

## Chapter 4 Transmission and Driveline

### Overview

(Sung to the tune of ‘Your hip bone’s connected to your thigh bone...’)

The drive system on the AT34 is comprised of several interconnected components:

- The **propeller** is what actually ‘drives’ the boat through the water.
- The propeller is attached to a propeller shaft which travels into the boat through the **cutless bearing**.
- The propeller shaft then runs through a **dripless shaft seal** into the boat
- The **propeller shaft** is connected to the transmission via a **coupling**.
- The **transmission** is connected to the engine via a **swash plate**.
- The **engine** is connected to the boat by four **engine mounts**.

### Engine Mounts

The engine mounts are what ultimately connect the engine and propeller to your boat. They take **all** of the forward thrust of the propeller against the boat – so it is critical that they are in place and tight.

The name ‘engine’ mount is little misleading. There are two mounts on the front of the engine (one on each side) and two on the transmission. The engine and transmission are tightly bolted together, so they can be thought of as one combined unit.

You need to periodically check the tightness of **all** of the bolts holding the mounts to the engine, the mounts to the ‘L’ brackets and the ‘L’ brackets to the stringers. Note that the ‘L’ bracket is ‘glued’ to the stringer so the bolts that hold them in place are in reality a secondary method of securing them to the stringers.

In addition to ensuring that all of the bolts holding the engine mounts in place are secure, you need to ensure that they alignment of the mounts does not change.



We have drawn lines with a magic marker across the bolts and mounts so that we can see at a glance if anything has moved.

This is critical since if the engine mounts have moved it means that the engine may have shifted, which could throw off the balance of power as we know it – or at least the alignment between the engine and the propeller shaft.

### Swash Plate

Between engine and transmission is a swash plate - an internal plate with springs. It is designed to dampen the shock to the transmission when a gear is engaged.

## Transmission

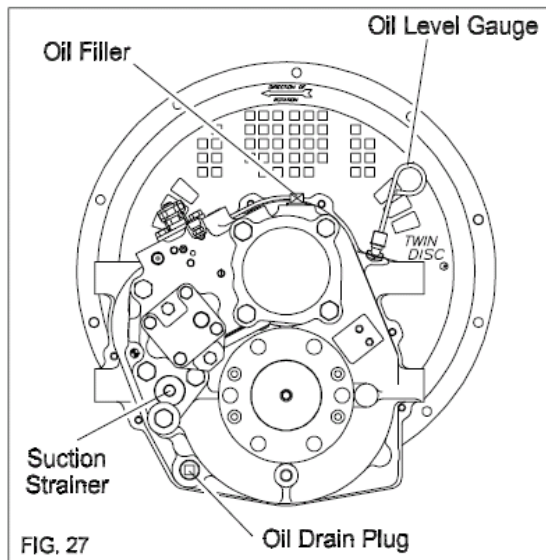
The transmission's primary job is to change the ratio between the rotation of the engine, and the rotation of the prop shaft. On our boat the engine rotates 2.4 times faster than propeller shaft.

I have a Twin Disk MG5050SC transmission with a 2.4:1 ratio.

If you have a Twin Disc transmission, you should have received the owner's manual with your boat. If you don't have it, it can be downloaded from:

[http://www.twindisc.com/Downloads/Manuals/Operators\\_Manual.pdf](http://www.twindisc.com/Downloads/Manuals/Operators_Manual.pdf)

This is the rear view of the MG5050 transmission, as on an AT34. The only difference is that Tomco plumb the oil drain directly to the Reverso Oil Change system, and the dipstick (called 'oil level gauge' here !) is extended and angled to port.



## Checking Oil Level

There is a plate on top of the transmission that has recommended grade and amount of oil to use.

Mine specifies 2.52 quarts (0.68 gallons) of SAE30 or SAE 40 oil, depending on ambient temperature. I use Chevron Delo SAE30.



Do not use Multigrade oil. Use only straight SAE30 or SAE40 weight oil.

Shawn Severn (AT41 #017 "Ocean Mistress" reports:

"We have been having a number of problems with the trolling gear on our Twin Disc transmission. We have also been having a number of problems with our transmission being very noisy (gear chatter) when it is cold or cools down running at slow speeds.

