

What's the big deal about marine engines and why don't you rebuild them?

Recently, while talking with an AERA member, he mentioned rebuilding marine engines in 1998 and at that time the learning curve was straight up! He was absolutely correct with that statement. We had a good laugh because we had both experienced the same problems with the boat owners and we made some of the same mistakes working with them on their marine engines.

That lengthy conversation brought up many topics and considerations we wished we would have covered before becoming involved with building marine engines. Below is a condensed version of the highlights of that conversation. We feel that remembering any one of these comments may save you time and money in the future.

1. Most boat owners can talk HP, MPH and RPM. That is about all they know about their engine(s) and the rest is hearsay.
2. The marine industry has done a fine job of not cutting prices on parts or service.
3. Adding RPM to a boat engine requires a great amount of torque increase.
4. It takes lots of money to add power to a marine engine, there are no short cuts.

5. Horsepower in gasoline marine engines is limited by their exhaust system.
6. Water in gasoline will lean-out carburetors and scuff pistons (big time).
7. Marine gasoline engines must use NO-SPARK alternators, starters and distributors.
8. Use Extreme Caution when using a battery charger or jumper cables. (Sparks)

Extreme caution must be used when gasoline spills in a boat, as its fumes settle in the bottom of the hull. Just one wayward spark and you might wake up in the water, that is, if you are lucky.

Working in the automotive/heavy duty machine shops you get used to working on the same engines day in and day out. Working near Chicago, IL with Lake Michigan at our front door we are used to having really cold winters. And as every spring rolls around the phone calls would start. These calls were from people who owned boats saying they have water in the engine oil. Most owners would remove the engine themselves and bring it to the machine shop to save money.

On the small block Chevys, I would remove the intake manifold while the customer was standing there. Doing so,

allows the customer to visually see the cracks in the lifter valley front to back above the lifter bores and giving the customer comfort that I did indeed know what I was talking about. After seeing the cracks the customer now believed me when I called and told him the price to fix their engine. The owners did their own boat winterizing to save money. Trying to save the money the Marina would have charged them was not a good idea. They really saved nothing because now they have cracked blocks, heads, exhaust manifolds or risers.

Depending on the location of your shop to inland waterways you might have seen some of these marine engines. It could be a small or big V8 like an AMC 327, Chrysler 318-440, Chevy 305-377, Ford 302-460, and Oldsmobile 455's used in 70's Jet boats. It also might be an old (L) head flat head style engine. Gasoline marine engines equipped with carburetor(s) or with fuel injection are common place today. Heavy duty diesel marine engines have specific HP ratings with special injectors and injection pump timing. Don't just use truck information when working on a marine diesel, because it will be a comeback! Most coastal shops see diesel engines all the time from fishing fleets, cargo ships and so on.

Business is booming at Port City Machine

In fifteen years of rebuilding marine engines, Skip Ohnmacht has learned to treat them as you would a mild performance engine. Reasons being, most boat engines operate at a mid- to upper-range of the RPM scale and are used to anything in the 4,000 RPM range and higher. Most of the marine engines he builds see very little idle time, so the engines had better be able to handle the RPM range.

Skip has been building engines in Oswego, New York for 17 years. His shop, Port City Machine, is located near the shores of Lake Ontario, where there is plenty of open water for the boating enthusiast.

After the block is checked out and found to be okay, he will align-hone it first. Then, bore and hone the cylinders with a torque plate. Then most commonly, deck the top of the block on almost all marine applications. The connecting rods are replaced or reconditioned and he only uses new bolts. The small or pin ends are checked for correct clearance or interference as required.

Switching over to a roller tappet camshaft is a good idea given the ongoing status of engine oils to eliminate any problems. When he has to use a flat tappet setup, he coats the contact surface of flat tappet lifters with a thick Moly paste to help prevent the cam lobe/lifter premature wear problems.

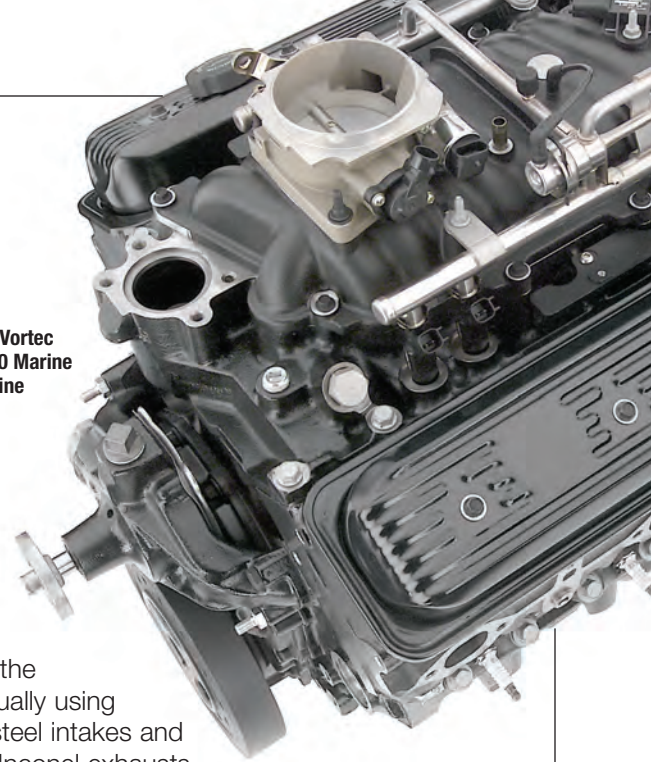
He recommends using the common upgrades whenever possible, such as hypereutectic pistons with coated skirts, Moly rings, high-volume oil pumps (if required) with heavy-duty drive shafts.

