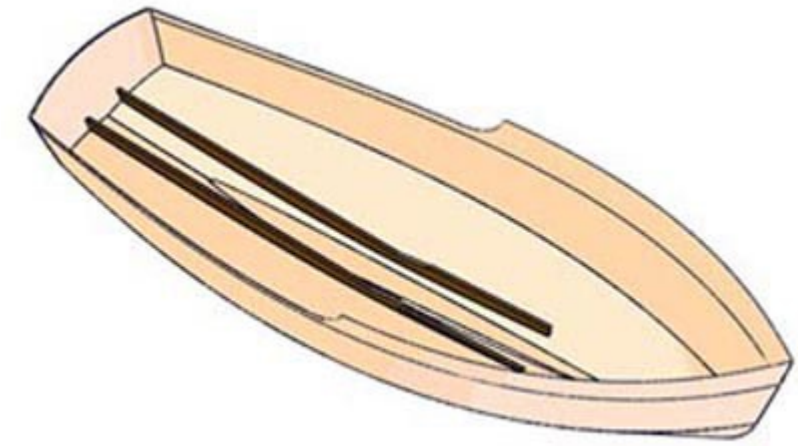
Inboard Engine Installation

The outline below describes engine installation steps common to most of our displacement power boats. The pictures show our TW28. The stringers and bulkheads may look slightly different but the procedure is always the same.

The steps are as follow:
1.Build the engine girders
2.Locate the axis of the prop shaft
3.Drill through skeg (keel)
4.Install stuffing box frame
5.Build and install stern tube (shaft tube)
6.Install and align engine



The stringers are used as engine bed (girders). They must be fiberglassed and tabbed to the hull with no less than the specified layers.

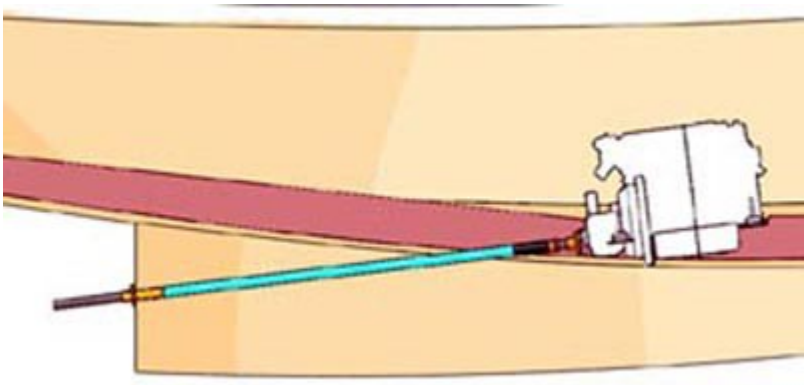
The engine installation, shaft tube included is doe when the hull is completely finished.

We will cover the installation of the engine in these building notes but we recommend investing in a good book: ?Inboard Motor Installations? by Glen L. Witt and Ken Hankinson.

To understand shaft tube installation, we must learn more about the engine.

Drive train components overview.

The picture below shows a typical drive train without the prop. The bulkheads are not shown on the drawing and we show only the port stringer for clarity

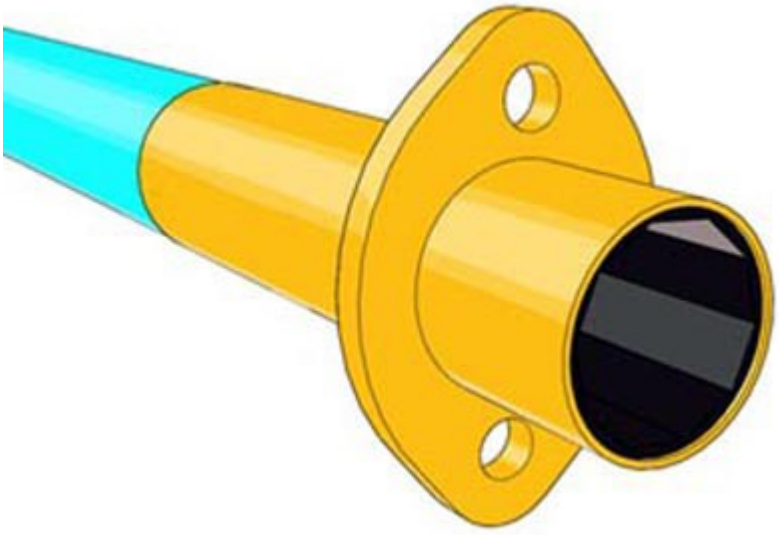


Starting from the stern, you see the stern bearing. The long cylinder going through the keel is the shaft tube: a tube through which the shaft runs.
The shaft tube passes through a small floor frame (not shown) and is connected with a rubber hose to a self-aligning packing gland.
The packing gland keeps the water out.
The forward end of the shaft is fitted with the shaft coupling. The shaft coupling is bolted to the engine transmission coupling.

