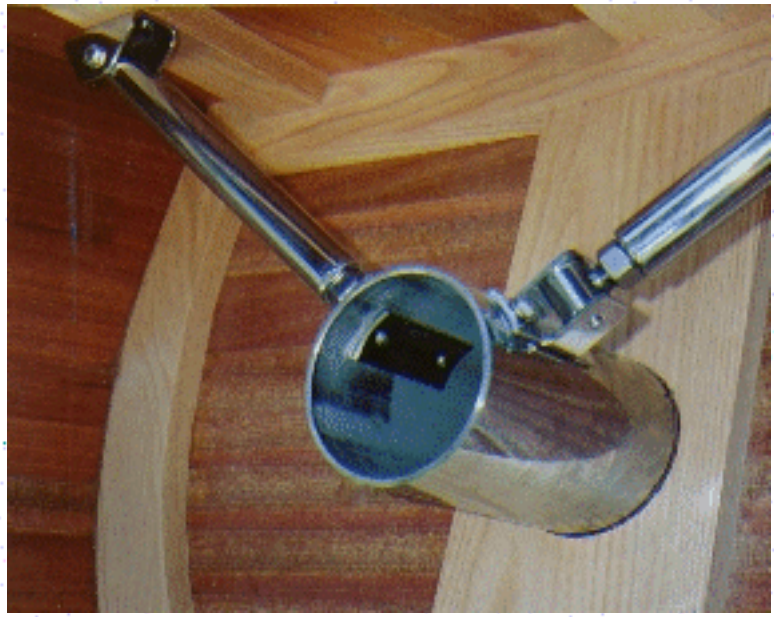
2 : b) Fasten the Mounting Tube

The Mounting Tube must be very strongly attached to the transom and hull. Aft, it must absorb the drag of the servo-pendulum through the water, and forward, the torque of the quadrant and pull of the control lines.

Notice that the Mounting Tube is marked fore and aft : the two bushings at each end are slightly different (the aft one is larger, due to the fact that at welding, the horizontal axle may have become slightly oval, and the chamfer is a bit deeper, due also to the weld); Hence, the tube must be inserted accordingly.

Fasten the Forward End

The forward end of the mounting tube is held in place with two struts bolted on the tube at angle between 90° and 120° and cut to reach either the underside of the deck above, or pads fiberglassed to the hull below.



The struts are cut to the appropriate length, (the tube has one turnbuckle-type end, which allows a 2 inch adjustment of its length) and a ¼ in. hole is drilled through it, ½ in. from the end (make sure this hole is drilled at 90°) for bolting to the flat U-shaped bracket.

Two holes are drilled, dia 5/16 in. (8 mm), 1 ¾ in. (44.5 mm) apart (center-to-center) through the Mounting Tube; the curved back-up plates are placed inside it and the curved U-shaped brackets are bolted on the tube. The bushing extends 1" inside the tube; consequently, the center of the struts should not be

closer than 2" (50 mm) from the end

The inside curved back-up plate is covered with a double-sided adhesive tape, that will keep it in place until it is bolted. Peel away the protecting paper before inserting.

The length of the struts is fine-tuned, using the turnbuckle end, to ensure the tube is level and parallel to the keel.

Bolting Struts to pads

If the struts can not be bolted to the underside of the deck, they can be led to pads which are bonded to the hull with epoxy.
Those pads, measuring 4" x 4" (or 4"x 6" if they are used for both the struts and blocks), min. 3/4" thick are made with either hard wood or plywood. Cutting the edges to a 45° bevel makes it easier to bond with fiberglass tape. U-shaped fittings and straps for blocks are through-bolted from the underside, using countersunk bolts, with the nut on top.
The surface of the hull is ground to expose bare fiberglass; all surfaces are coated with epoxy, then bedded in thickened epoxy making sure there is no void between hull and pad West system 404 filler provides the best bond). The bevelled edges of the pad are covered with fiberglass tape or mat.

Fastening the Aft End

Glassfiber or wood hulls

Once the fore-and-aft position of the tube has been determined, the struts cut and positioned, the tube can be bonded to the transom.

Mark the contour of the transom on the tube with a grease pencil or a marker, both inside and outside. Then grind with a power grinder or a file, stopping 1/4" short of its outside end, and about one inch past the inside mark.

On the inside of the hull, grind also about one inch around the hole, to remove existing paint and expose bare fiberglass.

