

# RMEngineTest

## *Peter Chinn reviews the popular four-stroke engine O.S.FS-40*

There is a paradox when it comes to powering many of the R/C vintage type models of today. Great care is taken to keep the original design and structure (allowing for the additional stresses of conventional free flight designs) of these vintage creations, but the approach to the selection of the engine is more ambiguous. Ideally, all vintage models would be fitted with vintage engines, i.e. spark ignition, early glow engines and original diesels. For commercial, or cost, reasons, this is not always a practical solution. One might imagine that, if 'genuine' vintage engines are unavailable, the choice would be for motors as near representative to the pre 1951 (or later for aerobatic models) as possible. Some of the Merco glow engines and P.A.W. diesels are getting near to the vintage era and there are the replica vintage engines available - see 'New engines for old'. However, the engines that are finding most favour for supplying the motive power for flying these old time aeroplanes are the latest engine designs, i.e. the new generation of four-stroke engines.

*It is not difficult to understand why this should be so, the four-stroke engines are pleasant to operate, quiet - with a 'non-irritating' sound quality - and are capable of swinging large diameter propellers at relatively slow r.p.m. These qualities are particularly suited to the slow flying and 'gracious' characteristics of vintage models - both free flight and R/C assist.*

*Among the most popular of modern four-stroke engines to be used in vintage designs is the OS FS-40 motor, it is an excellent replacement for earlier '35'glo engines and '40' to '60' spark ignition engines. A full test report of the OSFS-40 motor was published in the October 1982 Aeromodeller but it is too important an engine to ignore for R/C purposes The following article is a precis of the original test report.*

Although four-stroke motors appeared on the market, from time to time, over a period of nearly 40 years between the late 1930's and mid 1970's, few of them survived for more than a year or two, largely due to the fact that they could not compete with existing two-strokes on price, performance, compactness, lightness, or general suitability for model aircraft use. In recent years, however, two factors have combined to change the climate so far as four-strokes are concerned.

First, the enormous increases in power that model two-stroke motors have achieved, have, to some extent, also been their undoing, since extremely high noise levels (only partly ameliorated by the use of silencers) of modern high speed two-strokes, constitutes something of a public nuisance in many areas and has resulted in the loss of numerous flying sites.

Second, the immense increase in the popularity of radio-control and the more advanced models that modern R/C systems have made possible, have combined to open up a market to a wider public willing to buy ever more complex engines, so that the extra cost of a four-stroke engine is no longer a barrier to its acceptance by a larger and generally more affluent modelling fraternity.

In 1975, the OS company of Japan, the world's largest and longest established (45 years) manufacturer of model i.c. engines, decided that the market was ripe for the quantity production of a new breed of model four-stroke engine. In order to attract the widest possible acceptance, the engine had to be little or no larger, or heavier, than existing two-strokes of the same capacity and had to operate on glowplug ignition and the readily available two-stroke glow engine fuels familiar to all model i.c. engine users.

The result, introduced eight years ago, was the OS FS-60, a high-quality 10cc. pushrod-OHV motor that was easy to operate, compact and weighed no more than a good 10cc. two-stroke with silencer.

Four-strokes were soon beginning to attract the attention of the 'ordinary' modeller and it was clear that there was a good market for a smaller engine at a reasonable price. The result was the 6.5cc. FS-40 model, introduced in 1981, which is the subject of our present report. Having a power stroke once every two revolutions instead of every revolution, model four-strokes do not develop such high specific power or torque figures as modern high performance two-strokes, but although development over the next few years could bring about more powerful four-strokes, the gap is not, in any case, quite so

wide, in terms of actual usable performance, as mere figures would suggest. This is because the four-stroke develops higher brake mean effective pressure and delivers its peak brake horsepower at lower revolutions; as a consequence of which it is happier turning larger (and, generally, more efficient) props than is a two-stroke of the same peak power output.

