Model Engine Tests

OS Max BGX-1

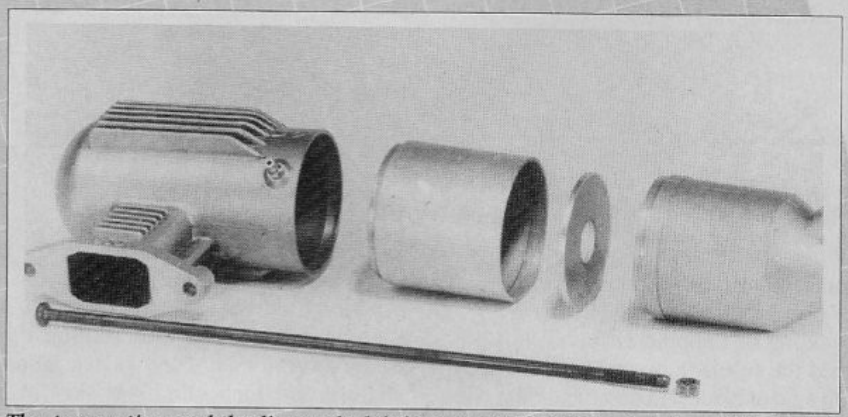
ENGINE EVALUATION

O.S. MAX BGX-1

by MIKE BILLINTON

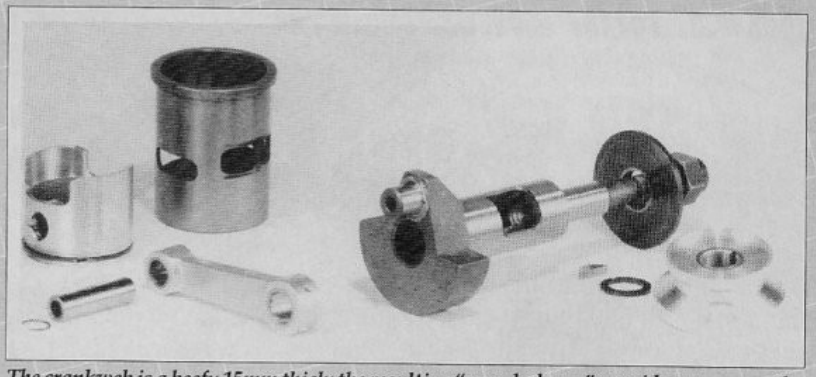
THE WORLD'S leading producer of model engines—O.S.—has now introduced its largest-capacity, single-cylinder engine: the MAX BGX-1.

Concerned about the noise of large engines and the loss of flying sites it causes, O.S. spent a long time on the development of this fine 35cc engine. (The company's previous multi-cylinder engines are much more complicated and expensive, so they aren't as competitive as the typical converted chain-saw engines.)



The two castings and the disc on the left form the first silencing chamber, while the tail casting on the right is the second chamber. This design suppresses sound very well.

Despite their noise, demand for large, simple engines remains strong, and O.S. has tried to ensure that the BGX-1's design allows a fairly lazy, low-rpm operation with moderate noise levels. O.S. also provides a really effective standard muffler to reduce this engine's noise output still further—in fact, to unusually low dB levels. With its modest dB readings and its low-frequency operation, the BGX-1 should be less irritating, and this should help to safeguard flying sites. (The noise level that constitutes a "nuisance" is very subjective: for some, a WW II Lancaster bomber's 4x27-liter, 108,000cc, 12-cylinder Merlins "open-exhausting" at 3,000rpm are less irritating than a typical 10cc 2-stroke doing its 12,000rpm!)



The crankweb is a beefy 15mm thick; the resulting "over-balance" provides very smooth running.

