The Online Flagship Publication for the Academy of Model Aeronautics

Published on *Model Aviation* (http://modelaviation.com)

The Basics of Glow Engines

Written by Aaron Balwich
Maintenance and running tips to keep your two-stroke engine happy
Technical
As seen in the August 2017 issue of Model Aviation.

Engine Speak

There is some basic engine terminology you should know to better understand and properly run your model engine. Here's a list of common terms.

The engine case is the main body of the engine.

The head is the part on top of the engine, which is usually bolted in place with four to six bolts. In its center is a threaded hole where the glow plug is installed.

The sleeve is the inside cylinder lining that houses and guides the piston. It is a separate piece from the engine case and has openings or ports cut into its side.

Ports are channels or openings inside the engine case that transfer the fuel and air mixture from the crankcase to the combustion chamber. The ports are opened and closed by the upward and downward motion of the piston.

ABC refers to the materials used in the engine. An ABC engine is one with an aluminum (A) piston, fitted inside a brass (B) sleeve, that's been chrome (C) plated. Most higher-quality engines have ABC construction.

The connecting rod is the part that attaches the piston to the crankshaft. The connecting rod has bushing at either end and is connected to the piston with a wrist pin and to the crankcase with a crankpin.

The Basics

Model airplanes powered by two-stroke or four-stroke glow engines have a long history in our RC hobby. Chances are, when you first started flying that you were introduced to the hobby with an electric-powered airplane. Whether it was kit-built or an ARF, all you needed to do was charge the battery pack and go. Taking a new step into RC airplanes with engines bolted into their noses is an exciting proposition. Let's take a look at what's involved.

Two-stroke engines are the most popular type of engines used in the hobby. They have a good power-to-weight ratio, are fairly inexpensive, and have relatively few moving parts. Maintenance is simple and with a proper break-in, a two-stroke engine will last many years.

The O.S. Max AX line of engines is excellent and they come in several sizes.

Two-stroke engines range in size from .010 cubic inch (cu. in.) displacement to 3 cu. in. and even larger. For the most part, the average engine size is .25 to .40 cu. in. displacement. For more

advanced, higher-performance airplanes, .60 to .72 cu. in. two-stroke engines, and four-stroke engines in the .90 to 1.50 cu. in. range are popular.

All model airplanes have a recommended engine size range, but most perform best when you choose the upper engine size that is recommended. There's nothing worse than an underpowered model, especially when you are trying to learn how to fly.

Engine Breakdown

The engine case is usually made up of three parts: the front housing, the crankcase itself, and the backplate. Some engines have a two-piece case design, but internally, all engines are the same.

The crankshaft is supported within the front housing with a ball bearing or bushings and has a threaded front end. A propeller nut and a propeller washer hold the propeller securely against the thrust washer at the front of the engine.

At its rear, the crankshaft has a counter weight and a crankpin that engages the bottom end of the connecting rod. The connecting rod attaches to the piston with a wrist pin. The piston fits within the engine's sleeve, which fits into, and is supported by, the engine case. The head sits on top of the cylinder and sleeve and the space between the top of the piston and the bottom of the head is the combustion chamber.

Basic Two-Stroke Operation

A two-stroke engine completes one revolution for every power cycle. As the piston moves up it compresses a fresh charge of fuel. The fuel and air mixture heats and is combusted by the glow plug. The upward motion of the piston creates negative pressure within the crankcase below the piston and draws air and fuel from the carburetor through the intake valve.

The combustion of the fuel mixture forces the piston down in the combustion cycle, which now compresses the fresh charge of fuel. As the piston travels down and the hollow crankshaft rotates, the intake valve is closed and the intake ports are opened.

The compressed fuel charge passes through the ports and is directed into the combustion chamber. This happens just as the spent fuel charge exits the combustion chamber through the exhaust port. As the piston starts moving up again, it closes the exhaust port, opens the intake valve, and the process repeats.

Four-Stroke Engines

Four-stroke engines are also extremely popular, mostly because of their wider power band, but also because of their great sound while running. Four-stroke engines are more expensive and more complicated than two-stroke engines and require more maintenance. Instead of having intake and exhaust ports, a four-stroke engine has intake and exhaust valves, as does the engine in your family car.