Apply a coat of epoxy (with hardener) to the ground portion

of the tube, and also to the inside and sides of the hole in the hull.

Thicken the epoxy with filler until it does not sag when you take a gob at the end of a stick and hold it for about 10 seconds. Fill the gap between the tube and hull and make a fillet inside. For an even better joint, you may add one or two layers of 2 inch wide glass tape.

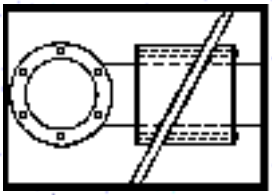
A light bead of sealant makes a nice finish outside.

Metal Hulls

The Mounting Tube can be welded to a steel hull, provided welding is done carefully to minimize tube deformation.

An aluminum Mounting Tube can be supplied for welding to an aluminum hull.

If welding is not practical, an optional Delrin Collar adapter can be used to bond the tube to the hull.



The Collar is cut to the angle of the transom, and the two halves are inserted over the mounting tube, one from the inside, the other from the outside, taking the transom in sandwich, and the two halves are bolted together, using a liberal amount of sealant to fill all voids.

If we are given the angle the transom makes with the horizontal, this collar can be provided precut.

3 : Insert the Control Axle and Fasten the Quadrant

3 : a) Insert the Control Axle

The Control Axle is now inserted into the Mounting Tube. It should **turn reasonably freely**. If it does not, it may be either because the tube has been **inserted back to front**, or because welding has pulled the tube out of shape. In the first instance, if the tube has already been bonded to the hull, all is not lost : just **switch** the two plastic **bushings**. In the first instance, or if switching the two bushings has not solved the problem satisfactorily, smear both ends of the control axle with a felt marker and rotate it inside the mounting tube : the ink will be transferred to the tighter points on the bushings which can then be scraped or sanded away.

3 : b) Bolt Quadrant

Quadrant above of below the axle ?

The quadrant can be placed either with the **groove above** the axis **or** with the **groove below**. Whether

it is mounted one way or the other is determined by the **most convenient placing of the first pair of turning blocks** and the most direct routing of the control lines to the rudder quadrant, wheel or tiller.

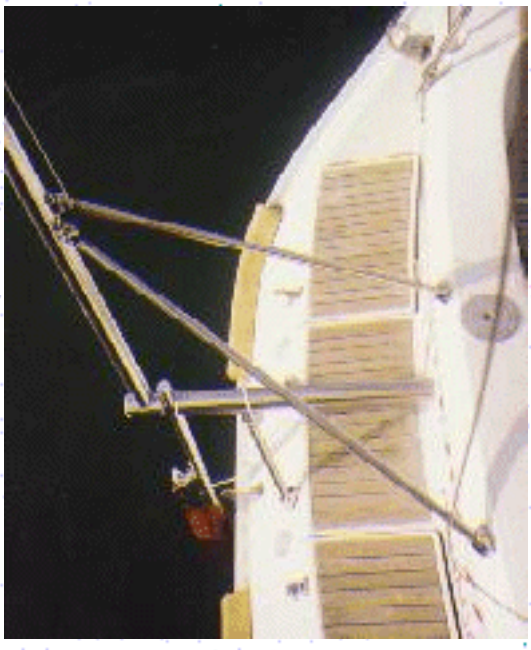
All the **power** transmitted to the yacht's rudder is **concentrated** on the link between the quadrant and the horizontal shaft; this is why the **quadrant** must be **bolted very tightly** on the axle.

Tighten first the two bolts on the center of the shaft itself, then the two bolts and nuts on either side of the collar. After the first few hundred miles of self-steering (or first bout of heavy weather), re-tighten if needed.

4 : Install the Windvane Tower

Braces

The windvane tower is kept vertical by two diagonal braces made of SS tube 7/8 in. OD supplied with their appropriate fittings for fastening to the tube at one end and to the deck at the other. These braces can be **placed wherever convenient** to provide adequate support. On the tower, they are connected with 2 U-shaped curved plates that are bolted to an inside back-up plate. They should not be higher than 2 ½ in. below the course-adjusting disk, to allow space for the back-up plate inside the tube.



On the tower, drill two holes dia. 5/16 in. (7 mm), on 1 ¾ in. (44 mm) centers at the correct height.