Let?s look at the components more in detail. Starting from the stern, we have the stern bearing.

The **stern bearing** is bolted to the rear face of the keel. Often, the housing of the bearing will be wider than the keel. This will require some shaping of the keel. The stern bearing is usually fastened with lag bolts (not shown). The lag bolts hold well in epoxy wood flour putty and the stern bearing housing is sealed in 5200.

Here is a picture of a typical stern bearing with its housing:

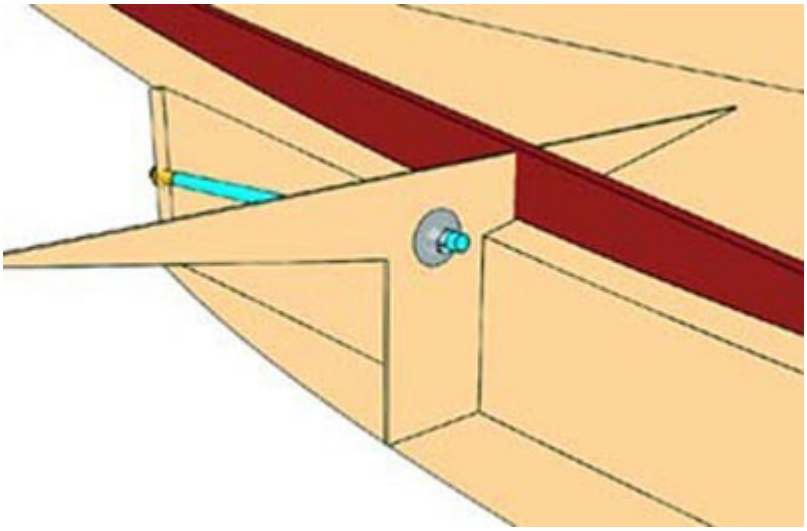


The serrated black cylinder inside is the bearing itself, hard rubber or sometimes a high-density polymer like Thordon. The inside part is often named cutless bearing.
The bronze housing extend in the keel where it meets the shaft tube. It lines up with the tube or is covered by the shaft tube.

The **shaft tube** can be purchased or made in house.
There are several ways to build a shaft tube but it is a simple fiberglass tube that will be fiberglassed to

the hull.
A PVC tube will make a nice core around which to fiberglass.
The fiberglass walls of the tube should be ?? thick. The inside diameter must be larger than the shaft diameter but not too large. ?? to 3/4? total clearance is fine.

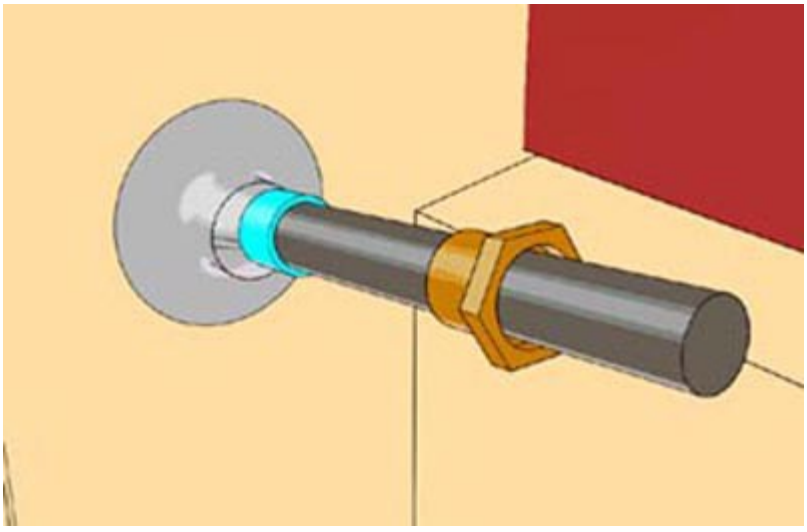
On the engine side, the shaft tube pass through a floor frame:



