

Fox 19BB R/C

ENGINE REVIEW

by PETER CHINN



Like other recent Fox engines, 19BB is designed to run well on economical no nitro fuel. Large volume muffler causes negligible power loss.

SPECIFICATIONS

Type: Single-cylinder, Schnuerle scavenged two stroke cycle, with crankshaft rotary valve and twin ball bearings. Throttle type carburetor with automatic mixture control. Convertible from side to rear exhaust.

Checked Weights: 230 grams (8.1 oz) less muffler. 275 grams (9.7 oz) with muffler

Displacement: 0.1991 cu in. (3.263cc)

Bore: 0.650 in. (16.51 mm)

Stroke: 0.600 in. (15.24 mm)

Stroke/ Bore Ratio: 0.923:1

Measured Compression Ratio (full stroke):
10:1

Effective Compression (ratio (exhaust closed):
7.6:1

Performance Data as tested:

Power Output, Gross: 0.49 bhp at 17.500 rpm

Power Output, Net: 0.43 bhp at 16.500 rpm

Torque, Gross: 34 oz in. at 10.000 rpm

Equivalent b.m.e.pt: 67 lb. sq in Torque, Net: 32 oz in. at 10.000 rpm

Equivalent b.m.e.p.: 63 lb sq in.

Specific Output, Gross: 2.46 bhp. cu. in.

Specific Output, Net: 2.16 bhp. cu in.

Power/ Height Ratio, Gross: 0.91 bhp lb

Power/ Weight Ratio, Net: 0.1 \ bhp lb

Gross figures = less muffler, with 25% nitromethane.

Net figures = with muffler and straight fuel.

Manufacturer: Fox Manufacturing Company.
5305 Towson Ave., Fort Smith. AR 72901.

The Purchaser of a Fox 19 has a number of options. For less than the cost of just about any engine of the same size, he can have the standard bushed bearing, crossflow scavenged Fox 19 and get at least as high a performance from it as he would from any imported rival of the same type. When we tested the original control-line version of this engine back in 1974, it outpaced the opposition by a sizable margin. It was no surprise when British modelers picked this American engine for the then new Club- 20 pylon racing class. Currently, Fox is offering an improved model of the standard Fox 19 in both control-line and radio control versions, the latter with a new, small edition of the Fox Mk. X automatic mixture control carburetor.

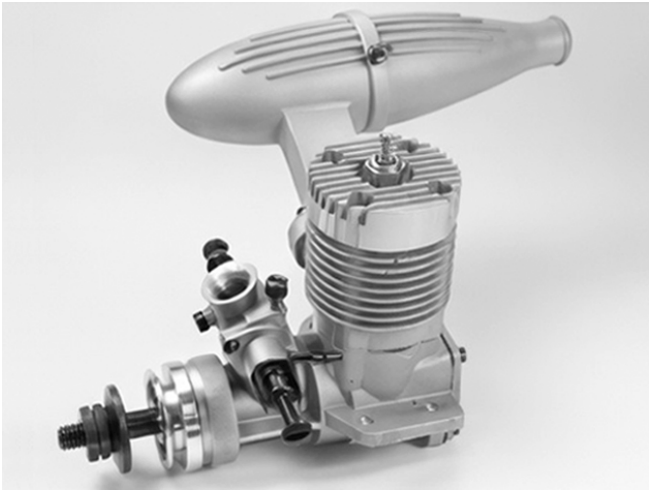
Alternatively, for those who want a "state-of-the-art" design, there is the recently introduced Fox 19BB which features a Schnuerle plus third port scavenging system, a twin ball bearing crankshaft, and a separate cylinder jacket that enables it to be converted, without additional parts, from a conventional side exhaust layout, to a rear exhaust configuration.

It is this new and more powerful model that is the subject of our test report this month. First, a few words about its component parts.

CRANKCASE.

This is a well executed pressure die-casting that incorporates a sturdy front housing, well braced with horizontal and vertical webs and large beam mounting lugs. The carburetor boss is bored 7/16 inch (11.1 mm) and has a generous outside diameter of 5/8 inch. The crankcase is faced off just above the crank chamber, where it incorporates four short identical channels, so that the three bypass channels in the cylinder casting are always fed with fresh gas, irrespective of whether the exhaust is located at the rear or either side. Between the channels (i.e.. at 90 degree intervals) the case has four vertical holes, tapped 4-40 for the cylinder attachment screws. The pressure cast back-plate, attached with four

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The Fox 19BB owner has choice of two special mufflers with angled entry ducts. This is alternative tilt up type. Pic Left.

