

Engine Test

by Peter Chinn

OS MAX 10FSR

SPECIFICATION

Type: Single-cylinder, glowplug ignition, Schnuerle-scavenged two-stroke with shaft rotary-valve and side exhaust. Crankshaft supported in bronze bushed main bearing. Throttle type carburettor.

Bore: 13.44mm (0.5291in.)

Stroke: 12.40mm (0.4882in.)

Swept Volume: 1.759cc (0.1074cu. in.)

Stroke/bore ratio: 0.923:1

Measured compression ratio (full stroke): 9.0:1

Measured compression ratio (exhaust closed): 6.7:1

Measured port timing:

Exhaust period:	146°
Transfer period:	124°
Third port period:	108°

Rotary-valve opens: 35° ABDC

Rotary-valve closes: 48° ATDC

Checked weights:

121gm — 4.28oz. (less silencer)

149gm — 5.25oz. (with OS-761 silencer)

GENERAL STRUCTURAL DATA

Main casting: Pressure diecast aluminium alloy comprising crankcase, front housing and full-length finned cylinder casing with beam mounting lugs and 8.5mm i.d. intake boss. Cast-in phosphor bronze main bearing bush. All joint faces machine finished.

Crankcase backplate: Pressure diecast aluminium alloy fitted with paper gasket and four 2.5mm Philips head screws.

Crankshaft: One piece, hardened and ground, with 9mm o.d. main journal and 4mm solid crank-

pin on circular crankweb with crescent counterweight. 6.6mm bore gas passage fed from rectangular 9mm long valve-port. Machined aluminium alloy prop driver keyed to flat on front end with shim steel washer fitted between driver and crankcase nose to prevent wear when electric starter is employed, or when engine is used with pusher prop.

Piston and connecting-rod assembly: Flat-crown, deflectorless, lapped cast-iron piston with fully-floating 3.5mm tubular hardened steel gudgeon-pin fitted with PTFE pads. Machined high-duty aluminium alloy connecting-rod, 23.5mm between centres, with plain eyes and oil hole at lower end.

Cylinder-liner: Steel investment casting, having thick (2.3mm) wall containing cast-in transfer passages and located by narrow annular seat in bottom of surrounding cylinder casting. Seat narrowed at three points to allow smooth entry to transfer passages. Single unbridged exhaust port, flanked by angled main transfer ports with upwardly inclined third port diametrically opposite exhaust.

Cylinder-head: Machine finished, pressure diecast aluminium alloy finned cylinder head with 2.6mm wide squish-band surrounding small central chamber. Head secured to cylinder casing with four 2.5mm Philips head screws. Single 0.2mm soft aluminium gasket.

Carburettor: Barrel throttle type with pressure diecast aluminium alloy body and ground brass throttle barrel, with adjustable nylon throttle lever on right side. Barrel retained by adjustable throttle stop screw. Nickel plated needle-valve assembly on left side with jet tube protruding into throttle barrel, giving nominal choke area of 10sq. mm, but adjustable to vary choke area between approximately 8sq. mm and 11.5sq. mm (depending on whether maximum suction or maximum power is required) by screwing the jet assembly in or out.

Silencer: OS-761 pressure diecast aluminium alloy expansion chamber type. Volume 16ml. Tailpipe i.d. 4.8mm. Outlet area 18sq. mm. Silencer attaches directly to exhaust duct with two long (22.5mm) 2.5mm Philips screws.

TEST CONDITIONS

Running time prior to test: Approximately 1 hour.

Fuels used: (i) 75 per cent methanol, 25 per cent castor-oil (running-in); (ii) 72 per cent methanol, 23 per cent castor-oil, 5 per cent nitromethane (tests 1 and 2); 37 per cent methanol, 23 per cent castor-oil, 40 per cent nitromethane (test 3).

Glowplug used: O.S. No. 8, platinum element, 1.5 volt.

Silencer used: OS-761 expansion chamber type.

Air temperature: 13°C

Barometric pressure: 772mm (30.4in.) Hg.

Relative humidity: 70 per cent.

TEST RESULTS

Power output, gross (40 per cent nitromethane): 0.275bhp at 18,000rpm.

Power output, gross (5 per cent nitromethane): 0.240bhp at 18,000rpm.

Power output, net (with silencer, 5p.c. NM): 0.225bhp at 17,500rpm.

Torque, gross (40 per cent nitromethane): 17.5oz. in. at 11,000rpm.

Equivalent b.m.e.p.: 64lb./sq. in.

Torque, net (with silencer, 5p.c. NM): 15oz. in. at 10,500rpm.

Equivalent b.m.e.p.: 55lb./sq. in.

Specific output, gross (40p.c. NM): 156bhp/litre.

