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Rebuilding a 4 Barrel Carburetor

There comes a time when your engine needs to have the carburetor rebuilt. So how do you know when it's that time? Unfortunately for most of us it occurs when the engine either won't start, run, or idle properly.

Sadly, most of our boats are not used often enough to ensure fresh fuel is passing through the system on at least weekly basis. Left alone, fuel tends to evaporate and the gummy residue remaining in the float bowls and various internal crevices and cavities turns into a sticky mess, or in extreme cases simply hardens and eventually becomes a solid. Once the small hidden passages become blocked, no amount of cranking and coaxing will bring the old girl to life, so it's time to give up and rebuild the carburetor.

Rebuilding a carburetor is one of those opportunities for us to display our hard-earned experience by applying care and patience, as opposed to unleashing the pent up joys of youth and enthusiasm. So, rather than diving in, let's begin with the older, slower, and much more methodical process. Follow along while we rebuild an Edelbrock #1409- 600 CFM marine carburetor.

First a little history. Carter Carburetor first designed and built the AFB (aluminum four barrel) carburetor back in the mid-fifties.

DID YOU KNOW?

Contrary to popular belief, a marine engine's **primary function** is to idle properly and without fail when in gear. The last place you want to lose the ability to maneuver is while docking. A gummed-up carburetor will rarely idle correctly since the low speed circuits are comprised of tiny passages and orifices, therefore the first to fall victim to blockages. Since many of these circuits are literally impossible to access without destroying the carburetor, special chemical cleaners are the only viable method for cleaning them.

SUBTLE DIFFERENCE

Tear down – Rapid disassembly, using brute force, with no forethought or familiarity, improper tools, and without the need to EVER reassemble the subject parts. This process produces a pile of mangled virtually unusable parts in record time.

Disassemble – To carefully take apart a device using the proper tools and place the parts in a logical order and orientation so the original location and orientation can be preserved for eventual reassembly in reverse order after cleaning and restoration. As it is removed, each individual part is inspected for damage and functionality. If fasteners are reluctant to loosen, stop and regroup, then engage "full patience mode". Apply various spray can penetrants (loose juice) followed by a cold beer and a short nap or alternate task, thus ensuring ample time for the penetrant to work. Failing that, heat is the next step. Heat, judiciously applied, can sometimes loosen a reluctant part. Failing that, drilling for an Easy-Out is the last resort.

Since that time literally millions have been made and have appeared on everything from cars to trucks and yes, even boats. As carburetors go it is very basic yet effective. The key to its performance lies in its simplicity. Over time the AFB has had some minor upgrades, but its base architecture remained essentially the same until the early 90's when carburetors were abandoned in favor of fuel injection and the tooling was sold to Weber, an Italian carburetor manufacturer. Since its birth the AFB has been a favorite of performance enthusiasts and used in a wide range of applications. Eventually, Edelbrock, a large well-known high-performance equipment manufacturer, acquired the rights and tooling from Weber to continue manufacturing the AFB here in the USA for the performance market. They came up with a broad line of generic high-performance carburetors designed to fit the needs of the aftermarket performance industry.

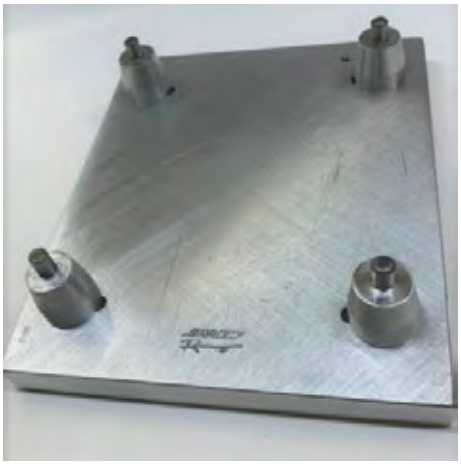
While most of the Edelbrock carburetor line is devoted to the automotive market, there are two models which are specifically offered for the marine market and more importantly are USCG approved. As with most automotive based engine, ignition, electrical, and fuel related parts, the marine versions have some subtle but very important differences when compared to their automotive counterparts.