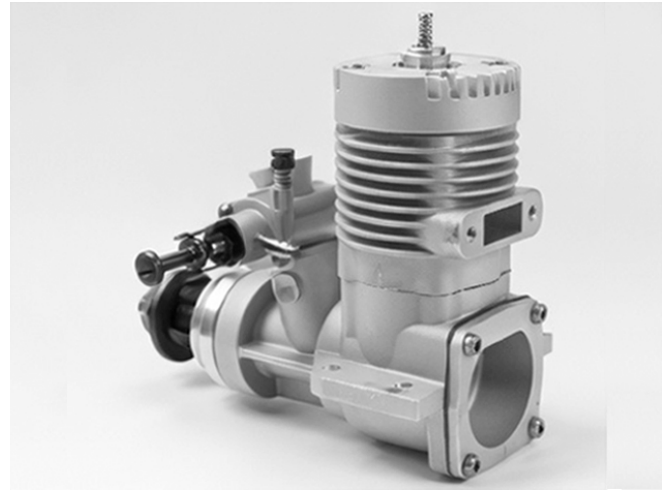
3-48 screws, is stepped to clear the piston at BDC and to avoid undue masking of the rear bypass entry when the cylinder is in the side exhaust positions.

CRANKSHAFT AND BEARINGS.

The crankshaft, machined from 8620 steel bar and case hardened, has a separate $\frac{1}{4}$ - 28 prop stud which, of course, means that in the event of its being bent in a crash, or otherwise damaged, it, rather than a complete crankshaft, can be replaced, and for about one-sixth of the cost of a new shaft.

The crankshaft has a metric size (11 mm) main journal and is carried in two 11x22x6 mm 9-ball steel-caged bearings that are specially made for Fox. The shaft has an integral 4.7 mm (0.186 inch) diameter crankpin on a counterbalanced web and a 7.5 mm (0.295 inch) bore gas passage fed from a 12 mm (0.472 inch) long rectangular valve port. The latter uncovers the parallel sided intake from 38 degrees after bottom dead center to 50 degrees after top dead center.

Immediately in front of the main journal, the shaft reduces to 0.300 inch diameter and has the familiar Fox short splines to which a machined aluminum prop driver is fitted. The latter is relieved on its rear face, forming a lip that surrounds the front bearing and helps protect it from foreign matter.



The 19BB features a separate cylinder assembly which can be rotated left, right, or rear exhaust. Pic Right.

The prop drive assembly is completed by a steel hexagon nut and a steel washer, serrated on its inner face.

CYLINDER LINER AND BARREL.

The cylinder liner is machined from leaded steel bar (a reliable old favorite used in numerous Fox engines) and is a slip fit in a pressure die-cast aluminum finned jacket or band. As previously noted, the latter, complete with liner, can be rotated through 90 degrees to place the exhaust to the rear, or through 180 degrees if the user wishes to have the exhaust on the left hand side of the engine, rather than the right.

The barrel incorporates well-shaped bypass channels to supply the three inlet ports in the liner, which is axially located, in the usual way, by a flange at the top.

Cylinder porting is of the Schnuerle plus third port type. A single unbridged exhaust port is flanked, each side, by a bypass port sharply angled away from the exhaust to direct gas flow to the opposite side of the cylinder. Here there is a fairly large third port angled to redirect gas flow upward into the combustion chamber.

Port timing of the engine used for our tests included a 138 degree exhaust period, a 122 degree main bypass period and a 116 degree third port period.

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Engine has traditional Meehanite lapped piston in a steel liner.

PISTON AND CONNECTING ROD ASSEMBLY.

The ringless piston, machined from an inoculated cast iron (Meehanite), has a flat crown and includes an annular rib above the wrist pin to ensure roundness. It is equipped with a 0.156 (5/32) inch diameter solid wristpin that is a close fit in the piston bosses and is retained by wire snap rings. The engine features a very sturdy conrod that is machined from 2024-ST aluminum bar and is fitted with phosphor bronze bushes at both ends. The oil hole for the crank pin end is drilled at an angle into the upper half of the bearing where, in a two cycle engine, the load is always concentrated. The rod is 1.125 inch (1.875 x stroke) between centers.