A four-stroke engine, although slightly more complicated and with more internal parts, produces a great sound while running and provides excellent torque for turning larger propellers.

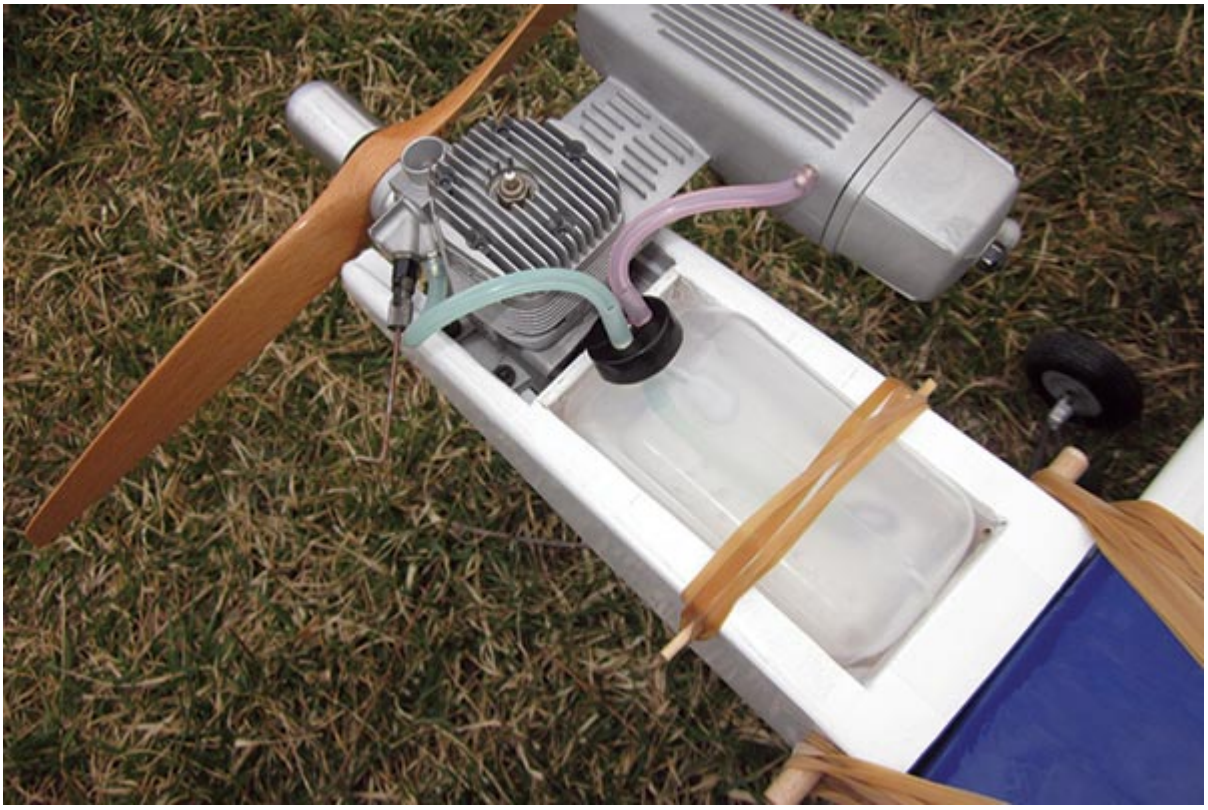
There's a cam assembly driven by the crankshaft as well as lifter rods, tappets, and valve springs. Adjusted properly, four-stroke engines produce a good amount of power, but they produce their peak power at lower rpm than a two-stroke engine of the same displacement. In comparison, a .90-size four-stroke engine produces roughly the same power as a .60-size two-stroke engine.

Start-Up and Break-In

When you have a new, out-of-the-box engine, it needs special handling before you can run it at full throttle. Don't just bolt your two-stroke engine to your airplane and go out to the flying field. Some airplane manufacturers suggest it is okay to do this, but it's better to play it safe the first time out and break in your engine at home where you have tools and supplies handy.

