

It is of vital importance, before attempting to operate your engine, to read this 'SAFETY INSTRUCTIONS AND WARNINGS' leaflet and to strictly adhere to the advice contained herein. Also, please read through the instruction leaflet or manual supplied with the engine, so as to familiarize yourself with the controls and other features of the engine.


Keep this leaflet and the engine instructions in a safe place so that you may readily refer to them whenever necessary. It is suggested that any instructions supplied with the aircraft, radio-control equipment, etc., are accessible for checking at the same time.


Remember that your engine is not a "toy", but a highly efficient internal-combustion machine whose power is capable of harming you, or others, if it is misused or abused.


As owner, you, alone, are responsible for the safe operation of your engine, so act with discretion and care at all times.





If at some future date, your O.S. engine is acquired by another person, we would respectfully request that these instructions are also passed on to its new owner.

■ The advice which follows is grouped under two headings according to the degree of damage or danger which might arise through misuse or neglect.

 **WARNINGS** Cover events which might involve serious (in extreme circumstances, even fatal) injury.

 **NOTES** Cover the many other possibilities, generally less obvious sources of danger, but which, under certain circumstances, may also cause damage or injury.

 **WARNINGS**

- Never touch, or allow any object to come into contact with, the rotating propeller and do not crouch over the engine when it is running. 
- A weakened or loose propeller may disintegrate or be thrown off and, since propeller tip speeds with powerful engines may exceed 600 feet (180 metres) per second, it will be understood that such a failure could result in serious injury. (see 'NOTES' section relating to propeller safety).
- Model engine fuel is poisonous. Do not allow it to come into contact with the eyes or mouth. Always store it in a clearly marked container and out of the reach of children. 
- Model engine fuel is also highly flammable. Keep it away from naked flame, excessive heat, sources of sparks, or anything else which might ignite it. Do not smoke or allow anyone else to smoke, near to it. 
- Never operate your engine in an enclosed space. Model engines, like automobile engines, exhaust deadly carbon-monoxide. Run your engine only in an open area.
- Model engines generate considerable heat. Do not touch any part of your engine until it has cooled. Contact with the muffler (silencer), cylinder head or exhaust header pipe, in particular, may result in a serious burn. 

NOTES

- This engine was designed for model aircraft. Do not attempt to use it for any other purpose.
- Mount the engine in your model securely, following the manufacturers' recommendations, using appropriate screws and locknuts.
- Fit an effective silencer (muffler). Frequent close exposure to a noisy exhaust (especially in the case of the most powerful high-speed engines) may eventually impair your hearing and such noise is also likely to cause annoyance to others over a wide area.
- Fit a top-quality propeller of the diameter and pitch specified for the engine and aircraft. Locate the propeller on the shaft so that the curved face of the blades faces forward-i.e. in the direction of flight. Firmly tighten the propeller nut, using the correct size wrench.
- Always check the tightness of the propeller nut and retighten it, if necessary, before restarting the engine, particularly in the case of four-stroke-cycle engines. If a safety locknut assembly is provided with your engine, always use it. This will prevent the propeller from flying off in the event of a "backfire", even if it loosens.
- If you fit a spinner, make sure that it is a precision made product and that the slots for the propeller blades do not cut into the blade roots and weaken them.
- Discard any propeller which has become split, cracked, nicked or otherwise rendered unsafe. Do not attempt to repair such a propeller: destroy it. Do not modify a propeller in any way, unless you are highly experienced in tuning propellers for specialized competition work such as pylon-racing.
- Use an electric starter. The wearing of safety glasses is also strongly recommended.
- Take care that the glow plug clip or battery leads do not come into contact with the propeller. Also check the linkage to the throttle arm. A disconnected linkage could also foul the propeller.
- After starting the engine, carry out any needle-valve readjustments from a safe position behind the rotating propeller. Stop the engine before attempting to make other adjustments to the carburettor.
- Adjust the throttle linkage so that the engine stops when the throttle stick and trim lever on the transmitter are fully retarded. Alternatively, the engine may be stopped by cutting off the fuel supply. Never try to stop the engine physically.
- Take care that loose clothing (ties, shirt sleeves, scarves, etc.) do not come into contact with the propeller. Do not carry loose objects (such as pencils, screwdrivers, etc.) in a shirt pocket from where they could fall through the propeller arc.
- Do not start your engine in an area containing loose gravel or sand. The propeller may throw such material in your face and eyes and cause injury.
- For their safety, keep all onlookers (especially small children) well back (at least 20 feet or 6 metres) when preparing your model for flight. If you have to carry the model to the take-off point with the engine running, be especially cautious. Keep the propeller pointed away from you and walk well clear of spectators.
- Warning! Immediately after a glowplug-ignition engine has been run and is still warm, conditions sometimes exist whereby it is just possible for the engine to abruptly restart if the propeller is casually flipped over compression WITHOUT the glowplug battery being reconnected. Remember this if you wish to avoid the risk of a painfully rapped knuckle!