Where the four-stroke really scores, of course, is in its much quieter operation. Not only does it have a far less piercing exhaust note - at 10,000rpm this has a frequency of only one-third that of a two stroke running at 15,000rpm - but actual sound levels are markedly reduced so that a four-stroke without a silencer is still quieter than a two-stroke with one. The sound produced by the four-stroke is also more pleasing and, particularly for a scale model, more realistic.

In the time since it was introduced to the UK market, the OS FS-40 has become by far the best-selling four-stroke engines.

As the drawing and photos show, the FS-40 is a pleasantly clean design, with totally enclosed valve gear and a cross-camshaft at the front of the engine that reduces overhang and places the glow-plug, as well as the carburettor controls, safely to the rear. In spite of its modest price, the engine is of quality construction throughout, has OS's special extra hard-wearing, low-friction cylinder plating and, unlike some of its rivals, has its camshaft, as well as its crankshaft supported in ball-bearings at each end. The valve gear is very robust, is hardened on all wearing surfaces and the engine has proved to be extremely reliable and hard-wearing.

## Performance

The FS-40 is supplied with an OS Type 'F' glowplug, a special plug intended solely for four-stroke engines. As with most of the current glowplug-ignition four-strokes, the makers state that the engine can be operated on standard model two-stroke fuels. Certainly it is a good idea to start off with such a fuel since the relatively high oil content (20-25 per cent) of the average two-stroke fuel is beneficial during running-in. When the engine is adequately run-in, however, there is no doubt that the average four-stroke requires far less lubricant. Eighteen percent castor-oil was used for the FS-40 during the tests which, one feels, is more than sufficient at this stage. It seems, from experience gained so far with four-strokes, that, in the future, recommended lubricant percentages for four-strokes are likely to drop to 15 per cent or less. There are certain benefits to be gained from these lower percentages, including better inverted operation, improved throttle response and, of course, cleaner running, although, with four-strokes, this latter is not generally a problem since most of the excess oil, in a well designed four-stroke, is discharged through the crankcase breather and can be drained away through a length of fuel tubing.

## Starting procedure

As part of the starting drill, therefore, we would recommend checking that the prop can be pulled through compression before any attempt is made to start the engine, either by hand or with an electric starter. If undue resistance is felt, remove the glowplug and flick the prop to eject as much surplus fuel as possible. Make sure that you have the proper size tubular plug spanner to reach the recessed glowplug. Such a tool should always be part of any power modeller's kit, since it is important that you should be able to quickly and safely remove and re-install the glowplug in any engine at any time. Only in this way is it possible, for example, to check, before starting, whether the plug is receiving enough current to provide the required red-to-orange glow at the plug element. Incidentally, OS offer an excellent double ended box spanner, with tommy-bar, which fits all standard glowplugs and also the standard size ¼ -28 UNF prop nut.

The manufacturer's suggested prop sizes for use with the FS-40 range from 12x5 for scale type R/C models having large wing areas and low wing loadings, through 12x5 and 11x6 sizes for lighter type scale, sport and trainer models, to 11x6 or 10½x6 for sport and aerobatic models.

Typical rpm figures obtained with similar props, on test, included 8,000rpm on a 12x5 Top-Flite maple, 8,950 on an 11x6 Top-Flite maple, 9,500 on an 11x6 Power Prop maple and 10,200 on a 10x6 Top-Flite maple. The latter is about the smallest practical size for this engine allowing for a 10 per cent rpm build-up in flight, the engine will then be just about on the peak of its power curve. Revolutions obtained on other sizes included 7,000 on a 13x4 Punctilio beech prop, 8,900 on a 1 2x 4 Zinger maple, 9,800 on an 11x4 Power Prop maple 10,800 on a 10x5 Top-Flite maple and 11,400 on a 9x6 Zinger maple.