To be specific, breaking in an engine is the gradual fitting together of the engine's internal parts by making short, well-lubricated engine runs.

First, get a new glow plug and make sure it is properly installed. Next, fill the fuel tank with two-stroke fuel that has approximately 5% nitro and 18% to 20% oil. Attach the fuel line to the needle-valve assembly and make sure that the line is not kinked or resting against the engine case because it will heat up as the engine runs.



When attaching the fuel line and vent line from the fuel tank, make sure that they are not kinked or resting against the engine.

Attach the recommended size propeller and install the propeller washer and propeller nut. Snug the propeller nut down and tighten it roughly 1/4 turn. Open the needle valve at least four full turns and fully open the throttle sleeve. Place your thumb over the intake venturi and flip the propeller counterclockwise several times. You will see fuel start to move into the fuel line and flow into the carburetor.

After you have fuel to the carburetor, close the throttle sleeve to approximately 1/4 power and hook up your glow plug drive battery. For safety, I recommend either flipping the propeller over with a chicken stick or using an electric starter until the engine catches and starts to run.

Slowly open the throttle all the way and let the engine run for roughly 10 minutes with a very rich, low-power needle-valve setting. Then stop the engine and let it cool. Repeat this process several times and gradually lean out the engine by a couple of clicks of the needle valve each time.

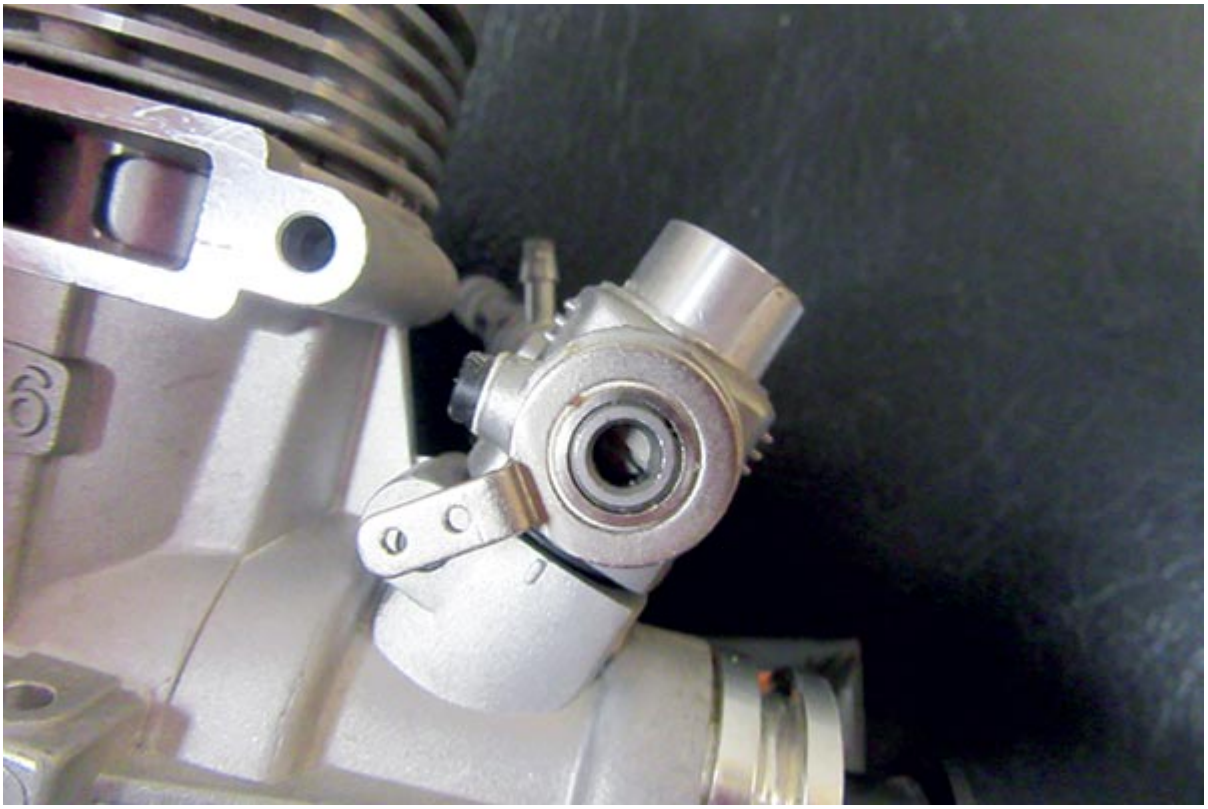
Don’t let the engine run at high rpm (lean setting) until you have run at least four or five tanks of fuel through it. When you break in the engine, you are trying to gradually wear all of its parts so that they match one another. It is the piston and sleeve fit that we’re most concerned about.