We recently had the gear examined by a mechanic who then consulted Twin Disc. Twin Disc suggested we try a fluid called Mobilfluid 424. It is a high performance hydraulic fluid for tractors. We removed the oil and replaced it with the fluid. After running the boat in a variety of conditions for several weeks, we can report a significant improvement in the gears performance. The gear chatter is completely gone and the gear is shifting much easier when it is cold. We haven't used the trolling gear yet but expect superior performance there as well. If you are having similar problems you might want to try switching to this fluid.

The down side is that fluid is expensive and only comes in 5 gallon buckets.”



When checking the transmission oil level, it's a very different method than for engine oil. You pull and read the dipstick right after the engine has been started, *while the engine is running in Neutral gear*

There is a cross-hatched area on the dipstick, and the oil should be in that area while the oil is cold. Do not add any oil if the level is *anywhere* in that cross-hatch area.

### Changing the Oil

The owner's manual specifies changing the transmission oil and cleaning the strainer after the first 50 hours, then every 1000 hours or 6 months thereafter.

I usually change the oil during every second engine oil change, and with the Reverso system it couldn't be easier. Be sure to check the data plate on the transmission for type and quantity.



It's extremely hard to measure the new level in the transmission (see above).

I pump all the old oil into an empty oil container, then put the same amount or level of new oil into a similar container, and then pour that in.

### Cleaning the Strainer

The filter (called a 'suction strainer'!) is hard to locate but easy to change. This can be done whether the transmission has been drained of oil or not: If you didn't drain the oil first, you'll only lose about 2 -3 spoonfuls.

I remove and clean this filter every year or so.

Kurt has created a wonderful animated slide-show on removing and replacing this filter on his 'tug maintenance' presentation. Download it from the 'Owners area' on the Tomco website if you haven't already. (You'll need ID/password for this. Contact Tomco if you

don't have one). I really recommend watching this animation before you do this the first time: removing the filter is not intuitive...

Use a mirror to locate the strainer cover on the rear port side. It is an approximately 1" round disc with a threaded hole in the middle. It has a large bolt and washer covering the bottom edge only, that holds it in place.

See the diagram above. (And yes, I think this is a strange and insecure way to engineer an oil-tight seal - with only partial coverage. However, it's not under pressure. All Twin Disc transmissions seem to work this way, and they don't leak.)

Remove that bolt (about 3/4" 19mm I think), then screw that bolt into the threaded hole. Pull like crazy to remove the strainer cover. It has a sealing o-ring that tends to hold it in place.

The first time it'll be stiff – that white paint that Cummins coats all new engines with will hold it in place. The strainer is behind the cover plate. It is a gauze tube about 1" diameter and 2" long.

Hopefully the strainer is pretty clean. There'll probably be some minor debris in there from the friction clutches. That's normal – but if you find metal bits or shavings, its time to call your bank manager and a transmission pro, in that order.

Otherwise clean everything carefully and put it back together. Put a little clean oil on the o-ring to help it seal, and that's it.

### ***Coupling***

This is a large circular gold colored item immediately aft of the transmission. It consists of a collar that attaches to the propeller shaft, with a flat flange that then lines-up with a similar flat flange on the output of the transmission.

The coupling is attached to the propeller shaft by a 2 1/8" Nylock nut holding the coupling to the reverse-taper shaft.

The engine and transmission unit needs to be aligned so that the output shaft is exactly concentric with the propeller shaft, and since the propeller shaft is rigidly aligned in the boat by the cutless bearings in the stern tube, the engine is the bit that must be moved.

This is done by jacking-up the engine and transmission by turning the adjustment nuts on the engine mounts.

### **Propeller Shaft Alignment**

The Factory aligns the propshaft and transmission coupling to less than 2 thousands of an inch (0.002") in the water before the sea-trial, and this alignment should be done in-water ONLY because the hull flexes a miniscule amount when supported on land.

At the 2007 rendezvous Kurt didn't suggest checking or re-aligning the engine, unless a problem or vibrations are felt, and that a boatyard pro be used for this job. He did not give instructions to do this job.