In marking these holes, make sure the **short horizontal tube** at the base of the tower **lines up perfectly fore-and-aft**, in the same plane as the mounting tube, otherwise the ring into which the base of the tower is screwed may bind and keep the axis from turning freely. If in spite of your precaution, the ring binds after it has been connected to the base of the tower, it can be brought back in line by enlarging the four holes that have been drilled into the tower on one side, to allow the tower to pivot until it is brought back in line. Since the U-shaped bracket covers the holes, nothing will show.

Bringing the threaded back-up plate in position inside the tube requires a little ingenuity :

Tie a small nail around its center at the end of a piece of light line long enough to reach the bottom of the tower, then feed it through the top hole until it drops to the bottom of the tube. Pass the nail through the top hole of the backing plate and pull it up with the string. When it comes in position, insert the bottom screw, then remove nail and string, and insert the top screw. The back-up plates are fitted sith double-sided adhesive tape to keep them in position; peel off the protecting paper before insertion.

Provided some angulation between them is kept, **the braces do not need to be placed symmetrically**. One of them can be placed almost fore-and-aft, and the other to one side, **to allow passage** through the stern on one side.

Connecting the windvane tower to the horizontal axle

The short tube welded horizontally at the base of the windvane tower is fastened to the control axle with four screws through its edge, into a ring revolving freely at the end of the horizontal axle. Two punch marks identify the top of the ring and makes alignment of holes easier.

Connecting the Control Mechanism

The **handle** that controls the steering oar **should be to the left** (to port) of the small vertical rod that bisects the short tube at the base of the tower. The function of this vertical rod is precisely to keep the handle from rotating more than half a circle and maintain the connecting rod to the left.

At the bottom of the pushrod that moves up and down inside the tower (and transmits the tilt of the vane to the steering oar), is screwed a connecting rod made with a piece of threaded rod welded to a short piece of tube with Teflon lining inside. Notice that the threaded rod if offset to one side. Connect it to the handle so that the **short tube** is **offset to port** (left, looking forward); this keeps the pushrod **away from the wall** of the tube.

5 : Rig Control Lines

Type and Size of Lines

We recommend rigging **rather light** control lines, in order to use them as a **fuse**. A control line is easily replaced and in the case of a sudden overload, it is better to break a control line than some other component of the system.

We recommend control lines made of polyester if they are relatively short, or Spectra if they are rather long, as this material stretches less, of a dia. ¼ in. (6 - 7 mm) for ***Jean-du-Sud*** , or 5/16 in. (8 mm) for ***Spray***. Alternately, in order to reduce stretch, a larger diameter line can be used, but in this case, it is prudent to provide a " weak link " somewhere in the system, for example by fastening a block with a lashing that will break before something else gives way.

First Pair of Blocks for Control Lines

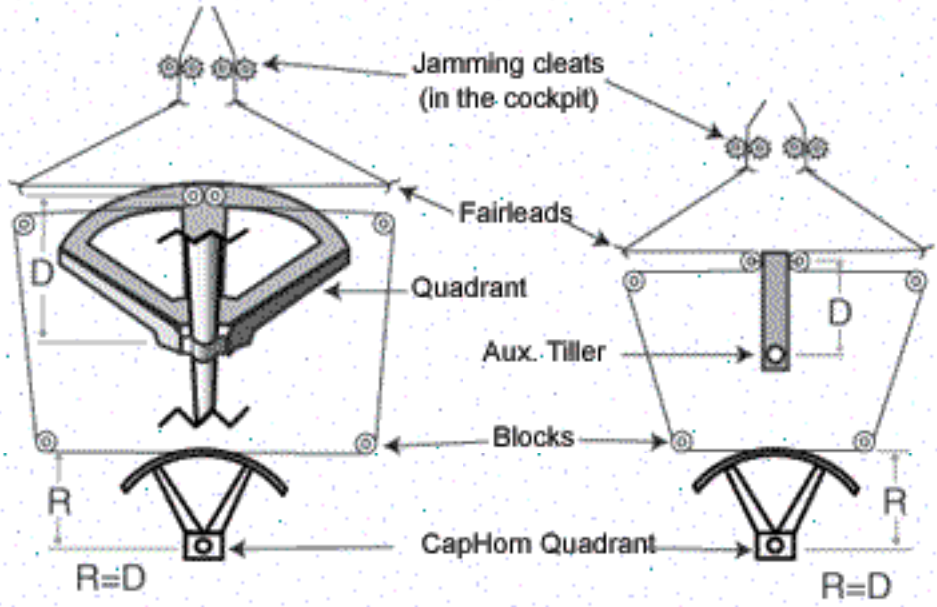
The control lines are fed through a hole at either end of the groove on the edge of the quadrant and prevented from pulling through with a figure-eight knot.