INSTRUCTIONS FOR O.S. FS-120S-E FOUR STROKE CYCLE ENGINE

IMPORTANT : Before attempting to operate your FS-120S-E, please read through these instructions so as to familiarize yourself with the controls and other features of the engine. Also, pay careful attention to the recommendations contained in the "Safety Instructions and Warnings" leaflet enclosed.

INSTALLATION

Use sturdy engine mounting beams: i.e. at least as strong as would be used for a two-stroke engine of 20cc, or greater, displacement. Make sure that these beams are firmly integrated with the airframe, reinforcing the internal surrounding structure as necessary to absorb vibration. Engine installation should be made in such a way that basic maintenance, including the checking and adjustment of valve clearances, can be conveniently carried out. As an aid to aligning the engine on its mounting beams, a simple mounting hole template is supplied with the engine.

As an alternative to horizontal beam mounting, a special O.S. radial motor mount is available, as an optional extra part, for use where firewall mounting is required.

SILENCER ASSEMBLY

Installation procedure is as follows.

1. Secure the exhaust header pipe by screwing the union-nut over the cylinder-head exhaust-stub. Adjust the header pipe to the required angle, then tighten the union-nut firmly with the 17mm wrench supplied.
2. Screw the silencer onto the end of the header pipe and tighten locknut firmly.

Note: It is advisable to apply silicone sealant at the joints to prevent leakage of exhaust gas and loosening of nuts.

CARBURETTOR

The needle-valve and throttle lever locations are interchangeable by reversing the carburettor. This can be done as follows:

Remove the carburettor carefully by unscrewing the two screws which secure both carburettor and choke valve. (See Photo 1.) If the carburettor remains difficult to remove, slightly loosen the two screws which secure the intake pipe to the cylinder head.

After reversing the carburettor, re-fit it to the intake pipe gently, taking care not to damage the O-ring in the carburettor by using force.

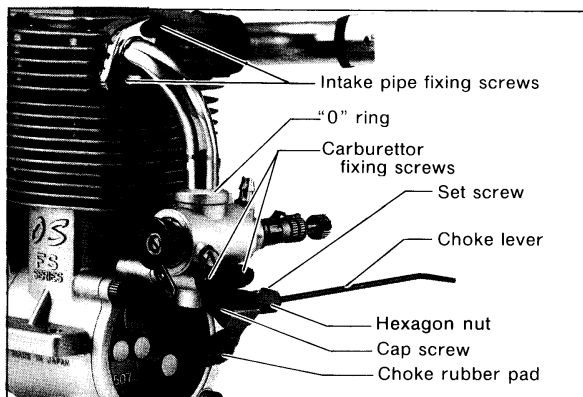
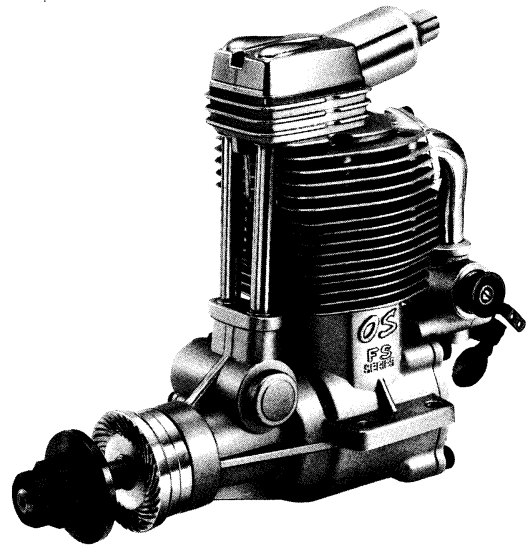


