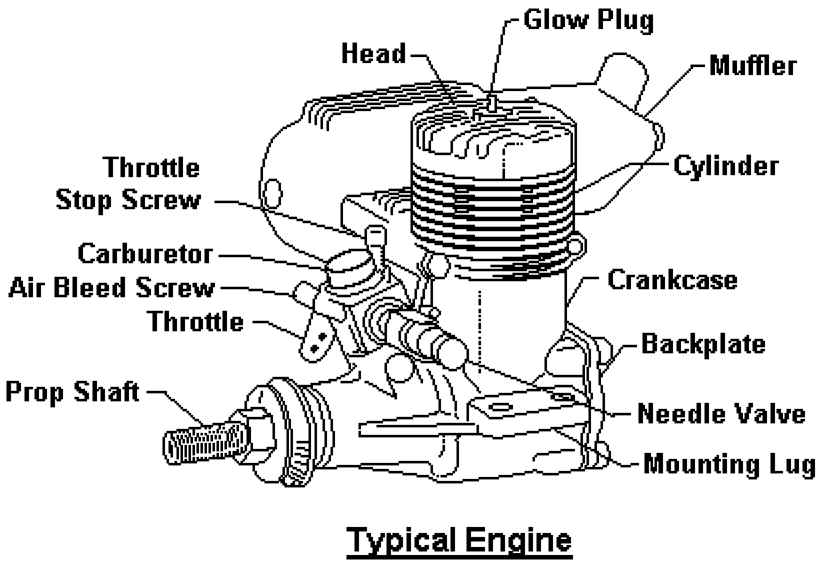
Useful Information on Model Glow Engines



Typical Engine

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Content

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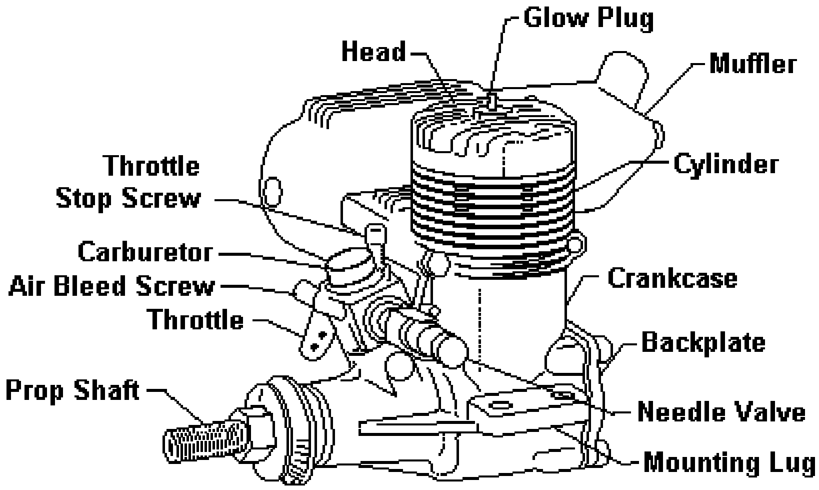
Model Glow Engines



Typical Engine

Legend

Air bleed screw - Screw for adjusting the amount of air allowed to bleed into the carburetor during idle

Backplate - Cover over the rear of the crankcase Carburetor - Device which mixes fuel and air and controls the amount of mixture entering the engine. The carburetor provides the engine with the proper mixture of fuel and air.

Crankcase - Main body of the engine

Cylinder - The section of the crankcase where combustion takes place

Glow plug - Device that provides heat for ignition of the air/fuel mixture

Head - The component which forms the end of the compression chamber of the engine

Mounting lug - The section of the crankcase used to mount the engine to the airplane

Muffler - The device which reduces the noise level of the engine

Needle valve - The device used to adjust the air/fuel mixture. Usually opposite the throttle arm is the high-speed needle valve. This adjusts the high-speed mixture of the engine and allows you to get peak power from the engine while preventing an over-lean condition. Some newer engines use an angled needle adjustment to keep your fingers at a safe distance from the spinning propeller.

Prop shaft - The main crankshaft that transfers the power of the engine to the propeller Throttle stop screw - Screw for setting the lower limit of the throttle movement

Throttle Arm - You will notice various controls and adjustments, the most prominent is the throttle arm which controls the speed of the engine. It will rotate about 45 to 90 degrees, with the barrel in the carburetor moving with it.

Idle Screw - The idle mixture screw allows you to adjust the mixture of the engine when it is idling. With high-speed and idle mixtures adjusted, your engine should operate smoothly throughout the entire speed range. The idle speed screw adjusts the amount the throttle barrel is closed when the throttle is fully retarded, and is important in getting proper idle speed.

Running an Engine In (General)

The object of running an engine in is to get the engine to the point where all the rubbing surfaces are nicely mated to each other at all temperatures likely to be attained (by the engine) while causing as little wear to the engine as possible in the process. The benefits of doing this properly are twofold; the engine would be a 'better' engine throughout its life and that life should be extended. A good tip is to use an old glow plug when first running in an engine, as often minute pieces of metal from the running in process or swarf left from manufacturing can destroy a glow plug in seconds.

The method used to achieve this is simple. Run the engine very rich and lightly loaded at first and gradually increase the amount of work the engine is allowed to do, at the same time gradually increasing the temperature that the engine is allowed to attain, by judicious use of the main needle valve. This gradual process is spread over approximately the first hour of the engine's life and at the end of this hour it should be ready for its first full speed run.

All running in is done with the throttle fully open.

Running in Ringed Motors

Start by using one of the smaller propellers recommended by the manufacturer and a minimum of 20% of castor oil in the straight or low nitro fuel.

