



**By Bill Hancock**

Assistant Editor

**Bill Hancock is a retired engineer with extensive experience in auto racing, engine design and problem solving.**

# 101 TROUBLE SHOOTING

## Engines Need Three Things to Run: Fuel, Air and Spark

*We have all had that moment of agony when the starter lets out a groan after it has either failed to turn the engine over or it has run down the battery after prolonged cranking. Ironically, the engine never fails to start when the boat is on the trailer, and you just want to fire it up to check something or just to hear it run. Invariably it will start every time.*

*But invite important guests, schedule a cruise, load up the cooler, tow to a beautiful lake, hop in the boat and then... Nothing. If it happens out on the lake, hopefully there will be some good Samaritan who will appear and either tow you in or offer a solution to your plight. With that in mind, let's review some troubleshooting basics.*



**A Digital Volt-Ohm Meter DVOM. This is an essential diagnostic tool used to test voltage, resistance, as well as continuity.**

First order of business, proper maintenance! The best way to avoid a no-start is to perform your engine and electrical system maintenance religiously beforehand. Aside from a fully charged battery and a good starter, an engine needs certain things in order to start and remain running; For our first example we will assume that your engine was running perfectly before suddenly not starting.

If the engine literally won't turn over or turns half a turn then abruptly stops, first remove the spark plugs and try to rotate the engine by hand (with the ignition off) to see

if by chance a cylinder has somehow filled with water or seized. If the engine turns freely by hand but won't spin over with the starter, it is probably a starter or electrical problem. Check the battery voltage and make sure all the battery cable connections are clean and tight.



**Premade cables ensure a reliable connection.**

6 Volt systems require heavy duty cables and excellent connections. There can't be any corrosion, or enough current necessary to spin the engine over won't be available. Since 6-Volt systems require twice as much current as a 12-volt system, 6-volt systems are often prone to high resistance problems and need much larger cables to operate properly.

This also goes for the ground strap running from the battery to the engine. Typically, if you have a dead battery, the battery may be low on water, have a bad connection/s, or the charging system has failed. If the charging



**Avoid this style of battery clamp at all costs. They have poor reliability.**

system has failed, you may get lucky and find a loose drive belt, otherwise you will have to replace or repair the system consisting of the generator or alternator and the voltage regulator. Some alternators have an internal voltage regulator. Alternators have become the charging system of choice because of their ability to produce abundant current at low rpm. Today, all but the staunch preservationists have switched over to alternators. Once the charging system has been repaired, you will still need to charge the battery before starting the engine for the first time.

Little known fact. The engine literally runs on the charging system. The battery is simply a well of electricity used to start the engine before the charging system begins to operate. Once the battery loses its charge, the engine cannot be restarted, so it is imperative to have a reliable charging system, and one that can endure prolonged periods of idle speed through no-wake zones without depleting the battery reserve.



**A battery terminal brush used to clean both the male and female terminals thus ensuring a good connection at a critical point in the system.**



**A 12V test light. This will allow you to quickly determine if a component is receiving 12V. Very handy to use in remote areas, where reading a DVOM may be difficult if not impossible to read.**

**Fuel** needs to be fresh and available in the carburetor. Once you have spun the engine over a few times, the fuel pump should have delivered adequate fuel to the carburetor to start the engine. To verify the fuel supply, remove the air cleaner/flame arrestor and look down the center of the carburetor while you have somebody rapidly open and close the throttle once or twice. If the carburetor is getting fuel, you should see a fine mist of gasoline sprayed into the airstream each time you actuate the throttle. If it is not there it means fuel is probably not getting to the carburetor.

### Start at the fuel tank:

Is the tank at least ¼ full? (You would not believe how many service calls are made because there is inadequate fuel in the tank. Do not believe the fuel gage, it may have failed.

Next, make sure ALL of the fuel filters are clean. Typically, there may be as many as three or four filters between the fuel in the bottom of the tank and the float bowl of the carburetor.



**A Sierra combination water separator-Fuel filter and a simple in-line fuel filter.**

**1** – Most boats are equipped with an in-tank screen filter to keep trash and tank debris from entering the fuel line. Servicing this typically requires removal of the tank to gain access. Because of the difficulty to access it, you may want to save this step for last. Note, it is not at all unlikely that this filter will be 40-50 years old since it is so hard to change.



**A collection of defective brass fittings and a classic glass fuel bowl filter arrangement all of which created problems until replaced.**

**2** – An inline metal canister with a paper element filter in the fuel line. These are cheap and easily replaced, just remember to install with the arrow pointing toward the engine, and the “in” pointing toward the fuel tank.



