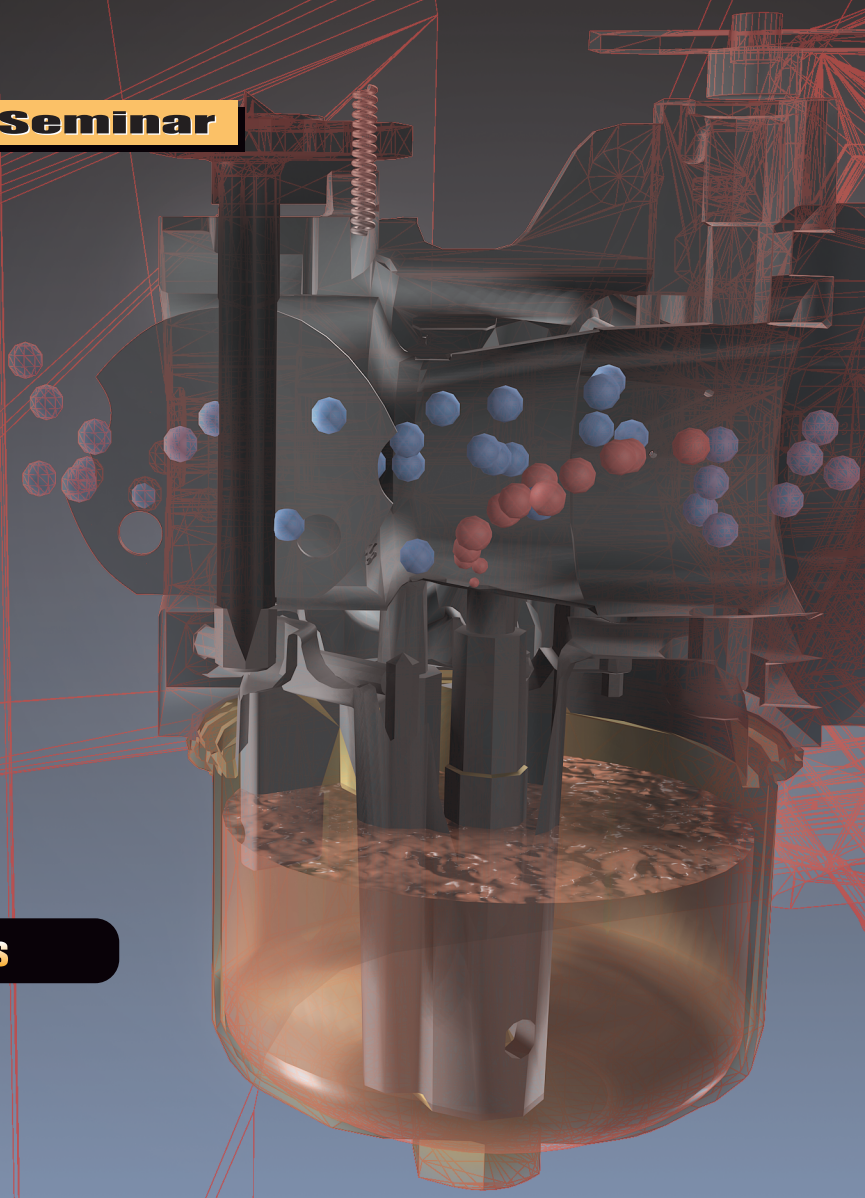
BRIGGS&STRATTON®

Technical Update Seminar



Carburetion Diagnostics

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Do you remember the first time you diagnosed a carburetion related problem? It might have been last year or 20 years ago. Whenever it was, it was probably frustrating and resulted in a lot of wasted time.

Briggs & Stratton recognizes that many new technicians struggle with understanding the variety of carburetors they're exposed to on a daily basis. Even seasoned technicians still struggle with carburetion related concerns.

Many technicians have diagnostic tools in their arsenal which, when used correctly, will reduce the time necessary to troubleshoot and repair carburetor problems. However, tools aren't the only thing you will need for diagnostic work. You also need experience, a clear understanding of what the symptoms of the problem are, and knowledge about what causes them.

During this update we're going to list the common symptoms that cause warranty and service-related issues in carburetion. Then we'll investigate the many causes of those symptoms. Before we list the common symptoms lets review the strokes of a four-cycle engine.