Make the first tank full absolutely soggy-rich, keeping the glow-plug lead attached if necessary to keep the engine running. Keep all runs of short duration with a few minutes cooling down time between each.

For the next few runs set the main fuel needle to give a very fast four stroke with just the occasional hint of two-stroking. Allow engine to run for 30 seconds and then close throttle or richen up needle to slow engine for 20 or 30 seconds cooling period, open the throttle again for 30 seconds then allow to cool again. Gradually increase the length of the full throttle run over two tanks full of fuel. At the end of these two tankfuls lean engine out to the point where the engine is two-stroking and four-stroking (ratio about 60/40) and repeat previous procedure of short runs, gradually being increased in length for the next two tankfuls. The next stage is to lean the engine out until a full two-stroke is attained, but make sure it is only one notch from the four-stroke coughing, i.e., still set richer than maximum rev's. Repeat above procedure of short runs gradually increasing in length for two tankfuls.

The engine is now ready for full speed running, but still needs the first couple of tankfuls to be short runs gradually increasing in length.

The engine is now run-in for normal use, but if the engine is to be used under more harsh conditions (e.g. with a tuned pipe), then it will need further running in under those conditions using the above short-run procedure.

All this might seem a long-winded process but it is necessary to get the best surface finish with the least wear inside your precious engine.

The reason for everything being done in small and gradual steps is that the facing surfaces have to be mated at gradually increasing pressures and to further complicate this the shape of the parts change as temperatures are increased. As an illustration, the cylinder and piston are round and parallel sided when made. As the engine warms up the top half of the cylinder gets hotter than the bottom half and so expands unevenly, worse than this the exhaust side of the liner runs hotter than the transfer side, then to add to the problem the front of the engine (in the air stream) runs cooler than the rear of the engine, so you can see the liner would be anything but perfectly round and parallel when thoroughly hot.

The piston and ring are subject to similar stresses. The ring alters its length depending on temperature and is also going up and down a bore which is no longer round or parallel sided and is guided through this operation by a piston which gets hotter at its head where it is in contact with the burning fuel mixture and therefore the diameter of the head is bigger than the walls. The exhaust side of the piston is hotter than the transfer side so the piston is no longer round or, as mentioned earlier, parallel sided either. All these distortions are larger or smaller depending on the temperature of the engine, so the running-in process has to allow the engine to make working surfaces suitable for all these varying conditions.

Now that the engine is run-in check all screws and bolts for security and if you have to tighten any cylinder head bolts, remember to tighten a little at a time and in diagonal rotation. You might also find the glow plug has been affected by small metal particles fired at it during running in. If you have any doubts change it and keep the old one only for running in.

Running in ABC engines

An 'ABC' engine is one with special liner and piston metallurgy, e.g., the piston is aluminum (A), the liner is brass (B), and the brass is chrome-plated (C). Generally, these are performance-orientated engines.

When an ABC engine is warmed up the liner, made of brass, will expand more than the piston, which is made of aluminum. Consequently, as the engine reaches working temperature the piston seal would not be very satisfactory. The manufacturers have taken note of this and taken steps to counteract this undesirable state of affairs by making the liner and piston the correct sizes for when the engine is hot. This means that when cold the piston is a very tight fit at the top of the liner, to the point where some make a light groaning noise when forced over Top Dead Center (when the piston is at the very top of its travel, or TDC for short).

Very little running-in can be accomplished with these engines, as the cylinder temperature must be raised to full working temperature as quickly as possible to avoid excessive piston wear due to the very tight fit at lower temperatures.

My usual method is to use about 5% extra castor oil in the fuel and set the engine for just below full speed running (throttle fully open, main needle just a little bit rich), and run the engine in short cycles of approximately 30 secs. full speed and 5 secs. at 1/3 speed, for the first 15 minutes. This keeps the cylinder temperature up and the slow running should give time for any hot spots to cool down somewhat. For the next 45 minutes use the engine normally but keep it just a touch rich (just 2 or 3 clicks).

Setting the main needle

This is a most important setting as not only does it set maximum power but it also controls the running temperature of the engine and from there the length of the engine's life, the life of the glow-plug and the overall reliability of the engine's running in flight or elsewhere. Engines don't very often cut out in flight because they are set slightly too rich, but they most certainly do when set too lean.

It takes about five minutes to learn the drill for correct needle valve setting so it's worth taking the trouble for the long-term benefits gained.

The drill is to start the engine on low throttle, for safety and usually easier starting due to higher gas speeds through the venturi and consequent better atomisation of the fuel droplets. Once started, open the throttle fully and set engine to maximum speed. Leave the engine to warm through thoroughly at top speed for a minute or so then adjust the needle to see whether an improvement in RPM can be achieved. From this established point, richen up slowly until a small but definite drop in RPM is noticed, with the engine still two-stroking. Lift the nose of the model up vertically and if the small loss of RPM is regained then you should have a good flight setting. If the model has a tendency to go rich or go lean in flight then an extra allowance will have to be made for this on the final setting.

The aim of this is to give maximum power from the engine when it is needed most, either when the model is climbing or when turning sharply and will also give sweet and cool running during level flight, the best of both worlds.

What happens when an engine is set too lean ?

The glow-plug engine is a semi diesel, which means that it is partly the heat generated by compressing the fuel/air mixture and partly the temperature of the hot glow-plug element that ignites the charge in the cylinder at the correct moment. A little thought will let you see that the whole system is very temperature dependent. No spark to set it off, no injection of fuel to set it off. Just the combination of these two temperatures.

When an engine is set lean i.e., for maximum RPM at the start of a tank full of fuel, anything which slows the passage of the fuel through the needle valve will make the engine run over lean. Some engines will not continue to run in this condition and so cut dead but the majority will continue to run to some degree.