Photo 1

CHOKE VALVE

The FS-120S-E is equipped with a spring-loaded choke valve. The choke valve operating lever can be located right or left by transposing the hexagon nut and cap screw. After mounting the engine in the model, secure the L-shaped choke rod by tightening the set-screw. If the rod supplied is too long, reduce it to the required length. If the rod length is more than 40mm (1½ in.) its outer end should be supported to avoid vibration.



SPECIFICATIONS

Displacement	19.96 cc (1.218 cu.in.)
Bore	30.4 mm (1.197 in.)
Stroke	27.5 mm (1.083 in.)
Practical R.P.M.	2,000 ~ 11,000 r.p.m.
Output	1.9 BHP/11,000 r.p.m.
Weight	864 g (30.5 oz.)

FUEL TANK

The suggested fuel tank size is 400cc or 14 oz. This will give approximately 10 minutes running time when some part-throttle operation is included. Locate the fuel tank so that the centre line of the tank is 10 to 15mm below the centre line of the needle-valve.

Note: If the model is left unattended with the fuel tank filled, fuel may flow into the carburettor, causing it to "flood" and making the engine difficult to start. Take appropriate action to prevent this.

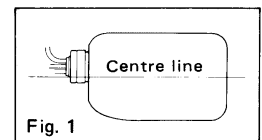


Fig. 1

FUEL

The FS-120S-E runs on standard commercially available model glowplug engine fuel. Fuels containing castor-oil and/or synthetic lubricants are acceptable, but for the best performance and reliability, a fuel containing 5 – 15% nitromethane is recommended.

For consistent performance and long engine life, it is advisable to use good quality fuel containing NOT LESS THAN 18% lubricant.

(The carburettor is adjusted with a fuel containing 20% lubricant when the engine leaves the factory.)

GLOWPLUG

An O.S. Type "F" glowplug is fitted to the engine.

With a four-stroke engine, ignition of the fuel charge takes place at every fourth stroke of the piston instead of every second stroke. Because of this, some conventional two-stroke glowplugs will not suit this engine. For general use, the special O.S. Type F glowplug is recommended.

PROPELLER

The choice of propeller depends on the design and weight of the model and on the type of flying envisaged. Determine the best size and type after practical experiment. As starting points, suggested propellers are listed below.

For stunt models	13x11~12, 14x10~11
For scale models	15x8, 16x6~7, 17x6, 18x5~6, 14x7 (3-blade), 15x8 (3-blade)

Note: Slightly smaller or larger props than those shown in the list can be used. However, it should be noted that propeller noise will increase if propeller blade tip velocity is increased (i.e. due to higher engine r.p.m. or a larger prop diameter).

For safety, keep your face and other parts of the body well away from the propeller when starting the engine or adjusting the needle-valve while the engine is running. Remember that the propeller turns through a much wider arc with the large sized propellers that this engine is capable of driving. Refer to the "Safety Instructions and Warnings" leaflet enclosed.

IMPORTANT: Use well balanced propellers and spinners only. An unbalanced propeller or spinner causes vibration and loss of power.

WARNING: There is always a danger, especially with nylon propellers (and depending on engine speed and weather conditions), of the propeller fracturing and a blade flying off and, obviously, this could cause serious injury. Therefore, never crouch over the engine when it is running and keep all onlookers well back and behind the model. If a spinner is used, make sure that the spinner notches are large enough to clear the propeller blades and so do not cut into and weaken the blade roots when the propeller nut is tightened.

