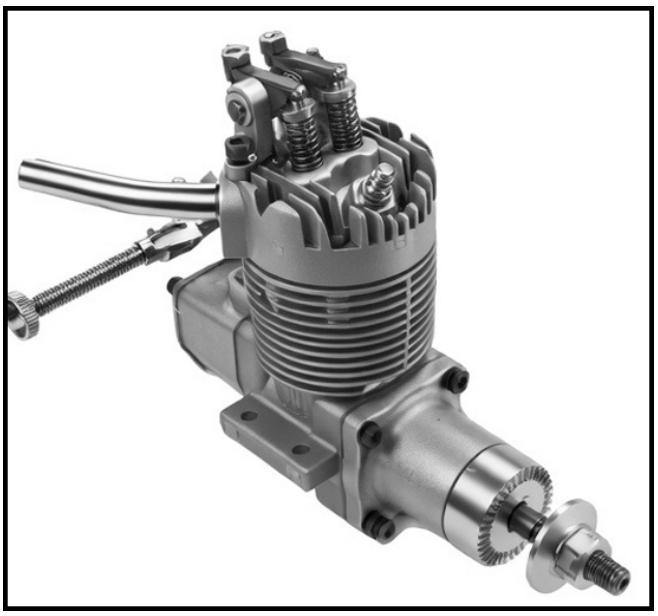


Heading Enya 40-4C features exposed valve springs and rocket arms. Some four stroke enthusiasts prefer to be able to see valve gear working.

Engine Test

by Peter Chinn

ENYA 40-4C

Four stroke

The October 1982 issue saw the first four stroke engine to be featured in the Aeromodeller Engine Test series, in the shape of the 6.5cc O.S. FS-40 We chose this engine, as an introduction to four strokes, because it had become the most popular four stroke on the U.K. market (and probably in world markets in general) by offering the modeller the fascination of a four stroke at a somewhat lower price than had hitherto applied to an engine of comparable quality.

One of the results of this has been a lowering of the U.K. prices of rival products, among them the similarly sized Enya 40-4C that we have chosen for this, our second four stroke report Like the O.S. the Enya is a pushrod OHV unit and overall levels of performance of the two motors are not dissimilar, but the Enya is totally different in design and construction and. alongside the O.S. makes for a most interesting study of the way in which these two Japanese manufacturers have approached the same basic problems.

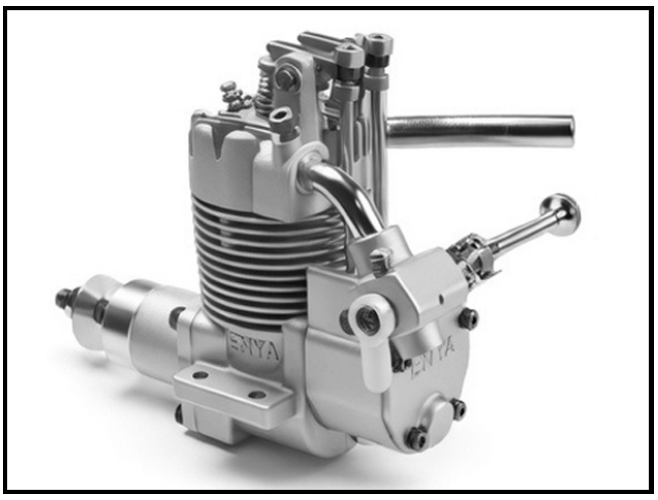
Outwardly, the most obvious differences are to be found in the valve mechanism Whereas the valves, springs, rockers and pushrods are all enclosed on the O.S. these remain exposed on the Enya something that is not unwelcome to many four stroke enthusiasts who like the idea of being able to see the valve gear at work even if 'at work' means seeing only a blur.

The lack of a rocket box on top of the cylinder head gives the Enya more of a squat 'short stroke' appearance which, in fact, is not entirely illusory; the 40-4C, essentially a bored version of Enya's first four stroke, the 35-4C, has a stroke of 17mm, giving a very low stroke/bore ratio of only 0.762:1 Combustion chamber shapes arc different that of the O.S. is discoidal with vertical valves and inclined glow plug behind them, whereas the Enya has a transverse wedge pattern with inclined valves and the glow plug at the front.

