



Raylar BCK103 Kit Installation Instructions

525 HP -- 496 ci

496 8.1L Engines Mercury, Indmar, Crusader, Volvo

2001–2004–cool fuel 1 mag or HO engines

2005–2010 cool fuel 2 mag or HO engines

Certified mechanic or qualified marine technician

Please read and familiarize yourself with these instructions before beginning any work on the 496 8.1L engine.

- The Raylar kits are best installed with the engine removed from the boat.
- All cooling systems on the motor must be drained before removing parts and installing Raylar parts.
- It is recommended that the engine have a compression test done on all 8 cylinders. On stock 496 the cold cranking compression should be approximately 155–165 PSI.
- If any cylinders are low more than 10 PSI, a leak down test should be done to ascertain leak down percentages as well as isolate whether the leakage is from valves or from piston and ring areas. If the losses are from the valves the Raylar heads will solve that problem. However, if the loss is because of piston, cylinder, or rings, these need to be

corrected before the Raylar kit is installed. If not corrected, serious engine damage can occur which Raylar will not be responsible for.

****Before starting the installation, check the Raylar kit for damaged or missing parts. Verify that all components on the parts list are ready for installation.****

Removal

1. Computer & Wiring Removal (Remove/Disconnect the following)

- Look for the 6 connectors
 1. Cam sensor on front of cam cover
 2. Single brown wire to temp sender on front water crossover
 3. Low water pressure sensor on raw water pump (late model 2005 & later have this PSI sender on the rear heat exchanger)
 4. The 3 wire connector to the throttle position sensor
 5. Right exhaust manifold over heat sender
 6. Left exhaust manifold over heat sender
- Mounting plate for the ECM & relays – two 10mm nuts to the side of the fuel rail and two 13mm nuts to the exhaust manifold.
- Under the computer, the two 10 pin connectors. One for the coil packs and one for the fuel injectors.
- On the other side, the 10 pin connector for the other coil pack.
- Check for the power wiring for the fuel pump or pumps. Roll back the loom to the rear of the engine.

- Map sensor connector, intake air sensor connector and the idle air control connector on the manifold.
- On the lower left & right hand sides of the block, two white connectors for the knock sensor.
- Just above the oil filter pad are the oil temps and oil pressure senders.
- On the rear bell housing studs will be one or two black ground wires.
- Remove the rear engine lifting plate as it will have the Merc 10 pin connector and the Merc Cathode box on it (on the later loom, Merc puts a twist lock 14 pin connector on top of the engine)
- Next will be the yellow starter wire and the red battery power wire. Also in lower front will be the alternator 2 wire connector, the red battery charge terminal and the black ground wires. Be careful when removing these two 10mm nuts so as not to twist off the wire ends.
- Remove the loom and set it aside.

2. Exhaust Removal

- Remove the 1" water cooling hoses on the lower check valves, right and left side.
- Remove the oil filter support bracket, being careful not to kink the hoses.
- Each manifold has a water temp over heat sensor. Make sure these are unplugged as the sensors are fragile. Each manifold

has four long and four short 8mm stainless bolts, uses a 13mm socket. **This is generally a two person job, the early manifold castings are aluminum; cumbersome but not too heavy. The late manifolds are cast iron and are very heavy. You will need two people to remove them. **

- Remove the six middle bolts, loosen the two remaining bolts, have someone support the weight and remove the last two bolts. Get out of the way, remove the manifolds and set aside.

3. Intake Manifold Removal

- At the rear of the manifold you will find the 3/8 fuel feed line. You will need a fuel line connector removal tool to remove it. Watch out for spraying fuel. There are 10 #6 bolts, 5 on each side, that need to be removed. Set the manifold aside.
- On early fuel rails, there will be a 3/8 fuel feed, a 5/16 fuel return and have an adjustable pressure regulator that will be used later to adjust fuel psi. See if the regulator can be adjusted, if not a new GM regulator will be needed. (It uses a # 10 anti-tamper torx bit which can be purchased at most auto parts stores.)
- The later fuel rails only have a 3/8 fuel feed and will need a Raylar adjustable pressure regulator at the fuel pump.