Checked reciprocating weights included 7.0 grams for the piston and 1.5 grams for the wristpin. The conrod checked out at 2.8 grams.

CYLINDER HEAD.

Made in two parts, the head consists of a machined combustion chamber insert (or head but-ton as Fox descriptively calls it) tied down by a pressure die-cast finned outer component. The insert is machined from 2011-T3 aluminum alloy bar. It features a small (9.3 mm) diameter, fairly deep (3.7 mm) bowl surrounded by a broad (3.6 mm) flat squish-band. There are two main reasons for using a separate machined bar stock insert. First, it allows better dimensional control of the combustion chamber. Second, it provides a



Most of the castings for the Fox 19BB are shown plus the finned head seen left.

more suitable material for the threads for the glow-plug.

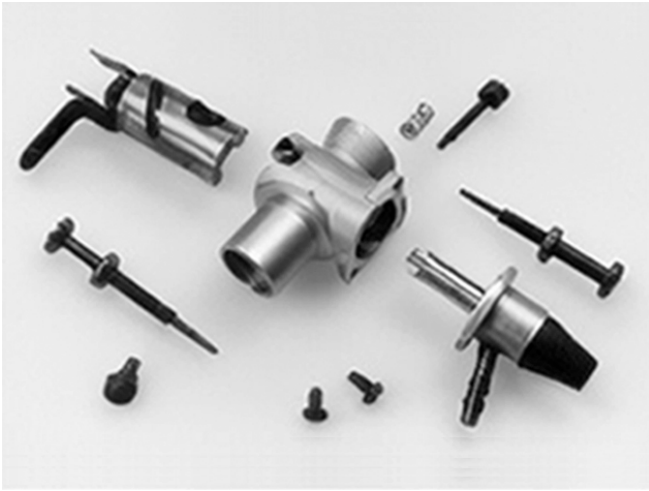
The checked chamber volume of the test engine was 0.36 milliliters. This indicates a nominal compression ratio of 10.0:1 or an effective compression ratio (i.e., based on the volume of the cylinder above the exhaust port) of 7.6:1.

The four 4-40 screws securing the complete cylinder assembly (head, head button, cylinder liner, and jacket) to the crankcase are 1½ inches long and are specially made for the engine from alloy steel in the Fox factory. The reason for using these special screws, rather than less costly commercial grade screws, is that the latter tend to stretch, which could allow the cylinder assembly to loosen.

CARBURETOR.

Contrasting with most Fox carburetors of the past (including some ingenious ones which worked very well but were not so popular with modelers used only to run off the mill designs), the carburetor fitted to the 19BB-RC works on the familiar two needle automatic mixture control principle. It has a pressure cast aluminum body and a steel throttle barrel which describes a helical path, moving into the body as it is rotated toward the closed position. The barrel carries with it the adjustable secondary needle which enters the fixed jet tube and restricts fuel flow at reduced throttle openings.

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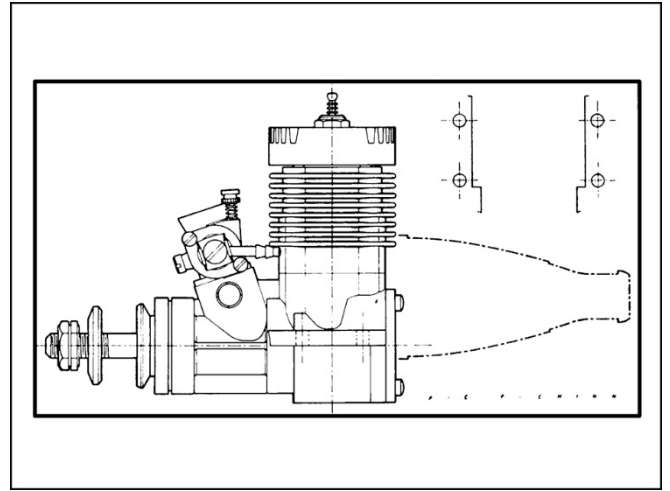
Two needle automatic mixture control carb has an orthodox adjustment procedure.

The carburetor has a 0.271 inch bore choke and a large jet tube diameter of 0.180 inch. Taking these choke and jet tube dimensions into account, the choke area can be worked out at approximately 14.5 square mm, but the true choke area is, in effect, rather larger than this because the barrel is counterbalanced 0.190 inch to receive the end of the jet tube at small throttle openings. When the throttle is open, this substantially lessens the degree of choke restriction created by the large diameter jet tube.