The four strokes are as follows:

1. Intake
2. Compression
3. Power
4. Exhaust

There are three very important components that must be present for an engine to run properly. They are:

1. Ignition (Spark)
2. Compression
3. Carburetion

If any of these three components are missing or are not working properly the engine will not perform as expected and problems will arise. Let's list the most common symptoms that can cause carburetion, warranty and servicing issues.

The symptoms are:

A. The engine will not start.
B. The engine is hard to start.
C. The engine starts but will not idle.
D. The engine starts and idles but will not run properly at top no-load speed.
E. The engine starts and idles but shows slight hesitation with possible stalling while performing light to moderate work.
F. The engine starts and idles, but will not run under load.
G. The engine starts, idles, runs at top no-load speed and under load, but stops running after a short period of time.
H. Engine oil dilution occurs when the engine is not running.
I. Engine oil dilution occurs only when the engine is running.

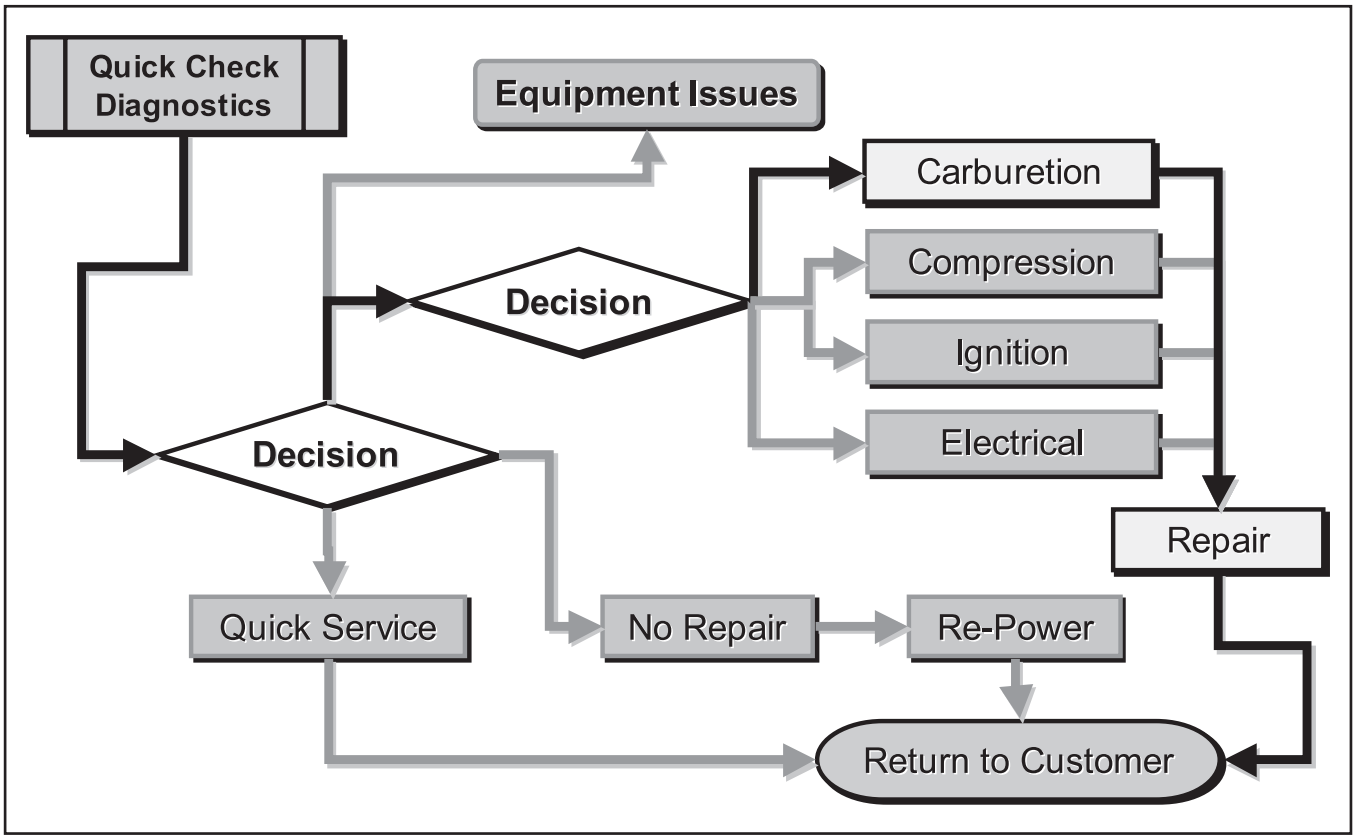
Now that we have a list of common carburetor symptoms, let's analyze the cause and effect relationships of each one. The systematic approach of troubleshooting displays well on a flow chart. Following a well-designed flowchart can make problem solving much easier. It's similar to using a road map, because each time you come to an intersection you have to decide where to go next.