A loop made of bungee cord crossed over the top helps keeping the lines inside the groove

They are led through turning blocks on either side. The turning blocks must be **solidly secured**, **to very strong points**, as they absorb the total steering effort and more. The blocks must be positioned so that each line **works precisely in the axis** of the quadrant groove. They can be placed higher or lower, as long as they allow the line to line up with the plane of the groove. The distance between the quadrant and the turning blocks is immaterial so the blocks can be placed close to the quadran

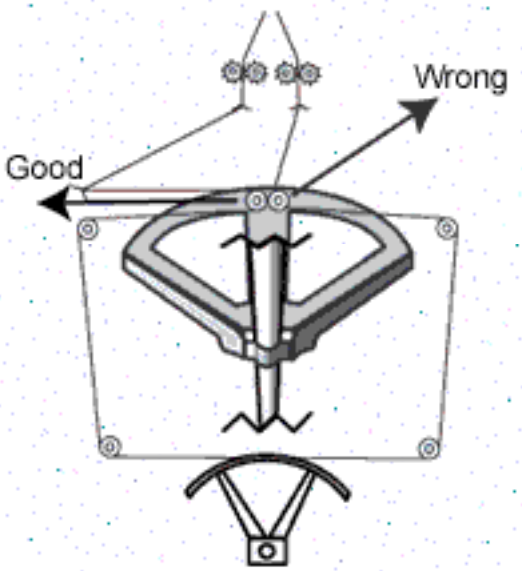
t or away to the sides. The sheaves of all the blocks must be allowed to line up freely with the lines (if not, the lines would chafe through very rapidly).

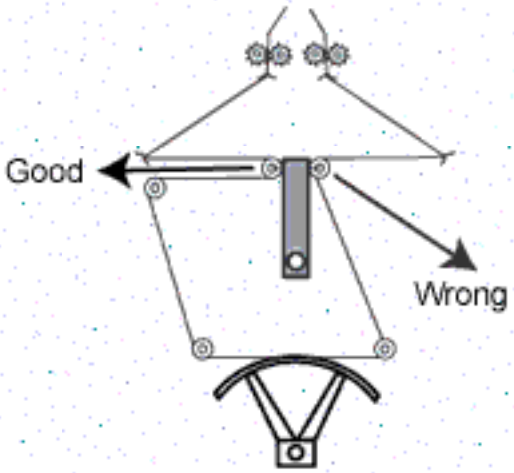
Direct Connection to Yacht's Steering System



The control lines can be connected directly to the yacht's steering system. They are led through turning blocks fastened to the quadrant (or to a short auxiliary tiller such as the tiller of a hydraulic system), **pulling from a direction 90°** from the attachment point of the blocks on the quadrant (or tiller) and the rudder axis.

After passing through the blocks on the quadrant (or tiller), the control lines are led back to a fairlead placed close to the last turning block. From there, they are led to jamming cleats placed within reach of the wheel.





If the blocks are fastened to the rudder quadrant, it is better to fasten them to its underside, to prevent fouling the steering cables with the control lines when they are loose.

The vane is connected by putting the lines in tension and cleating them; it is adjusted for weather or lee helm (if any is needed to maintain a given point of sail) by varying the length of the lines. Releasing the lines from the jamming cleats instantly disconnects the vane and allows to take over manually.

Note : when the vane is in operation, only the segment of control lines between the two quadrants (or vane quadrant and aux. tiller) moves and therefore, needs to be led through blocks. The segment between the rudder quadrant (or tiller) and the jamming cleats does not move, it is only kept in tension and can be led through fairleads instead of blocks.

Position of the Turning Blocks on steering quadrant

The ideal ratio between the tilt angle of the pendulum + quadrant, and the rudder angle is 2 : 1.(for 10° of pendulum + quadrant tilt, 5 ° rudder angle). Since the turning blocks on the rudder quadrant (or tiller) divides the travel by half (and doubles the force), the **distance between** these **blocks and** the **rudder axis** should be **equal to** the **windvane quadrant radius** : 8 in. (20 cm) for ***Jean-du-Sud*** and 10.1/2 in (27 mm) for ***Spray***.

