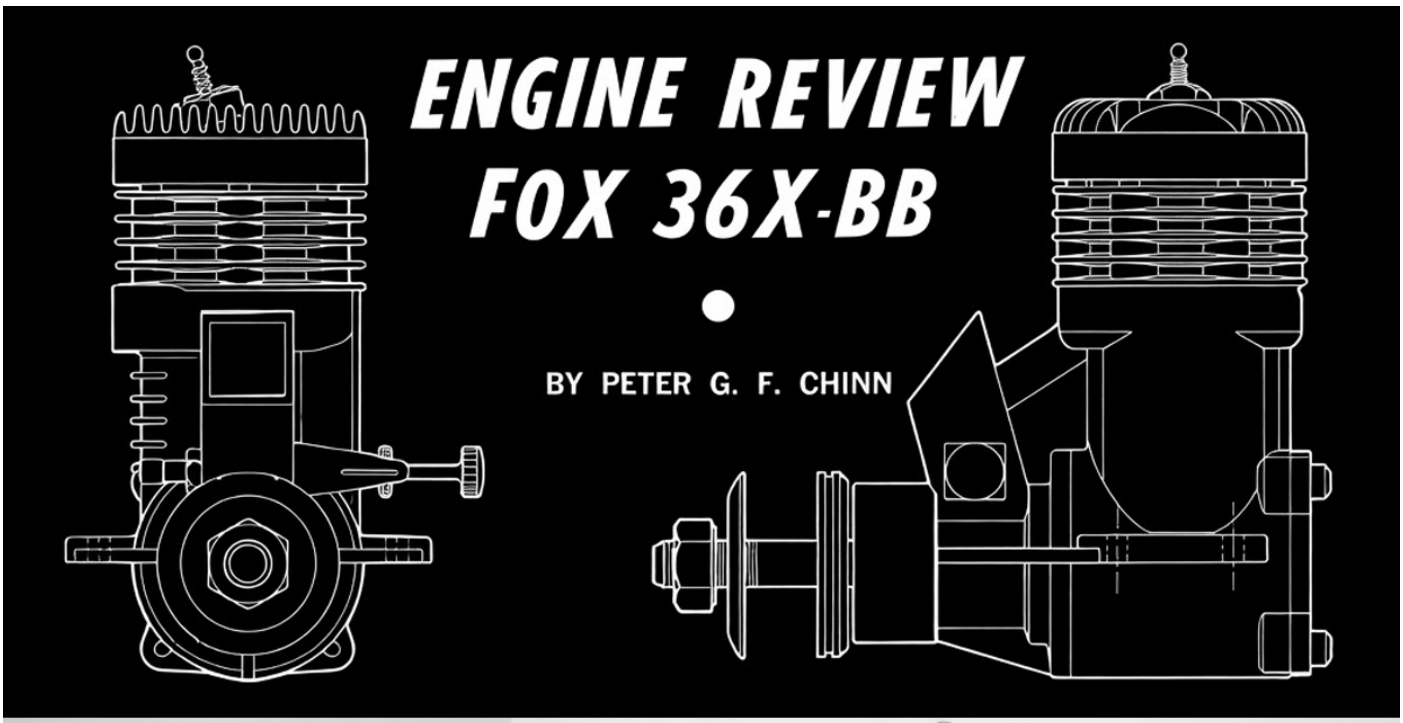
Fox 36X BB



Features are heavy duty ball-bearing, reworked shaft porting, higher compression rating, and polished exterior. Pressure fitting and omission venturi insert.

DEVELOPED FROM A LONG LINE OF NOTED FOX COMBAT MILLS, CUSTOMIZED 36X-BB IS MOST IMPRESSIVE CONTRIBUTION YET.►

In our July 1963 Engine Review, we had the pleasure of dealing with the then new Fox 35X and, purely from a point of personal interest, put it through an extended series of tests that subsequently demonstrated the remarkable potential of this modestly priced motor. Starting with a conservative maximum of .53 bhp at around 13.700 rpm on mild fuel (5 percent nitro) with the stunt size venturi and suction feed, we eventually had the 35X putting out .87 bhp at nearly 16.000 rpm on Fox “Blast” running on pressure feed and with a wide open intake. Not surprisingly the 35X was soon stealing the thunder of its more expensive brother, the Combat Special and to such effect that the latter engine was discontinued and development concentrated on the 35X.

Model Airplane News Magazine March 1966 by Hlsat

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Early in 1964, in response to enthusiastic but heavy demands made on the motor by combat fiends, the 35X was given a new shaft and renamed the 36X. The new shaft was strengthened by means of a slightly thicker crankweb with more meat around the crankpin. At the same time the opportunity was taken to move the crankpin and stroke the engine to .715 in., thereby taking full advantage of the .36 cu. in. displacement limit under combat rules. (This latter move probably caused Duke Fox some soul searching, for the .800 x .700 bore and stroke of Fox stunt and combat engines had virtually become a trade mark.)