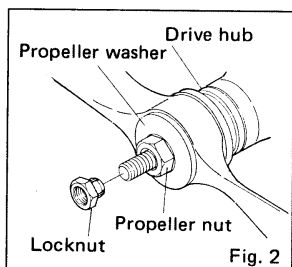
There is also a risk, particularly with four-stroke engines, of the propeller flying off if the propeller nut loosens due to detonation or "knocking" when the engine is run too lean or under too heavy a load. Obviously this can also be very hazardous.

To combat this danger, we have developed the special Safety Propeller Locknut Assembly supplied with the FS-120S-E. This prevents the propeller from flying off, even if the propeller itself should slip or loosen.

1. Ream the propeller centre hole to 8mm dia. Make sure that the propeller is properly balanced.
2. Fit the propeller sleeve-nut and washer to the propeller, screw onto the shaft and tighten firmly with 17mm wrench supplied.
3. Finally, insert the Safety Propeller Locknut. Tighten Locknut firmly (but not with excessive force) using 14mm wrench. (see Fig. 2)

IMPORTANT:

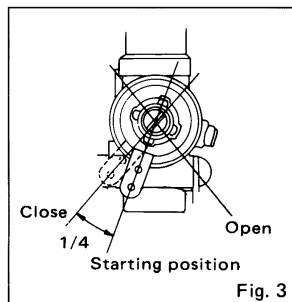
Regardless of the type of propeller fixing used, make a habit of always checking the tightness of the propeller before starting the engine. Remember that, especially with wooden propellers, there is a tendency for the material to shrink, or for it to be reduced by the serrated face of the drive hub.



STARTING

It is preferable to use a heavy-duty electric starter.

1. Firstly, fit a spinner so that an electric starter can be used. The O.S. special locknut set for spinner, that is available as an optional part, enables you to fit a spinner securely and easily.



2. Open the throttle so that the throttle-arm is at one-quarter of its full throw. (see Fig. 3)

(a) If a silencer pressurized fuel system is employed, set the needle-valve 2½ turns open from the fully closed position.

(b) If a silencer pressurized fuel system is not employed, set the needle-valve 3 turns open from the fully closed position.

3. Energize the glowplug and apply the electric starter after making sure that the battery leads are properly connected for counter-clockwise rotation. If the power of your starter is insufficient to immediately rotate the engine freely, turn the propeller clockwise ('backwards') until compression is felt, then, with the propeller in this position, try the starter again. This will enable the kinetic

energy of the rotating propeller to assist in carrying the engine through its compression stroke. Also, make sure that your starter battery is in good condition and fully charged.

CAUTION: Never apply an electric starter with the choke closed. Such an action will cause an excess quantity of fuel to be drawn into the cylinder and result in an hydraulic lock that may damage the engine.

4. When the engine starts, keep it running, initially, with the original needle-valve setting while steadily moving the throttle to the fully open position. If the engine slows down because the mixture is excessively rich, close the needle-valve slowly until the engine runs evenly. Then disconnect the battery from the glowplug and close the needle-valve slowly so that revolutions increase. Adjust the needle-valve gradually. Abrupt adjustment of the needle-valve may cause the engine to stop.

Note: Excess fuel in the carburettor may drip into the engine compartment when the choke valve is reopened. Therefore, it is advisable to drill a drain hole in the bottom of the engine bay or cowling and to apply fuelproof paint to the surrounding surfaces to prevent fuel from penetrating the airframe structure.

RUNNING-IN ("Breaking-in")

All internal combustion engines benefit, to some degree, from extra care when they are run for the first few times — known as running-in or breaking-in. This is because the working parts of a new engine take a little time to settle down after being subjected to high temperatures and stress. However, as O.S. engines are made with the aid of the finest modern precision machinery and from the best and most suitable materials, only a very short and simple running-in procedure is required and can be carried out with the engine installed in the model.

For running-in, use the same sized propeller as you intend for flying your model.