Leading the Control Lines to the steering quadrant

The horizontal axle and the rudder stock should move in opposite directions : when the pendulum and quadrant pivot clockwise, the rudder stock should turn anti-clockwise. When the CH quadrant is above the axle and the blocks on the vessel's quadrant, disk or tiller are forward of the rudder stock, the lines are connected directly. When the CH quadrant is below the axle and the blocks on vessel's quadrant are behind the stock, the lines are also connected directly. If the CH quadrant is below and the blocks are forward, then the lines need to be crossed. If the CH quadrant is above and the blocks are aft, the lines also need to be crossed (refer to examples below).

A few examples of direct connection (Click for more details)

52'Farington Schooner

Allied Seawind II

Beneteau First 375

Beneteau Moorings 45

Beneteau Oceanis 390

Bounty 42

Cape Dory 330

C&C 34+

Christina 40

CS 36

CT 37 (Hydraulic)

Dufour 35


Hans Christian 38 T


Jeanneau Melody


Nonsuch 30

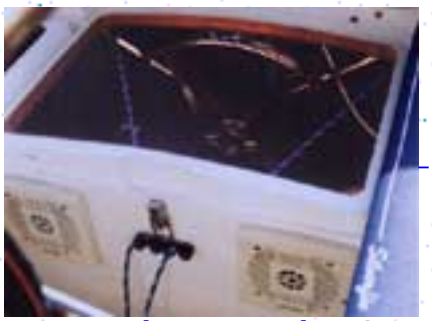

Pan Oceanic 43


Swan 43


Swan 44


Union 36


Valiant 40


Wauquiez Pretorien 35

Jamming Cleats

The jamming cleats should be located within easy reach of the wheel. Whenever possible, they should, placed side by side, which allows tying the two lines in a knot when the rudder is amidships and quadrant and pendulum are vertical, and to find this position automatically by pulling the two lines together. (If the cleats can not be located together, the lines should be marked to locate the position rudder amidships and pendulum-quadrant vertical.)

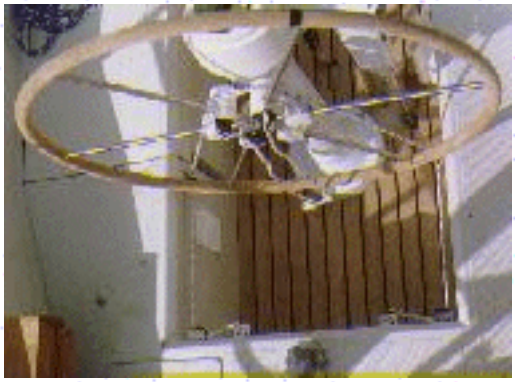
If the jamming cleats are located above the holes (instead of below), the lines can be pulled and cleated in one single movement.

Connection to Wheel or Tiller

The control lines are led out through holes drilled in the sides or back of the cockpit bulkhead, then (trough other blocks if needed), to the wheel or tiller..

The turning blocks must be placed in such a manner that the control line is guided exactly in the center of the hole, and that it does not touch its side; otherwise, it will chafe through very rapidly. In the case of a line chafing on one side, enlarge the hole with a round file or a Dremel tool.

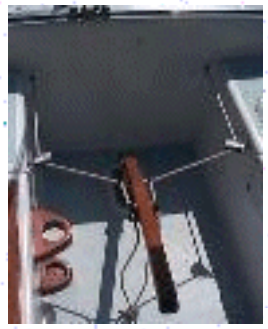
Connection to Wheel



The control lines turn the steering wheel by going around **grooved Delrin cylinders** placed on the wheel spokes, then to a cleat. These cylinders can be placed closer of farther from the hub, so the ideal ratio of rudder angle for a given quadrant tilt can be arrived at. This ideal ratio is 2 to one: for 10° of pendulum-quadrant tilt, 5° of rudder angle.

