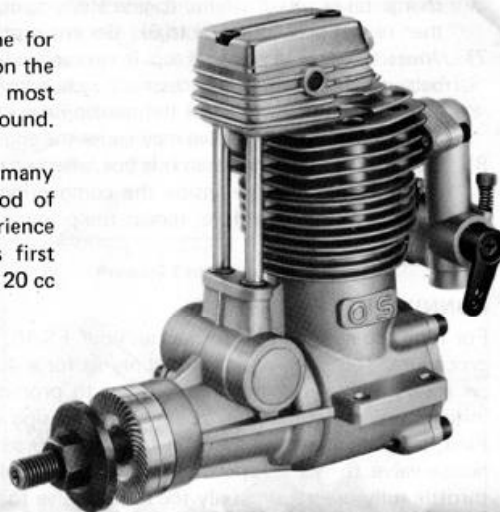


INSTRUCTIONS FOR O.S. FS-40 FOUR STROKE CYCLE ENGINE

The O.S. FS-40 is an air-cooled, overhead-valve, four-stroke engine for model aircraft use. Because it operates, like most fullsize engines, on the four-stroke-cycle principle, rather than the two-stroke cycle of most model engines, it has a quieter, lower-pitched and more "realistic" sound. A silencer (muffler) will not normally be required.

Bringing a quality-built four-stroke engine within the reach of many more enthusiasts, the 6.5 cc FS-40 is the outcome of a long period of technical development. It benefits from our many years' experience with four-stroke engines, including the 10 cc FS-60, the world's first volume-production miniature four-cycle engine, and the outstanding 20 cc twin-cylinder FT-120 'Gemini'.



SPECIFICATIONS

Displacement	6.495 c.c. (0.3964 cu. in.)
Bore	21.2 m.m. (0.8346 in.)
Stroke	18.4 m.m. (0.7244 in.)
Practical R.P.M.	2,500 - 10,000 r.p.m.
Weight	340 gr. (12 oz.)

IMPORTANT

Before attempting to operate your FS-40, please read through this instruction leaflet so as to familiarise yourself with the controls and other features of the engine. Also, please pay careful attention to the recommendations contained in the "Safety Instructions and Warnings" leaflet enclosed.

INSTALLATION

Use a strong engine mount, at least as firm as is used for existing 40 class engines. Installation should be made in such a way that maintenance, checking and valve tappet adjustment can be done easily.

FUEL

The FS-40 runs on standard commercially available methanol-based model glowplug engine fuels. Fuels containing castor-oil and/or synthetic lubricants are acceptable, but for the best performance and reliability, a fuel that also contains between 5% and 10% nitromethane is recommended. A fuel tank of only 150 cc (5 oz.) capacity will run this engine for 15 - 20 minutes because of its economical fuel consumption.

FUEL TANK

The ideal fuel tank location is with the top of the tank 5 - 10 mm (1/4 - 3/8") above the level of the needle-valve. However, in the case of a normal upright engine installation, model design will usually require the tank to be located lower than this, in which case simply install the tank as high as possible. In the case of a side-mounted installation, the fuel tank will usually be located in the ideal position.

PROPELLER

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

Check the balance of propellers before fitting them to the engine. Unbalanced propellers cause vibration and a loss of power.

Important Do not use a small propeller than will allow the engine to reach speeds above the quoted practical r.p.m. limit. Excessive r.p.m. with a four-stroke engine does not produce more power and may cause damage through over-speeding the valve gear.

For scale models of early type aircraft with large wing areas and light wing loadings:	12 x 5
For light-aircraft type model (sport, scale or trainer)	11 x 6 or 12 x 5
For sport type aerobatic model	10-1/2 x 6 or 11 x 6

HAND STARTING

With a two-stroke engine, hand starting is performed by cranking the engine counter-clockwise after priming. For the FS-40, the newcomer is advised to adopt a rather different procedure, as follows.

- 1) The propeller should be fixed in such a way that it is positioned horizontally as compression is first felt when turning the prop. counter-clockwise.
- 2) Open the throttle valve fully and unscrew the needle valve approximately 3 turns from the fully closed position.
- 3) Prime the engine fairly generously through the exhaust pipe.
- 4) Crank the engine clockwise (i.e. "backwards") so that fuel is drawn well into the cylinder.
- 5) Gradually turn the propeller counter-clockwise until compression is felt.