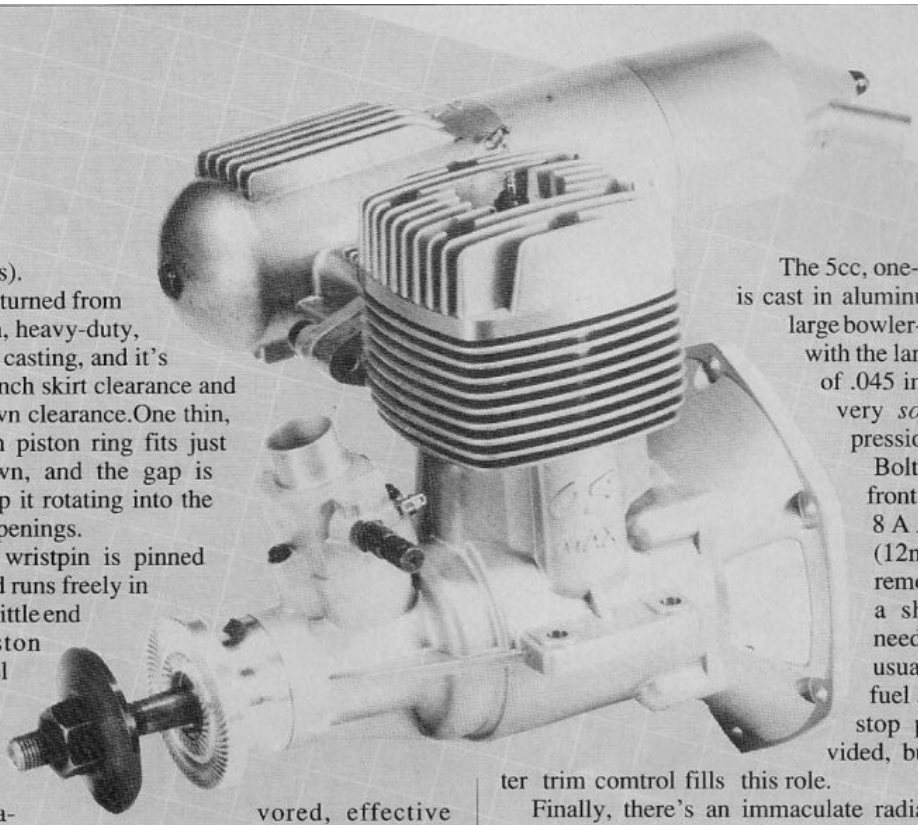
MECHANICAL DETAILS

O.S. was obviously determined to make a product that would be hard to resist! The simple, stocky, rigid, 18½-ounce, one-piece crankcase/front housing is superbly pressure-die-cast in aluminum alloy (a design that owes much to lessons learned with the much smaller 3.5cc engines used in ⅛-scale cars). Maybe the provision of an adjustable spark ignition would be a final "coup de grace" for this converted chain-saw engine.

A massive crankshaft (almost 10 ounces of hardened steel) continues the theme of high rigidity, the web itself being 15mm thick. Induction timing is a restrained 172 degrees, and the early closing point of 42 degrees ATDC ensures good low-speed performance. Torque transmission is by means of a Woodruff key in a shaft that drives the substantial aluminum propeller driver.

The connecting rod is of strong aluminum alloy (the shank is 6mm thick and 14mm wide), and each end has the plain phospor-bronze bushings usually used in smaller 2-strokes (unlike the usual provision in industrial engines—rolling

This single-cylinder 35cc powerhouse takes up the converted chain- saw engine challenge.



The finely constructed O.S. 35cc single is a powerful, practical performer.

element bearings).