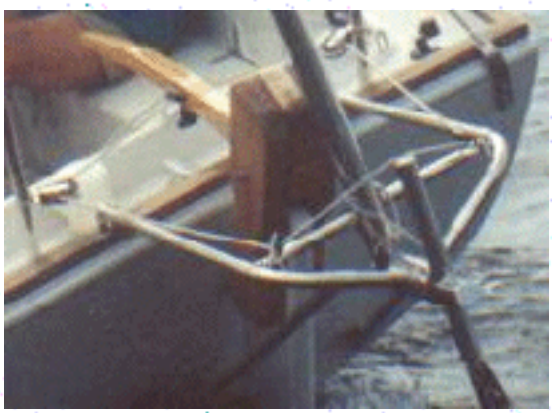
An autopilot drum already fitted to the wheel poses no problem : the cylinders are placed inside this drum and when it is to one side of the wheel, they can be place on the other side.

Connection to Tiller



The control lines are led through fairleads placed on either side of the tiller, and then forward to a pair of jamming cleats. These fairleads should be placed at a distance from the rudder axis, close to **twice the quadrant radius** :

16 in. (40 cm) for ***Jean-du-Sud***, and 21 in. (24 cm) for ***Spray***.



If connection is done on an auxiliary or emergency tiller, it can be kept shorter by connecting in the manner described under **"Direct Connection to Yacht's Steering System ".**

Rig Lines for Remote Course Setting

The friction of a 5/32 or 3/16 in. (4 - 5 mm) endless line inside a groove at the base of the control disk rotates the revolving turret at the top of the windvane tower and allows to set a precise course from a remote position.

Two rollers guide this line down to blocks at deck level. Leading

this endless line through blocks **around the cockpit** (along the coaming) allows to **set** the **course from any position** in the cockpit, even from below by reaching through the companionway.

Important : The turret is built to revolve freely; consequently, if this endless line is not used, **rig at least a line down to the struts** to create additional friction and maintain set course. Otherwise, the wind will cause turret to revolve by itself and course will vary.

If the turret becomes stiff and the line slips in the groove, put a rubber band in the bottom of the groove to increase friction.

Installation of Outboard Models

Assembling the *Varuna* or *Joshua*

In order to reduce the volume of the parcel for shipping, the mounting arms, the horizontal axis and the tower are shipped unassembled. The assembling procedure is as follows :

1 : Insert the horizontal axle (the T-shaped piece) through the horizontal tube at the base of the tower. As you push the piece through the tube (and before putting the bolts through the bronze collar), connect the crank at the forward end of the tower in the manner described and illustrated in "**Connecting the Control Mechanism**". When this is done, insert the bottom bolt through the bronze collar (the other three will be inserted after the arms are assembled). Note that this bottom bolt is shorter than the other three.

2 : Assemble the vertical tower to the mounting arms. The base of the tower goes inside the curved plate on which the two arms meet. Insert the two bolts through the small curved plate welded to the horizontal tube linking the two arms. Insert the three through the curved plate where the two arms meet, into the bronze collar. Tighten moderately.

Installation to the transom

If the freeboard is less than about 28 in., the mounting arms can be bolted to the deck or taffrail. If it is greater, they are bolted to the transom.

Cut the mounting arms to the appropriate length, so that the body of the unit or the steering oar clears the rudder by at least an inch.

The arms should be fastened to the transom at a height that keeps most of the wood part of the servo-pendulum below the (dynamic) waterline, while keeping the metal plate at the top of the steering oar out of the water in normal sailing conditions.

Control Lines

The control lines are connected to the vertical control arm in this manner : in the middle of a continuous line, tie a clove hitch around the short piece of tube. Insert the tube inside the control arm and insert the bolt through the arm and tube. Pass the two segments of the control lines through the two holes in the cap and put the cap in place at the end of the control arm. Shackle a turning block on the half-ring on each side of the mounting arms and pass the control lines through. From there, the control lines are led to the tiller or wheel in the manner described in "**Connection to Wheel or Tiller**".

Installation of the *Toucana*

Installation of the Toucana is only a matter of cutting the mounting arms to a length that keeps most of the wood part of the servo-pendulum below the (dynamic) waterline, while keeping the metal above it most of the time, and fastening them to the underside of the boomkin. Fasten also the diagonal struts to either the boomkin or the hull.

An Omega-shaped strap can be used to fasten the tower to the boomkin. Additional diagonal struts can be added to the boomkin for more support.

Guarantee

We build the **Cape Horn** with the greatest of care, and when we ship a unit, we have the assurance that it could steer us around the world.

We naturally expect that comparable care will be given to installation. **We guarantee its performance for one circumnavigation, 28 000 miles or three years against any damage caused by the wind or the sea.**