Here we should mention that, generally speaking, it is inadvisable to run a four-stroke at speeds much in excess of its peak bhp revolutions. Of course, there is no practical advantage in doing so, but some

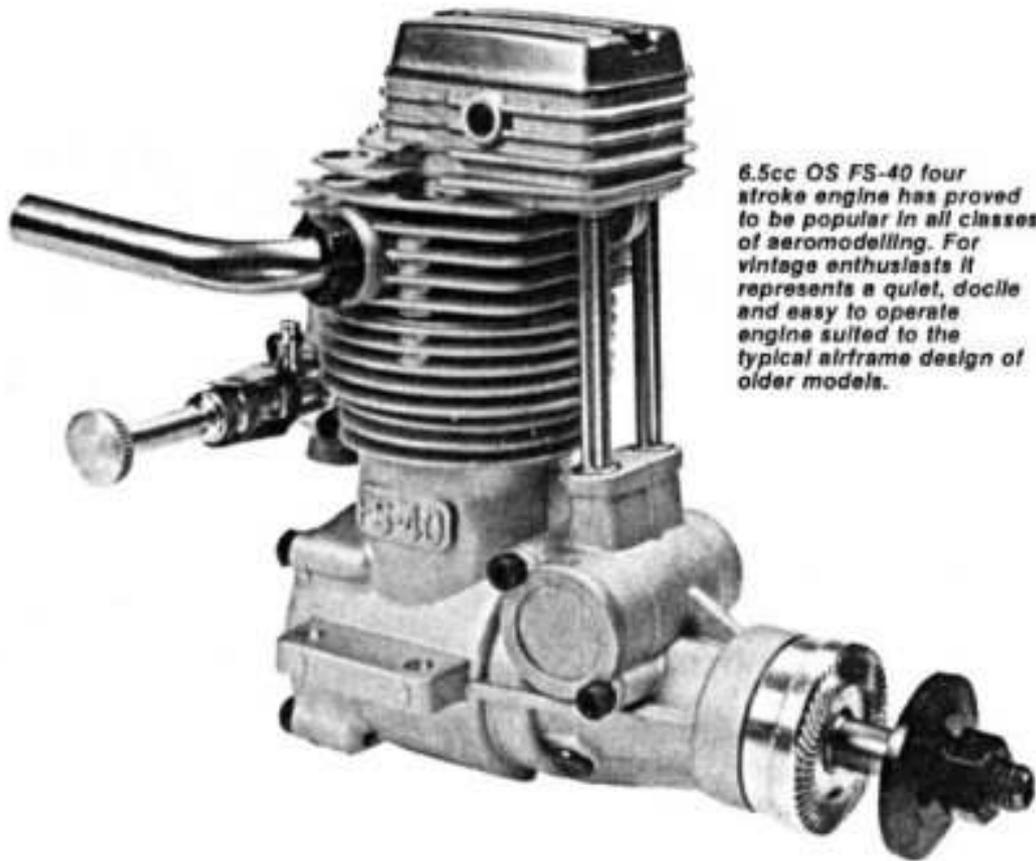
users, familiar only with two-strokes, might be tempted to fit a very small prop with the idea of seeing how fast their new four-stroke will turn. Unlike a two-stroke which under minimal load, will often turn at phenomenal revolutions, limited, ultimately, only by reduced breathing ability and escalating frictional losses, the four-stroke has more mechanical limitations to contend with: i.e. the risk of valve float occurring and the danger of a valve hitting the piston. However, it does appear that most of the present generation of model four-strokes are capable of withstanding the sort of over - revving that can occur in a dive with the throttle wide open and, by way of checking this with the FS-40, we allowed our test motor to run up to just on 13,500rpm, with no harmful effects. Nevertheless, this is not something that we would recommend. We would suggest that the FS-40 is propped for a speed of not more than 10,000rpm static. With the average model, it may well be found that equally good performance can be obtained by using a slightly larger, more efficient prop, even though this will be turning more slowly and absorbing less of the engine's potential output. The power curve is fairly flat and, with a 12x 5 prop, the engine is still likely to be developing over 90 per cent of its peak output in the air, a figure that may rise to 96-99 per cent full power on an 11x6

The FS-40's throttle reponse was outstandingly good: linear, with a low idling speed. We actually had the engine ticking over as low as 1,800rpm on a 1 2x 5 prop (this, with a four-stroke, sounds like only 900rpm). Allowing a safety margin, a 2,200-2,400rpm idling speed would seem to be realistic with 11-12in. dia. props.