So where do we begin? Sixty years ago, I would have already had the carburetor ripped halfway apart by this point in the story. Today, 60 years later, I went to the internet and was quickly able to print out a free manual from the manufacturer's website. With my manual, I was able to properly identify the model and view a complete list of the specifications as well as an exploded parts diagram. Older and wiser kicked in as I sat down and took a minute to read up on the product and the rebuild process. I learned that replacement parts and rebuild kits were readily available, more importantly though, I learned that, unlike the low cost offshore generic AFB rebuild kits, the Edelbrock kits included all the marine specific gaskets and unique seals.

Armed with the confidence that all of the necessary rebuild parts were available, I removed the carburetor from the engine. The first step was to go outside and tip the carburetor upside down and let any remaining fuel drain into a suitable disposal container.

Start by making a carburetor stand which supports the carburetor at least an inch above the base. It will greatly aid the process and prevent damage and allow the throttle plates to open without damage to the linkage and throttle blades. Use the old base gasket as a template and some long 5/16 bolts and nuts. Take the time to prepare a clean area on your bench or work area and spread out a large piece of paper towel, preferably white so you can easily see the tiny parts you are about to remove.

Once mounted on the carburetor stand, remove the choke piston housing which is held in place by three screws. Before removing the plastic cover to access the interior screws, mark the setting of the choke by scribing a line or mark on the housing. If you don't have a parts diagram, get one. If you have no other alternative, take a lot of pictures with your camera. You will thank yourself later. Try to save all the old parts and gaskets intact in case you must reuse any of them in an emergency or to verify your new parts are correct. Once the rebuild is satisfactorily functioning, feel free to throw the old parts away.



A carburetor stand is very helpful since it allows the carburetor to be supported without damaging the throttle blades and linkage.

TAKING IT APART

1 Remove the pump arm and the S link connecting the linkage to the accelerator pump plunger. I like to reinsert the pump arm screw into the airhorn just to keep track of it.

2 Remove two screws holding the metering rods in place. Carefully raise

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the metering rods and their pistons. Be sure to remove the tiny step-up piston springs.

3 Remove the 8 screws which attach the airhorn assembly to the main body. Delicately remove the tiny hairpins connecting the linkage rods to the levers. Carefully lift the airhorn off and place it upside down on your work bench.

4 Remove the accelerator pump plunger assembly.

5 Carefully remove the float lever pins and then remove the floats and needle valves. If you are not replacing the needle and seats, be sure to keep them separated and in their original location and orientation.

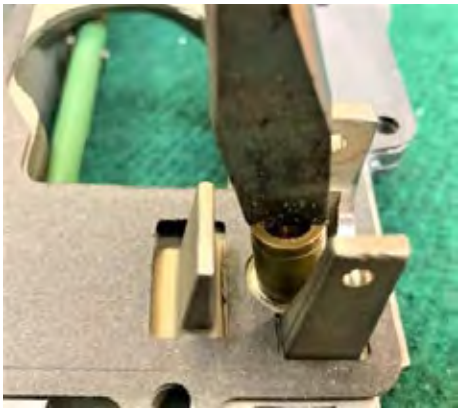
6 Using a wide blade screwdriver, carefully remove the 2 brass needle seats and gaskets. While you have the screwdriver, remove the main jets and secondary jets from the floor of the bowl, taking care to keep them properly oriented for proper positioning during reassembly.

7 Now you will be able to remove the airhorn gasket. Be sure to carefully clean all gasket remnants to ensure a leak free surface.

8 Turning our attention to the main body of the carburetor, start by removing the primary boosters and their gaskets, being sure to keep them in order, followed by the larger rear or secondary boosters. Once the secondaries are removed, the auxiliary air valve can be removed by simply lifting it out.

9 Next, carefully remove the two screws holding the accelerator pump jet housing sometimes called the squirter. Underneath that will be a spring, tiny brass weight, and finally a tiny steel ball about the size of a BB. I like to spread a bath towel on the bench to capture the parts then turn the carburetor over so the tiny parts don't roll off the bench and become lost forever. Most rebuild kits include a new check ball, but few provide a spring which helps to keep the ball seated when you encounter rough water. The

Step 2 – Remove the screws retaining the metering rod covers.