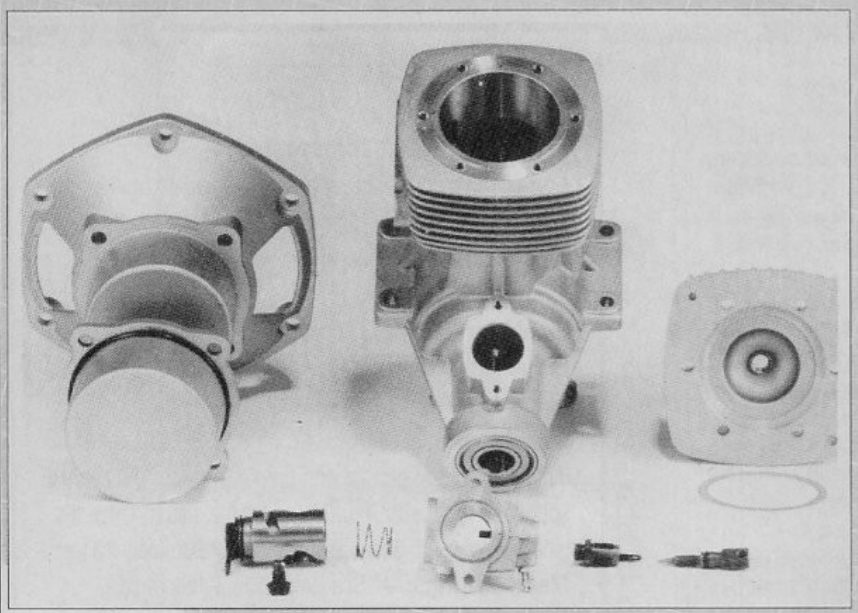
The piston is turned from a low-expansion, heavy-duty, aluminum-alloy casting, and it's fitted at a .004-inch skirt clearance and a .007-inch crown clearance.One thin, strong, cast-iron piston ring fits just below the crown, and the gap is "pegged" to stop it rotating into the cylinder port openings.

The hollow wristpin is pinned into position and runs freely in both the conrod little end and the piston bosses. The steel cylinder liner is completely plated (after being ground to size) by the favored, effective O.S. "Nikasil" method. Schnuerle porting with a mild 153-degree exhaust timing is used, and there's a sufficient overlap period of 19 degrees over transfer timing to allow a reasonable response from the available tuned pipe—available to the public, that is. I didn't use one for this test because it costs almost as much as the engine itself, but its *claimed* higher power at even lower sound levels would have been interesting to verify.

The 5cc, one-piece cylinder head is cast in aluminum alloy and has a large bowler-hat shape. Together with the large squish clearance of .045 inch, it gives a final, very *soft*, effective compression ratio of 6.16:1.

Bolted directly onto the front housing, the simple, 8AA, 11mm-bore (12mm if the sleeve is removed) carburetor has a short, rigid, main-needle adjuster and the usual secondary-needle fuel adjuster. A throttle-stop position isn't provided, but a radio-transmitter trim comtrol fills this role.

Finally, there's an immaculate radial mount, which is provided as an alternative to the built-in beam-mounting lugs. My dynamometer readings were taken using the beam mounting, so I can't comment on the radial mount. (It does, however, *look* the part, and it should take most of the stress to which the engine will subject it.) The single-cylinder model engine is usually more of a problem when it's hanging over the end of a radial mount and subjected to high power and rpm combined; but I speculate that with normal muffler use and rpm below, say, 8,000, you'll have no problems using this mount.



The castings meet O.S.'s consistently high standards. The carburetor (in front) doesn't have an adjustable throttle stop; the idle and mid-range mixture goes through a secondary needle in the left side of the throttle barrel.

PERFORMANCE

The fine finish and accuracy of the BGX-1's parts meant that running-in was relatively brief. The recommended propeller sizes are around 20x6 and 18x12 (depending on craft size and type). I started with a light-load 20x6 Zinger, and it soon became clear that larger-load propellers were within the capabilities of this powerful engine. The *soft* design features mentioned earlier allowed a detonation-free 4,146rpm from the final (heaviest) loader—the 24x12 Punctilio Airflow beech propeller.

It also became clear that the usual attempts to hand-start wouldn't work. The compression seal was so effective, and the glow ignition worked so well, that the only effective method was lazy reverse-rotation of the propeller. The instant ignition kick then swiftly initiated normal rotation.

Test 1. Open exhaust. Fuel: 5 percent nitro/10 percent castor/5 percent ML70 synthetic oil/80 percent methanol. O.S. no. 8 glow

plug.

O.S. makes no recommendation as to oil percentages, but it advises the use of a "good commercial fuel" based either on castor oil or synthetic oil. The low rpm achieved with the 24x12 propeller encouraged me to do further tests during both this open-exhaust torque test and the standard muffler test.