With a flow chart, you base your decisions on the data obtained using diagnostic tools, your own experience, or advice from a more experienced technician. From this point on we will use our carburetor symptoms to build a detailed carburetor diagnostics flowchart, which should make solving future carburetor problems easier.

A carburetor is a mechanical device that combines fuel and air. The fuel and air are usually metered and mixed in the proper proportions. It stands to reason then, that problems will typically involve the mechanical nature of the device, and/or with the delivery of fuel and air in the proper proportions. Carburetors use fresh fuel, clean air and up to four moving mechanical parts. The mechanical parts are the choke shaft (if equipped), throttle shaft, float and inlet needle and seat. If any of these are unable to perform their function, the carburetor will fail to perform properly.

Following a systematic diagnostic approach is critical. It's important to check and verify each step. We've made some presumptions for this program that a thorough Quick Check has been performed, such as fresh fuel is present, the choke operates as it should, etc.

With this in mind, lets get started. In our first example, the symptom is:



A. The engine will not start.

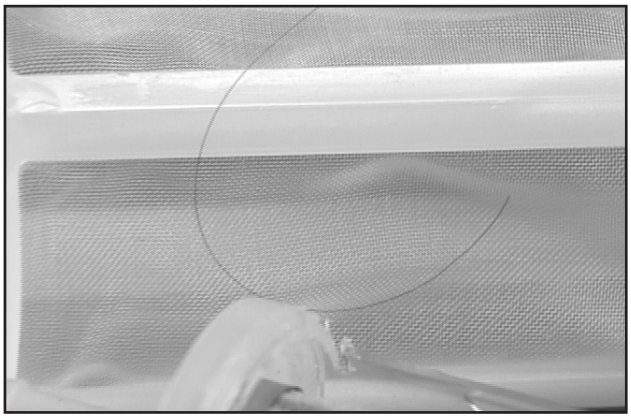
Dirt and debris has been and continues to be the number one problem for carburetors. We need to better understand what dirt or debris is and where and how it enters the carburetion system.

Dirt is a natural substance that can find its way into the carburetor through the air intake or dislodged gaskets. Dirt can also enter through the fuel system when the customer removes the gas cap or directly from a contaminated supply tank. Depending on the type of fuel filter being used and the size of the particles of dirt, the carburetor may never be affected.

Debris is an undesirable substance such as plastic, rubber, or metal shavings. When material other than fuel is found within a fuel system, making a distinction as to what the material is and where it was found can aid in establishing how it got there. Sometimes, the type of material can even establish who is at fault. For instance, small black, plastic chips found plugging a fuel inlet on a brand new lawn mower featuring a black plastic fuel tank, may place the blame on the manufacturer.

Non-professional servicing practices such as dirty repair benches or using bolts to plug fuel lines can cause dirt or debris to enter the system. A carburetor repair bench should always be kept clean. Fuel line clamps should be used to stop fuel flow before disconnecting any fuel lines

Fuel filters capture some of the dirt and debris that enters the fuel system during equipment usage. Briggs & Stratton has always offered a fuel filter with its engines. Ultimately, Original Equipment Manufacturers (OEM) decide what fuel filter will or will not be used on the application, with the exception of most Briggs & Stratton fuel tanks that come standard with fuel filters. Fuel filters are rated by the size of debris the filter will not allow through the filter media. This measurement is referred to as Micron size. There are 25,400 microns in one inch. By comparison, an average human hair is 40 to 300 microns thick.



If passing debris is smaller than the smallest orifice in the carburetor, it won't cause a problem unless enough fine particulate passes through the fuel filter and builds up in the carburetor passageways. Eventually it could cause an obstruction. If dirt or debris in the fuel continues to flow through the filter it will end up in the carburetor bowl. If the dirt or debris lodges in the main jet, the fuel cannot flow up the high-speed circuit to start the engine.