Skip installs marine grade Fel-Pro or Victor head gaskets, although he is careful to mention that there are other good brands on the market.

All bearing clearances are checked with a dial bore gauge graduated in .0001" increments. On small block Chevy crankshaft oil clearance, he holds the connecting rod clearance to .0020/.0025". The main bearing oil clearance is limited to .0023/.0028". He generally increases the piston to bore standard clearance an additional .0007-.0010" over typical street engines.

The cylinder heads get bronze valve guide liners or new valve guides during the valve job and he installs hardened seats (if needed).

GM Vortec
5700 Marine
Engine



He also upgrades the valves, usually using stainless steel intakes and Stellite or Inconel exhausts.

The customers (if retail) are strongly encouraged to seek the services of qualified marine technicians for their installation. Skip has found that the customer with a "buddy" who "knows all about engines" is usually a problem.

Costwise, if possible, he offers the added service of cleaning and installing the tinware and intake manifold. And then, adding on priming the oil system to check for leaks and to ensure all rockers/push rods are getting oil up to them. He also prefers to install the damper or flywheel (if applicable) to check the accuracy of the timing marks. In other words, make sure TDC is actually a true TDC, which is very important on any engine.

Attention to detail and double-checking your work goes a long way in the engine business, and marine engines are no different.

He always tells the guys in his shop that if something doesn't seem right, stop, because it probably isn't.

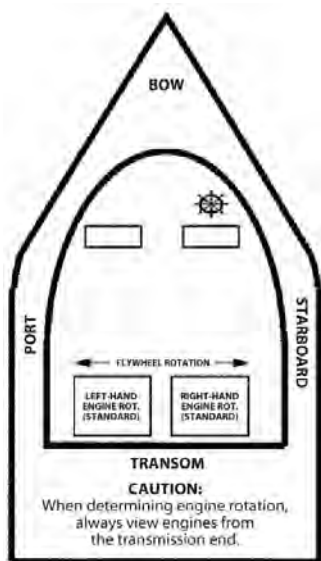
Machine shops need to make SURE that they charge enough MONEY to do the job correctly. Don't try to compete with mass auto parts retailers — you don't know what they are quoting over the phone. Production engine builders are sometimes your best advertising. Also, try to establish a good working relationship with area marinas that do good service work. Make it a point to know the mechanics, as you can both help each other through possible problems. ■

Skip Ohnmacht from Port City Machine in Oswego, NY.
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General Marine Engine Information

Open or closed cooling systems – what does that mean?

The basic marine engine using an open or raw lake water cooling system uses a brass water pump impeller, brass core plugs, stainless steel gaskets and a stainless steel 140° F thermostat. A marine engine which is using a closed cooling system that is just like a car / truck engine will use what is called a heat exchanger. These engines will use a 50/50 water/antifreeze mix in the engine which passes through the heat exchanger just like a radiator. The heat is removed from the 50/50 mix as the air does in a car radiator but it also uses raw lake water passing through the heat exchanger which also cools the 50/50 mix. So, it is really kind of like a double radiator. The closed cooling systems will use a 170° thermostat.



Right- or left-hand engine rotation?

Rotation is always determined by looking at the flywheel end of an inboard engine. The flywheel of a standard rotation engine turns left, or counter-clockwise, when viewed from the flywheel. The flywheel of a reverse rotation engine turns right, or clockwise, when viewed from the flywheel. Most single engine inboard and I/O boats use a standard rotation (L.H.) counter-clockwise engine. Use the illustration to the right, supplied by API MARINE, to help understand engine rotation.



Reverse and standard rotation engines, are you sure which one you are working on?

Reverse rotation engines have a different cylinder firing orders as shown in the example below.