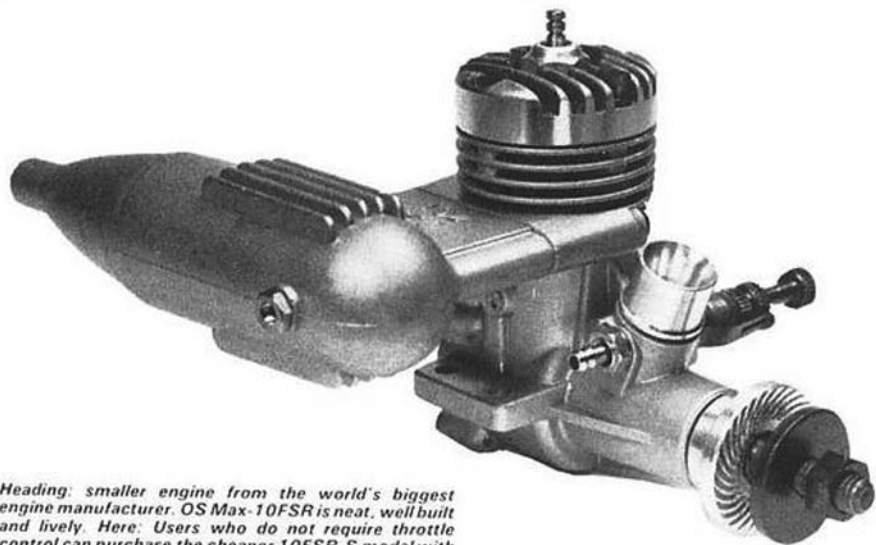
Specific output, net (w/sil., 5p.c. NM): 128 bhp/litre.

Power/weight ratio, gross (40p.c. NM): 1.03 bhp/lb.

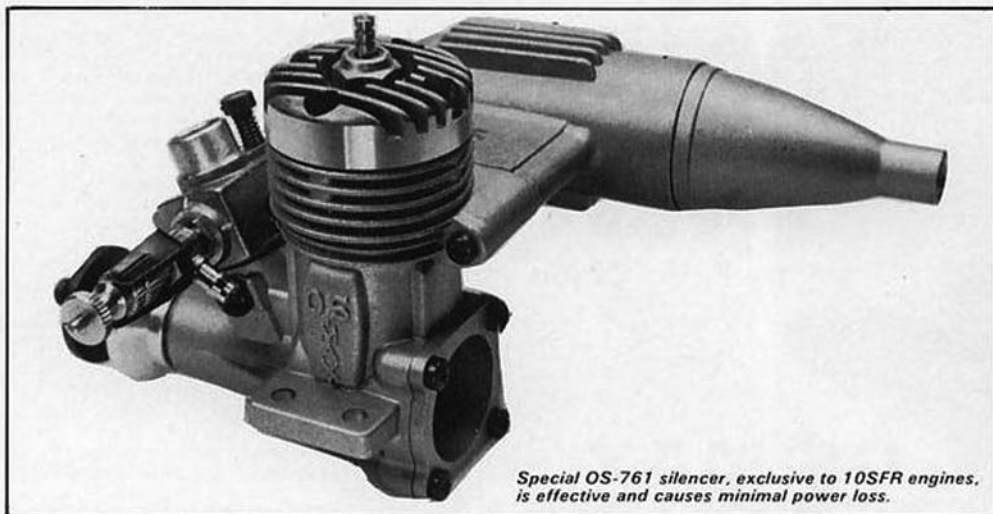
Power/weight ratio, net (w/sil., 5p.c. NM): 0.69bhp/lb.

MANUFACTURER: O.S. Engine Mfg. Co. Ltd., Osaka 546, Japan.

U.K. Distribution & Service: O.S. Products Ltd., Brunswick Industrial Park, Brunswick Way, New Southgate, London N11 1JL.



Heading: smaller engine from the world's biggest engine manufacturer. OS Max-10FSR is neat, well built and lively. Here: Users who do not require throttle control can purchase the cheaper 10FSR-S model with standard venturi and needle-valve.



Special OS-761 silencer, exclusive to 10FSR engines, is effective and causes minimal power loss.

The O.S. engine range currently numbers over 50 different models and variants in both two-stroke and four-stroke types, the largest and most expensive being a 20cc twin-cylinder four-stroke, the splendid FT-120 'Gemini' model. At the opposite end of the size and price scale is the 1.76cc Max-10FSR two-stroke dealt with here; a neat little engine that is aimed at newcomers to the hobby and at those who favour smaller or lighter types of models.

The suffix letters 'FSR' denote that this is a front induction, Schnuerle-scavenged motor. It is supplied complete with an OS-761 silencer and is fitted with a throttle type carburettor but, for control-line enthusiasts and others who do not need a throttle, it is also available with a simple venturi insert and spraybar assembly and is then designated Max-10FSR-S.

As one might expect of a motor that is appreciably smaller than other current O.S. Schnuerle scavenged units, the 10FSR is a somewhat simpler design than its bigger brothers. It uses a bronze bushed main bearing, a lapped ferrous piston/cylinder assembly and a simple carburettor without a separate idle mixture adjustment. Instead of having its transfer passages formed in its

main casting, these are actually contained within the cylinder liner itself. This has been achieved by making the cylinder liner from a steel casting, the walls of which are thick enough to accommodate the transfer and third port passages without the need of corresponding channels in the wall of the surrounding aluminium casing. An unusual feature is that the liner is rotated in the casing so that the exhaust port is relocated about 40 degrees to the rear. This has the advantage of leaving a continuous vertical wall surface, fore and aft, uninterrupted by ports, against which the piston's fully-floating gudgeon-pin can bear by means of pads, thereby eliminating the complication of circlips.

