VALVE CLEARANCE ADJUSTMENT
Valve clearances are correctly set before any O.S. four-stroke engine leaves the factory and, in normal use, will seldom need resetting. However, if, after a considerable amount of running time has accumulated, a loss of power or engine deflection is noticed, the valves may have to be re-adjusted.

1. Remove the rocker cover by unscrewing the two 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 0.04 mm ± 0.10 mm (0.0015 ± 0.004 in.) measured between the valve stem and the rocker arm. Use the 0.04 mm (0.0015 in.) and 0.10 mm (0.005 in.) feeler gauges to check clearances. The 0.04 mm feeler should pass through the clearance gap.
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.

REPLACE DAMAGED PARTS AND GAUGES
If, after a considerable amount of running time has accumulated, a loss of power or engine deflection is noticed, the valves may have to be re-adjusted.

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

PARTS LIST

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INSTRUCTIONS FOR O.S. FS-91 SURPASS FOUR STROKE CYCLE ENGINE

To obtain the best possible performance and life from your engine, observe the following:
1. Avoid running the engine under dusty conditions. If necessary, lay a sheet of newspaper 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:
   - Without the engine running, unscrew the fuel cock for approximately 3 turns and install 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 which do not leave your fuel completely unexposed.
   - Check filters periodically and clean them when necessary.
3. Do not leave raw fuel in the engine at the conclusion of a flight session. If movement of the engine is necessary, disconnect the fuel delivery tube from the carburettor while the engine is running.

SILENCER ASSEMBLY

Installation procedures are as follows:
1. Screw the exhaust header pipe into the exhaust port until it “bottoms”; then unscrew it just sufficiently to achieve the required exhaust outlet angle. Secure the pipe in this position by tightening the locknut firmly against the cylinder head with the wrench supplied.

CARBURETTER THROTTLE

The needle valve and throttle lever locations are inter-changeable by reversing the carburettor. This can be done as follows:
1. Remove the carburettor carefully by unscrewing the two screws which secure both carburettor and choke valve. (See Photo 1) If it is still hard to remove the carburettor, loosen a little two screws which secure the intake pipe to the cylinder head.
2. After reversing the carburettor, re-insert it into the intake pipe gently, taking care not to damage the Dr-Inj in the intake pipe by using force.

CHOKING VALVE

The FS-91 Surpass is equipped with a spring-loaded choke valve. The choke valve operating lever can be located right or left by removing the hexagon nut and cap screw.

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 experimentation. As starting points, suggested propellers lies below:

For stunt models:
11.1x10, 11.1x11, 12.6x9, 12.5x11, 12.8x13

For scale models:
11.1x10, 11.1x11, 12.5x11, 12.5x12, 12.8x13 (blade)

(Continued on next page)
**Note:** Smaller or larger print size shown in the text can be adjusted. It should be noted that propeller noise will increase as the rpm increases.

For safety reasons, keep your face and other parts of the body well away from the propeller when starting the engine or adjusting the needle valve. Remember that the propeller turns through a much wider arc with the large size propeller. It is possible to cause injury to the engine and critical parts of the boat and may damage the engine. 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 wear on the engine and may damage the engine and other parts of the boat.

**WARNING:** There is always danger, especially with nylon propellers, that the propeller may become loose or completely detached, especially if the propeller is not tightened, the blade roots or the blade bolts are damaged, or if the propeller is not kept in good condition. Never clean the propeller using a pressure washer. Always keep all outboard wax well back and behind the propeller. If a spinner is used, make sure that it is securely fastened and that the spinner is large enough to cover the propeller blade roots and that the blade bolts are tightened. Never permit anyone to touch the blades of the propeller when the propeller is in operation.

There is also a risk, particularly with four-stroke engines, of the propeller rotating in the wrong direction (propeller cutters down) 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 (sold separately or applied with the FS.91 Supers). 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 held firmly balanced.
2. Fit the propeller sleeve-nut and washer to the propeller, screw onto the shaft and tighten firmly with 14mm wrench. (Fig. 2)
3. Finally, insert the Safety Propeller Locknut. Tighten the Locknut firmly with hand or using 12mm wrench. (See Fig. 2)

**IMPORTANT:** Note the type of propeller fitting used, make a habit of always re-checking that the propeller is securely fastened to the shaft and that the blade bolts are tightened. It is very important to re-check the bolt fastening before each start-up and especially if any knocks are heard. It is also recommended that you check the serrated face of the drive hub, periodically. (See Fig. 2)

**STARTING**

It is essential to use a heavy-duty electric starter, although hand-starting is also possible, as will be explained in a moment.

1. To fit a starter so that an electric starter can be used, the Safety Propeller Locknut is required. This special locknut set for spinner, propeller and boat manufactured by wooden propellers, there is a strong tendency to "spring" or "play" in the propeller shaft, with the result that the propeller may not fit into the propeller housing or be retained in the square face of the drive hub. (See Fig. 3)
2. Close the throttle so that the throttle-arm is at the 3/4 mark of its full throw.
3. [b] If a silencer pressurized fuel system is employed, set the needle valve to 2/25 open from the fully closed position.
4. Gaseous the propeller and the electric starter after making sure that the propeller blades are properly connected for counter-clockwise rotation. If the power of your starter is weak, 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 starting propeller to assist in starting the engine through its compression stroke. Also, make sure that your starter battery is in good condition and fully charged.

**CAUTION:** Never apply electric starter with the choke closed. Such a condition will allow gas to be drawn into the cylinder and result in an hydraulic lock that may damage the engine.