As the tank full of fuel gets used the fuel pressure, as seen by the needle valve, gradually reduces and as a result the engine gets a progressively leaner mixture as the flight continues. As the engine started set in a lean condition it must progress into the over lean condition and maybe go so far as to cut out.

When the engine runs flat out, ignition timing and engine temperature should be as the designer intended but as the mixture gets into the over lean area temperatures will start to rise. This is due to over-lean mixtures changing combustion characteristics in a way that imparts more heat to the surrounding engine structure and less to useful work.

Because of this the incoming charge is heated a little more than it should be and when compressed is at a higher temperature than it otherwise would be. The secondary effect of the engine structure being at a little higher temperature is that the glow-plug element is also a little hotter.

As already explained, ignition timing is controlled by the temperature of the compressed fuel/air mixture combined with the temperature of the glow-plug element. The net result of both of these being raised is early ignition in the next cycle. This early ignition gives just a little more time for even more heat to be transferred to the engine structure before the hot gasses are exhausted from the engine and so jacking up engine temperatures just a little more, resulting in the next cycle jacking up temperatures yet again.

This is the slow build situation that causes engine seizure in some cases and in other cases runaway early ignition that makes an engine stop quickly in the air, as though it has seized, but in fact feels perfectly O.K. and runs O.K. when it has cooled down again
.
Many of the modern engines do not reach these extremes but keep running at a steadier but much higher temperature than they were ever designed for. These engines run other risks that are much less obvious.

One risk common to ail engines which are run at elevated temperatures is that the oil gets very hot, thins out too far and so can no longer lubricate as effectively as it should, resulting in excess wear and shortened engine life.

The less obvious damage that can occur is not usually laid at the door of a lean fuel setting but I believe much of the time it is a relevant factor. When the engine has overheated and reached the point of too early ignition the burning mixture expands the gasses well before top dead center and so the pressures inside the cylinder are much higher than they should be. These extra high pressures at the wrong time in the combustion stroke try to force the piston down with greater power than the designer intended and therefore overload the gudgeon pin in the piston and the little end bearing, the con-rod is more highly stressed, the big end bearings and the main bearings on the crankshaft are also subjected to higher loads.

These extra stresses may only result in wear being more rapid than necessary but if it is a regular occurrence it can result in very early bearing failure, and if it happens to be the con-rod that gives up first the resultant damage can be very expensive.

With all this in mind, when adjusting the main needle of your engine the catchphrase should be 'The future of your engine is in your hands'

Setting the low speed

The need for a low speed adjustment on the carburetor is because as the throttle is closed it lets less air through into the engine and to keep the fuel air mixture within combustible limits the fuel flow has to be altered, it's too fussy to leave to chance.

Most manufacturers have opted for a two-needle configuration or something, which works in a similar manner.

To adjust this low speed mixture start the engine, warm it up and make sure the main needle is properly set. Connect the glow-plug lead to energise the plug and slow engine down by gradually closing the throttle until the engine starts to run badly. At this point, adjust the slow run needle to give smoothest running characteristics just a little on the rich side of fastest setting. Having made this adjustment slow the engine further until it runs badly again, now adjust slow needle until engine runs smoothly once more and continue this step by step procedure until the desired tick over has been reached. Now remove the plug lead and repeat the whole process. If the engine cuts dead in the middle of adjustments, it's usually because it is too lean.

Having reached a slow tick over we have to check if the engine will pick up properly. Open the throttle to full speed as fast as a servo would move it. If the engine picks up but splutters a little whilst doing so, the low speed needle is a little on the rich side. If the engine appears to miss and then picks up suddenly the low speed needle is slightly lean, and if the engine cuts dead when the throttle is opened richen the low speed needle 1/4 turn and try again.

If the engine starts to pick up well and then cuts at about 1/3 speed or so, try opening the main needle two or three clicks.

On many engines there has to be a compromise or two to get the low speed, midrange, top speed and pickup to 'gel' into a useable whole, and usually the compromise is that somewhere in the range the carburetor has to be set a little richer than would be considered ideal.

A Few General Do-'s and Don'ts

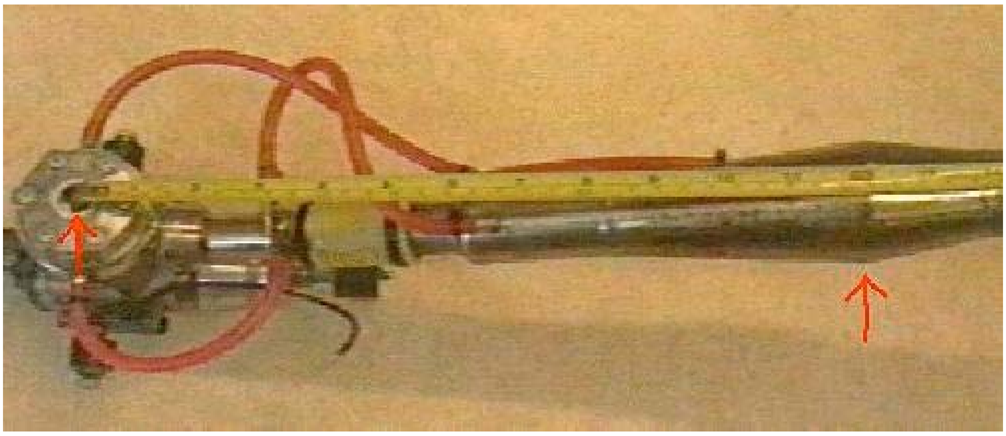
- Always keep your engine clean and free of dirt.
- Choose the propeller that allows the engine to run in the RPM range that the designer intended.
- Always filter your fuel from fuel bottle to tank and from tank to engine, and keep the filters clean.
- Don't wipe model with cloth that sheds fibers, some will undoubtedly find their way into the needle valve or somewhere just as inconvenient.
- Don't use a damaged propeller, an 11-inch diameter prop turning at 15,000 RPM has a tip speed of 490 m.p.h., and to shed a blade can obviously be lethal.
- Always balance propellers and if possible spinners as there will be less vibration to affect the engine, model and radio.
- Make sure your glow-plug battery is charged before you go out.
- At the end of a days running 'dry' the engine out by pulling the fuel line off at full RPM. Then put After-Run oil in the carburetor and ensure it is dispersed throughout the engine. Raw fuel is corrosive to steel, aluminum and copper bearing alloys.
- Never store the model nose down in the corner of your garage, going home in the car, or even while cleaning it at the field, if it is fitted with a tuned pipe or an extra large silencer. The exhaust residue that collects in these is highly corrosive and would run straight back into the engine.
- If the engine is badly 'flooded' i.e., liquid fuel in the crankcase turn the model over in such a manner that the excess fuel in the crankcase runs up the transfer passage, into the cylinder through the transfer port (make sure it's open-piston at the bottom of it's stroke), across the cylinder, out of the exhaust port and out of the silencer.