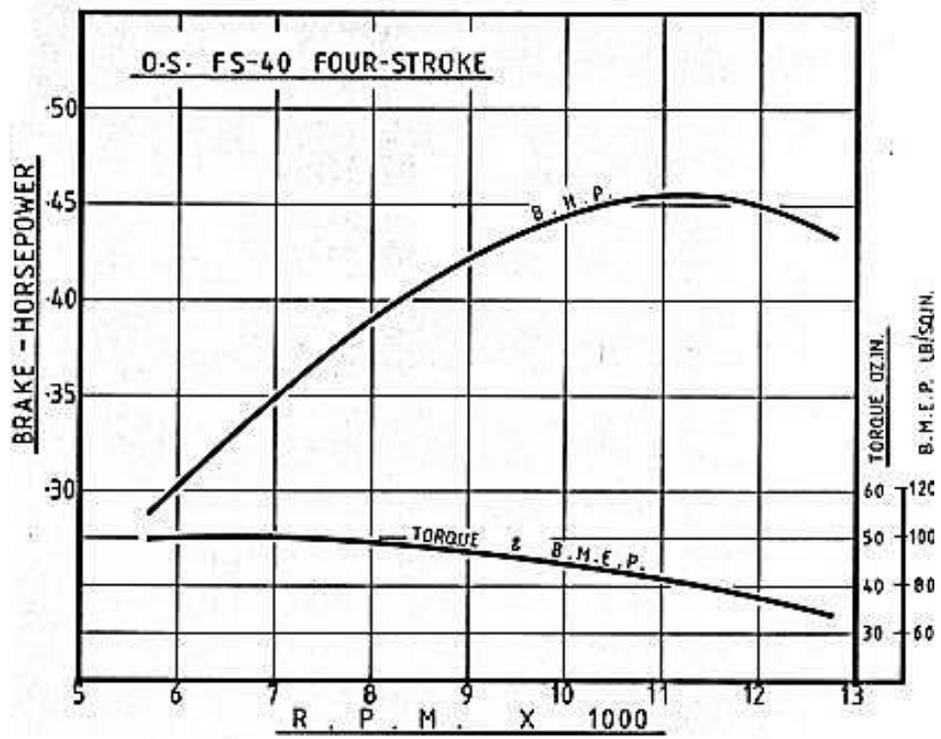
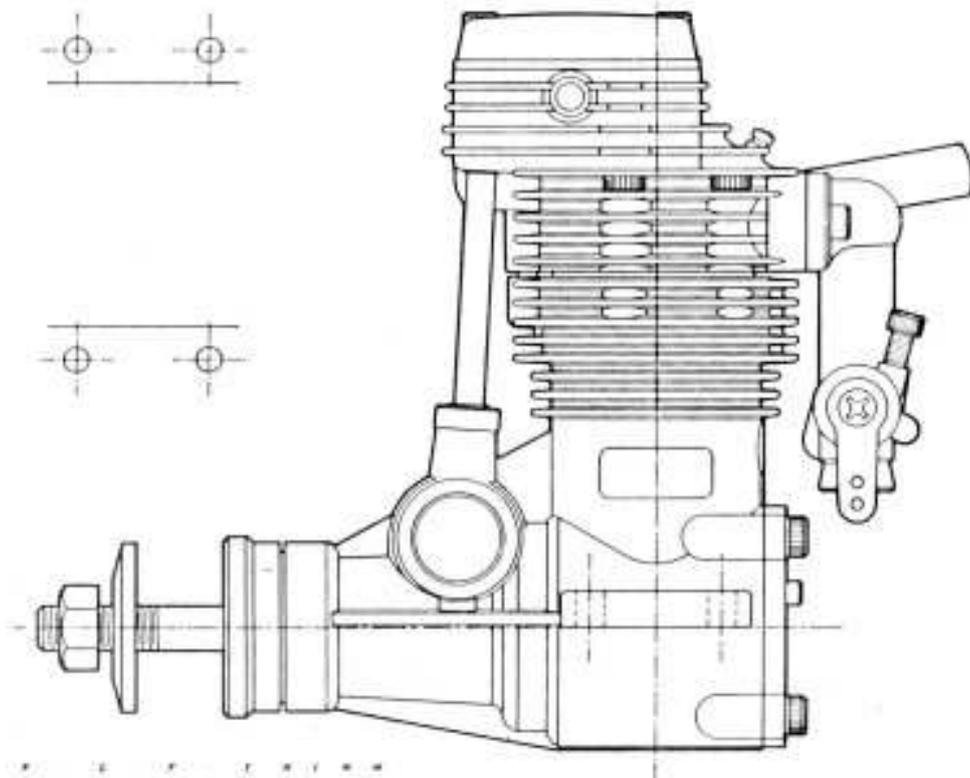
#### General Information