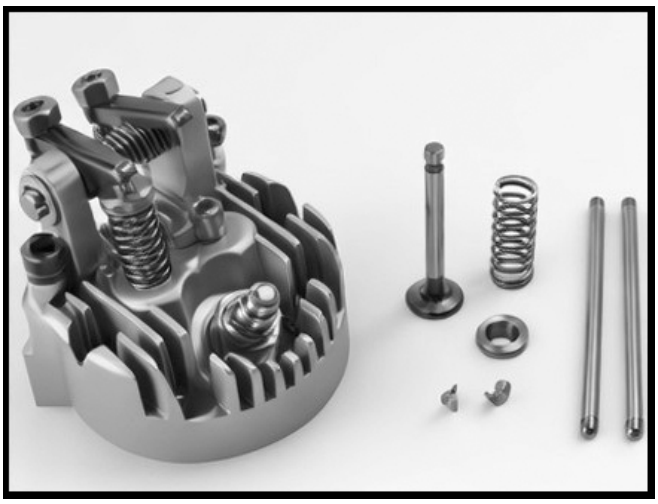
It will be seen that the Enya's pushrods are behind the cylinder rather than in front of a single cross camshaft, driven directly from the crankshaft by helical gearing and supported at each end by ball journal bearings housed in the mam casting. The Enya's pushrods, on the other hand, are operated by twin, side by side camshafts, carried in bronze bushes and spur gear driven from a separate twin ball bearing supported timing shaft at the rear of the engine, driven by the crankpin, the whole being enclosed in a separate timing case attached to the back of the crankcase.

Despite these many design differences the two engines do not differ very much in overall performance. The Enya was a trifle down on the O.S. when pulling a big prop, but went on to develop a slightly higher peak bhp. An ounce heavier and fractionally larger in cylinder capacity, the Enya's power/weight ratio was marginally less than that of the O.S. but its specific output was slightly higher.

Enya 40-4C Four Stroke



Enya 40-4C has same external dimensions as previous 35-4C model and is only ½ oz. heavier Its 13.3 per cent larger swept volume oilers improved performance, particularly on larger sized props.



Cylinder head showing Enya's business like valve gear with one valve and spring assembly removed. On right are its bimetallic pushrods.

Atmospheric conditions were a little in the Enya's favour. However, it should be noted that all these statistics apply only to single test samples of each engine and differences might very well be either reversed, or amplified, in a recheck of other examples.

PERFORMANCE

The Enya 40-4C is supplied in the U.K. without a glow plug The manufacturer recommends the Enya No. 3 platinum-rhodium filament 1.5 volt plug as being the best for this engine and we therefore used these (imported from Japan) for our tests. However, it should be pointed out that the No. 3 is a standard (hot rated) plug not a special 4 stroke type and there would appear to be no reason why the 40-4C should not perform satisfactorily on a similarly rated plug of another make more readily available in the U.K.
Some experiment with different plugs may, in this case, be necessary.

A useful instruction leaflet is supplied with the Enya 40-4C, together with a small spanner and screwdriver for adjusting tappet clearances and a pair of Allen keys for the assembly screws.
The instruction leaflet recommends the use of a fuel containing 18-20 per cent castor oil and 5-15 per cent nitromethane. We followed these recommendations, using 18 per cent castor oil and 10 per cent nitromethane for the test fuel, although it is probable that a lower oil content would have been permissible.
Higher percentages of nitromethane did not significantly increase power.

Starting the engine, following the procedure outlined in the instruction leaflet, is no problem. The procedure can be simplified if an electric starter is used The drill that was adopted with the test motor was as follows 1) open throttle and choke intake while rotating prop sufficiently to raise fuel to carb, 2) flick prop through one more suction stroke (no choke) to draw fuel into cylinder, 3) pull prop through compression to make quite sure cylinder is not overprimed, 4) close throttle to just above idle setting, energise plug and apply starter. This normally gave a start within two or three seconds. Hot restarts usually called for no more than momentary application of the plug lead and starter i.e. no choking.

As the performance curves show, our test model 40-4C reached its maximum torque at just over 8.000 rpm. Torque declined quite evenly as load was reduced, as a result of which peak power output was realised at between 11.000 and 12.000 rpm, a figure of 0.47 bhp being determined at 11.500.