Sample:

350 Chevrolet
Standard Rotation 1-8-4-3-6-5-7-2,
Reverse Rotation 1-2-7-5-6-3-4-8.

Piston pin offset (if there is any) has to be reversed on reverse rotation engines. Reverse rotation engines must have the pistons installed with front arrow or notch facing the rear of the engine. Pistons without an offset or front marking will not matter in standard or reverse rotation engines. Reverse rotation engine camshafts are special ground and some are out of production, so you'll have to have yours reground if it can't be replaced.

Some marine engines have non-directional crankshaft oil seals so they can seal whether standard or reverse rotation. But others have SPECIAL directional crankshafts seals which must be used to prevent engine oil leaks. Other, older engines still use a rope seal for oil containment.

Which oil pump to use in a 454 Big Block Chevrolet... a standard or hi-volume pump?

If it is a MerCruiser 330 HP with small oval port heads and a cast iron crankshaft, use the standard oil pump. If the engine is a MerCruiser 454 with big rectangular port cylinder heads and a steel crankshaft, use the Hi-Volume pump.

High-performance marine engines

A machine shop just starting in the marine rebuilding process should probably NOT venture into the marine high-performance area at first. Take your time and look around at boats with High Performance engines in them. Check out the HP engine manuals for said boat. There is a learning curve that should be first mastered before jumping into the HP marine engine market. High-performance marine engines have their own needs that you must be aware of, or the after effects can be very costly.

Remember, you are performing a specialty service, don't be afraid to charge accordingly. Don't give your labor away, and use quality parts, and charge accordingly.

Make sure of the engine's rotation before you price the job!

This can be a nightmare if you deliver a standard rotation engine when a reverse rotation engine is required. Marine engines account for approximately one-third of our business, and we have been rebuilding them for about 15 years.

Market Share

Well, it's really very difficult trying to determine how many marine engines really exist worldwide, maybe even impossible to accurately guess. I do know however, it is one area of constant growth as manufacturers like high margin products. Press releases like the following really confirm that statement...

"According to NMMA (National Marine Manufacturers Association), the total number of recreational boats in use

Marine vs. Automotive Replacement Parts

Consumers may be unaware of the many important differences between a marine and automotive engine and its respective accessories. The most notable differences are somewhat visual and include the exhaust systems, cooling systems, electrical systems and the fuel systems.

In the different cooling systems, one of the major differences is found in the water-circulating pump (water pump). Unlike their automotive counterparts, some marine pumps work in an open cooling system. This type of system is extremely corrosive to the pump so it must be altered for longevity. A true marine water pump has a special ceramic seal, stainless steel backing plate and a bronze impeller to resist corrosion. An automotive style pump, with its stamped steel impeller, may fail in a short time due to corrosion and possibly begin leaking.

Marine electrical systems are also more specialized than automotive. In an automobile, any gasoline vapors that may escape, will evaporate or vent from the bottom of the engine compartment. Whereas, in a boat with a sealed engine compartment, will allow the escaped gas vapors to accumulate in the bilge or engine compartment. Therefore, any wayward spark could literally cause a catastrophic explosion.

All electrical components in a boat are either completely sealed or specially vented to prevent such a catastrophe. This includes the starter, alternator, distributor and electric fuel pumps and that's why they cost more money.

Although we've only briefly touched on some of the differences between automotive and marine applications, hopefully it will serve to remind us that there are differences and the reasons for these differences need to be shared with our customers.

There may be many other engine component differences as well and replacing with only a like fit verification may provide unwanted results. Here is a short list of common engine components that oftentimes are different than their automotive applications ancestors.

- Lower compression pistons
- Camshaft
- Connecting Rods
- Oil pump volume
- Intake and exhaust valves
- Valve springs coated for rust protection
- All gaskets
- Freeze (core) plugs brass

It is very critical to use the right combination of marine components as no one wants to be responsible to leaving a customer stranded offshore. There is no room for experimenting as you go into the marine business, use only marine duty parts when performing any marine repair. ■



(registered) rose less than 1% in 2007 to nearly 17 million vessels in North America alone. Plainly put, if you're an optimist anyway, that number may represent an opportunity for future engine build sales." ■

We're interested in your thoughts

If you found this information useful or if you have other topics of interest for the magazine, please let us know by calling the AERA tech team directly, toll-free 888-324-2372.



The AERA tech team, from left to right:

Steve Fox has over 20 years experience in the engine building industry with eight of those years spent working in the machine shop. Steve is an ASE-certified Master Machinist, as well as a longtime member of the drag racing circuit.

Dave Hagen, our Senior Technician, has over 36 years of experience in our industry. An ASE-certified Master Machinist, Dave specialized in cylinder head work and complete engine assembly for the first 17 years of his career.

Mike Caruso brings over 42 years of rebuilding and high-performance experience to AERA. An ASE-certified Master Machinist, Mike came to us from FEL-PRO's high-performance R&D and tech line, where he worked for 11 years.