Step 6 – Notice how the float valve seats are mounted at an angle to the face of the airhorn. Be careful when starting the thread to prevent from cross threading.

Step 7 – Use a razor knife to remove any small remaining pieces of gasket material.

spring is only found in off-road and marine carburetors.

10 Finally, before removing the Idle mixture screws, gently screw them

Step 9 – A magnet can be used to retrieve the accelerator check ball. This ball is held against its seat by a tiny brass weight.

Step 9 – The marine version has this tiny spring attached to the weight.

Step 10 – The main idle mixture screws

into the base, counting the turns it takes and make a note of that for future reference, then remove them. Note: Unless it is absolutely

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CARBURETOR NOMENCLATURE

Every tribe has its own lingo, so let's review some of the basics of carb talk so you will be able to follow the remainder of the story. Bear in mind that much of this lingo was created by engineers and therefore utilizes straightforward comparisons to real life devices. Most of the terms are loosely based on the physical location of the carburetor as it appeared in traditional 60's era American V8 automobiles.

Throttle side – also T/S. This is the side where the throttle arm is located, which in almost all cases is on the left or driver's side of an automotive application.

Front – In automotive applications, the front of the carburetor is farthest away from the flywheel. This is an important distinction since many of our engines are mounted "Flywheel forward" in the boats and the transmission is driven off the original front end of the crankshaft. In those cases, the T/S is on the port side, and the front of the carburetor is closest to the bow when mounted in a boat.

Jets – Small round brass orifices which are screwed into the carburetor to meter the flow of fuel. These are available in a variety of sizes to enable tuners to make incremental fuel flow changes, thus changing the fuel economy and power output.

Primary side or primaries – The 4-barrel carburetor has four round air passages called barrels each controlled by an individual throttle blade which when rotated acts as a door to let air into the engine thus controlling the amount of power produced. Greater opening allows more air + more gasoline which equals more power. Traditionally a pair of smaller primary passages are located on the front half of the carburetor. The typical automobile spends approximately 90% of its time at 15% or less of its output. Reserve power is only needed when accelerating, climbing hills, or towing loads.

Secondary side or Secondaries – The rearmost and larger pair of throttle barrels are used only when greater power or acceleration is called for.

Metering rods – The AFB has small, stepped brass rods which partially plug the holes in the primary jets. As the engine load increases, the rods utilize a vacuum signal to raise and transition to a smaller diameter thus reducing the restriction in the jet and allowing more fuel to flow thereby enabling the engine to make more power.

Boosters or venturis – These are removable passages which are located in the middle of each throttle bore. As the air rushes through these carefully shaped venturis the pressure lowers due to the venturi effect thus creating a suction which draws fuel from the fuel reservoirs called appropriately "the fuel bowls" and introduces it into the airstream allowing it to mix with the air rushing through the venturi.

Floats – Literally two brass floats which control tiny float valves which maintain the fuel level in the float bowls. This part of the carburetor function literally borrows its technology from the household toilet. As the fuel is used, the floats drop thus opening the needle valves thus allowing fuel to enter until the level rises and the float actuates the valve to shut off the flow.

Accelerator pump – Think of the accelerator pump as providing a shot of adrenaline for the engine. When the driver rapidly depresses the throttle and demands more power, the rapid throttle opening causes the accelerator pump to produce roughly a thimble full of fuel to enter the incoming airstream immediately thus allowing the engine to accelerate rather than bog and stumble.

Rich/Lean – Internal Combustion Engines (ICE) produce usable power by burning a mixture of air and fuel to heat air which when heated rapidly expands and drives the pistons down the bore on the power stroke. In a perfect world roughly 14.7 parts of air by weight mixed with 1 part of gasoline create a perfect mixture. This chemically correct mixture is called stoichiometric or simply stoic. In actual practice we typically run our engines at an air/fuel ratio of 12.5:1 in order to maintain better driveability. When fuel is mixed with air it relies on the heat from the engine passages and compression to sufficiently vaporize it so it can burn efficiently. When the A/F ratio drops from 12.5 down to 11:1 let's say, we term that mixture as "rich" meaning that it has more fuel than is necessary. "Lean" is just the opposite. Mixtures of 13:1 are considered to be lean because there is more air than the normal 12.5:1 mix.