Typical prop revs recorded with the 40-4C included 6.800 rpm on a 13 x 4 Punctilio beech. 7.500 on a 12 x 6 Top Elite maple. 7.900 on a 12 x 5 Top Flue maple, 9.000 on a 12 x 4 Zinger

Enya 40-4C Four Stroke

maple, 9.500 on an 11 x 6 Power Prop maple, 9.600 on an 11 x 5 Punctilio beech, 9.750 on a 10 x 7 Zinger maple, 10.250 on a 10 x 6 Power Prop maple and 10.900 rpm on a 10 x 5 Zinger maple. The throttle worked well, with reliable transition between fast and slow and with idling down to 2.200-2.400 rpm (depending on prop size) which, incidentally is better than the manufacturers claims.

It may be observed that the 40-4C accumulated a somewhat longer period of running, prior to testing, than is customary in these reports. This was due to a slight problem that arose at the beginning, when it was found that the 40-4C could not be persuaded to run without intermittent misfiring. All the usual checks were made, the engine was tried with and without its decompression gasket and various fuel mixtures and glow plugs were also tried. The engine was also given a further series of checks under different climatic conditions, a week or two later, but the problem persisted. As a result of all this, the normal running-in period was more than doubled

At the time, the 40-4C had only just gone into production. A single test sample had been submitted and the only course open was to postpone further testing until a replacement unit could be obtained.

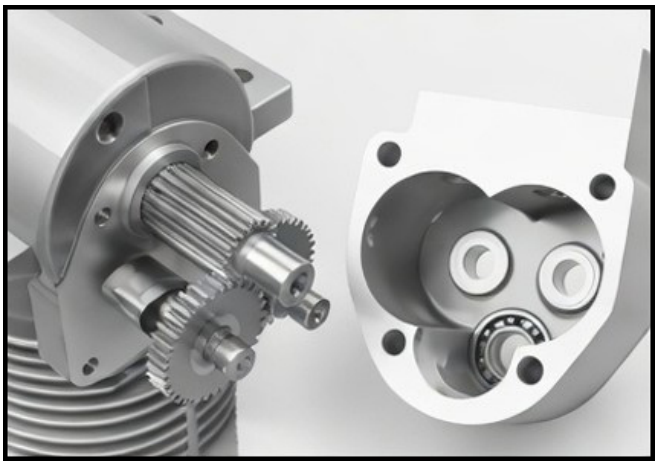
Below left: basically a larger bore version of the Enya 35-4C the 40-4C also differs from its smaller brother in having a ringed piston running in a steel cylinder liner instead of a ringless piston in a chromed aluminum liner.

However, the opportunity was taken to dismantle the motor to enable its components to be examined and photographed In fact, all the parts were in perfect condition and. in due course, the 40-4C was reassembled. At this point, it was decided to try the engine just once more Whereupon it behaved perfectly.

It is not exactly a rare occurence to encounter a problem when testing an engine but, almost invariably, the cause is detected without difficulty and the fault is usually put right at the same time. The cause of this particular quirk has yet to be positively established, but it seems that, somewhere between the engine's being dismantled and reassembled again, the cause of the trouble was removed.

The one problem that had occured with the 40-4C's predecessor, the 35-4C, namely, a tendency to detonate (a phenomenon which, as reported by other users, can result in the prop being kicked off, appears to have been eliminated in the 40-4C. The 40-4C's compression ratio (measured at 7.0: 1) is substantially lower than that of the 35-4C (8.5: 1 measured) and this seems to have cured the problem.

Detonation, knocking or pinking can occur when an engine is running at full throttle under load and the fuel/air mixture is made too weak as when trying to squeeze a few extra revs from the motor.



Right: a unique feature of all Enya four strokes (35-4C, 40-4C, 60-4C and 90-4C) is their rear twin camshaft layout.

Enya 40-4C Four Stroke

We found that it was just possible to cause the 40-4C to pink' if the needle-valve was leaned out too far when the engine was hot, but this ceased immediately if the needle valve was reopened again instantly. Compression ratio is one of the other factors involved in the cause of detonation and it was found that, by adding the decompression gasket supplied with the engine, detonation could be entirely eliminated: the engine then simply cut out when the mixture was leaned out too far.