Towards the end of 1964, the engine appeared with a remodelled head, still with the familiar Fox wedge shaped combustion chamber but with the plug now inclined to fit flush with the wedge surface. In addition to eliminating the pocket produced by the old vertical plug location, this had the practical merit of facilitating quick plug changes in sidewinder combat wings when the cylinder was hard up against the leading edge.

In order to accommodate the longer piston stroke, a slightly longer cylinder sleeve was fitted. This extended approximately .025 in. higher, relative to the case and the sleeve ports. Piston height and conrod length were unaltered, so the exhaust and bypass periods were slightly extended. Incidentally, it is possible to fit a 36X shaft to a 35X without replacing the cylinder: a head spacer is available to give the necessary head clearance for the increased stroke.

Still later, a special custom version of the 36X was introduced. This, the 36X- BB, the subject of our present report, embodies a number of further changes, as follows.

Crankshaft. This has the valve port lengthened and widened to give a timing of approximately 40 deg. ABDC to 54 deg. ATDC. The gas passage through the shaft is reamed out from a stock .375 to .390 in.

Main Bearing. The rear needle-bearing of the 35X and stock 36X, is replaced by a Fafnir ball journal bearing at the front end, the half-inch shaft continues to run in the silicon-aluminum crankcase material.

Main casting. In the 35x, the extreme ends of the 180-degree exhaust port in the cylinder sleeve were partially masked by the casting. This is still the case with the 36X, but both the 36X and the 36X-BB now have a modified casting in which the back of the exhaust stack extends around the cylinder to join up with the outside of the bypass. This enables the stack to be milled out on the 36X-BB for more complete scavenging through the full width of the sleeve port.

Cylinder sleeve and head. The “picture window” bypass port of the 35X has been replaced by a port of conventional depth in the 36X and 36X-BB. Ports are otherwise unchanged but, with the revised piston stroke, measured exhaust and bypass periods for both .36 cu.in. models are now 146 deg. and 138 deg., an increase of 4 deg. on each. A slightly higher compression ratio is standard with the 36X-BB. The gasket recess is machined and only one 10 thou, gasket (instead of two) is used.

Piston and connecting rod. The 36X and 36X-BB pistons have slightly taller (.170 in.) baffles than the 35X (.160 in. on our original test engine), but are a trifle lighter. The stiffening web above the wristpin bosses is narrower and the skirt wall slightly thinner. On the 36X-BB the skirt has a cutaway at the front to ensure that it will clear the top edge of the ball-bearing that is exposed at this point. The 36X-BB conrod has the addition of an oil hole at the crankpin end. Both 36’s have solid wrist- pins with domed ends instead of hollow pins with brass pads.

General. The 36X-BB is set up for a pressurized fuel system as received. A venturi insert is not supplied and the back plate has a pressure fitting ready installed. Apart from this, the engine can be distinguished externally from the stock 36X by its polished castings.

Desaxe cylinders. In describing many of the Fox engines dealt with in these Reviews notably the 35’s, 40’s and 59 we have often commented that they embody a “desaxe”, or offset, cylinder.

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The 36X and 36X-BB retain this and it is perhaps, about time (for the benefit of readers unfamiliar with this feature), that we explained what a desaxe cylinder is and how it affects the design and operation of the engine.

In a normal symmetrical engine, the cylinder is located so that its axis intersects the crankshaft axis. In a desaxe engine, however, the cylinder is offset in the direction of rotation. In other words, it is displaced to the left side when looking at the front of the engine assuming normal anti-clockwise rotation.

The obvious mechanical advantage (and this applies to all reciprocating piston engines two-cycle, four-cycle, gas or steam) is that the side thrust of the piston against the cylinder wall is reduced. Side-thrust causes piston and cylinder wear and reduced performance through frictional loss. Side-thrust is the resultant of the downward force acting in the direction of piston travel and the upward force acting through the angle of the connecting-rod. The greater the angle of the connecting- rod, the greater will be the resultant. One way of reducing side thrust is to use a very long connecting-rod. This, however, is impractical in modern engines since it means increased engine height and weight and, in a two-cycle engine, excessive primary compression chamber volume.

Offsetting the cylinder towards the direction of rotation means that the angularity of the connecting-rod for any piston position between slightly after TDC and slightly before BDC, will be less than for corresponding positions in a symmetrical motor. We can probably understand this better if we envisage an exaggerated example in which the cylinder offset is equal to half the stroke. In this, the connecting rod will be approximately vertical at a point midway between TDC and BDC (i.e. no side-thrust) whereas, on a symmetrical engine, the conrod angle would be about 15 or 16 degrees at the same point. There is, of course, a corresponding increase in conrod angle and side-thrust on the return stroke between BDC and TDC, but since the pressures are much less than during the power stroke, this is not so important.

Here we must insert a word about the use of the use of the terms ‘TDC (top-dead-center) and “BDC" (bottom-dead- center). Strictly speaking, these refer to the uppermost and lowermost positions of the crankpin which, in a symmetrical engine correspond to the uppermost and lowermost positions of the piston also. In a desaxe engine, the top and bottom positions of the piston occur after the dead center positions of the crankpin are reached. Therefore, the use of the terms TDC and BDC to describe piston positions in desaxe engines is not strictly correct. However, these terms now seem to be more widely understood to mean the uppermost and lowermost positions of the piston and we do not, therefore, propose to be dogmatic on this point.