Running-in procedure is as follows:

Start the engine and run it for about 5 seconds at around maximum r.p.m., then open the needle-valve ½ turn to produce a rich mixture for cooler, slower running, and run for .20 seconds at this setting. Keep the throttle fully open, using only the needle-valve to reduce speed. Repeat this procedure, alternately running the engine fast and slow with the needle-valve, but gradually extending the short periods of maximum speed running until two full tanks of fuel are consumed.

Note: Take care to avoid dusty and sandy locations. Dust and grit drawn into the engine will seriously damage its working parts.

Following the initial break-in on the ground, the engine should be given a period of moderately rich running in the air. For the first flights, set the needle-valve rich, consistent with adequate take-off power and steady level flight and, if necessary, readjust the throttle trim on the transmitter so that the engine does not stop when the throttle is fully closed.

With each successive flight, close the needle-valve slightly, until, at the end of 10 flights, the needle-valve is set for maximum power. The carburettor can now be adjusted for optimum throttle performance following the instructions given in the next section.

Note: Remember that, while the engine is being run-in and the needle-valve is set on the rich side, the carburettor cannot be expected to show its best response. Therefore, avoid abrupt throttle operation at this stage.

ADJUSTING THE CARBURETTOR

The carburettor of your FS-120S-E has been factory set for the approximate best result, but the settings may, in some cases, vary slightly in accordance with fuel and climatic conditions.

If the desired throttle response is not obtained after the completion of the running-in period, the carburettor should be re-adjusted as follows. Please refer to Photos 2 and 3.

Three adjustable controls are provided on this carburettor.

- **The Needle-Valve:** For adjusting the mixture strength when the throttle is fully open.
- **The Mixture Control Screw:** For adjusting the mixture strength at part-throttle and idling speeds, to obtain steady idling and smooth acceleration to medium speeds.
- **The Throttle Stop Screw:** For establishing the minimum idling speed.

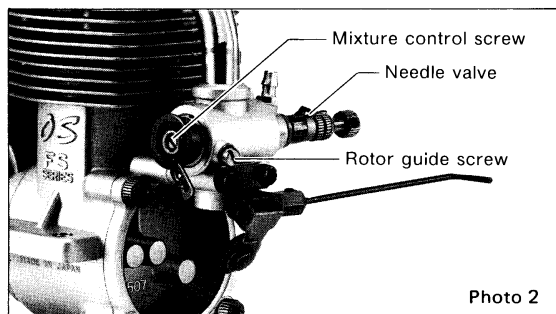


Photo 2

1. Set the throttle lever 1/4 open from the fully closed position (see Fig. 3) and start the engine in the usual way. It is preferable to have the throttle only slightly open, to avoid unnecessarily high revolutions when the engine starts.
 2. Now open the throttle fully and gradually close the needle-valve until the engine is running at its optimum r.p.m. in the air. The needle-valve setting at this time will be 1/8 to 1/4 open from the maximum r.p.m. setting.
- Note:** Make sure that the engine is fully "run-in" before operating it continuously at full power. (See RUNNING IN section.)
3. Having set the needle-valve as described above, close the throttle and run the engine at idling speed for approximately 5 seconds, then steadily move the throttle to the fully open position by means of the throttle servo.
 - (a) If, at this point, the engine hesitates before picking up speed, with a low-pitched exhaust note and an excess of exhaust smoke, it is probable that the idling mixture is too rich. In this case, it will be necessary to turn the mixture control screw clockwise about 45 degrees.
 - (b) If, on the other hand, the engine hesitates or even appears to cease firing for an instant, before increasing speed, it is probable that the idling mixture is too lean. In this case, it will be necessary to turn the mixture control screw counter-clockwise about 90 degrees, then turn it clockwise 45 degrees.

Turn the mixture control screw 30 to 45 degrees at a time in the early stages. When the response improves, turn the mixture control screw 10 to 15 degrees at a time. Carry out adjustments progressively and patiently, remembering the symptoms of rich and lean running, quoted above, until the engine responds quickly and positively to the throttle.