Under all normal conditions, the head gasket will not be necessary, but it is there to use if the owner should encounter a problem of this nature. Remember that, if the gasket is fitted, it will be necessary to readjust the tappet clearances.

Like all Enya motors, this is a well built engine and, with normal care and attention, it should give its owner long and trouble free service.

SPECIFICATION.
Type: Single cylinder, glow plug ignition, four stroke, with push rod operated overhead valves. Twin ball bearing crankshaft. Twin camshafts supported in bronze bushed bearings
Bore: 22.3mm (0.8780 in.)
Stroke: 17.0mm (0.6693 in.)
Swept volume: 6.640cc (0 4052cu.in.)
Stroke/bore ratio: 0.762:1
Measured compression ratio: 7.0.1 (6.4:1 with decompression gasket)
Measured valve timing:
Inlet opens: 25° BTDC
Inlet closes: 85° ABDC
Exhaust opens: 57° BBDC
Exhaust closes: 43° ATDC
Recommended tappet clearance: 0.05- 0.10mm (0.002-0.004 in.)
Checked weight: 369 grammes (13.0 oz.)

GENERAL STRUCTURAL DATA.
Main casting: Pressure die cast aluminum alloy, comprising crankcase and full length finned cylinder casing and fitted with two 4mm i.d bronze bushes supporting forward ends of camshafts.
Crankshaft: One piece, hardened and ground, with 10mm o.d main journal, bored 6mm to reduce weight. 7mm o.d. front journal and 5.5mm solid crankpin on T type crank web. Shaft end reduced to 6mm dia. and threaded M6 x 1.0 for prop nut. Machined aluminum alloy prop driver keyed to two flats on shaft
Front housing: Pressure die cast aluminum alloy containing one 7 x 19mm 6 ball NSK steel caged shielded bearing at front and one 10 x 22mm 9 ball NSK steel caged bearing' at roar. Housing attached to crankcase with four M3 x 0.5 Allen cap screws.

Cylinder and piston assembly: Drop-in steel cylinder liner, located in main casting by flange at top and having 1.2mm wall thickness.
Flat crowned machined aluminum alloy piston with single compression-ring. Fully floating 5mm o.d. tubular gudgeon pin with brass pads Forged aluminum alloy connecting rod. 29mm between centres, with bronze bushed bearings at both ends.
Reciprocating weights: piston and ring 7.0g, gudgeon pin 2.2g, conrod 4.1g.

Timing case: Pressure die cast aluminum alloy, fitted with two 4mm i.d. bronze bushes supporting rear ends of camshafts. Timing case and rear cover plate attached to crankcase with four 25mm M2.5 x 0.45 Allen cap screws.

Camshafts and timing gears: Hardened steel timing pinion and shaft, with integral 26mm dia crankpin drive pickup disc, supported in 8 x 16mm 9 ball steel caged bearing in crankcase wall at front and in 5 x 10mm 7 ball steel caged bearing in timing case at rear. Separate inlet and exhaust camshafts, side by side, each with 36 tooth 15mm dia. liming gear.
Round Hank cams giving 1.87mm lift

Cylinder head: Pressure die cast aluminum alloy with integral rocker shaft posts and one piece cup type valve guides and seats. Parallel side by side valves, inclined at 10 deg, In transverse wedge shaped combustion chamber with flat squish areas front and rear Glow plug located forward of valves and inclined at 30 deg. Head secured to cylinder with five M3 x 0.5 Allen cap screws.
No gasket fitted. Optional 0.3mmsoft aluminum gasket supplied for reducing compression ratio.