Choke – Just like in real life, the choke literally restricts the air entering the engine and causes the resulting increased vacuum to draw proportionally more fuel relative to the air into the engine thus richening the mixture and ensuring ongoing combustion until the engine warms up. As the engine warms, the choke opens, and the correct air fuel ratio is established.

Step 11 – This gallon can of carburetor cleaner is the best way to get your carburetor clean.

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necessary, never remove the throttle and choke blades or the linkage levers and rods.

11 The carburetor and its collection of small parts is now ready for the dip tank. I use Gunk carburetor cleaner kit, part # CC3K which is available at your local parts store and over the years has done an excellent job. It comes in a partially filled 1 gallon can and includes a handy small parts basket. The can is partially filled so there is room to dunk parts without overflowing the fluid. The body of the AFB will not fit in the can, so head to the grocery store and buy a small aluminum foil roaster pan just slightly larger than the part you are trying to dunk. Place the part in the pan and carefully pour the contents over the parts. Let the part sit for several hours then remove it and gently wash off the solvent with hot tap water. Note: do not use high pressure since it will spray all over you as well as fling small parts all over your shop. Caution: like any good cleaner, it stinks, but remember we are cleaning a carburetor here, not washing bedroom sheets. You may want to do this outside or at least in a well-ventilated area.

12 Once the parts are cleaned, I like to arrange them in an orderly fashion according to function and somewhat in reverse order of disassembly. The reason

Step 12 – Once clean, It helps to lay out the parts for inspection. Use a magnifying glass and carefully check all the parts for cracks, dirt, or signs of wear.

Step 13 – A needle point blow gun which is very convenient for blowing out the tiny passages in a carburetor.

for this is to serve as a visual reminder and hopefully prevent repeated false starts when you suddenly discover extra parts which may have fallen out of sequence.

13 Here is the step that separates the pros from the also-rans: Now that everything is clean, use a bright pen light and magnifying glass to inspect the tiny details of the parts looking for dirt and debris still remaining. Use compressed air and a needle blowgun to blow out the various passages and areas. Do not use wires or tiny drills, screwdrivers, etc. to remove the debris. Let the cleaner do its job. Redip the parts until they are clean. Use a razor blade to carefully remove the remnants of the gaskets from whatever surfaces need extra help.

Step 14 – Lay out the parts that come in the rebuild kit. You will want to compare them to the old parts. Be especially careful about gaskets. Place them over each other and look for any discrepancies.

14 Inspect your rebuild kit. Match and compare the new gaskets to the old gaskets.

15 Arrange the gaskets and small parts in reverse order to facilitate reassembly.

REASSEMBLY

Start by placing the body on the carb stand and install the main and secondary jets.

1 Install the fuel bowl baffle plates. They are oriented so the raised kick out is away from the floats thus providing clearance for the floats.

Step 1 – The primary Jets are located adjacent to the primaries in the float bowl cutout.

2 Place the accelerator pump return spring in the pump cavity.

3 Remember to install the small round gasket and the bent linkage rod on the choke piston housing, then install the housing on the carburetor.

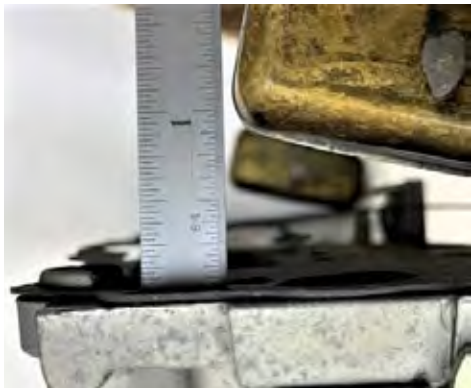
AIRHORN ASSEMBLY

4 Turn the airhorn housing upside down on the bench and install the large gasket loosely.

5 Install the two float valve seats with their gaskets. When you are starting the threads, notice that they are threaded at a slight angle. Install the new needles and then install the floats by slipping the float lever pin in place.

Step 6a – A 7/16 drill is used as a gage to set the floats. Placed as shown above, it should just touch the float when the float valve is in its closed position.