Tuned Pipes

1) Where do I start with my settings when I put my boat on the water for the first time?

If setting up a boat for the first time and the motor, pipe and carburetor are all different to what you normally run then start as follows: First install a smaller propeller than would normally expect to finally run with onto the boat, at least 2 sizes smaller to ensure that the motor can spin it. Then make the pipe the length that the manufacturer states it should be for the motor size it was made for. If you do not have a clue, then you can make them the following distances as indicated in the list below. Remember that these lengths are by no means the optimum but will get you started. Look at the measurement points used in the picture.

- 3.5 cc Motor - 20 - 22 centimeters
- 7.5 cc Motor - 24 - 27 centimeters
- 15 cc Motor - 30 - 32 centimeters



It is difficult to say where you should set the carburetor but if you are really starting from scratch, you should screw the mixture needle totally in and then screw it 2 complete turns out. This should give you a rich mixture however that is subject to each needle arrangement.

The boat is now ready to start and put in the water. Once the motor is started, determine whether it's rich or lean while trying to rev the motor up. This can be achieved by either pinching the fuel line to the carburetor and seeing if it revs up or by choking the carburetor in short bursts to see if it needs more fuel to rev up. Then adjust the main mixture accordingly. Normally make the mixture a little rich while on land.

The idle mixture is then set by bringing the engine revs down on the throttle and then pinching the fuel line again. If the motor stops then the idle is too lean. If it first revs up a little and then stops its too rich and it needs adjusting. The boat is then put on the water and should go. Then lean it off, a little at a time until it starts revving smoothly on the water. Don't be worried about speed at this stage you are only checking that the motor sounds smooth. Take the boat out the water and repeat the idle mixture adjustment as indicated before. Note that the idle mixture effects the main mixture slightly. If you make the idle mixture leaner, then the main mixture will also get slightly leaner. If the main mixture was correct then you need to make it a little richer. Note that it is not in the same proportion. The main mixture will only need to change a fraction. This is a reiterative process but gets you set up.

2) How do I know what prop to put on my boat?

The propeller that you use is subject to your pipe length, exhaust port height and gearbox if you use a gearbox. If you run a big prop you should have a longer pipe length, if you run a small prop you should shorten the pipe. The mixture does not really play any part, bar that you need to adjust it depending on the load on the motor. If you have, no idea here is some guidance to start with. Note that there are many variations but this reference table should put you close.

Reference TABLE

MOCOM Propellers			
MOTOR	**Gearbox**	**Recommended prop**	**Desired prop**
3.5 cc	1.8 : 1	2023	2024
3.5 cc	2 : 1	2024	2026
7.5 cc	1.4 : 1	2024	2026
7.5 cc	1 : 1	1924	1924
15 cc	1 : 1	2026	2127

3) How do I optimize my performance with the pipe and prop?

Every motor has its ideal point of performance and that is the difficulty, to identify where your motors performance is. Without a test bench, you will not be sure that you have reached it but try this and see. You must first set up buoys in the water so that you can time your boat with a longer than usual pipe and get a reference. Then keeping the same prop make the pipe 5mm shorter. Get a reference again and see if it's better. Keep on making it shorter until the boat cannot stay on the pipe if you turn a sharp corner. Plot all the results and see where the best performance is. Write down that measurement with the prop that was used. Now take a bigger prop and start all over. Make the pipe longer again and slowly move the pipe shorter as indicated above while taking readings. Chart all your results. Note do not put a too small prop on and over rev your motor. If your motor is not designed to rev then do not try that range of props.

Make sure that you get an average speed to ensure that you get a fair result. Ensure that the fuel mixture is set correctly before taking a speed reading, as the mixture will need to be adjusted slightly if you change the pipe length and prop. Also, make sure that you test from a small prop to a big prop to ensure that you cover the entire range. Also, note that the more props you test the clearer your result becomes.

Within a certain range, you are able to decide what prop was the best for what pipe length and you are then able to set up your boat to run with this prop. Advanced modifications are available but this would require that you start working with the motor timing and does get a little technical. As a general rule the higher you make the exhaust port the higher your revs can go. The smaller the prop and the shorter the pipe and vise versa, the lower you make the exhaust port the lower your revs will be. The bigger the prop can go and the longer the pipe should be. This is all to a certain limit of course.