Maximum torque appeared at 5,711rpm, and maximum bhp occurred right on 10,000rpm, and at 4.06hp, it was very close to the O.S.-specified 4.1hp at 10,000rpm. Unfortunately, O.S. gives no indication of engine configuration: tuned pipe, open exhaust, or silencer? It's probably safe to assume they mean open exhaust.

Rapid torque loss past 10,500rpm brought this test to a close, with this O.S. BGX-1, like other large-capacity singles, showing signs of running out of steam at these rpm.

Test 2. Standard muffler. Fuel and plug as in Test 1.

Even lower rpm were reached during this torque test, and at 2,650rpm, the engine was still churning out 320 ounce/inches (2¼ Newtons) with no signs of distress. I'm not sure what practical use could be made of this area of performance, or which load propeller would be required to achieve it—but, like Everest, it's there...!

The maximum torque of 365 ounce/inches at 5,200rpm is 20 percent less than open-exhaust levels, and the final maximum bhp of 2.54 at 9,093rpm is an even larger (37 percent) reduction in hp. These both illustrate the restrictive nature of this O.S. muffler and its understandably strong ability to suppress noise. It generally gave a reduction of between 10 and 14dB on open-exhaust figures.

Why is it so effective? There's a double chamber inside a normal, back-pressure, expansion-style muffler. On escaping from the exhaust port, the gas expands into the first chamber and then exits through a 14mm hole in a flat disc; the gas then expands in the rear chamber and finally leaves the engine through a standard 12mm pipe. This simple, efficient system is, in effect, two silencing boxes in series and, to test this principle further, I added yet another expansion muffler to the final 12mm exit pipe. In fact, I tried four: a J'Tec add-on device; an old Amps "garbage-can" muffler (car type); a 3.5cc quiet tuned pipe (car type) and a standard OPS 29/40 quiet tuned pipe (aircraft type). The last one had the largest extra-expansion volume, so—not surprisingly—it offered the greatest noise reduction, and it even showed a further average drop of 2dB without noticeable rpm loss at around 8,000rpm.

This is all rather bulky, of course, but additions of this kind would clearly be useful in situations where noise is a real concern.

IDLING

Using a 20x6 Zinger, a standard muffler and the associated fuel-pressure line, the BGX-1's idling speed was a gracefully lazy 1,800rpm. As O.S. claimed, pick-up was swift and secure (given the carburetor's simple design and the high inertia of the large propeller).

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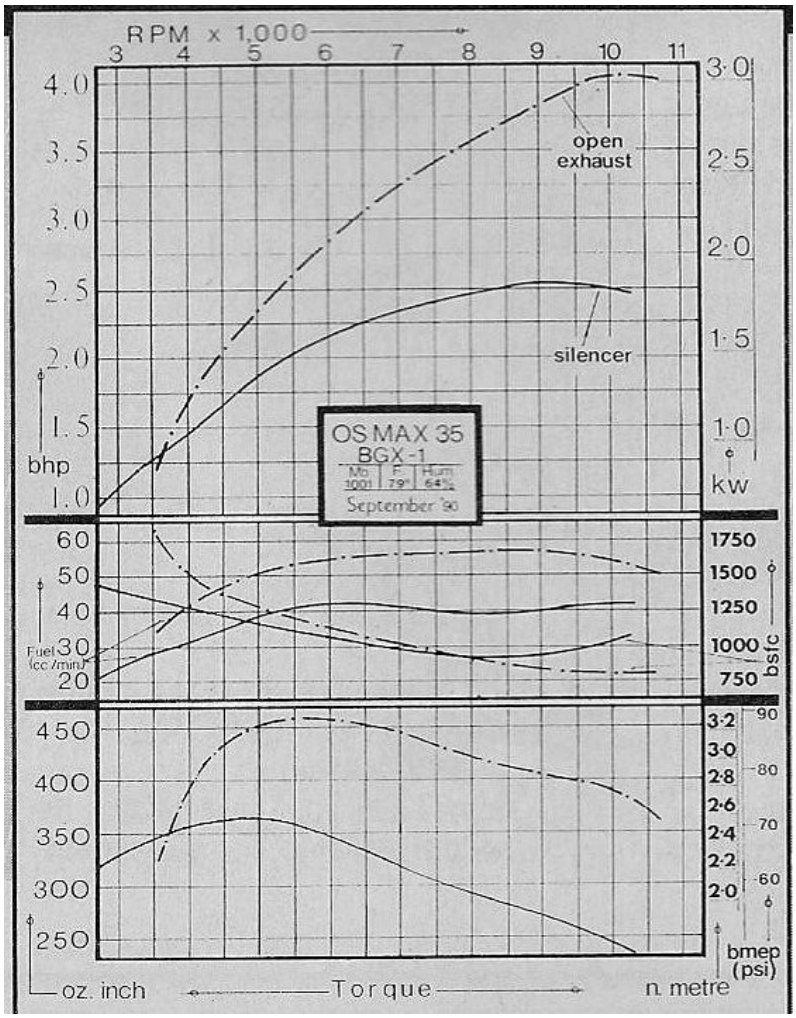
FUEL CONSUMPTION