Some engines can be broken in more quickly than others, but all of them must go through the break-in process to operate properly. If you try to run your engine without breaking it in first, it will run hot because of excess friction and localized heat caused by the metal contact points. This will eventually damage it.

You will know your engine is properly broken in when it runs consistently without overheating and it has a good transition from idle to full throttle. It is always better to operate your engine a few clicks on the rich side than a few clicks on the lean side.

The Low-End Setting

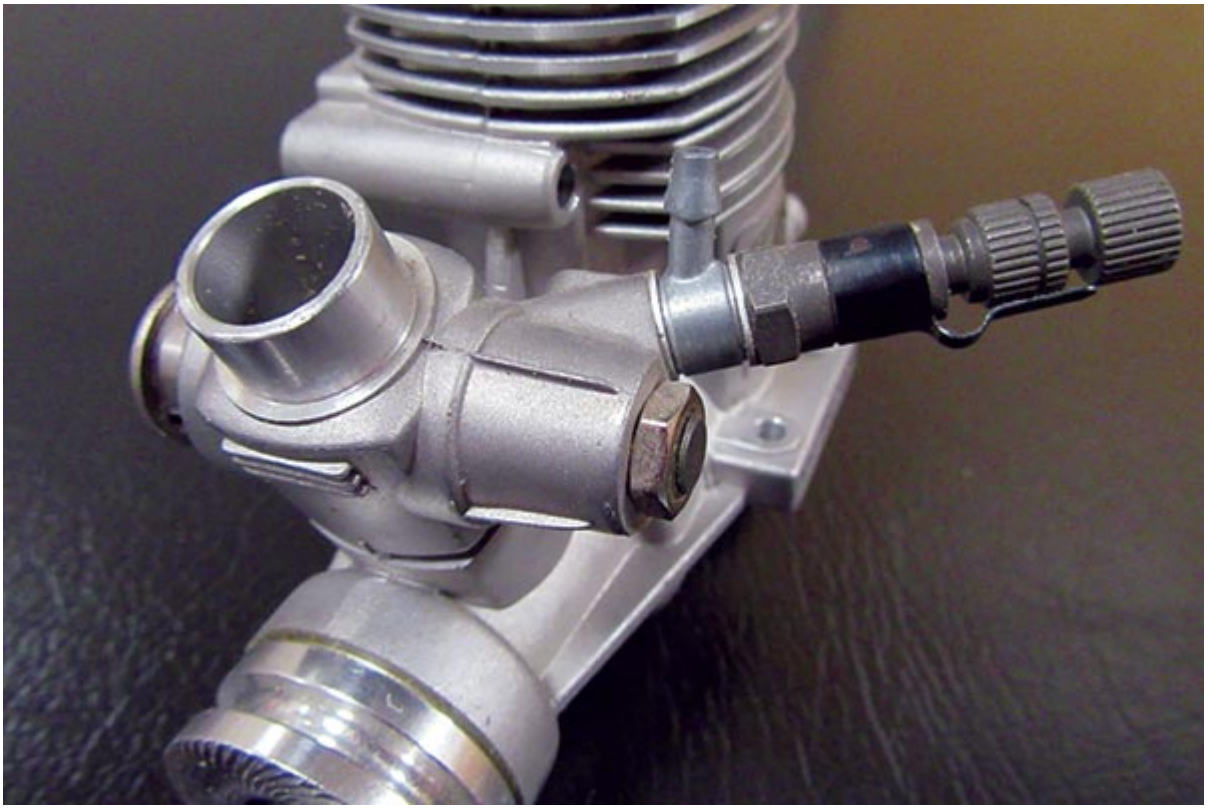
Some engines have a single needle valve and a small bleed hole, which is used for the low-end or idle-mixture setting, while others have two needles (one large one for the main and a smaller one for idle). It is during the break-in process that you will also learn how to adjust the low-end mixture setting.