4. The throttle stop screw is for fixing the minimum idling speed. If, after carrying out mixture adjustments, the idling speed is found to be too high, the throttle stop screw should be turned counter-clockwise until the desired idling speed is obtained.

Note: Once the correct carburettor settings have been established, it should be unnecessary to alter them. Such slight needle-valve readjustments as may be required to compensate for variations in atmospheric conditions, will not normally affect the other two controls. Slight readjustments may be necessary for optimum performance if different types of fuel, glow-plugs or propellers are used. In this case, begin by flying the model with the needle-valve approximately 1/8 to 1/4 turn open from the peak r.p.m. as a safety measure, then readjust as necessary.

REALIGNMENT OF MIXTURE CONTROL VALVE

In the course of making carburettor adjustments, it is just possible that the Mixture Control Valve may be inadvertently screwed in or out too far and thereby moved beyond its effective adjustment range.

Its basic setting can be reestablished as follows:

The basic (factory) setting is as shown in the main sketch, i.e. with the shoulder portion 'A' exactly at a tangent to the throttle rotor hole.

To return the Mixture Control Valve to its original position, first screw in the Mixture Control Valve, while looking into the rotor hole. Then gradually unscrew the Mixture Control Valve until 'A' is precisely tangential to the rotor hole (i.e. so that 'A' and 'B' are superimposed) as in the main sketch.

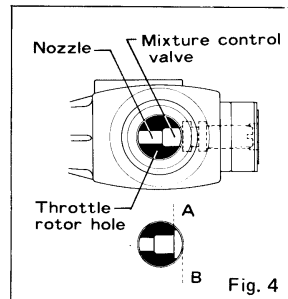


Fig. 4

CARBURETTOR CLEANLINESS

The correct functioning of the carburettor depends on its small fuel orifices remaining clear. The minute particles of foreign matter that are present in any fuel can easily partially obstruct these orifices and upset mixture strength so that engine performance becomes erratic and unreliable.

It is recommended that fuel is passed through a filter when the tank is filled and that a good in-line filter is installed between the fuel tank and carburettor and, furthermore, that this filter is frequently cleaned to remove dirt and lint that accumulate on the filter screen. Finally, occasionally remove the needle-valve holder from the carburettor, using the wrench supplied, and extract any remaining foreign matter that may have lodged in the location shown in Photo 3.

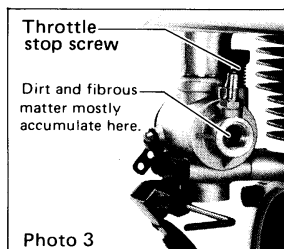


Photo 3

VALVE CLEARANCE ADJUSTMENT

Valve clearances are correctly set before any O.S. four-stroke engine leaves the factory and, in normal use, will seldom require adjustment. However, if, after a considerable amount of running time has accumulated, a loss of power is detected, or if the engine has to be disassembled or repaired as a result of a crash, valve clearances should be checked and readjusted as necessary. For checking and adjusting the valve clearances, a valve adjusting kit, containing two feeler gauges and two wrenches, is available as an optional accessory.

Note: Valve clearances on this engine must be checked and re-set only WHEN THE ENGINE IS COLD.

1. Remove the rocker cover by unscrewing two Allen screws from the rocker box on top of the cylinder head.
2. Turn propeller until compression is felt, then turn it one quarter turn and stop. Both valves should now be closed.
3. The required valve clearance is between 0.04 mm and 0.10 mm (.0015 to .004 in.) measured between the valve stem and rocker-arm. Use the 0.04 mm (thinner one) and 0.10 mm (thicker one) feeler gauges to check clearance. The 0.04 mm feeler should pass through the gap: the 0.10 mm gauge should not.
4. If the gap is found to be less than 0.04 mm or more than 0.10 mm, carefully slacken the locknut on the rocker-arm with the 5 mm wrench supplied, turn adjusting screw with 1.5 mm Allen key to open or close gap, then retighten locknut.

Finally, re-check gap and readjust if necessary.

IMPORTANT: Incorrect valve clearances may cause difficult starting (due to valve not closing properly) or loss of power (due to valve not opening sufficiently).