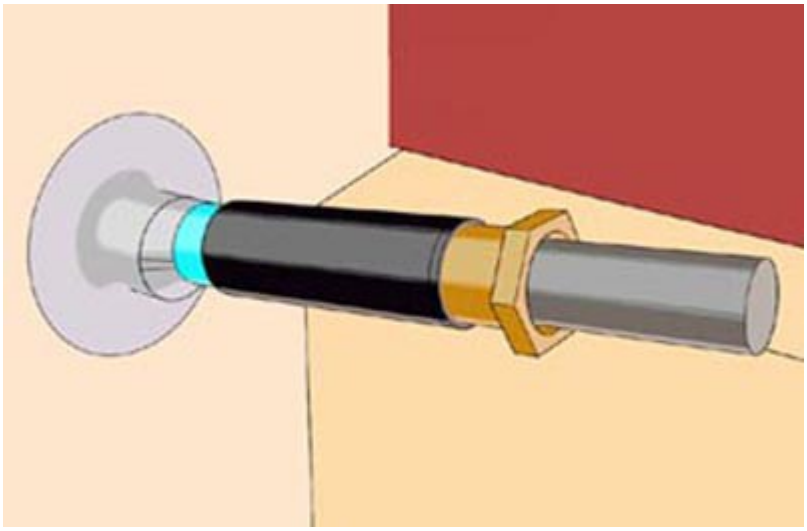
The tube is fiberglassed to that frame. That seam must be strong. If you use a PVC pipe, beware of the poor bond between PVC and resin. PVC is a good core but the tube should be made of fiberglass around PVC, not PVC only.

The end of the tube should be clean: a rubber hose will be clamped on it.

To seal the shaft tube, we use a packing gland. Here we show what is called a self-aligning packing box.



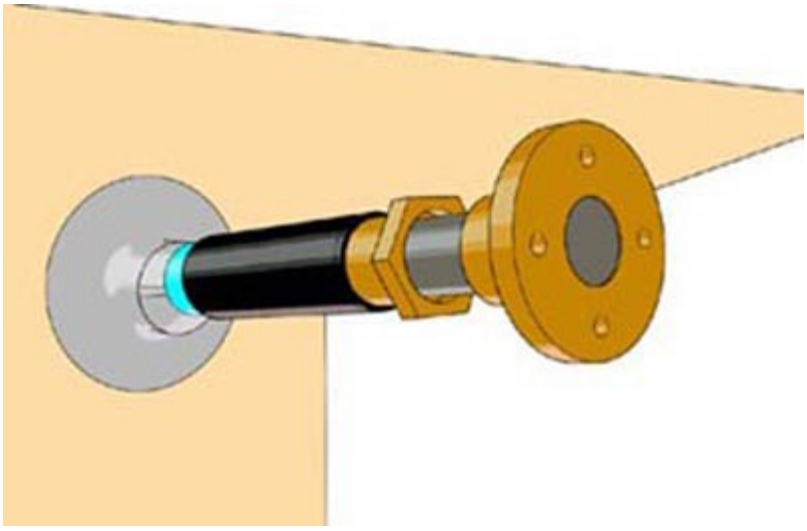
A rubber hose connects the shaft tube to the packing box. The rubber hose is double clamped on each side. (Clamps not shown)



The packing box is made of two threaded bronze pipes that fit in each other. Between the two pipes, there is packing. Packing is a rope made of greased flax or Teflon. The pipes are tightened to compress the packing and seal the shaft.

There are other types of shaft seals, in particular spring loaded friction seals but they all fit the same way over the same shaft tube.

The **shaft coupling** fits over the end of the shaft on the engine side.



It is bolted to the engine transmission coupling. In some cases, there is an intermediate coupling that absorbs torque and vibrations.

All those parts maybe a little different than what we show but the principle is always the same.

What is important is to line up all drive train components and the engine with the shaft axis.

The shaft axis will be our reference for the installation of all the drive train parts.

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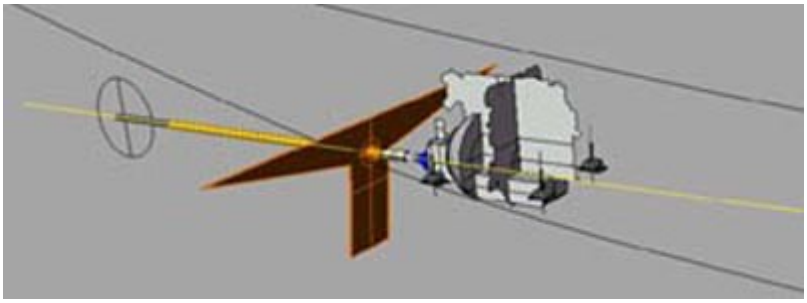


Note that this is the axis of the output shaft of the transmission. The shaft axis is not necessarily in the same plane than the crankshaft axis or engine mounts.
We did all the calculations for you. In most of our plans show the exact shaft axis and engine mounts location.