**An old outboard gas tank which has been refitted and repurposed to provide a portable “test tank” filled with fresh, known good fuel with no filters. Hooked directly to the fuel pump for a test run, it eliminates any question of plugged lines, clogged filters, water in the fuel, or broken fittings.**

**3** – A combination water separator/fuel filter. Best to just replace these filters.

**4** – A porous bronze filter inside the fuel line fitting on the carburetor. You should be able to blow through these. If not, replace it.

## RUBBER FUEL LINES

Some rubber hose materials are not compatible with fuels containing ethanol. Today, it is safe to assume that ALL pump gas contains up to 15% ethanol unless specifically labelled as NON-Ethanol. Continued exposure to ethanol-based fuels causes some types of hose material to soften and degrade. Some fuel lines have been known to soften internally and become severely restricted or blocked completely while still looking fresh and new on the outside. The solution is to replace the entire line with new fuel line specifically rated for ethanol-based fuels. Auto parts stores typically refer to this as fuel injection hose. It is much stiffer and more resistant to ethanol fuels.



**Flexible fuel line suitable for fuels containing ethanol.**

Next, detach the fuel line from the carburetor, disable the ignition to prevent a spark, and have somebody briefly crank the engine while you hold a cup to catch the fuel that should flow out of the open line. If nothing comes out, you have isolated the problem to be lack of fuel. In most cases there is usually some fuel flow, but not enough to sustain running at speed. The engine may idle and move the boat slowly, but once the throttle is opened, there is not enough fuel flow to supply the required power. Sometimes this problem is somewhat random. One day the boat will run fine, and on another day it won't run wide open. This is usually a sign of debris in the tank itself which sloshes around and gets sucked up to block the in-tank fuel screen. Once the engine is turned off, the debris falls off the screen and settles into the tank. To fix the problem, remove the tank, have it professionally cleaned, and the in-tank filter replaced. Radiator repair shops are the best place to have this done.

If a fuel fitting or fuel line somewhere between the tank and the fuel pump is plugged or cracked the fuel pump cannot draw fuel from the tank. Just because a fitting is cracked, it may not leak fuel. It may be higher than the fuel level and act as an air leak preventing the pump from developing necessary suction to draw the fuel from the tank. In some rare instances, engines with cracked fuel fittings will run fine until they are under load and the fuel demand

increases, at which time the air leak in the line prevents full flow from reaching the engine thus limiting the power.

If the filters are clean or new, fully inspect the fuel lines over their entire length. If they are copper or steel, perhaps they were somehow partially crimped shut thus limiting full flow.

### Intermittent Problems –

Occasionally an engine will run well at the dock and at low speed but fail to make full power once it is out on open water. With greater power demand, more fuel must be delivered. Either due to blockage or leakage causing insufficient fuel flow, the engine



**A combination vacuum-pressure gauge and inline tee fitting used to connect the gage to an existing fuel line. Useful in measuring not only fuel pressure which typically should range from 5-7 psi for a carbureted engine, but also able to measure intake manifold vacuum.**

cannot produce its rated power. Isolate the entire fuel system by using a small portable auxiliary tank. Disable the old tank and lines, being careful to cap off the existing fuel supply line, then plumb the test tank into your system, just before the fuel pump. Next, using a Tee, plumb a fuel pressure gage into the line just before it enters the carburetor, and make another run. The fuel pressure at the carburetor must remain at 5-7 psi for the engine to perform correctly. If the pressure drops, there is a fuel starvation problem downstream of the gage, indicating blockage or a bad fuel pump. If the pressure spikes, it could indicate a blockage in the carburetor. Typically, the blockage would either come from a stuck float or a plugged internal filter.

**Air** – Checking for sufficient air is simple. Unless you have a clogged air filter or flame arrestor, or the throttle is closed, the engine should have air.

**Spark**, or lack thereof, can be complicated. Start your troubleshooting by disconnecting a plug wire and removing the spark plug. Reattach the wire to the spark plug, then lay the plug on the engine so the threaded portion of the plug is grounded to the engine. With the throttle closed, have somebody try to start the engine by turning on the ignition while you watch the tip of the spark plug to see if there is a spark.



**A test spark plug. Simply clamp to a grounded part of the engine and hook a spark plug or coil wire to the plug and see if there is a spark when the engine is turned over with the ignition on.**



**Ignition coils and a ballast resistor used to reduce the voltage going to the coil once the engine is running.**

If there is no spark, disconnect the wire leading from the center of the coil to the distributor cap. Using a pair of insulated pliers, hold the coil wire next to bare metal

on the engine, and try spinning the engine with the ignition on. You should see sparks coming from the wire.

If the coil fails to provide a spark, remove the distributor cap and rotor. Look at the points. If the points are not opening or if they are pitted or out of adjustment, the system will not produce a spark. Next, check the condenser. Carefully remove the condenser, (it may be charged and give you a nasty shock, so be careful to discharge it before touching it to remove it. Discharge it by touching the wire to the side of the distributor body. The easy way to do this is by using a pair of insulated long nose pliers). Since you will have no way to test the condenser, simply replace it. If your system uses a condenser and points, it pays to carry spares. These days points and condensers are

a dying breed and not all auto parts stores carry some of the less than popular part numbers.