Useful Information on Model Glow Engines

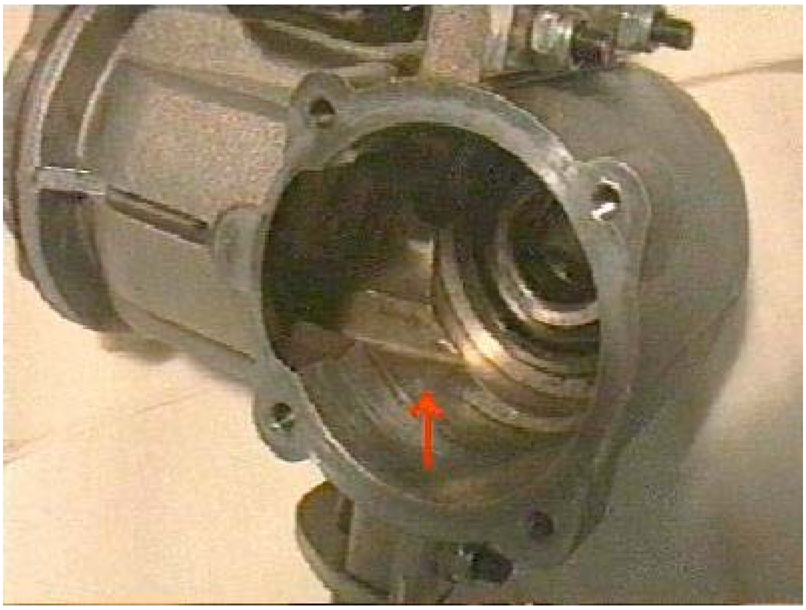
How can I get my motor to go without major Modification?

If you want to do these modifications, you are also going to do them at your own expense and risk. It would be advisable for you to get more detail before you actually attempt to do these modifications, as this document will only be giving a brief description of the modifications.

The first thing to do when you buy a new motor is strip it down completely. Various modifications can be done on the timing of the sleeve however these will not be discussed here. You can refer to Prestwich Models in the UK for more details on that. Before you re-assemble the motor, take all the sharp edges off the casing and sleeve because of machining.

Modification 1

Take the engine casing and look into the back of the motor where the crank normally would have been. You will see that the crankcase has been machined nicely round to allow the crank to rotate. But on each side where the side inlet port starts, there is a little lump of metal still left due to the way the machining is done. That metal is machined away to make it a smooth straight flow up from the crankcase to into the inlet side port. Do not polish the ports inside, as it is better to leave it with a rough-like surface. See picture.



Modification 2

Your cylinder head gap is normally set from the factory for a specific Nitro mix and normally the motor manufacturer informs you of the recommended fuel to be used. Take note that when you use more Nitro than recommended you need to reduce the compression ratio and or make your glow plug colder. If you run above sea level, you need to increase the compression ratio. The exact gap would be impossible to tell you, as each motor would vary depending on the head, altitude, plug and fuel mixtures. But this is an area that is very critical. How do you know if you are too high or too low? The answers are important to know. If you have a Too High compression ratio, you will be blowing plugs. But then again, if you have a too hot plug and lean mixture you can blow plugs as well, so that does not help you, you may say. Yes, that’s true, but if you have set your motor such that the mixture is a little on the rich side and you have already put in the recommended cold plug, and it still blows, then you have an idea that the ratio is too high. A better indication would be if you see small pit marks on the head if you remove it. That would be a sign of pre-ignition. Action: Colder plug, reduce your compression ratio or reduce your Nitro mix.

Modification 3

The piston is cut away by the center inlet port to allow for better flow. Most new engines already do this and thus you need not increase that cut away much more. However, some pistons are almost not recognizable due to the cutting away. Take note that on the smaller motors you should not cut too much away as the piston requires the length to prevent it from twisting. It must be noted that better flow is not the only reason for cutting it. You may be getting more revs due to the weight reduction as well.

Modification 4

On the casing again, always increase the exhaust outlet port with the grinder. During this process, remove any lumps, and then shape it to allow a smooth flow. Even polish it if you can.

General:

There are various modifications that are done on the inlet port timing and these will not be discussed as they are more advanced type of modifications together with the sleeve modifications. In addition, each motor type has its unique requirements depending on the inlet arrangement. Most motors that you buy are already in the best all round performance position and need not be tampered with. If the above alterations are done to your motor, you should have a motor that works well!

Useful Information on Model Glow Engines

What Sort of Glow Plug ?

Long or Short Glow Plugs — There are two lengths of glow plugs available. The short ones are generally used on engines of .15 cu in displacement and smaller. The long plugs are used on all engines larger than .15. Please follow the manufacturers recommendations.

Idle Bar Glow Plugs — An Idle Bar Glow Plug has a metal bar across the bottom of the plug that prevents raw fuel from dousing heat from the element during idle.

What Sort of Engine Features

Crankshaft - Ball Bearings or Bushings?

You can get engines with either ball bearing supported crankshafts or with just bushings. Ball bearing engines usually have a bit better performance, run smoother and last longer with proper maintenance but are more expensive than those with bushings.

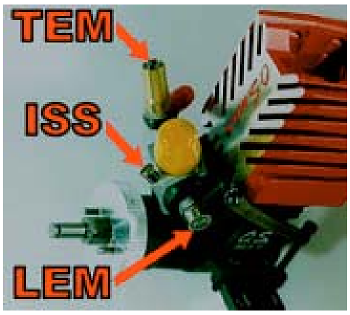
Cylinder - Ringed or ABC?

The piston and cylinders for model engines are generally constructed in one of two methods; ringed or ABC. Ringed engines have been employed on model engines for years and were the main method of construction until recently. An aluminum or iron piston with a ring moves in an iron sleeve. The ring provides the compression when operating. Ringed engines are easy to flip start, generate good power, are inexpensive to restore compression after long usage by simply replacing a ring, and are generally slightly cheaper. Ringed engines require a generous break-in period where the motor is run very rich to provide lots of lubrication while the ring fits itself to the cylinder. They are also more easily damaged if the engine is run too lean.