- 6) Connect the glowplug to the battery and flip the prop. **clockwise** from the centre of the right blade. The engine will then bounce smartly in the counter-clockwise direction to the point where ignition and expansion of the charge takes place. If the engine stops again, make sure that fuel is reaching the carburettor from the fuel tank, then repeat procedures 3) to 6). Generous priming is the secret of easy starting.
- 7) When the engine starts, keep it running, initially, with the original needle-valve setting. If the engine slows up because the mixture is excessively rich, screw in the needle-valve slightly. Then disconnect the battery from the glowplug and slowly close the needle-valve so that revolutions increase. Adjust the needle-valve gradually. Abrupt closure of the needle-valve may cause the engine to stop, especially when it is new and insufficiently run-in.
- 8) To restart the engine when it is hot, after a run, first prime through the exhaust pipe, as for a cold engine. Initially, the high temperature inside the combustion chamber will turn the liquid fuel into gas and emit it through the exhaust pipe. Therefore, repeat the priming procedure once or twice until the cylinder becomes cool enough for another start.

RUNNING-IN ("Breaking-in")

For long life and high performance, your FS-40, like any other engine, requires the correct running-in, or breaking-in, procedure. The same basic rules apply as for a 40 class two-stroke engine -i.e., when new, the engine must be operated on a very rich needle setting in order to promote cool running and maximum lubrication. It is recommended that initial running-in is done on a bench mount using an 11 x 6 propeller.

First, start the engine and run it for about 10 seconds with the needle-valve set for 6,000/7,000 r.p.m., then open the needle-valve to reduce speed to approximately 4,000 r.p.m. and run for 20 seconds at this cooler 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 high speed running until a total of at least 20 minutes running time has been accumulated. For those who do not have a tachometer, the exhaust gas colour can be a help: e.g. as the needle-valve is screwed in, the exhaust gas will turn lighter, from the original grey colour.

Following the initial break-in of 20 minutes minimum on the bench, the engine should be installed in your model and run-in for a further period in the air. For the first flights, have the needle-valve set as rich as possible, consistent with adequate take off power and, if necessary, readjust the throttle rotor stop 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 re-adjusted for optimum throttle performance.

THROTTLE VALVE ADJUSTMENT

The carburettor of your FS-40 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.

Remember, also, 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. If, however, the desired throttle response is not obtained after the completion of the running-in period, the carburettor should be re-adjusted as follows.

Three adjustable controls are provided on this carburettor:

- 1) The Needle-Valve
- 2) The Air-Bleed Screw
- 3) The Throttle Rotor Set-Screw

I. The Needle-Valve is used in the same way as on all model engines, i.e., for adjusting the high-speed mixture strength. Start the engine and, with the throttle fully open, gradually close the Needle-Valve until it is running at its maximum speed. Caution: Do not close Needle-Valve to too "lean" a setting as this will cause the engine to overheat and slow up. Set the Needle-Valve very slightly to the "rich" side of the peak r.p.m. setting. Make sure that the engine is fully "broken-in" (about 1 hour to total running time in short runs) before operating it continuously at full throttle.

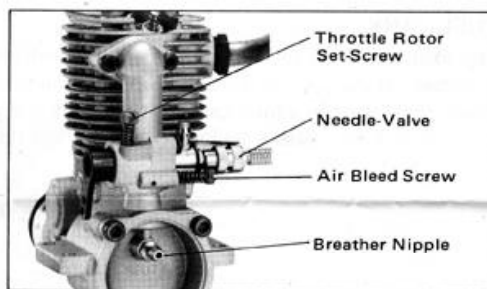


Photo 1.

II. The Air-Bleed Screw is for adjusting fuel mixture strength at idling speeds. Having set the Needle-Valve as detailed above, close the throttle. The engine should idle continuously and steadily without further adjustment.

- a) If, however, the engine begins to idle unevenly, first re-open the throttle. If the engine then hesitates before picking up to full speed, it is probable that the idling mixture is too rich.