At this stage of the building, we will install the shaft tube and the small stuffing box frame.

The engine mounts are adjustable and give almost 2? to play with but we want to align that shaft tube as precisely as possible.

The first thing to do is to define the shaft axis.

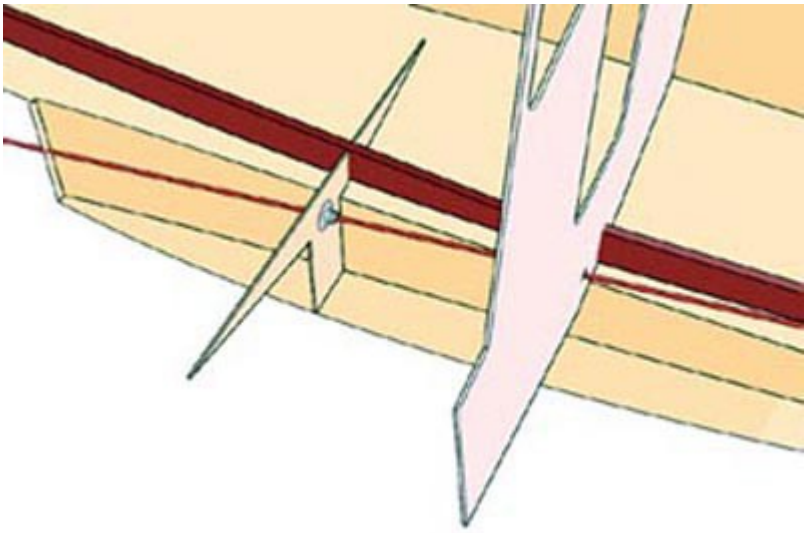
Look at your plans: we show two points to locate that axis, one on a bulkhead in front of the engine and one on the skeg.

With the main bulkhead in place, drill two small holes, 3/8? or less, at the location of the shaft axis, in the rear face of the keel and in the main bulkhead.
A straight line between the center of those two holes is your shaft axis.

No need to have the boat level, if your bulkhead is properly installed, the axis will be correct.
That axis line can be a thin steel cable (fishing leader) or the beam of a laser pointer.

Next step, install the stuffing box frame.
That small frame is parallel to the other frames and it?s location is easy to mark by offsetting the marks for the frame just in front of it.
Drill the hole for the shaft tube before installing the frame.

Check that the shaft axis passes through the center of the hole before fiberglassing the frame to the hull. Great precision is not necessary. You can always make the hole a little larger since you will fiberglass over it later when installing the shaft tube.



Install the shaft tube and fiberglass it to the keel and frame.

The alignment can be done with the steel line or laser beam representing your shaft axis or better, with the shaft itself.
To align with the shaft, the engine or an engine template must be in the boat, sitting on the engine beds.

Assemble all your shaft components on the shaft: stern bearing, shaft tube, stuffing box and coupling. Mate the whole assembly either with the engine or engine template. Check the alignment and when satisfied (+ or ? 1/8?, 3mm), fiberglass the stern tube to the hull.

If you do not use the shaft but, we still recommend lining up the stern bearing at the same time. This will guarantee an easy alignment later.
All hardware temporarily installed should be covered with plastic sheets.

The shaft tube diameter usually fits closely inside the rear part of keel and can be spot welded to the sides with small pieces of glass. We will reinforce it later.

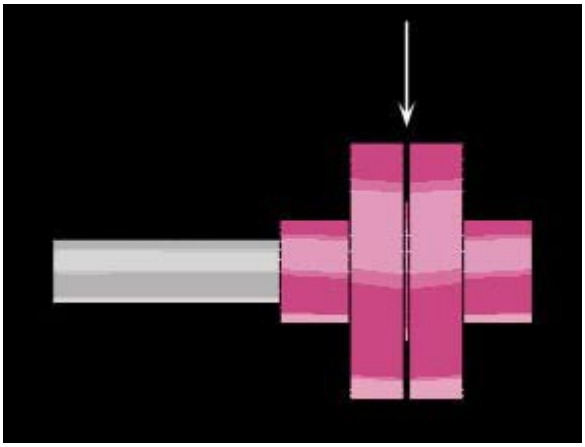
Engine Alignment:

Proper alignment is extremely important.
With the shaft tube and all fiberglass around it fully cured, proceed with the engine alignment.

At this point, the engine mounts are loose, not bolted to the girders.