MUFFLER.

This is a conventional expansion chamber type of pressure die-cast aluminum. It has a fairly generous volume of 40cc and an outlet area of some 65 square mm. The inlet duct is angled at 20 degrees to the horizontal and the purchaser has the choice of two versions, enabling the body of the muffler to be located above or below the level of the exhaust port. The muffler attaches to the engine's exhaust stack with two short 6-32 screws.

Incidentally, the mufflers are listed as "Tilt-Down" and "Tilt-Up" types. This refers to the muffler position with the exhaust located as supplied i.e., on the right side of the engine. If you are planning to relocate the exhaust stack to the left side, it will be necessary to use a "Tilt-Up" type muffler for the lower position, and vice versa.



PERFORMANCE.

For our tests of the Fox 19BB-RC we used the Fox "Tilt- Down" muffler (Part No. 90220) with the cylinder in the position as installed at the factory, i.e., with the exhaust on the right. The engine comes complete with a Fox long reach idle bar type glow-plug.

The most interesting thing about the performance of the 19BB-RC is how very little its power output is affected by (a) the use of the muffler and (b) changes in fuel. We ran tests both with and without the muffler and on 0%, 5%, 10%, and 25% nitromethane fuel.

So far as fuel is concerned, our findings clearly bear out Duke Fox's claim that the 19BB-RC will run well with no nitro in the fuel, particularly in warm weather. At the time of testing (April) the weather was not very warm (just below 60° F) and we were prepared to find that the 19BB would need a little nitro. In fact, the addition of 5%, nitro had a barely measurable effect. Even with 25% nitro, prop rpm were increased by only 2% or 3%. The muffler had even less effect. Over most of the rpm range, it caused virtually no power loss.

Our performance curves show the results of two series of tests run under "least favorable" and "most favorable" conditions: the former on a straight 80/20 mixture of methanol and castor oil and with the muffler fitted: the latter on 25% nitro fuel and with an open, totally unrestricted exhaust.

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it will be seen that adding the muffler and using inexpensive 80/20 fuel cut the recorded peak power output from 0.49 bhp at 17.500 rpm to 0.43 bhp at 16.500 rpm, a total loss of 12%. This, under such conditions, is a very small power loss indeed. As followers of these test reports will know, a 12% difference might well be accounted for by the nitro content alone, while it is customary for mufflers to cause rather more power loss than 12%.

Naturally, the loss of power caused by a muffler, with any engine is, to a large extent, linked to its effectiveness in attenuating noise levels. A muffler of large volume, but a small outlet area, will be more effective than a small volume muffler with a large outlet area. The Fox 19BB muffler has a large diameter outlet, for an engine of only 0.20 cubic inch displacement. Its outlet area of 65 square mm is, in fact, 25% larger than the engine's exhaust port area. One would not expect this muffler to be as effective as it would be with an outlet area of, say, 30 square mm. But the Fox muffler is also of quite large volume (40cc) which allows the exhaust gases to expand quickly when they leave the cylinder and this is beneficial in that it reduces pressure (and thus noise level) when the gases are released from the silencer to the atmosphere.

The maker's recommended prop size for the 19BB-RC is an 8-inch diameter of 4 or 5 inches pitch. Current Fox advertising claims 17.000 rpm on an 8x4. On an 8x4 Power Prop maple, our test motor reached 16.500 rpm on straight fuel with the muffler fitted and 17.200 rpm on 25% nitro fuel, less muffler. This prop, it will be seen, would be a trifle too small for the best performance in flight as, after allowing for the reduction in load on the prop, as the aircraft accelerates up to normal flying speed, the engine would actually be turning at speeds beyond those at which it develops its maximum power output.

In these circumstances, the alternative recommendation of an 8x5 or, possibly, an 8 ½ x4, would be better. Some of the speeds recorded with the 19BB-RC, on these and larger props, included: 14.600 rpm on an 8x5 Power Prop.

14.200 on an 8.5x4 Zinger, 13.100 on a 9x4 Power Prop, 12.200 on a 9x4 Top Flite, 12.000 on an 8.5x6 Zinger, 11.600 on a 9x5 Top Flite, and 11.200 rpm on a 10x4 Zinger. All these figures were taken with the engine running on no-nitro fuel and with the muffler fitted.