More recently a method of construction has been developed called ABC (aluminum, brass, and chrome) where an aluminum piston runs in a chrome plated brass sleeve. The piston and cylinder are matched at the factory to give a perfect fit and provide optimum compression. ABC engines start easily by hand, give more power than their ringed counterparts, have a good life span, and are less susceptible to damage with a lean run. They are slightly more expensive to buy and very expensive to restore compression if required as the entire piston/cylinder assembly must be replaced. No extended break-in is required for an ABC type engine.

Useful Information on Model Glow Engines

Troubleshooting Glow Engines

Adjustment Screws				
	Names	**Other Names**	**Purpose**	**Approx. Settings**
	Top End Mixture (TEM)	needle valve, high end needle, main needle valve	adjusts gas/air mixture at high speeds	2-3 turns out from bottom
	Idle Set Screw (ISS)	idle screw, throttle stop screw	Adjusts engines idling speed	carburetor opening at 1-2 mm
	Low End Mixture (LEM)	Mixture control screw, low end needle	adjusts gas/air mixture at low speeds	1.5 turns out from bottom

Step 1: Test the Glow Plug

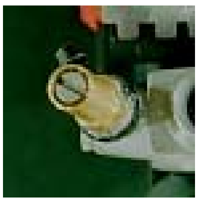
The real test of the life of the glow plug is whether it runs better with the glow plug igniter on rather than with it off. If the engine doesn't run smoothly with the glow plug off, then its time to change the glow plug. Sometimes this isn't noticeable until the plug is so far-gone that the engine won't even run anymore, but sometimes you can still tell.

Step 2: Test for Compression

Low compression results in stalling problems (flame outs), inconsistent idling, and poor performance (poor overall power). An engine with low compression most likely means that dirt or other foreign matter has worked its way into the engine and has scratched up the piston and sleeve. It can also be caused by poor engine maintenance. If you don't do any after run maintenance to your engine, then low compression can result. A section on engine maintenance is given below. To test for compression, just turn the flywheel with your hand. At one point, there should be some turning resistance, making it hard to turn the flywheel any further. The amount of resistance at that point is what you are interested in. The amount of resistance is the amount of compression in the engine. As you keep turning it, it should break free and become easy to turn again. If it's easy to turn the flywheel past that point of resistance (one complete revolution is enough), then you have poor compression and may want to consider replacing the piston and sleeve. If you have a compression tester, compression should be around 60psi. When it gets to around 35psi, it's time to rebuild the engine.

Step 3: Adjusting the Engine Settings

Top End Mixture



The top end mixture (TEM) screw controls the top speed of the engine. Turning the TEM clockwise will lean out the engine. Turning it counter-clockwise will richen the engine. The leaner you are the more top end you get. However, the more lean you are, the hotter the engine gets. Ideally, you want the TEM to be as lean as possible without overheating the engine. When you run the model, you must listen to when the motor is coming up onto the pipe. When it does, it should really hit a nice scream and have a clean whine down the straightaway. If it doesn't and stays harsh, you are rich and you must lean the TEM. Lean the TEM by turning it clockwise, around 30 degrees at a time. If the engine peaks out then cuts out down the straight, you are way too lean, and the engine is not getting enough fuel so the TEM must be richened. Richen the TEM by turning it counter-clockwise, around 30 degrees at a Time. The correct settings for the TEM should be somewhere around 2-3 turns out from bottom ("bottom" means starting with the screw all the way in).

Low End Mixture

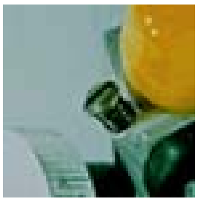
The low-end mixture (LEM) screw works the same as the TEM, only it just controls the low end. Does it sound like it runs out of fuel when you accelerate and then it dies (really whiny with a shutter when it stalls), or does it sound more blurbly and plugged up (like it's getting too much fuel and accelerates really slow)? If it sounds more whiny when it accelerates and dies (lean), then try turning the bottom end mixture screw two clicks counter-clockwise (you should be able to feel it click) and give it a test run. If it sounds more plugged up and blurbly when it accelerates and dies (rich), then try turning the screw clockwise two clicks and give it a test run. If you find that any of these adjustments help, continue turning it one click at a time in that direction after each test run until it feels like it's accelerating perfect. Acceleration must be clean, crisp and abrupt. At the end of the straight, the motor should cleanly fall off the pipe into a nice 4-stroking sounding idle when you let go of the throttle. If it doesn't the LEM may need to be richened. The correct settings for the LEM should be somewhere around 1.5 turns out from bottom.

Another way to tell if your LEM is too rich is by starting your engine and getting it warmed up. Then bring it in and pinch the fuel line with your fingers (be careful of the flywheel!) and count how long it takes to stall out. If it takes more than 4 or 5 seconds to die, it's too rich and you should take a screwdriver and turn the LEM clockwise one click to lean it out a bit.

During break-in, the bottom end adjustment has to be rich to compensate for the rich TEM. This means that after break-in you usually need to lean out the LEM a bit after leaning out the TEM. After playing with the LEM for a while, you get used to how much punch it should have for the temperature you run it at and you can always set it for that amount after break in or whatever else you might have done. Nevertheless, you should be able to just let that motor sit and idle forever without stalling.

If your looking for more power, leaning out the TEM will only give you top speed. Only leaning out the LEM will help with torque and punch off the line. Also, any leaning of the TEM also makes the LEM adjustment turn a little richer, so watch for this. Also, watch the temperature of the engine! Leaning the LEM really makes it heat up faster, so make sure you don't go too far! As you LEM, the idle tends to go up, and you must compensate for this by turning down the idle using the idle setscrew on the front of the carburetor.