**WARNING:** Always start the engine from cold. Slowly and steadily rotate the propeller through a full 360 degrees, and then release the propeller gently.

4. When the engine starts, keep it running, initially, with the original needle valve setting and gradually 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 speeds up. Then disconnect the battery from the glowplug and close the needle valve slowly until the engine stops. Adjust the needle-valve gradually. Abrupt adjustment of the needle-valve may cause engine to stop.

The above starting procedure is standard for the FS.91 Supers. However, the engine may be safely hand-started – even in the case of the four-stroke engine. To do this, just fit a "chicken-stick". The procedure is as follows:

1. The propeller should be fitted in such a way that it is positioned horizontal. This is first felt when turning the propeller counter-clockwise.
2. Open the throttle so that the throttle-arm is at one-quarter of its full throw.

[b] If a silencer pressurized fuel system is employed, set the needle valve to 3/4 turn open from the fully closed position.

[b] If a silencer pressurized fuel system is not employed, set the needle valve to 3/4 turn open from the fully closed position.

3. Prime the engine by closing the choke valve and turning the propeller through 4 to 5 revolutions, depending on the length of pipe from primer pump to engine.
4. Turn the propeller counter-clockwise several times so that fuel is delivered to the carburettor.
5. Gradually turn the propeller counter-clockwise until compression is felt. Leave the prop at this point.
6. Set the throttle to a position midway between the setting at which the engine started and the setting at which the spark plugs were fired. (Fig. 3)
7. Connect the glowplug battery and, using the chicken- stick, briskly work the chicken-stick from the position determined above and from the centre of the right blade. The engine will then bounce gradually and the counter-clockwise direction to the point where ignition and expansion of the charge takes place. If the engine stops, make sure that the carburettor from the fuel tank, then repeat procedures (3) to (7).
8. When the engine starts, keep it running, initially, with the original needle-valve setting. It is better to wait until the mixture has become 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 until that revolution speeds. Adjust the needle-valve gradually. Abrupt adjustment of the needle-valve may cause the engine to stop.
9. To restart the engine when it is hot, after a run, first try flipping the propeller, with the throttle in the idling position, after re-engressing the glowplug. If the engine does not re-start, re-start by closing the choke valve while rotating the propeller once or twice until the cylinder becomes cold enough for restarting.

**CAUTION:** Do not connect the glowplug to the battery while running.

**Note:** Excess fuel in the carburettor may drip into the engine compartment. Reduce the engine speed. Therefore, it is advisable to drain a drain hole in the bottom of the engine bay and re-filling it and to apply firewall for external surfaces to prevent fuel from penetrating the airspace structure. (See Fig. 3)

**RUNNING-IN ("Breaking-in")**

All internal combustion engines benefit, to some degree, from an extended "running-in" period. 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 to turn a rich mixture for cooler, slower running, and for 20 seconds at this setting. Keep the throttle fully open, using full power, to complete the running-in procedure. This running-in procedure, alternatively running the engine fast and slow with the needle-valve, but gradually extending the short period running-in procedure so that all fuel tanks are fully consumed.

Now that you have reached your cruising speed, it is advisable to avoid dusty and safe locations. Dust and grit dirt into the engine with serious damage to the working parts. After 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 flight, open the needle valve rich 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. For maximum performance, the carburettor can now be adjusted for optimum performance following the instructions given in the next section.

**RECOMMENDATION**

While the engine is being run-in and the needle valve is set on the rich side, the carburettor cannot be properly adjusted (see below). Therefore, avoid throttle operation at this stage.

**ADJUSTING THE CARBURETTER**

The carburettor of your FS.91 has been factory set for the approximate balance, 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 course of your break-in period, the carburettor should be re-adjusted as follows:

Three adjustable controls are provided on this carburettor:

- **The Choke Adjuster:** for controlling the mixture strength when the throttle is fully open.
- **The Mixture Control Screw:** for adjusting the mixture strength on the starting speeds, to obtain steady idling and smooth acceleration to medium speeds.

The following are simple instructions for establishing the minimum idling speed. (see Photo 3)

- Set the throttle lever 1/4 open from the fully closed position (see Fig. 3) and start the engine with the needle valve open, in the usual manner. If the engine is too rich, open the needle valve slightly to avoid unnecessarily high revolutions when the engine is started.

- Now open the throttle fully and gradually close the needle valve slowly until the engine runs at a steady 500 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.

**REALIGNMENT OF MIXTURE CONTROL VALVE**

In the course of running-in, it is 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 re-established as follows:

- The basic (factory) setting of the main shaft, i.e. the collar with the shoulder portion 'A' exactly at a tangent to the rotor of the main shaft. (see Photo 2)
- To re-tighten the Mixture Control Valve to its original position, first screw in the rotor of the Mixture Control Valve, while looking into the rotor hole, and gradually unscrew the Mixture Control Valve until 'A' is precisely tangential to the rotor hole (i.e. so that 'A' and 'B' are superimposed) in the main shaft.

**CARBURETTER CLEANLINESS**

The correct functioning of the carburettor depends on the cleanliness of its small fuel orifices remaining clear. The minute particles of foreign matter that are present in any fuel can partially obstruct these orifices and upset mixture strength, so that engine performance becomes erratic and engine start becomes difficult. It is recommended that fuel is passed through a filter when it is first filled and that the fuel line between the fuel tank and carburettor and, furthermore, that this filter is frequently cleaned to remove dirt and allows that accumulates on the filter screen. Finally, occasionally...