The general handling and running characteristics of the Fox were good. Now-a-days, it is customary to use electric starters and, although it is part of our standard procedure to check the hand starting qualities of engines on test, we have to confess that, as an engine may be stopped and started up to a hundred times in the course of a full test program, we always have an electric starter standing by to hasten matters when needed. In fact, at no time, in the course of checking prop rpm figures for the Fox, did we find it necessary to resort to using the starter. The engine hand started easily and was very docile, showing no tendency to bite one's fingers even on the smallest diameters.

There is no doubt that, power apart, a good nitro fuel, like Fox Missile Mist, still offers an advantage in that it makes for greater flexibility, i.e., less critical needle valve adjustment, usually better throttling and, very often, steadier running, but there is nothing to complain about in the way that the 19BB runs on straight no nitro fuel. Properly adjusted, the throttle worked well, with a safe 2.600 rpm idle on 9 inch diameter props, rising to 3.000-3.200 on the 8 inch diameters.

Engines with lapped ferrous pistons and cylinders sometimes need a lengthy break-in and, in the past, we have often had cause to be grateful for Duke Fox's "Lustrox" polishing compound as a means of freeing off a tightly setup new motor. This, however, was unnecessary with our 19BB-RC, which was quite free from the beginning. It was, of course, subjected to the usual basic rich-mixture break-in procedure, but quickly showed that it was capable of holding a fully leaned out run without tightening up. Over leaning would simply cause the engine to cut out cleanly as the mixture became too weak to support combustion.

Incidentally, Duke Fox tells us that pistons are initially fitted fairly tight but each engine is

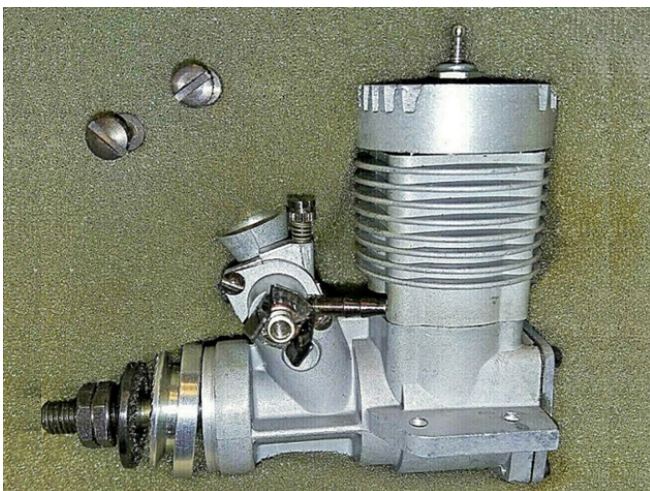
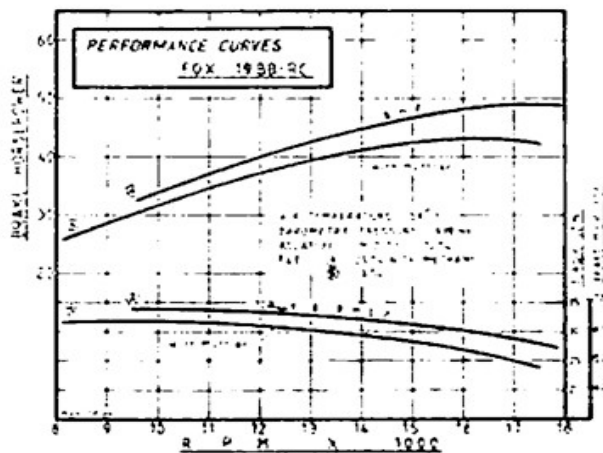
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motored over for several minutes before put on the test rack. Not all manufacturers, nowadays, test run their engines before dispatch. Fox motors are test run with a control line type intake assembly, and R/C carburetors are installed afterward. In this way, the customer does not get a carb gummed up with residual oil. Carburetors are first checked on an air gage to insure that they have no clogged passages or incompletely drilled holes.

More: https://flyinghlsat.com/search.php?search_keywords=Fox-Engines

All in all, the 19BB-RC is a nice little motor: easy to handle and with plenty of go. It is best when not over propped: use a prop that will allow it to run full throttle at not less than 12,000 rpm static. The engine is sturdily built and should be capable of standing up to hard use and, because it also runs so well on less expensive fuel, it should be economical to operate.

Peter Chinn, c/o Model Airplane News. 837 Post Road, Darien. CT 06820.■



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