The coil might be at fault. If you have an ohm meter, check the resistance between the positive and negative terminals. Compare the resistance to the specification for your coil.

If the coil is good, check to make sure you are getting current to the coil when the ignition is in both the start and run positions of your ignition switch. In many systems, with the key in the "start" position, full voltage is delivered to the coil thus producing a better spark to aid in starting. Once the engine starts and the key is returned to the "run" position, the current to the coil is reduced to reduce wear on the system. A ballast resistor is used to reduce the current, and if it fails, spark will not occur. Check for

# GIESLER BOATS

## Builders of traditional wood boats

**Computers don't design our boats. Craftsmen do**

**18 models to choose from including rowboats and canoes**

B. Giesler & Sons Ltd  
303 elm street  
Powassan, On P0H 1Z0  
Ph 705 724 2648  
[www.gieslerboats.ca](http://www.gieslerboats.ca)

## YEAR, MAKE, AND MODEL

Today, the small independent auto parts stores are disappearing. They are being replaced by chain stores which utilize a computerized inventory. Along with the computerized inventory are counter people whose parents were not even born when points and condensers were abandoned over 50 years ago. Learn what vehicle or piece of industrial equipment uses similar ignition parts to those in your engine and use that knowledge to communicate with the counter person. After greeting you, their first question will be "What Year, Make, and Model do you have?" Telling the counter person that you have a 1947 Hacker with a straight 6 will just get you a blank stare. Learn what year make and model car or tractor had the same engine as your boat has and shop for these items BEFORE you need them so when the parts fail you will have the correct parts on hand to make the necessary repairs. The best place to find the correct parts is from one of the advertisers in the various Antique & Classic boating ads.

continuity.

At this point, if you are still in a no-start condition, look deeper. The next step is to remove a spark plug and do a compression check. Compare the readings from cylinder to cylinder. If the compression is 90-100 psi or better and the cylinders don't vary more than 10%, best to worst, you should be OK. If the compression is low, you may have worn rings, or the oil may have been washed from the bores by either a rich condition such as a malfunctioning choke or due to a sunken carburetor float. With the spark plugs removed, squirt a few squirts of engine oil in each of the cylinders while spinning the engine and rerun the compression test. If the compression is still low after squirting oil in the cylinders, this may indicate you have suffered a cam timing problem. A quick way of testing for this is to hook up a timing light

and see if the spark timing has moved. If the timing has moved significantly, chances are that your engine has suffered a broken or slipped timing chain or stripped gear. This will require a major repair typically involving removing the timing cover, cam drive gears and cam, then removing the debris from the oil pan, realigning the camshaft, installing the gears and chain, reassembling the engine, and retiming the distributor.

In the event of a no-start, do not panic. Stop, collect your thoughts, and take a deep breath. Recite "Fuel, Air, Spark", then eliminate the causes one by one in methodical order rather than skipping around. Follow the Fuel, Air, and Spark in a logical sequence. Resist the temptation to use the shotgun approach and start trying things out of order as they occur to you or because they are easy to reach. **If you use the random**

**approach you will tend to invariably skip over the critical step.**

Never fear! What typically happens in these scenarios is that "Uncle Bob", a well-meaning passenger or neighbor will immediately chime in and start becoming the mechanic or troubleshooter. If he is truly an experienced engine mechanic, step aside and stay out of his way. If not, find something for him to do since he will just confuse the issue and compound the problem. In their own way, he is really trying to be helpful, but reciting what may have happened to his friends over the years is sort of a hit and miss proposition. Use a methodical approach based on common sense. When you have followed a logical troubleshooting sequence to no avail, then turn to Bob and tell him that it is his turn.

During the off-season, get a generic engine repair manual and practice with your engine, while it is not mission critical. Learn how your engine works and how to perform basic repairs and adjustments. It's great to have a good mechanic, but other than Uncle Bob, they are never there when you need them.

If you do need to get towed, be careful if you use a towing service. Unless you have a current membership with the service, always get a quote first. One of the best deals on the water is one of the towing service memberships. They are very reasonable and provide excellent service.

*Happy Boating*

Gary Scherb                      Ingrid Scherb                      Doug Scherb



Shop: (352) 742-0475                      28206 CR 561  
Cell: (352) 267-5771                      Tavares, FL 32778

**Engines and Accessories Rebuilt**



**Don Wilson**  
Keeping Legends Alive

33212 Manatee Rd, Tavares, FL 32778  
250 Alsace Ave, Venice, FL 34293  
201-835-2616      bluskydw@gmail.com