Idle Set Screw



The idle set screw (ISS) controls the idling speed of the engine. Simply turn the ISS clockwise a little to make the idle speed go up, or turn it counter clockwise to make the idle speed go down. You can adjust the ISS any time you want and it won't change anything other than how fast the engine idles at. Try to adjust the ISS while there is no servo pressure on the screw. This means give the engine just enough throttle from idle to allow the pressure on the screw to be released. This will prevent a stripped out ISS. When the ISS is set correctly, the carburetor should very slightly open with the opening at around 1-2 mm wide.

Step 4: Check the Engine's Temperature

Have you ever checked the temperature of the motor when it's been running for a while? Really heating a motor up seriously shortens your motor's life span and shouldn't be done at anytime.

> **The Spit Test -** You must have heard of this method to check the general temperature of the engine. After running for a minute or so, you just spit on your finger (plenty of spit), wipe it on the motor heatsink head, and if it boils away really quickly, it's too hot and therefore too lean, so you should richen the TEM by turning it counter clockwise a few clicks (I emphasise the few, not just one). This should cool it down enough to make the engine last a bit longer than it would at that lean setting. Normal running temperature is around 210 or 220.

However, don't think that running a motor very rich all the time so that it is barely warm to the touch is healthy. Running too rich causes the walls of the sleeve to stay very wet and cool, while the combustion chamber temp is much higher. This can cause the sleeve to not expand according to the piston expansion creating more wear then if you were running normally. A properly set engine can give blistering performance, and if the fuel is clean and fresh, and if the air filter is doing its job, the engine will last very long.

"End of the Day" Engine Maintenance

- Run the engine completely out of fuel. That means to run the vehicle until it runs out and then start it again to get every last drop of fuel out of the motor. This is a very important and usually unknown fact to the performance of glow engines. The fuel draws moisture from outside the engine and this starts to attack the metal parts inside with corrosion.

- Clean off the dirt around the air filter with motor spray then remove the air filter.

- Look inside the carburetor. It should be nice and clean. There shouldn't be any dirt particles in the carburetor. If there is, then that means your air filter is not doing its job and has to be changed. It also means that particles got into your engine and probably scratched up the piston and sleeve, causing low compression.

- Put a few drops of after-run oil in the opening of the carburetor. It is used to prevent moisture damage and to protect the parts. You should be able to find this at any hobby store carrying gas cars, trucks, planes, or boats. If you're desperate, you can also use a few drops of synthetic motor oil (like Amsoil) or if desperate, you can use WD-40.

- Clean the air filter pads with diluted simple green. Motor spray might work too. For the OS CZZ and CV engine, there are 2 pads in the air filter. I only clean the outer one most times. I clean the inner pad like once out of every 8 times that I clean the outer pad. Dry the pad thoroughly with a clean rag. It doesn't make sense to clean the filter pad only to put it back into a dirty place. When removing, dirt usually falls off the pad and ends up inside that rubber pad holder. So, before putting the pad back, use a Q-tip to clean the area where the pad goes. Also, clean where the air filter attaches to the carburetor as shown in the photo.

- Put the air filter back on.

- Turn the motor over for about 5 seconds or so to suck the stuff into the motor and coat all the parts. Do not put on a Glow starter!

- Pat yourself on the back for saving yourself a whole lot of polishing you would have to do in the future if you didn't do this procedure!

Useful Information on Model Glow Engines

Keep the Dirt Out!

Your number one concern: You never want ANY small dirt particles to get inside your engine. Let’s say that again. You never want ANY small dirt particles to get inside your engine. There are three major places where dirt can get inside the engine:

- **The carburetor** your air filter is very important because it keeps particles from entering the engine through the carburetor. Never run your engine without the air filter. And when removing the filter for cleaning, make certain that particles don’t fall into the exposed carburetor. It just takes one particle to ruin the piston and sleeve.

- **The head** if the glow plug is removed, it leaves a huge hole that leads straight to the piston and sleeve. Before removing the glow plug, clean the area well with motor spray and let it dry off. Then remove the glow plug and do it with the car (engine) upside down. That way, no loose particles can fall inside the engine (things can’t fall upwards). And leave it upside down all the way until that new glow plug is secured in the head.

- **The fuel line** If you disconnect the fuel line from the engine or the gas tank, make sure the tips of the fuel line and the fuel line connectors are clear of dirt particles. Gas has a nasty tendency to attract dirt particles into this area when you remove the fuel line. The fuel line comes after the fuel filter in the gas tank, so any particles in the fuel line will have a free path right into the engine. Don’t think that an external fuel filter will solve everything because there is still fuel line after the external fuel filter to the engine. Any particles that get in that fuel line will still have a free path right to the engine.

Fuel Choice

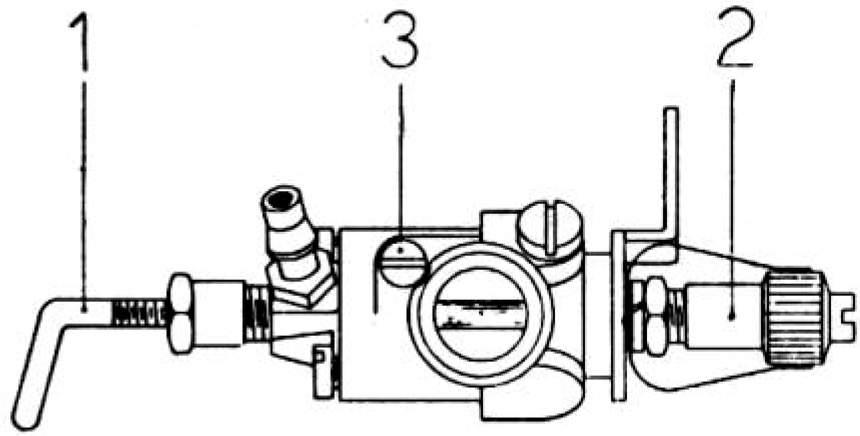
Certain fuels may have a tendency to heat motors up unnecessarily. On the other hand, if your fuel works fine and you are not familiar with adjusting the settings on the engine, then don't change your fuel from manufacturers recommendations. Settings need to be changed when you switch fuels and you may end up with more headaches if you are unfamiliar with tuning an engine to the different fuel. As the saying goes, "If it ain't broken, don't fix it".