The low-end needle valve is adjusted by turning the small setscrew shown in the center of the throttle arm.

Start with the setting that comes with the engine. It will usually be close to the correct setting. When you bring the engine to an idle and the engine dies, this means the setting is too lean. You must increase the amount of fuel drawn into the carburetor at idle. If the engine settles into an idle, but then burbles or dies when the throttle is opened again, the lower-end mixture setting is too rich and the amount of fuel entering the carburetor at idle must be decreased.

With a twin needle-valve design, you adjust the amount of fuel entering the carburetor with the idle needle valve. With an air-bleed design, you adjust the amount of air entering the carburetor during idle.



A typical carburetor has two needle valves to adjust the fuel/air mixture. The high-end needle assembly is shown here.

Both types of carburetors work well, but most high-powered engines rely on the twin needle-valve carburetor for mixture adjustment. It is important that your engine has a good, reliable idle before you commit your model airplane to flight.

Care and Maintenance

Proper engine care from the start will ensure that you get maximum power and longevity, so start caring for your engine the day you bring it home. Most engines come with tools such as Allen or hex wrenches to tighten and loosen the screws that hold the engine together. Keep these in a safe place and if you lose them, be sure to replace them with the correct sizes.

Glow engines need to be installed on your airplane with a strong, rugged mounting system. Your propeller should be the recommended size and properly balanced. Notice the wire extension added to the main needle valve to keep fingers clear of the propeller.

Start by removing the engine's backplate and checking inside the crankcase for metal shavings or other foreign material. Remove the head and check the combustion chamber for the same. Squirt some 3-in-One Multi-Purpose Oil into the engine and turn the engine over. Lubricate the bearings as well as the connecting rod bushings. Check to make sure the ports in the sleeve match the ports cast or machined into the engine case.

Now reassemble the engine and tighten the screws in a crisscrossing pattern. Do not use threadlocker compound on the engine case or head screws. It is not required and will make future maintenance difficult. You could strip the threads out of the holes.

Never force anything that won't go on or move easily. The engine is made mostly of aluminum and it is easy to damage threads. Always use the proper size wrench to tighten the propeller nut; never use vice grips or pliers. A 6-inch adjustable wrench is a good tool to keep in your field box.

After the last flight of the day, drain the fuel from the tank and run the engine dry. Squirt some after-run oil into the carburetor to coat the inside surfaces of the engine to prevent corrosion. Alcohol-based fuels attract moisture and unprotected engine surfaces will corrode—especially the ball bearings. Oil is inexpensive insurance for a long engine life.

Proper Balance

Perhaps the most important thing to do before you run your engine and install it in your airplane is to use properly balanced propellers. Good-quality propellers, for the most part, come out of the package well balanced, but to make sure your propeller is balanced, use a propeller balancer such as the one from Du-Bro Products.

Using an unbalanced propeller increases vibration. This is bad for your airplane's structure and engine because it puts undue stress on its parts. Vibration can cause hardware to come loose and even cause control surface hinges to wear out and break during flight. Do yourself a favor and be a stickler for smooth-running, properly balanced propellers.

A Du-Bro propeller balancer is an excellent tool to add to your workshop. This precision tool allows you to fine-tune any propeller's balance.

So, that's it. At first it may seem as though this is a lot of effort, but it is all part of properly running and taking care of your two-stroke model airplane engine.

A good piece of advice is to find an modeler who has experience running glow engines and have him or her help you get started. The task will be easier and more fun. With proper care and feeding, you can expect your glow engine to last a lifetime.

—Aaron Balwich
aaron.balwich@gmail.com

Sources:

Du-Bro Products
(800) 848-9411
www.dubro.com

3-in-One Multi-Purpose Oil
(888) 324-7596
www.3inone.com