2007 – 2010 Bolt GM black GM # 11609264

2001 – 2005 Regulator fuel rail GM # 12574986

2005 – 2010 Regulator Raylar BP REGULATOR
2001 – 2010 Grommet Cover GM # 12557831

- Remove the valley tray and set aside. Remove the oil pump drive and lifter bar retainer and set aside. Check and see if you have black or silver manifold bolts. You will need black bolts because they are longer.

4. Valve Cover Removal

- Inspect the rubber grommets under the bolts. Sometimes they tear and will leak. Keep the valve cover o-ring in its groove so it keeps its shape.
- Remove the rocker arms and set aside.
- Remove the pushrods and set aside. The pushrods will be reused, the rockers will not.

5. Cooling System Removal

- If not done already, drain the coolant in the block.
- The best way is to remove the 2, 18mm block plugs directly above the pan rail.
- Remove the U shaped hose from the water pump to the coolant crossover as this contains coolant also. Don't make a mess; use a container to save the coolant as it can be reused.
- Remove the heat exchanger, the hoses on the end and the 2 big clamps in the center.

- Remove the support from the raw water pump support studs to the coolant crossover. It will have either a tensioner or an idler pulley. Between the crossover and water pump is a hose clamp that uses a 1/4" nut driver to remove. Loosen this. Pay attention to its location as it must be reassembled the same way.
- Next, use a 3/8 drive, 15mm wobble socket and extension to remove the 4 crossover retaining bolts to the head. The dip stick is held to the crossover with a 6mm bolt. Remove this and the dip stick will just float. Don't try to remove it. Pull the crossover forward and up to work it off the water pump.
- Get the two gaskets off the front of the heads and inspect their condition.
- Next, 4, 15mm bolts for the water pump and off it comes, 2 more gaskets. And inspect.
- **Now is a very good time to remove the end caps on the heat exchanger to make sure it is clean**

6. Damper Removal

- Remove the 3 Allen screws holding the 6 groove pulley to the damper, set aside.
- Remove the damper retainer bolt. For references, scribe a line across the dampener and the end of the crank. This engine is neutrally balanced, but just in case. Using a standard 3 bolt puller and 3, 10mm 496 head bolts
- Remove the dampener and set aside.

7. Timing Cover removal

- Remove the 6, 10mm bolts holding the timing cover.
- Gently pull the cover off from the top, paying attention to the 2 dowel pins down low on the front of the block.

8. Removing Cylinder Heads – **Carefully!!! They are 76lbs a piece.**

- There are 18 bolts in total. 12 long, 2 medium and 4 short.
- Remove both cylinder heads from the engine. Carefully inspect all the tops of the pistons for cracks from the eyebrow to the ring land. On cast pistons it will show up here first.
- Also inspect the cylinder walls for any unusual wear or damage. Pay particular attention to any cylinder scoring that may be greater in one cylinder than the others.
 - This could be an indication of problems in that particular cylinders due to improper piston ring fit or overheating.
 - Address any problems and repairs before proceeding with the kit installation.
 - Some vertical marks and light scores marks are normal, but they should not be deep enough to feel with a fingernail when scraped across.
 - If all looks good, carefully clean the top of the block. Be careful not to scratch or gouge the deck surface as this may affect proper head gasket seal.

- Make sure all carbon and dirt is removed from all cylinders. Blow out the cylinders when done.
- Set the right and left head gaskets on the deck of the block and check to make sure the water passages in the **rear of the block** matches the openings in the gasket.
 - If the gaskets are installed incorrectly the engine will overheat and serious damage may result!
 - Use a 10mm/1.50 tap to **clean all the head bolt holes in the deck surface**. This is important!
 - Locate the 14, 100mm long bolts and 4, 60mm short bolts for each head. The new ARP head bolts use a stainless flat washer between the bolt and the aluminum head. You must use GM thread sealer P# 1050026 or equivalent on the head bolt threads where they go into the block. The threads are exposed to the water in the block.
 - If you don't use sealer, **THEY WILL LEAK COOLANT**. Best to use too much than not enough in this situation!

Installation

1. Cylinder Head Installation

- Remove the RAYLAR heads from their packaging and inspect them. If all is well and gasket surfaces are clean and dry, set them carefully on the engine (36 lb). The heads are interchangeable.