Check this by closing the throttle again and letting the engine idle for a little longer before again opening up. If the engine now puffs out a good deal of smoke and hesitates or even stops, it will be necessary to screw out the Air-Bleed Screw to weaken the mixture. Do this by turning it '**counter-clockwise**'.

About 1 - 2 turns should be sufficient.

- b) If instead of being set too rich, the Air Bleed Screw is set too lean, the engine will stop when the throttle is closed, or will lose speed while idling and then cut-out abruptly (without smoking) when the throttle is opened again.

In this case, turn the Air-Bleed Screw about 1 - 2 turns '**clockwise**'.

Air-Bleed Screw adjustment is not critical and by remembering the symptoms of rich and lean running quoted above, it is a very simple matter to establish the best setting.

III. The Throttle Rotor Set-Screw is for establishing the minimum idling speed. If the engine runs too fast with the throttle closed, the Rotor Set-Screw should be turned counter-clockwise to allow the throttle opening to be reduced.

Subsequent Operation and Care

Once the required carburettor settings have been established, it should be unnecessary to alter them. Such slight needle-valve alterations as may be needed to cope with differences in atmospheric conditions or fuels, do not affect the other two adjustments. The engine should start readily with the throttle in the idle position.

It is important that the carburettor operates under clean conditions. Make sure that fuel is properly filtered before use. We advise fitting a filter in your fuel can and another in the delivery tube between tank and engine, to reduce the risk of the carburettor jet becoming partially clogged and upsetting running adjustments. Remember to clean the filters occasionally.

Provided that fuel is double filtered in this way, the carburettor should not need any special attention.

PRESSURE ADAPTOR

A pressure adaptor is supplied with this engine. This looks like a small silencer but does not function as such. Its purpose is to serve as an exhaust pressure pick-up device for pressurizing the fuel system.

If, in the case of an upright engine installation, the design of the air craft requires the fuel tank to be fitted too far below the carburettor, the engine may be starved of fuel, as the tank empties, or in certain manoeuvres, such as a sharp pull-out after a power-dive. This is likely to cause the engine to cut out.

Therefore, to ensure an adequate fuel supply under such conditions, fit the pressure adaptor to the end of the exhaust pipe as shown in photo. 2. Fit one end of a length of silicon tube to the pressure adaptor and the other end to the vent pipe on the fuel tank. If the tank has two vents, the second one must, of course, be capped or plugged to prevent loss of pressure.

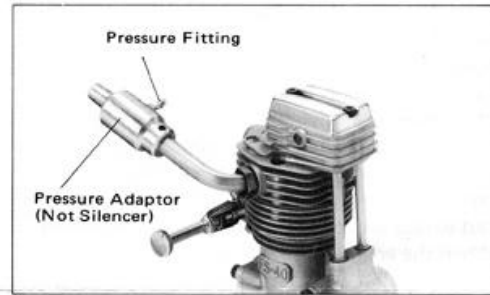


Photo 2.

INVERTED OPERATION

If your model calls for an inverted engine installation, the FS-40 will run just as well in this position, provided that the recommendations on fuel tank location are observed. It will not be necessary to use the pressure adaptor unless the tank is located below the carburettor.

Important Please refer also to the notes on Care of Your FS-40.

VALVE CLEARANCE ADJUSTMENT

Valve clearances are correctly set before the FS-40 leaves the factory. However, as the engine becomes properly run-in, the smoothing and polishing of the valve gear surfaces gradually widens the tapped gap. Therefore, when a total running time of about one hour has been accumulated, valve clearances should be checked by using the feeler gauges supplied with the engine.

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 0.04 mm or more than 0.10 mm, carefully slacken the locknut on the rocker-arm with the 5 mm spanner supplied, turn adjusting screw to open or close gap, then retighten locknut. Finally, re-check gap and readjust if necessary.

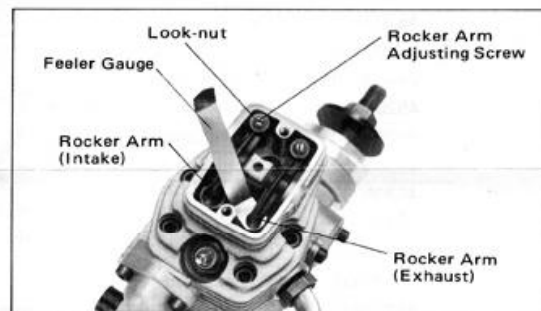


Photo 3.