6 Using a 7/16 drill bit as a standard, place it between the float and the gasket. When the drill is resting between the gasket and the middle of the length of the float, (Step 6a) the float should just touch it. If needs adjustment, remove the float and using a pair of needle nose pliers, carefully bend the arm and retry. It won't take much movement to change the height, so be careful and gentle. This adjustment may take a few tries, but float height is critical! Once the closed float height is established, adjust the float drop using a similar procedure. The rearmost float tab controls the drop and will have to be bent until the top edge of the far end of the float is 15/16 from the gasket. (Step 6b)



Step 6b – Using a scale, the float drop is measured at 15/16 " as shown.

7 Place the accelerator pump in the pump cavity then gently lower the airhorn over the pump shaft. Be careful not to force the airhorn down on the carburetor. If you have misoriented the primary boosters and installed them side for side, the tiny brass air tubes will prevent the airhorn from seating. Gentle is the watchword here!

8 Gently hold the airhorn seated in place while loosely installing a few screws to hold it down. Run the remaining screws in, and once they are all in, snug them down, then go around and tighten them. They should be tight, but don't get carried away, remember, the carburetor is aluminum!

Step 9 – The "S" link shown attaching the lever to the accelerator pump rod. The rod position controls the volume of the pump shot. If the rod is located in the hole closest to the pivot it will produce the largest volume, while the opposite position will produce a smaller shot.

WHY IS FLOAT HEIGHT SO IMPORTANT?

Float height controls the fuel level in the bowl. If the fuel level is too high, the carburetor will run rich, and conversely if it is too low, it will run lean and be constantly starved for fuel. If the level is too high, fuel will spill over during turns and high G maneuvers causing flooding, while too low will cause the engine to cut out or run lean.

9 Install the "S" pump connection link and install the lever followed by the pivot screw and the rod. Place the rod in the middle hole of the lever as a starting point. Make sure that when actuated, the pump does not bottom out. If it does, bend the rod at the kink to shorten the travel.

Step 10 – Gently tighten the metering rod covers.

10 Install the metering rod return springs in the holes. Next, loosely install the piston cover plates then swing them out of the way and install the rod and piston. As you gently insert the pistons and rods, you may have to gently wiggle and giggle the rods a bit to get them to line up with the hole in the jet below. This may take a few tries but be gentle and patient. Once fully installed, swing the covers back

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over the pistons and gently tighten the tiny retaining screws. If you decide to do some tuning, remember, if you are only changing the metering rods, it is not necessary to remove the screws. Merely loosen them and swing the plates out of the way until the piston and metering rod can be removed. This saves time and eliminates the chance of dropping the tiny screw into the engine.

11 Reinstall the idle mixture screws. Run them all the way in and gently seat them, then back them out to their prior settings, or back the screws out 1 ½ turns which provides a good starting point to set the final idle adjustment.

12 Install the gasket on the inlet fuel line fitting and tighten. Note: When attaching the fuel line to the fitting, always hold the carburetor fitting with a wrench to prevent it from turning while tightening the fuel line fitting.

13 Install the gasket then the black plastic cover and the thermostatic coil assembly, making sure to engage the choke arm to the coiled spring located inside the housing. Turning the adjustment clockwise will cause the choke to close and make the idle mixture richer. Attach the three retaining screws but do not fully tighten.

The Coast Guard USCG oversees the published rules and specifications regarding the marine versions of what in most cases began as automotive parts. As perhaps an oversimplification, the USCG rules are in place to ensure that explosive gasoline vapors do not end up in the bilge, and that sparks or other sources of ignition are eliminated, thus hopefully preventing nasty life-threatening explosions and fires. Do not install automotive electrical, fuel, exhaust, or ignition related parts on your engine. The parts are much cheaper and may look the same to the casual observer, but they are subtlely different. The guy in the auto parts store will tell you that they will fit and should work just fine, and they will; right up until they go boom! When the insurance loss investigators examine the parts and find the non-USCG approved parts, they will deny the claim, so always be sure to use USCG approved parts.