My tests confirm the manufacturer's fuel-consumption figures of 700cc in 10 minutes. Their advice to set fuel controls on the rich side—particularly for the first few flights—is sensible. My test figures also show the more economical results of operating at maximum power after running-in has been completed.

SUMMARY

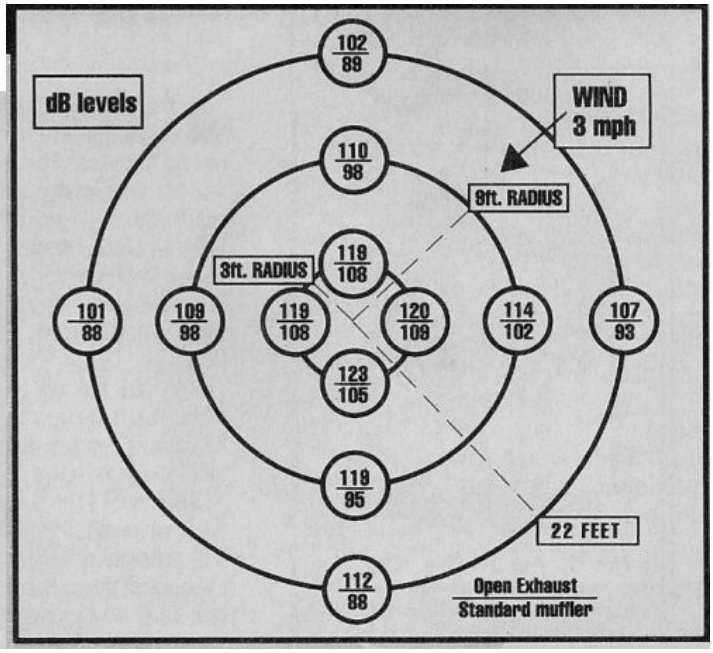
The BGX-1's construction seems to be even more rugged than previous engines, and this fits it to its designed task. This, and its clearly good condition at the end of my tests, shows that O.S. has made a wise choice in designing a large engine specifically for models, rather than converting a small industrial engine to our use.

There seems to be no reduction in O.S.'s obvious pursuit of a high-quality finish and construction accuracy, and it was a pleasure to test this particular O.S. product. ■



SOUND LEVELS—dB

Engine: O.S. BGX-1 2-stroke (35cc)
Equipment: open exhaust and O.S. standard muffler
Fuel: 5 percent nitro/15 percent oil
Engine position: 3 feet above the ground
Temperature: 71° F
Humidity: 76 percent
Propeller: 20x6 Zinger
Mean rpm: 8,300 (open exhaust); 7,800 (muffler).
Sound meter: Radio Shack's model 33-2050 set at 38 inches above the ground and pointing toward the nearest sound, i.e., propeller, muffler, or open exhaust. Three distances were used: 3 feet, 9 feet and approximately 22 feet.
Meter settings: "A" Scale and "Slow" response.