The best access to this coupling is at the fwd end of tank room, by unscrewing two panels in the forward end of tank room bulkhead.



I have the old sailboaters trick of a 2in collar zinc on the propshaft INSIDE the boat - just in front of the stuffing box. Doesn't do anything for corrosion, but if the drive coupling parts, the propshaft doesn't slide back and foul/jam the rudder (and on some sailboats.....drop out of the boat altogether).

### **Propshaft**

The propeller shaft is 2 inch diameter stainless steel shaft.

### **Dripless Shaft Seal**

Manufacturer

Tides Marine.

3251A SW 13<sup>th</sup> Dr

Deerfield Beach

FL 33442

Telephone: 800-420-0949 954-420-0949

[www.tidesmarine.com](http://www.tidesmarine.com)

They also manufacture the rudder shaft seal on our boat. It's of a similar design, although that one is only 1 1/4" diameter. (See the '*Rudder Shaft Seal*' section of the '*Steering System*' chapter for more information.)

The seal is a 'lip' type rubber seal around the propshaft, and a PTFE ('Teflon') bearing, held onto the hull by a short length of blue hose and hose clamps.

Newer boats have a spare seal installed on shaft already in a carrier – a black plastic 'donut' installed an inch or two in front of the regular seal, under the Tank Room floor. Not all boats have this spare: mine (hull #48) did not.

These seals need a good raw water flow for lubrication – it comes from a connection on the transmission cooler. They *can* run dry for a few hours in the event the boat is towed, or the raw water pump fails.

### **Maintenance**

Tides recommend inspecting this seal annually:

1. Inspect the blue hose for damage, as well as the hose clamps for corrosion.
2. Hand-tighten the hose clamps.
3. Remove the water lubrication hose, and inspect. If the boat is in the water there should be a strong inflow of water from the fitting into the boat. Stop it with the inspection cap.
4. Inspect the water lubrication hose in the bilge in the tank room, as well as at the transmission cooler in the engine room.

5. Start the engine, and run in idle. There should be a flow of approx 1 gallon/minute.
6. Reassemble everything tightly.

### Replacement

Replacing the seal is an easy job if there is a spare seal on the propshaft already. It's a big job if the spare seal is not there, as the coupling needs to be removed. If you have to replace it, it would be a good time to add a spare as an upgrade.

Replacement should only be necessary if the seal is leaking 'like a conventional stuffing box', and can even be done (if you're brave) while the boat is in the water.



Tides Marine provides a warranty on seals for 2500 engine hours or two years, whichever comes first.

### *Cutless Bearings*

There are 2 Cutless bearings supporting the propshaft (one inner and one outer). The expected life is 2000 engine hours, but that depends on the operating environment. Running aground and/or sucking sand through the cooling system will wear the bearing faster.

There is a 15 thousands of inch play as normal – be sure to have a boatyard expert evaluate their condition, rather than a haulout guy or a diver.

### Replacement

They are held in place with 2 setscrews under the paint/sealant. One to two inches of the bearing is deliberately left exposed so it can be grabbed with pipe wrench if it needs to be replaced.

### *Propeller*

American Tug 34s have a Bronze 4 blade left hand propeller of 26 inches diameter with an anti-sing trailing edge, tuned to class 1 specifications. The pitch seems to vary according to the engine size and HP.

My boat with a 330HP engine has a 26LH23 prop, which means that it is a 26 inch left hand prop with a 23 inch pitch. The size of your prop should be stamped into it somewhere near the hub.

AT34s built with the 380HP engine have (according to Kurt) a 26LH25.5 and little to no cup.

**AT41** AT41s have a 5-bladed Nibral ('Ni'ckel 'Br'onze 'Al'uminum) prop.



The AT is a 'Starboard-side' boat by design. The left-handed prop means that in reverse gear, the boat will back to starboard, and so Starboard side landings are easier as the stern moves towards the dock – and its easier to judge distances from the starboard-side helm.

### **Pitch and engine loading**

The propeller needs to be matched to the engine and the load on a boat. The pitch should be set so that the engine can achieve maximum RPM when you run with a wide open throttle (WOT) with a normally loaded boat, or perhaps 50 RPM over max when the boat is not fully loaded.