Enya 40-4C Four Stroke

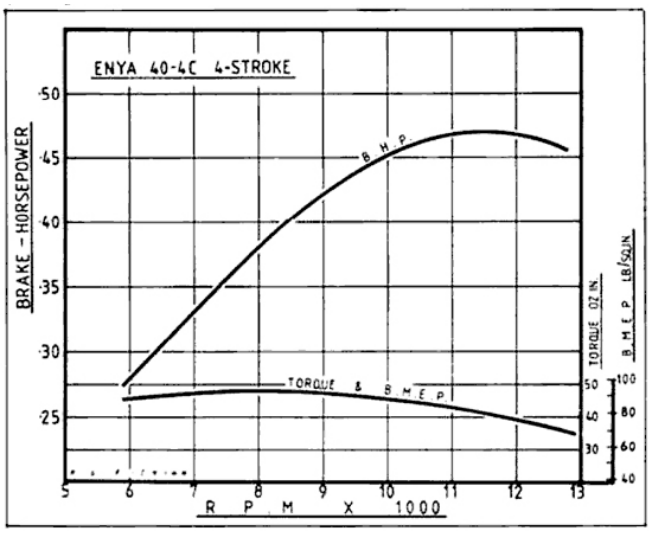
Valves and valve gear: Valves 26mm long with 8mm dia. heads and 2.5mm dia stems. Valve springs retained by familiar 'full size' method, tapered collar, mode in two halves, fits into groove in valve stem and is locked in place by pressure of valve spring cap. Cast steel rocker arms with screw and locknut adjustment tor setting tappet clearances. Rockers mounted on 4mm dia. hardened steel rocker shaft pressed into support posts on head and retained by E-clips. Rockers aligned with valve stems by light coil spring on rocker shaft. Push-rods, 45mm long x 2.5mm diameter, of aluminum alloy with hardened steel domed ends, operated by 5mm dia. x 14mm long hardened steel cam followers running directly in timing case material.

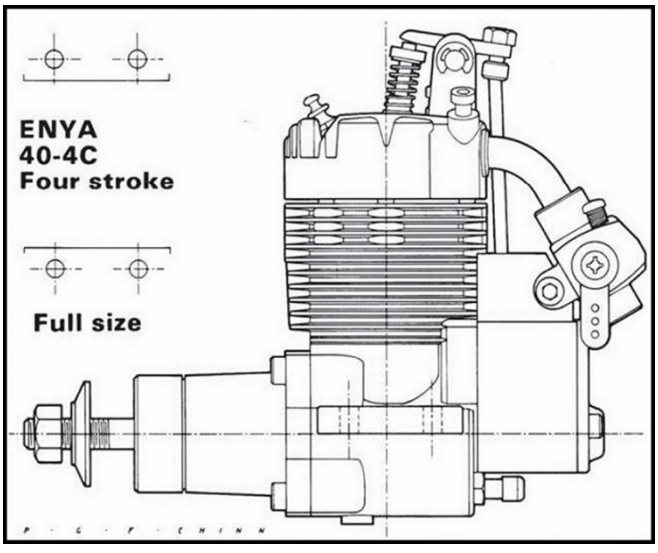
Carburettor: Barrel throttle type with fixed automatic mixture control supplemented by air bleed for adjusting idling mixture. Pressure die cast aluminum alloy body. Ground steel throttle barrel. Conventional needle valve assembly with flexible control stem. Choke diameter 4.5mm. Effective choke orca of 12 sq.mm. Carburettor mounted at an angle, intake downwards, by means of single screw, to vertical lug on timing case.

Inlet and exhaust pipes: Chromium plated 6mm i d. copper tube. At lower end, inlet pipe plugs into carburettor with 0 ring seal. At top end pipe has 9mm o.d. collar which is inserted into cylinder head and secured with 3mm sot screw. Exhaust pipe attached to head in same manner.

TEST CONDITIONS.
Running time prior to test: Approx 4 hours.
Fuels used: (i) 75 percent methanol. 20per cent castor-oil. 5 per cent nitromethane (running-in), (ii) 72 per cent methanol. 18 per cent castor-oil. 10 per cent nitromethane (tests)
Glow plugs used: Enya No. 3 platinum-rhodium element, 1.5 volt
Silencer used: None.
Air temperature: 10°C.
Barometric pressure: 767mm (30.2m.) Hg.
Relative humidity: 57 per cent

TEST RESULTS.
Power output, gross: 0.47 bhp at 11.500rpm
Torque, gross: 48 oz.in. at 8.000 tpm.
Equivalent b.m.e.p.: 93 lb/sq.in.
Specific output, gross: 71 bhp' litre.
Power/weight ratio, gross: 0 58 bhp/lb
Manufacturer: Enya Metal Products Co Ltd. Nerimaku. Tokyo 176. Japan.
U.K. Distribution: Ripmax Ltd. Ripmax Corner. Green Street, Enfield EN3 7SJ
U.K. Service: John D Haytree, The Haven, Rixey Park, Chudleigh, Newton Abbot, Devon TQ14 OAN.





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