Aside from having a good carburetor, you must also have a good fuel system. Starting with the fuel tank and ending with the carburetor, fresh clean fuel with the proper

If your fuel pump has a vacuum fitting, be sure to attach a line connecting it to this port. This fitting is a USCG requirement and is only found on marine carburetors.

flow capability and at the correct pressure is required. Make sure you have fresh filters including the one inside the fuel tank, and the fuel pump is delivering the correct amount of fuel to insure proper operation. Without the proper fuel flow capability, your engine will never make rated power. The critical filter that many people miss is the one located inside the fuel tank covering the opening to the fuel pickup tube. Because they are out of sight or difficult to access and remove, they rarely if ever get changed. In many cases you will have to remove the fuel tank to access this, but until it is clean, the fuel will never flow properly. The engine will

MAKE IT LEVEL

Carburetors are designed to operate in a level condition. It is amazing to see how many installations, including ones from the original boat manufacturer, where the carburetor is not mounted level. The next time you are out cruising around, bring the boat up on plane and establish a good cruising speed, then take a small protractor level and place it on the top of the air cleaner. The carburetor should be fairly level front to rear and side to side. When you return to idle the boat will slow down to docking speed and be at a different attitude. If both conditions are fairly level your carburetor will be able to function properly. If, as we have seen in some cases, the carburetor angles are grossly off in one or both conditions, you will never get the engine to run properly. The solution is to have some angled carburetor spacers made to place between the intake manifold and the carburetor. If they are not available from the manufacturer, any competent local machine shop should be able to handle this. You will be amazed at the difference this makes.

Preferably with the boat in the water but at least with the water line level, place a level on the carburetor mounting flange and check to make sure it is level. If not, make an angle spacer to correct the problem.

Basic vacuum gage kit.

idle beautifully and cruise slowly, but when the engine has to run hard or get up on plane, there won't be enough fuel flow to support the demand. Many of the so-called experts miss this one. Pull the tank and do it right!

ADJUSTING YOUR REBUILT CARBURETOR

Before starting your engine, hook up a vacuum gage to one of the available manifold vacuum ports at the base of the carburetor. Next hook up a timing light so you can check the spark timing once the engine is running. It is useless to final tune the carburetor and set the idle if the timing is incorrect. Crank the engine over without starting it to fill the bowls and check for and repair any leaks BEFORE starting the engine! If you are doing this at home, make provisions for cooling water, since you will be running the engine for some time.

Now you are ready to start the engine. Pump the throttle once slowly to set the choke. DO NOT PUMP THE THROTTLE more than once! This will merely flood the engine. The choke should snap shut completely.

Do not connect the throttle cable. Have a friend help you by turning the key. Once the engine starts, you may have to give it some throttle to keep it running initially until you set the idle. Once the engine warms up and the choke releases, using the idle stop screw on the throttle arm, set the engine idle at 500 rpm if possible. Using a screwdriver, make tiny adjustments side to side to the idle

Idle screw. This sets the main idle when the engine is warmed up.

mixture screws until the vacuum increases. Keep going back and forth and get the vacuum as high as possible. As the engine rpm rises, keep reducing the idle speed to the original 500 rpm by backing off the idle stop.

When you have achieved a good clean idle, the try to open and close the throttle rapidly and see how the engine responds. If the engine responds poorly you may have to adjust the accelerator pump stroke by changing the rod position on the lever arm. When you are all done, back the idle mixture screws out approximately 1/8 of a turn to slightly richen the idle mixture.

Turn off the engine and let completely cool down several hours until Stone Cold!. With the throttle linkage hooked up, prepare to start the engine by fully opening and closing the throttle completely one time. This will set the choke. Now without touching the throttle attempt to start the engine. If it starts

The choke idle screw controls the idle only when the choke is engaged. The screw is a bit difficult to reach so you will need a stubby screwdriver.

and keeps running, good. If not, stop the engine immediately before the engine and choke warms up and turn the choke setting clockwise to richen it, and try again. You will need to set the choke idle setting which only controls the idle while the choke is engaged. It is a second idle screw on the choke lever. When you take the boat to the lake, you will want to adjust the idle again with the engine in gear and idling.

The choke setting can be a finicky adjustment at best, and will take a few tries, but once you have it set perfectly it is one of life's small joys! Early on a gentle summer morning you can come out, hop in your boat, pump the throttle once, hit the key, and listen to it idle perfectly.

Life is good! Nice job! Happy Boating