- Do not use any sealers, coatings or gasket cements on the new Cometic MLS gaskets. **They are designed for dry installation only!**
- Install the head bolts with washers and plenty of sealant
- Torque in the correct center out, radial pattern. First to just snug, then all to 30ft.lb torque, then all to 50 ft.lb torque. Then the 100mm long bolts get torqued to 55ft.lb.
- When you are done, go back over them at least once more to verify an even torque down.
- **DO NOT OVER TORQUE THE BOLTS.** It is not needed and will damage the block threads.

2. Camshaft Swap

- Turn the crankshaft so the timing mark on the crank gear and the mark on the cam gear line up.
- Remove the three cam gear retainer bolts and remove the gear and chain, set aside.
- Remove the cam retainer, the lifter guides and lifters. Set these in the valley.
- Remove the cam, being careful not to scratch the cam bearings. Check the new cam for any damage. If ok, liberally lube the cam lobes and Journals.
- Slide the new cam in carefully. Replace the cam retainer and bolts. Put two drops of Loctite per bolt.

- Inspect the roller lifters for any roughness. If there is, replace the lifters!
- Oil and reinstall the roller lifters.
- Reinstall the lifter guides.
- Reinstall the guide retainer and its 4 bolts.
- Reinstall the oil pump drive. Make sure it drops in all of the way.
- Loctite and torque the bolt.
- Next, use the cam gear to turn the cam so the alignment mark on the cam gear lines up with the crank mark. Using a straight edge helps here.
- Install the cam gear and chain. Check alignment again!
- Loctite and tighten bolts to 20 ft.lb.
- Remove the rubber gasket from the timing cover, clean the gasket and its groove, removing any old silicone sealer and reinstall the gasket.
- Clean the block and oil pan. Place a small blob of gray GM silicone sealer at the corner of the block and oil pan junction.
- Carefully push the timing cover back over and on to the dowels on the block with the bottom going in first.
- Once the cover is in place, reinstall the 6 bolts and tighten. Using a harmonic balancer installation tool, reinstall the balancer with its reference mark lined up on the crank snout.
- Reinstall the dampener retainer bolt and torque to specs.

3. Now that the heads, cam and lifters are installed you can start putting the pushrods in, long exhaust, short intake, making sure they seat in the lifter cup.
 - Take each roller rocker after oiling it, and install it on a rocker stud, making sure to have the **TRUNNION SEAT UP**.
 - Install a new AFN rocker retainer nut onto each stud making sure that it threads down into the trunnion body of each rocker. Once again check to make sure that the trunnion is right side up.
 - To tighten the rocker nuts, do not use any tool bigger than a 1/4" drive socket set!
 - Starting at cyl #1 TDC and going through the firing order with both valves closed and lifters on the cam base circle, tighten the AFN nuts until the pushrod stops spinning in your fingers. This is 0 clearances between the lifter and valve.
 - At this point it should take between 1 and 2 turns to seat the AFN nut. Don't over tighten these nuts. **120 in.lb MAX!**
 - When this is done, bar the engine over several complete revolutions to make sure there is no binding or valve contact.
4. Reinstall the water pump. Then the water crossover between the front of the heads.
5. Reinstall the tensioner, brackets and belt.
6. Install the 1 3/8" freeze plugs with a small smear of sealer on tap them flush into the holes in the back of the heads. Don't forget to tighten the 1/4" clamp between the crossover and pump.

7. Intake Manifold Installation

- If all looks good, reinstall the valley cover plate being careful that all 4 locating tabs are down against the head intake surface and snapped in place.
- Bend down the 4 tabs of the Cometic head gaskets so they don't hold up the intake manifold.
- Place the intake gaskets on the heads surface and lock them into the tabs of the head gaskets. Using GM gray silicone gasket sealer lay a large bead of sealer on the clean top block rail at each end of the block. This bead should touch and cover the corners of the intake gaskets.
- Once this bead and gaskets are in place, carefully and evenly lower the Raylar intake manifold in to place.
- Use a couple of the intake bolts (BLACK) to check alignment, while checking to see if the manifold is level right to left.
- USE ANTI SIEZE on the intake manifold bolts and thread in by hand as much as possible to insure the manifold is aligned and the bolts are not cross threaded.
- Check the gaskets to make sure they are not sliding down while the manifold is being tightened down.
- Tighten the bolts evenly from side to side; middle out, to insure the manifold is pulled down evenly. **106 in.lb**
- The gasket cement should be squishing out. Let it dry and cut it off later if you want.