Head Shims

As a general trend, the removal of head shims increases compression, increasing output, raise operation temperature, and resulting in the use of lower nitro. Less compression allows higher nitro use, less strain on the motor, less bottom end, sometimes-higher top end.

Useful Information on Model Glow Engines

The Carburetor



The carburetor has two needle valves fitted:

No. 1 is the high-speed adjustment.
No. 2 the slow speed mixture control and
No. 3 is the throttle stop which controls the low speed r.p.m. See Fig. 1.

To set up this carburetor it is useful to have a short piece of clean fuel pipe handy to blow through. Firstly, the idle needle has been factory set and should only need minor adjustment for correct setting. So don't loose the original setting before running. The low speed setting is controlled mainly by the throttle stop and not the idle needle, which is only used to set the mixture.

It is best to adjust either the throttle stop or servo travel in the slow position, so that the amount of opening is approximately the diameter of a modeling pin. Now fit the fuel tube to the fuel inlet nipple and set the high-speed needle 2 1/2 turns open from the fully closed position. Now close the throttle and whilst gently blowing through the tube, establish the setting of the idle needle where air just starts to escape.

The correct idle setting will now be 1/2 turn open from this point. Bear in mind if you change the position of the throttle stop, you will have to reset the idle needle. Use very slight adjustments at a time (1/16th of a turn or less for final adjustment). As a check on settings, if you, whilst still blowing through the tube, open the throttle, you will find a rapid change in air flow when the arm has moved about 15 Deg. from the slow position. When pinching the fuel line with the engine at idle, the engine should first run a bit faster before slowing because of fuel starvation. In cases where poor transition occurs when opening throttle, a variation in the mixture strength can be obtained by rotating the fuel inlet spray bar so that the fuel pipe nipple is pointing at the front engine fixing hole in the mounting lugs. This rotation brings the slit in the spray bar towards the front and will richen the transition mixture and vice versa. This rotation is only documented in these series instructions, and is omitted in later versions. It seems that clockwise rotation slightly richens the transition and anti-clockwise rotations leans the transition. Sometimes this works, but not all the time.

We recommended the use of idle bar plug on R/C engines and the cold type elements suit these motors best. Good results have been achieved with OS-F and OS #8 and Enya #3 plugs.

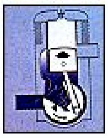
The situation you are trying to achieve is to have a normal mixture setting at the desirable idle r.p.m. Don't use the idle needle to make a deliberately rich mixture in order to slow the tick over. **If you need to reduce the idle, then close the drum further and readjust the mixture by unscrewing the idle needles lightly.**

Useful Information on Model Glow Engines

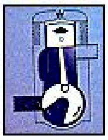
Two Stroke Engines

Most models will use a two stroke glow engine, however you will find that some helicopters and aircraft are design for four stroke power, and some of the larger model cars actually use 22.5cc petrol engines. Two stroke engines have a firing stroke every revolution, they are fast revving and powerful.

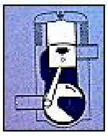
Mechanically, they are relatively simple, with ports for timing rather than the moving valves found on a four stroke. Years of development refining the production of two stroke engines has resulted in reliable, easy starting, easy to adjust engines that represent excellent value for money. If you have ever wondered how they work there are some step by step diagrams to show you below.



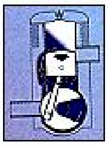
To start, the engine must be turned over by flicking the prop or using the stating mechanism, e.g. Electric or pull start. This moves the piston up sucking the fuel/air mixture from the carb through the just opened crankshaft port.



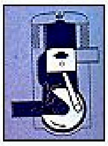
At the top of the piston travel, the fuel/air mixture fills the whole of the volume below the piston and the crankshaft valve is now closed. This completes the induction stroke.



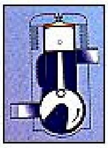
The piston now starts to move downwards compressing the fuel/air charge beneath it.



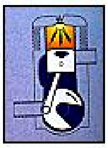
The downward movement of the piston has now uncovered the transfer port so that the compressed fuel/air charge escaped into the cylinder above the piston.



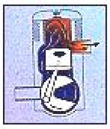
As the crankshaft rotates further, the piston rises to shut off the transfer port, trapping the fuel/air mixture above the piston. The crankshaft port is now open to such in a fresh fuel/air charge.



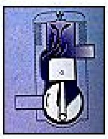
Approaching top dead center, the now highly compressed fuel/air mixture is on the point of being fired - either by the heat of a glow pug element, of spontaneously in the case of diesel.



The piston is now moving downwards, driven by the pressure developed by the burning of the fuel. At mid-stroke the piston has reached its maximum speed. Meanwhile the crankshaft valve has trapped the fresh fuel/air charge in the crankcase.



The downward movement of the piston opens the exhaust port and the burnt fuel escapes, assisted by the incoming fuel/air mixture as the transfer port opens.



With the piston at the bottom of its stroke, the transfer port is open for the fuel/air mixture. The exhaust stroke is now finished and the piston begins to rise, and the cycle begins again.

Useful Information on Model Glow Engines

Acknowledgments

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