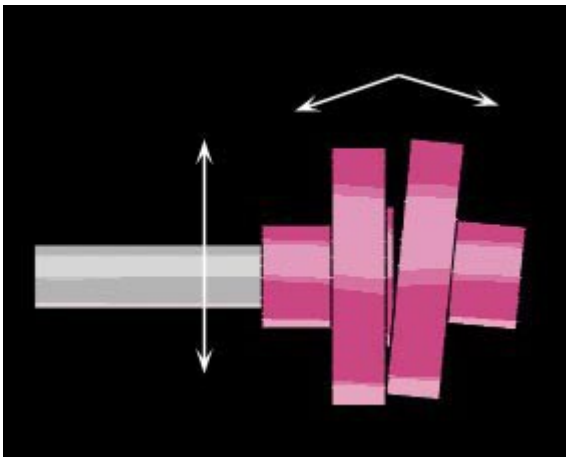
You will move the engine back until the transmission coupling touches the shaft coupling. Since you have a flexible shaft packing gland, the shaft can move a little bit up and down and sideways. Block the shaft somewhere in the center the tube: if it moves vertically 1/2?, block it 1/4? up from the bottom, same thing for sideways movement. Great precision is not necessary.

Now look at your two couplings: they should touch all around, make good contact with their full surface.

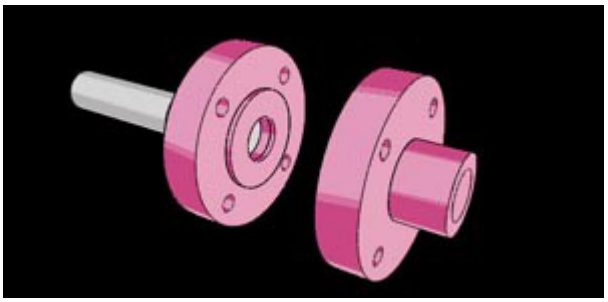


This is probably not the case and you will have to move your engine to mate the two couplings perfectly.

You will use the engine mounts to move the engine, first up and down then left and right.



At that point the couplings should fit into each other: there is a little recess in one and a shoulder in the other one. They should slide into each other easily.



Put your engine neutral and turn the output coupling by hand.
Once the couplings fit, take a flash light and look for gaps. Unless you are extremely lucky, there will be a gap on one side.
You must close that gap by turning the engine around its axis.
You can move the engine front up and down or left and right with the adjustable engine mounts.

Once the gap is small, let's say 1/8?, you can bolt the engine to its girders but leave the mounts loose for the final adjustment.
That final adjustment is done with feeler gages.
The two couplings are precisely machined.

Fine tune the position of your engine with the mounts, gaps measured between couplings must be smaller than 3 thousands of 1? in all directions.
Tighten all your mount bolts and free the coupling by pushing it back 1/4?. The boat will move during the transport and we do not want to bind the shaft.

Alignment must be checked immediately after launching the boat. The hull shape will slightly change: launch the boat with an open coupling, check alignment in the water and bolt coupling.
Not all boat yards are aware of that procedure.

A removable drip pan under the engine is convenient. That drip pan can be made to fit tightly in the keel. Do not install it now: you need access to the inside of the keel for the optional trim ballast.

Fuel system:
See the plans and notes above. A good fuel filter is a must.

Exhaust and Air:
Diesel engines require more air and larger exhausts than gas engines. The engine room must have an air intake either through a louver vent under the steps or through large diameter hoses feeding air from under the gunwale.

Do not skimp on exhaust hose diameter.

To prevent the cooling water to fill the exhaust manifold, you must install a waterlock at the lowest possible level.
To prevent siphoning, you need a siphon break valve or vent in the water injection system. We prefer an overboard vent as shown on the plans but the cooling system diagram shows an anti-siphon valve. At the transom, the exhaust must be fitted with a gooseneck to prevent seawater from entering the system.
All exhaust parts and hoses are available as a kit from BoatBuilderCentral.com.

Water Cooling System:
The engine is cooled by seawater through a fresh water heat exchanger. The seawater pick up is fitted with a valve (seacock) and a scoop strainer on the outside. The water supply goes through an optional sea water filter mounted on a bulkhead.

Insulation:
The engine room compartment can be insulated for noise and heat.

Plumbing:
Refer to the manufacturers instructions for the installation of a marine head. There is room for holding tanks between the water tanks or under the seats.

With the engine and other mechanical components installed, we can now proceed with deck installation.

If you did not find the answer to your question, please use our message board and we will respond within a few hours.
Or explore the HowTo files at our technical support web site bateau2.com