*Manufacturer: OS. Engine Mfg. Co.  
Ltd., Osaka, Japan.*

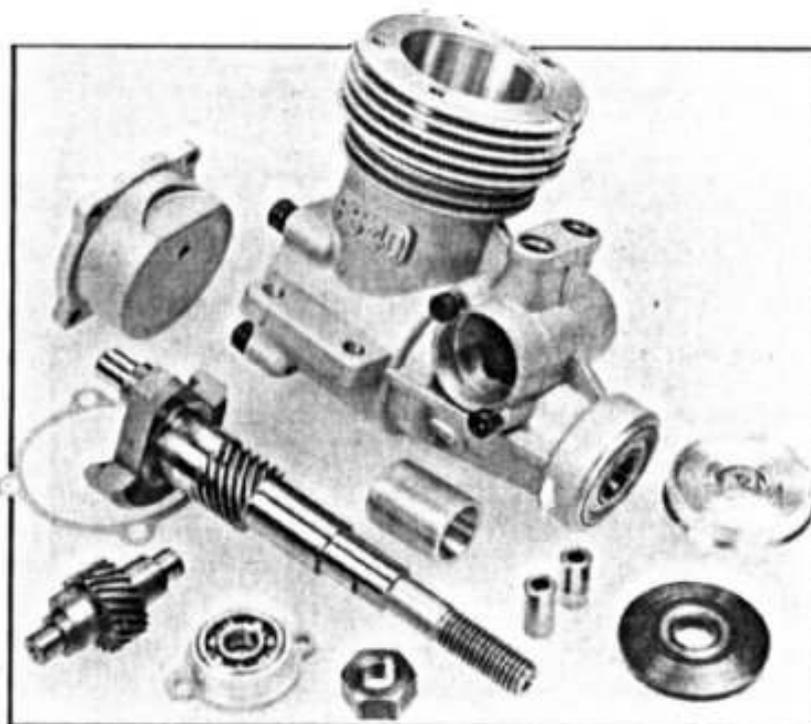
*U.K. Distribution and Service: O. S.  
Products Ltd., Brunswick Industrial  
Park, New Southgate, London N111JL.*



*6.5cc OS FS-40 four stroke engine has proved to be popular in all classes of aeromodelling. For vintage enthusiasts it represents a quiet, docile and easy to operate engine suited to the typical airframe design of older models.*



*FS-40 has skew-gear driven camshaft. Special reverse rotation crankshaft is available for pusher models or twin engined designs using opposite rotation propellers. Fuel economy, as with most four-stroke engines, is very good.*



*FS-40 has totally enclosed valve gear, is of compact dimensions and weighs exactly 12 oz. Easy to operate and very quiet. (right). Neat cylinder-head incorporates valve rocker with detachable cover. Note the substantial rocker assembly shown below.*