Other symptoms that can occur with a clogged or partially blocked main jet are:

F. The engine starts and idles but will not run under load.

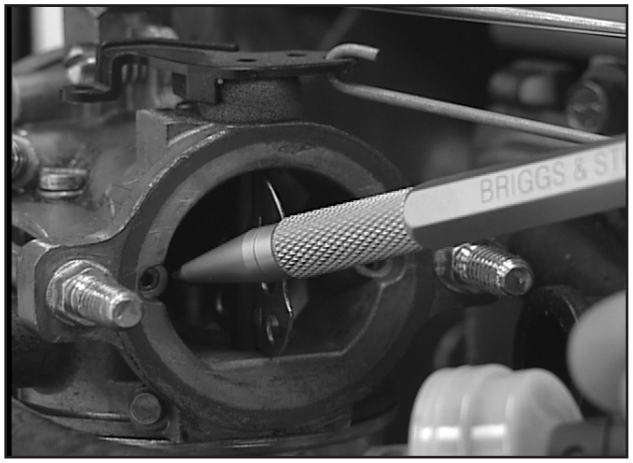
G. The engine starts, idles, runs at top no-load speed and under load, but stops running after a short period of time.

The flow charts for these two symptoms follow very similar paths.

If dirt or debris partially blocks the main jet while the engine is running and a load is applied, the carburetor cannot supply enough fuel to keep the engine running. Known also as a loss of power, the engine stops running and the dirt falls away from the main jet resulting in the customer being able to once again start the engine. The customer can continue performing some work until the dirt once again becomes temporarily lodged in the main jet. This cycle will repeat itself until the dirt becomes permanently lodged in the main jet, causing a permanent “no start” symptom.

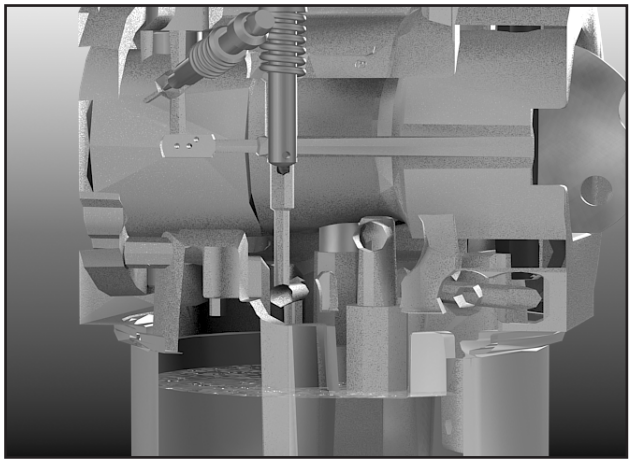
Lets look at symptom “C” next.

C. The engine starts but will not idle resulting in a pronounced hunting and surging.



This symptom is the result of dirt or debris lodged in the fuel idle circuit. The dirt or debris can be introduced from the fuel system or an external bowl vent. Remember, the external bowl vent is typically not filtered since there is very little air movement. If the idle fuel passageway is completely clogged, the engine will try to stall. As the engine begins to coast down, the governor spring opens the throttle plate. As the governor spring opens the throttle plate, the low-pressure area moves above the main nozzle. This causes a charge of fuel to enter the carburetor and engine speed increases. The result is hunting and surging.

To isolate whether the problem is carburetor or governor related, hold the throttle plate closed to force the engine to idle. If the engine continues to run, you know there’s a problem with the governor system. If the engine stalls, inspect the fuel supply route to the idle circuit. The smallest fuel orifice in most float feed style carburetors is the idle circuit pilot jet.



These carburetors can have an idle air orifice size as small as .024 (.6mm) and an idle fuel pilot jet orifice at least .0025 (.064mm).

Dirt and debris entering through a ripped or torn air cleaner can collect in the idle air circuit causing it to become clogged before the pilot jet. When this occurs the pilot jet will only flow raw fuel to the combustion chamber from idle to light load conditions. This can result in light black smoke from the exhaust. The carburetor will hunt and surge due to this symptom. An otoscope is a great tool to help diagnose this condition.

If the carburetor has an idle mixture screw, you can use it as a diagnostic aid. While the engine is running, adjust the idle mixture screw until the engine runs smoothly. Shut the engine off. Count the number of turns it takes to bottom the screw out. If the idle mixture screw was turned less than one revolution, there is a good chance the idle air circuit is clogged.