A peculiarity of the desaxe arrangement is that the locations of the crankpin at the upper and lower piston positions, are no longer at 180 degrees to each other, due to the fact that the angularity of the conrod at the upper piston position is different from that at the lower piston position. For example, at piston TDC, our exaggerated desaxe engine would have a conrod angle of about 12 degrees to the cylinder axis, but at piston BDC the angle will have increased to about 22 degrees.

This has an effect on the velocity of the piston at various stages of crank rotation. In a symmetrical engine, the piston starts from rest at TDC, accelerates rapidly to mid-stroke, takes a little longer to decelerate to BDC and an equal time to accelerate back to mid-stroke, finally decelerating quickly towards TDC. With an offset cylinder, the piston acceleration to mid-stroke is a little slower and the deceleration to BDC takes even longer, but the mid-stroke position is regained much more rapidly and the final stage back to the top of the cylinder is also quicker. This, in turn, influences port timing. When the exhaust port is uncovered, it takes longer to open fully and then closes more quickly. The same, of course, applies to the bypass port.

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Theoretically, at least, this offers several advantages. The expanding gas in the combustion chamber has a little more time to do useful work before the exhaust port opens. It may also be argued that, since the ports reach their fully open positions more slowly, there is time for the cylinder to be more completely scavenged and refilled with fresh gas, after which the ports close quicker to avoid charge loss. It has to be admitted, however, that, since the amount of offset used in model two-cycle motors is usally very small (about 7 percent of the stroke on the Fox) these effects may not be significant.

There are other effects of offsetting the cylinder which may or may not be practical considerations in the design of a model engine. Among these is the engine's inability or, at least, unwillingness, to run in the reverse direction, even in the case of sideport or reed-valve induction systems. This is easily understood, but less obvious is the fact that in an offset engine the crank throw (i.e. the radius described by the crankpin center about the shaft axis) is not precisely half the piston stroke but very slightly less. In other words, the desaxe engine will accept a slightly smaller diameter crank chamber than an equivalent displacement symmetrical engine, although the difference is rarely enough to cause any worthwhile reduction in crankcase volume and thus pumping efficiency. So much for desaxe cylinders.

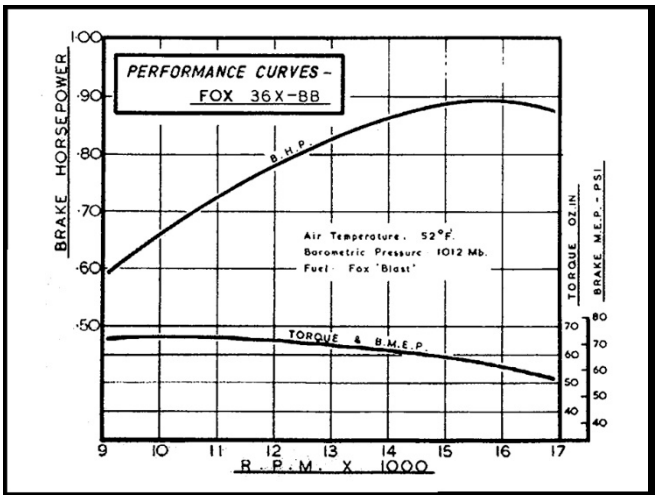
Performance-wise, the favorable remarks contained in our July 1963 report on the 35X apply equally to the 36X-BB. Tests in this instance were on Blast fuel only, using an orthodox metal pressure-tank coupled to the back plate pressure fitting. The torque and power curves quite closely matched those of the 35X previously tested, with just a slightly higher output indicated on the performance graph. In fact, the difference between typical examples of the 35X and 36X-BB may be a little more than we recorded with our test engines. Our 35X was, undoubtedly, a good one and we believe that the 36X-BB may be capable of even higher performance than the figures we achieved good as they are.

Starting was excellent, hot or cold. Running was smooth and consistent. We blew a couple of plugs during the first hour or so of running, which is no more than we expect in loosening up a hot performer, after which plug life was good. The engine was easy to adjust in that it responded positively to needle-valve adjustments but was never over critical.

This is clearly another exceptionally high performance Fox engine. We think it has just about all the power that combat enthusiasts need or can use, although combateers themselves are the best judge of this latter point. Other important "combat" features are its moderate weight (to aid acceleration, climb and maneuverability), strong case (for crash resistance) and quick hot-restarting for rapidly getting airborne again.

Summary of Data

Type: Loop-scavenged two-cycle with crankshaft rotary-valve induction and single ball-bearing.
Weight: 7.8 oz.
Displacement: 0.3594 cu.in. or 5.890 cc.
Bore: 0.800 in. Stroke: 0.715 in.
Stroke/Bore Ratio: 0.894 : 1
Specific Output (as tested): 2.48 bhp/ cu.in.
Power/Weight Ratio (as tested): 1.83 bhp/lb.
Price: $19.95
Manufacturer: Fox Manufacturing Company, 5305 Towson Avenue, Fort Smith, Arkansas.



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