8. Injector Removal

- Take the previously removed stock intake manifold, fuel rail and injector assembly and carefully remove the 8 green injector retainer clips.
- Remove the connectors from all 8 injectors.
- Remove the 2 wire clips from the crossover and discard.
- Disconnect the harness clips from the fuel rail and set the harness aside.
- Locate the steel retainer clip at the junction of each fuel rail with the crossover tube.
- With a die grinder and carbide cutter, CAREFULLY remove the outer edge of these retainers until they split apart to allow the fuel rail crossover to separate.
- **** DANGER , GAS WILL COME OUT, DANGER, GAS WILL COME OUT, DANGER ****
- **Be careful, no sparks, smoking, fires, anything!!! Get all of the fuel out of the FUEL RAIL.**
- Remove the blue o-rings and save.
- Test fit the new Raylar fuel crossover to the new manifold and old fuel rails. Do not use the crossover O-rings for this test!
- Lube the o-rings on the bottom of the injectors and set the rails on the correct side of the manifold.
- The crossover will only fit one way. When the crossover fits in the fuel rails correctly, the o-ring shoulder stops go completely inside the fuel rails.

- Now push the injectors into their respective holes in the manifold.
- Check carefully as the injectors are being push into place that the o-rings do not bulge out, dislodge, get pinched or cut while sliding into their holes.
- The rails and injectors should fit down tight on the manifold and the crossover shoulder should stay completely inside the receiver.
- The retainer bolt holes should have a slight compression.
- If all is well, now take it apart, put the o-rings on the crossover and set it aside.

9. Injectors Installation

- The #2, 4, 6, 8 injector connector wires need to be fished under the center of the Raylar manifold.
- A wire hook will be useful here. Make sure the correct cylinder connectors go to the correct side of the manifold.
- With that done, the fuel rails and crossover are reassembled with the o-rings and worked in.
- Watch the o-rings of the crossovers and injectors for fit.
- When it is installed correctly, use the 6mm short bolts to secure it down. Look it over again. You don't want fuel leaks!
- The crossover should be very stable and not move.
- Now put the green locks back in the injector connectors and connect to their correct injectors.
- The connectors are numbered so make sure you put the correct connector on the correct cylinder!

- This fit is critical to prevent any high pressure fuel leaks. After installation of the engine but prior to starting and running the engine, the crossover and injector o-ring seals should be checked with fuel pressure and the pump on. The injector fit and seal can only be checked with the engine fuel pressure on. When first started, carefully check and inspect for leaks!
- When doing these fuel leak tests, it is a good time to bleed the air out of the fuel rails by way of the Schrader valve and fuel pressure gauge. The gauge will also be needed to set the fuel pressure to 51 lb. No vacuum. This is required because of the higher HP.

2001 - 2004 Merc engines.

1. Remove the plastic cover from the existing cool fuel assembly on the lower left side of the engine by the left motor mount. There is an existing pressure regulator on top front of the fuel cooler.
2. Unthread the steel fuel line from the front of this regulator and reinstall the brass fuel line plug included in the kit.
3. Take the 5/16" black fuel hose supplied with the kit and attach this fuel hose to the steel line removed using the brass coupler included in the kit.
4. Tighten these fuel line fittings carefully so as to properly seal them and prevent fuel leaks.

5. Route this fuel hose back along the bottom left side of the block and up to the factory 5/16" fuel return connector on the fuel rail.
6. Using a push-on fitting fuel line removal tool, remove the existing return line cap from the fuel rail and plug the new 5/16" rubber hose, push on fitting end on to this location.
7. The primary fuel feed hose can now be reattached to the fuel rail. The fuel pressure is now adjusted with the regulator on the fuel rail, pump running, engine off, and no vacuum. 51 PSI.
8. You need a # 10 anti-tamper torx bit to turn the regulator adjusting screw. If the screw won't turn and strips out, you will need to remove the snap ring that holds in the regulator and get a replacement regulator.