Now, lets go back to symptom “B”.

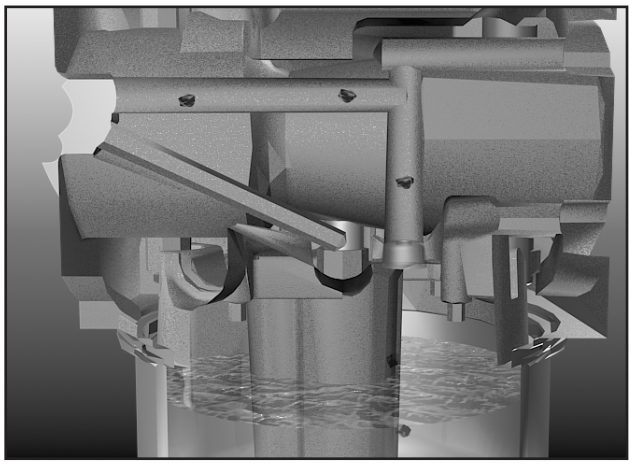
B. The engine is hard to start.

A choke style carburetor exhibits harder starting when the high-speed air circuit is clogged. The high-speed air bleed acts as a vent to allow the fuel to be drawn up the emulsion tube. When dirt or debris enters the high-speed air circuit, it stops the airflow from reaching the emulsion tube. The carburetor cannot mix the air with the fuel. The visual sign of a clogged high-speed air circuit under load conditions will be black smoke from the exhaust and a possible loss of power. This same cause can result in an engine showing the symptom of “Engine starts and idles but will not run under load” that we looked at earlier.

Restrictions to the circuits that support light to moderate load conditions can result in similar symptoms. Lets take a moment to identify these.

D. The engine starts and idles, but will not run properly at top no-load.

E. The engine starts and idles, but shows slight hesitation with possible stalling when light loads are applied.



Dirt and debris can enter the transition ports in three different ways resulting in similar symptoms. The first path is when dirt or debris enters through the idle air bleed and mixes with fuel in the pilot jet. The dirt or debris continues to the transition ports. When the transition ports become partially or fully blocked, the engine will hesitate when the engine is under a light to moderate load.

The second path is when dirt or debris enters from the fuel system and travels through the pilot jet orifice to the transition ports.

The final entryway can be the carburetor's bowl vent. The bowl vent does not experience a great deal of air movement. However, because the bowl vent is an unfiltered pathway to the environment, this route must be considered.

The last two symptoms, "H" and "I", can be the easiest to identify and fix. In some cases you need to educate the customer about the equipment.

H. Engine oil dilution occurs when the engine is not running.

I. Engine oil dilution occurs only when the engine is running.

Many customers have described a "gusher" when checking the oil. When they removed the oil fill cap, oil gushed out of the hole as if the engine had mysteriously increased its oil volume. Of course, no engine adds its own oil - even though that's what some customers may describe.

The symptom of "Oil dilution when the engine is not running" is typically caused by dirt or debris wedged between the carburetor's inlet needle and seat. It can also be caused by the float hinge pin sticking, or a defective or mis-adjusted float. When this occurs, it allows the fuel to continually flow through the carburetor intake manifold, through the intake port, down the cylinder wall, and into the crankcase. This condition is called "cylinder wall wash" and will eventually cause a failure of the piston rings and cylinder wall.

One additional condition that can occur while the engine is not running is "Float Bounce". This occurs when the equipment is transported on a trailer or in the back of a car or truck. If the fuel supply shut-off valve is not turned off and the float bounces, it opens the needle and seat allowing unwanted fuel into the carburetor bowl. When fuel overfills the bowl, the excess fuel migrates to the crankcase. A quick and easy fix is to install a fuel shut-off valve in-line between the fuel tank and carburetor inlet.

The final symptom we're going to look at is when engine oil dilution occurs only when the engine is running. This can be caused by:

- Fuel slosh due to operation over rough terrain
- A plugged air cleaner element
- A rich fuel mixture adjustment

Diagnosing and repairing carburetion-related problems requires more than having the right tools. It's a clear understanding of what the symptoms are and what is supposed to happen when the equipment runs properly. If you use a systematic approach of working through the symptoms, your success rate will dramatically increase.