For example, our 330HP engine has a maximum recommended RPM of 2800. When we sea-trialed her with no personal gear aboard and minimal fluids (water and diesel fuel), the engine easily revved to 2850 RPM and did some 16-18kts.

Once we moved aboard, and started carrying full fuel and water tanks as well as all of our stuff, we couldn't get more than 2400RPM from the engine. It would not go any higher even when we were running with full throttle.

I had the boat hauled, and had the propeller reconditioned and trued and all of the cup removed.. That enabled the engine to achieve 2800RPM with the same load on board, but decreased the maximum speed we could make by about 2 knots.

So why did we do this??

In a gas engine, when you 'step on the gas' you actually open-up the throttle valve in the *air* intake, and allow more air to flow in. This causes the carburetor to pass more gasoline through the jets (or the fuel injection computer to inject more gas). Either way, you control the air, and the engine responds with more fuel, and the engine speed increases. If the engine can't speed-up because of load, then the airflow stabilizes, and no more fuel is injected. No real harm done.

Diesels are different: When you push the throttle forward, it tells the fuel injector to inject more fuel (either by moving the injector rack on a mechanical engine, or via the CPU on an electronic engine). More fuel causes the combustion to burn hotter, speeding-up the engine, which then sucks-in more air. There may also be a puff of black smoke from the temporarily unburnt fuel. Eventually the injector governor limits the fuel-flow (usually well above the WOT rating). Essentially, you control the *fuel*, and the airflow speeds-up to match.

What happens if the engine can't speed-up sufficiently, because the loading is too great (whether due to a fouled or oversized prop on a boat or an overloaded truck going up a steep hill)?? There will be too much fuel for the airflow, and the combustion temperature will be too high. There may be black smoke as well, but the danger is the internal combustion temperature. This probably won't show up on the water temperature gauge since this is inside the combustion chamber. The ultimate result will be a blown head gasket or melted pistons.

So, don't run the engine if lots of black smoke appears (actually, lots of any color smoke is usually bad news). If you can't reach WOT, don't run more than about 1600-2000RPM until you fix it.



I think the Cummins Smartcraft digital display indicates the load factor on the engine as a percentage. You should not see a high load factor at high RPMs. For example, if you can't reach maximum RPM at WOT and you see a load factor of say, 80 percent or higher, this means that your engine is overloaded and you should get it checked.

The WOT Rating is on the rectangular black engine data plate on the Injector pump - port side near the front. It's a good idea to run the engine up to this speed once or twice a year - at sea, in gear, and with a typical load.

Go on - it won't hurt it. Cummins specify a maximum of 1 hr in every 8, so 5 minutes won't damage anything (except maybe your wallet when you have to pay for the spent fuel.).

If you can't get to maximum RPM with a wide open throttle (WOT), then:

- Try again in neutral. If it doesn't get to max RPM with WOT then either there is an engine problem (a clogged fuel or air filter, bad turbo or maybe the throttle cable just stretched.).
- If it reaches WOT in neutral, then it's a propeller problem - (barnacles, bent blades or the wrong pitch).

### **Maintenance**

Kurt recommends that the prop should be removed every second year, and inspected and repaired as needed by a competent Propeller Shop. The shaft key, keyway and threads should also be checked.



If you received a 'Propscan' propeller data sheet with the boat - don't necessarily believe it! Have the prop actually measured before making any changes. My paperwork was different from the actual measured propeller size....

### **Line Cutter**

The Factory install a 'Razor' serrated circular line-cutter as an option.

After consulting with the 'Spurs' cutter manufacturer, we concluded that there was no way to install their product. The cutless bearing protrudes several inches, so there is no place to attach the fixed 'anvil' part that the rotating 'spur' cuts against.

We installed a Prop-protector 2-piece circular blade cutter, as it did not involve removing the propeller

Depending on the amount of exposed propshaft, you may have to switch to a propeller nut zinc (a Camp 'H') instead of a donut shaft zinc. However, it's more expensive, and has been known to loosen and fall-off. (Ask me how I know....)

See the underwater maintenance section for more details.