2005 – 2010 Merc engines

1. Fuel pressure regulator. It is located on top of the fuel pump on the right front of the engine. It is held in by 2 Allen screws.
2. Remove these and remove the regulator.
3. The replacement Raylar regulator is simply lubed and pushed back in the hole.

4. Reinstall the 2 Allen screws. Use the correct size Allen wrench to adjust the regulator screw and be sure to tighten the lock nut. You should also put a drop of paint on the threads.
5. The pressure is set at 51 PSI. Pump running, engine off, with no vacuum.

10. Intake manifold

- From the original manifold, you will need to remove these parts:
 - Remove the 3 10mm nuts holding the throttle body and linkage, set it aside.
 - Remove the three 6mm studs and screw them in to the Raylar manifold, same place.
 - Next, the 10mm bolt holding the map sensor. Take the sensor and its grommet and insert it in to the back of the new manifold plenum.
 - Remove the IAT sender and screw it in next to the MAP sensor. Remove the IAC motor and spacer plate. Be careful with the gaskets as you still need them.
 - Install the base on the plenum with the 2 10mm bolts, hose nipple down. Then attach the IAC motor with the 2 Allen screws.
 - Unscrew the 10mm bolt that holds down the oil fill tube from the manifold. Remove the tube from the manifold; it is very tight.

- To reinstall the tube in the Raylar manifold there are 2 common ways.
 - First way is to bend the mounting tab to line up with the $\frac{1}{4}$ bolt hole in the throttle body mount. This makes it very solid.
 - The second way we have seen people do it, is put a screw through the new manifold oil fill tube and into the steel oil fill tube from the original manifold to hold it in place and use either silicone or JB weld to make it permanently attached to the manifold.

11. Throttle body

- Remove the $\frac{1}{8}$ " spacer plate and progressive linkage and save the hardware.
- Save one gasket and put it on the three studs already screwed into the Raylar manifold at this time.
- Increase the size of the hole in the throttle plate to $\frac{5}{16}$ " and install the throttle body with the three 10mm nuts. This will allow enough air to pass through the throttle body to still idle and set the TPS sensor at 0.6 volts. The 375 HP has a $\frac{3}{16}$ " hole; the 425 HP has a $\frac{19}{64}$ " or just less than $\frac{5}{16}$ ".
- For our starting point, we use $\frac{5}{16}$ ". Idle RPM in a HO computer is 650 RPM. This is what you want it set at. Now route the $\frac{3}{4}$ " IAC hose under the plenum from the throttle body to the IAC block in the rear.

- For reference, the BP203 cam gets a 5/16" hole, and the BP206 cam gets 3/8" in the throttle body.
- The Raylar Throttle arm lever is attached to the throttle body with a spacer and 1/4" screw that the original progressive linkage donates.
- Use the spacer and 1/4" bolt to attach the lever to the throttle body. (See pictures).

12. Wiring and Computer

- At this time you can start piling all that lovely wiring and computer back on top of the engine.
- It is very self-explanatory where the wires and connectors go too, as they only connect to their particular connectors.
- Under the computer support plate it gets very tight. Be careful not to pinch or damage the wiring.
- Another good idea is to drill a hole through the computer mounting plate to allow adjusting the fuel pressure regulator after the computer is mounted.
- For those who want to beautify their engines, we have a computer relocation plate that moves the computer to the rear of the head. It requires understanding of wiring and some minor wire extending. It really cleans up the top and valve cover area.
- Now for those who are very competent in wiring we also have a coil relocation kit. It takes the coils off the valve covers and puts them down under the exhaust headers. Very cool stuff. Requires

somebody to be very comfortable with rewiring but the results are worth it.

13. GET A SCAN TOOL!!!

Either a Merc scanner or Rinda technologies dia- com for Merc engines. I can't say that enough times! Whenever somebody calls up and says it won't run or start or whatever; my first question is, what did the scan tool say? If they reply, Uhhhhhh I don't know; then neither do I. If you don't want to buy one, find someone who has one, it will save you so much time in the long run. Considering the investment in your boat and engine it just makes dollars and sense. It isn't that big of an investment and you can rent it too your friends! You need to check voltages and scan codes to dial in your engine. If you have any issues down the road or on the lake, it can save your whole vacation.