NEEDLE VALVE EXTENSION

The needle-valve supplied with this engine is designed to incorporate an extension so that, when the engine is enclosed within the fuselage, the needle-valve may be adjusted from the outside. An L-shaped rod, of 1.6 – 1.8 mm dia. and appropriate length, should be inserted into the needle's centre hole and secured by tightening the set-screw in the needle-valve knob with the small Allen key provided.

CARE AND MAINTENANCE

To ensure that you obtain long life and peak performance from your engine, observe the following.

1. Avoid running the engine under dusty conditions. If necessary, lay a sheet of plywood or hardboard in front and under the nose of the model when starting the engine.
2. Foreign matter in the fuel can cause the carburettor jet to be partially clogged. Therefore:
 - rinse out the fuel tank with methanol or fuel before installing it
 - fit a fuel filter in the fuel delivery tube between tank and carburettor
 - fit a fuel filter to the outlet of your squeeze bottle, or to the pump inlet if you use a manual or electric pump
 - do not leave your fuel container open needlessly
 - check filters periodically and clean them when necessary.

3. Do not leave raw fuel in the engine at the conclusion of a flying session: it may cause corrosion. The best practice is to disconnect the delivery tube from the carburettor while the engine is running.

Remaining fuel in the tank should also be drained off.

IMPORTANT: After the engine has run dry, liberally inject corrosion-inhibiting oil or light machine oil into the crankcase, via the breather hole, until excess oil runs from behind the drive hub when the engine is pointed downwards. Rotate the crankshaft to distribute the oil to the bearings, etc. Failure to carry out this procedure may cause internal rusting, resulting in engine malfunction and voiding the warranty.

4. Clean the exterior of the engine with a clean cotton cloth. If this is not done, oil and dirt will burn onto the outside of the engine each time it is run and the engine will soon become blackened.
5. If the engine is not to be used for a while (more than two months) remove the glowplug and rinse out the interior with kerosene (not gasoline), by rotating the crankshaft. Shake out residue, then inject corrosion-inhibiting oil or light machine-oil through the exhaust pipe and breather hole, again rotating the shaft to distribute the protective oil to all working parts.
6. Avoid unnecessary dismantling of your engine.

PARTS LIST

Code No.	Description	Code No.	Description
45501020	Crankcase	45530010	Crankshaft Bearing (Rear)
45501110	Cam Cover	45231100	Camshaft Bearing
45502011	Crankshaft	45560030	Intake Valve Assembly
45503100	Cylinder Liner	45560040	Exhaust Valve Assembly
45503210	Piston	45561010	Rocker Arm Assembly
45503400	Piston Ring	45561401	Rocker Support Assembly
45504020	Cylinder Head (w/Valve Ass'y)	45562010	Camshaft
45504110	Cylinder Head	45564000	Cam Follower
45504210	Rocker Cover	45566000	Push Rod
45505010	Connecting Rod	45566101	Push Rod Cover Assembly
45506010	Piston Pin	45569420	Intake Pipe
29017004	Piston Pin Retainer	45581000	Carburettor Complete
45507010	Cover Plate	45484000	Choke Valve Assembly
45508030	Drive Hub (w/Key)	45525001	Silencer Assembly
45508200	Woodruff Key	71615009	Glow Plug Type " F "
45520000	Thrust Washer	* 71904200	Radial Motor Mount
45510100	Propeller Locknut Assembly	* 72200060	Valve Adjusting Kit
45513010	Screw Set	* 72142000	EX-502 Silencer
45514010	Gasket Set	* 72140400	EX-502 Exhaust Header Pipe (120 IN)
29031009	Crankshaft Bearing (Front)	* 72140500	EX-502 Exhaust Header Pipe (120 C)

* Optional parts

The specifications are subject to alteration for improvement without notice.

O.S. ENGINES MFG. CO., LTD.

6-15 3-chome Imagawa Higashisumiyoshi-ku
Osaka 546-0003, Japan TEL. (06)702-0225
FAX. (06)704-2722