Important

Incorrect valve clearances may cause difficult starting (due to valve not closing properly) or loss of power (due to valve not opening sufficiently). Therefore, it is advisable to re-check clearances periodically.

CRANKCASE BREATHER

The nipple located in the rear cover plate is the crankcase breather. As some surplus oil will be emitted from this, use silicon tubing of approx. 2.5 mm I.D. to discharge it outside the model.

LUBRICATION

All parts of the FS-40 are automatically lubricated by the oil content of the fuel mixture.

EXHAUST PIPE ADJUSTMENT

The direction of the exhaust pipe may be altered in accordance with individual installation requirements. The angle is easily adjusted by loosening the nut that secures the exhaust pipe to the cylinder head. Use the special 10 mm spanner supplied.

CARE OF YOUR FS-40

The FS-40 should be treated with the utmost care at all times. At the conclusion of a flying session, do not leave the engine "wet" with raw fuel by stopping it after rich-mixture running or prolonged idling. Instead, let it run for a few moments at full throttle with the correct needle setting, to bring it up to normal running temperature, then cut off the fuel supply — preferably by removing the fuel line from the carburettor. Extra protection against internal corrosion should be given by injecting some special moisture-displacing oil or light machine oil through the crankcase breather and rotating the crankshaft for several revolutions to draw the oil into the bearings, etc.

Keep the engine in a clean, dry atmosphere when it is not in use.

When the engine is installed in the inverted position, there is a tendency for oil to drain towards the cylinder head. It is therefore advisable, before attempting to start the engine, to make sure that the accumulated lubricant is not so excessive as to cause an hydraulic lock. Attempting to start the engine in this condition, especially with an electric starter, could cause damage. Therefore, first check, by carefully turning the propeller by hand, that the piston can pass over compression freely and do not over-prime. If necessary, remove glowplug, turn prop a few times to pump out excess and blow oil from glowplug cavity before replacing it.

When the engine is not in use for a lengthy period, it is advisable, with inverted installations, to store the aircraft upside-down, so that oil drainage into the combustion chamber and glowplug does not leave the ball-bearings, etc., too dry. Do not dismantle the engine needlessly.

OPPOSITE ROTATION

If reversed engine rotation should be required (e.g. for a "pusher" installation with a standard propeller, or for a twin-engined model requiring opposed prop. rotation) a special reverse-rotation camshaft is available for the FS-40.

Unless you are familiar with model four-stroke engine design and construction, it is recommended that this conversion be carried out at an appointed O.S. service depot. Alternatively, new FS-40 engines are available to special order with the reverse camshaft ready installed.

PARTS LIST

Code No.	Description	Code No.	Description
45201030	Crankcase	45231100	Camshaft Ball Bearing
45201110	Cam Cover	45260000	Valve Assembly
45202001	Crankshaft	45261000	Rocker Arm Assembly
45202100	Crankshaft Spacer	45261500	Rocker Shaft
45203100	Cylinder Liner	26381501	Rocker Shaft Set Screw
45203200	Piston	45262000	Camshaft
24203410	Piston Ring	45264000	Cam Follower
45204000	Cylinder Head (w/Valve Ass'y)	45266000	Push Rod
45204200	Rocker Cover	45266101	Push Rod Cover Assembly
45205000	Connecting Rod	45269000	Exhaust Pipe Assembly
45206000	Piston Pin	22681953	Breather Nipple
45207000	Cover Plate	23081715	Plug Screw
45208001	Drive Washer	71615009	Glow Plug Type "F"
23209003	Propeller Washer	45281000	Carburettor Assembly
23210007	Propeller Nut	72200030	Feeler Gauge Set
45213000	Screw Set	*45069012	Exhaust Pipe Set (45°)
45214000	Gasket Set	*45069021	Exhaust Pipe Set (Straight)
45231000	Ball Bearing (F)	*23024008	Spinner Nut
22630002	Ball Bearing (R)	45270000	Pressure Adaptor

* Optional Spare Parts

The specification is subject to alteration for improvement without notice.

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