SPECIFICATIONS

DIMENSIONS & WEIGHTS

Capacity	2.1326 cubic inches (34.947cc)
Bore	1.468 inches (37.3mm)
Stroke	1.260 inches (32mm)
Stroke/bore ratio	0.858:1
Timing periods	Exhaust - 153° Transfer - 115° Boost - 106° Front Induction: Opens - 50° ABDC Closes - 42° ATDC Total period - 172° Blow-down - 19°
Combustion volume	4.7cc
Compression ratios	Geometric - 8.43:1 Effective - 6.16:1
Exhaust-port height	0.385 inch (9.8mm)
Cylinder-head squish	0.045 inch (1.14mm)
Cylinder-head squish angle	10°
Squish-band width	0.2 inch (5.1mm)
Carburetor bore	0.433 inch (10mm)
Crankshaft diameter	0.866 inch (22mm)
Crankshaft bore	0.598 inch (15.2mm)
Crankpin diameter	0.432 inch (10.99mm)
Crankshaft nose thread	0.371x24 TPI (3/8 ONF)
Wristpin diameter	0.353 inch (9mm)
Connecting-rod centers	2.32 inches (59mm)
Engine height	5.5 inches (a139.7mm)
Width	3.34 inches (84.8mm)
Length	Bare - 5.25 inches (133.3mm) w/radial mount - 6.19 inches (157mm)
Width between bearers	2.44 inches (62mm)
Beam mounting-hole dimensions	1.259x2.913x0.2 inches (32x74x5mm)
Radial mounting-hole dimensions	a 100mm-diameter circle with 6, 5mm holes spaced 50mm apart

Performance:

Max. BHP	4.06 @ 10,000rpm (Open exhaust) 2.54 @ 9,093rpm (Standard muffler)
Max. torque	453 oz/in. @ 5,711rpm (Open exhaust) 365 oz./in. @ 5,200rpm (Standard muffler)

RPM on standard propellers:

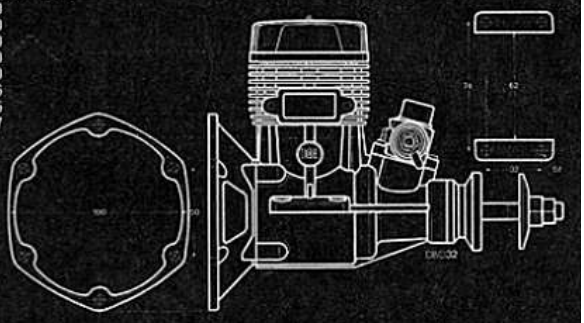
	Open exhaust	Standard silencer
16x6 Merati	10,660	9,540
18x8 Top Flite	8,900	7,920
20x6 Zinger	8,805	7,920
20x10 Top Flite	7,100	6,240
22x8 Mastro	6,310	5,560
20x10 Mastro	5,160	5,626
24x8 Zinger	6,011	5,415
24x8 Airflow	4,930	4,677
24x10 Airflow	4,417	
24x12 Airflow	4,146	

Performance Equivalents:

BHP/cu. in.	1.90
BHP/cc	0.116
Ounce inch/cu. in.	212
Ounce inch/cc	12.96
Ounce inch/pound	155.9
Gram meter/cc	9.15
BHP/pound	1.39
BHP/kilo	3.076
BHP/sq. inch frontal area	0.305

Exhaust-manifold bolt spacin...	1.732 inches (44mm) & 2.362 inches (60mm)
Frontal area	13.3 square inches
Weight	Bare - 46.5 ounces (1.32 kilo) w/muffler - 57.5 ounces (1.63 kilo) w/muffler & radial mount - 60.05 ounces (1.7 kilo)

Crankshaft weight	9.7 ounces (276 gm.)
Piston weight	1.1 ounces (32 gm.)
Connecting-rod weight	0.8 ounce (23 gm.)



Manufacturer: O.S. Engines, Osaka, Japan.
U.S. Distributor: Great Planes Model Distributors, 1608 Interstate Dr., P.O. Box 4021, Champaign, IL 61820.

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