Owners of early versions of the Max-10FSR may care to note that these had a slightly different cylinder-liner. Current examples, including the model featured in this report, have a longer cylinder liner and, to accommodate this, these later models have an internally modified crankcase. *These parts are not interchangeable.* Early models with the short (24.5mm) liner can be identified by the maker's code letters: FA, FD or GY, which are stamped on the machined underside of one of the mounting lugs. The appropriate O.S. part numbers for

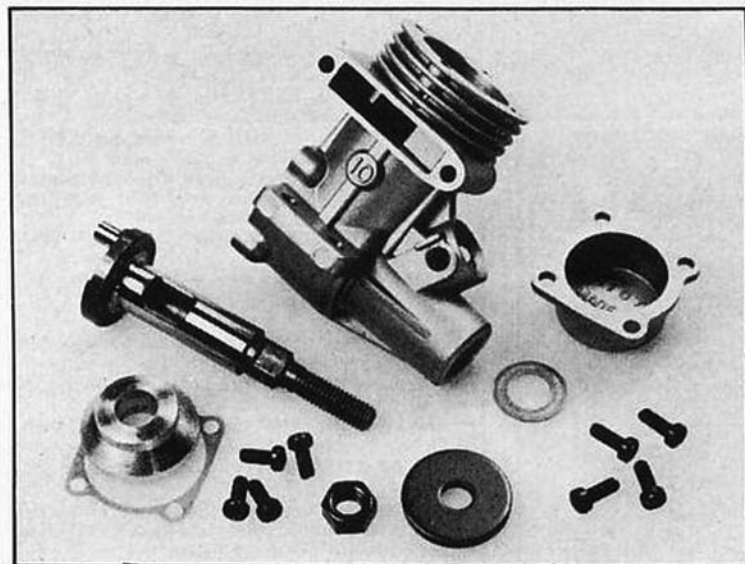
these are 21101007 (crankcase) and 21103001 (cylinder/piston assembly). Engines carrying any other code letters, with the exception of 'GS', are of the later type and the correct part numbers for these are 21101016 (crankcase) and 21103010 (cylinder/piston assembly). The very small number of engines carrying the letters 'GS' may be of either type and it will, in this case, be necessary to measure the length of the cylinder liner (24.5 or 26.0 mm) in order to identify it.

PERFORMANCE

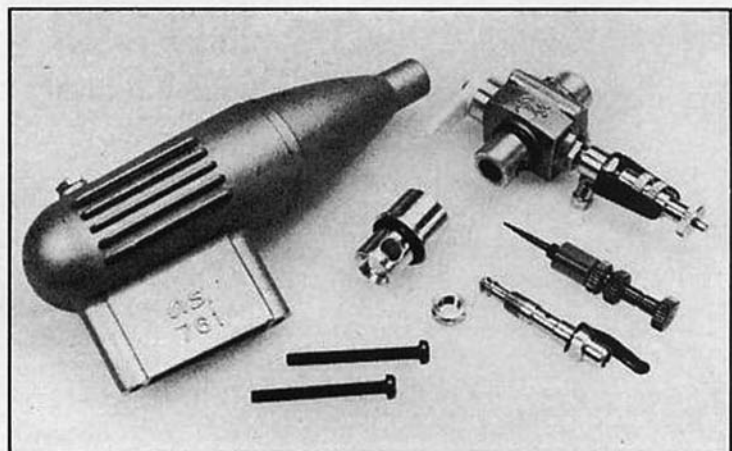
Since the Max-10FSR is intended for beginners as well as for more experienced modellers, the O.S. company has taken the trouble to provide an instruction leaflet that conducts the newcomer through the basic operating procedure by means of a ten-point starting drill. If he still has difficulty, he can then refer to a subsequent section which lists the symptoms of possible errors in handling and the corrective action necessary.

In fact, we found the 10FSR very easy to handle. As with most small engines, any reluctance to start is more likely to be caused by over-priming than under-priming. For the very first start from cold, the best procedure, we found, was to inject a small prime through the plug hole, after checking the plug for 'glow' (adjust lead length or rheostat for bright red or orange-red glow). Having opened the needle-valve, slightly, from the running setting and sucked the fuel up to the carburettor, it was then found that the engine would start within two or three flicks of the prop. Warm restarts were generally 'first flick', without choking the intake, provided that the fuel delivery tube to the carburettor was full and the throttle was set in the idle position. A single choked flick of the prop was the only preliminary required for a quick restart with the throttle open.

The 10FSR was pleasantly docile as regards handling characteristics. It could be safely hand started on the smallest practical prop sizes with no tendency to



Left: engine's wide exhaust duct conducts gases from port in rear right quarter of cylinder. Shaft is counterbalanced. Below: on right, Max-10FSR carburettor with, below, needlevalve and venturi of 10FSR-S model. OS-761 silencer is supplied with both engines.



'backfire' or abruptly snap round and bite the fingers of the operator.

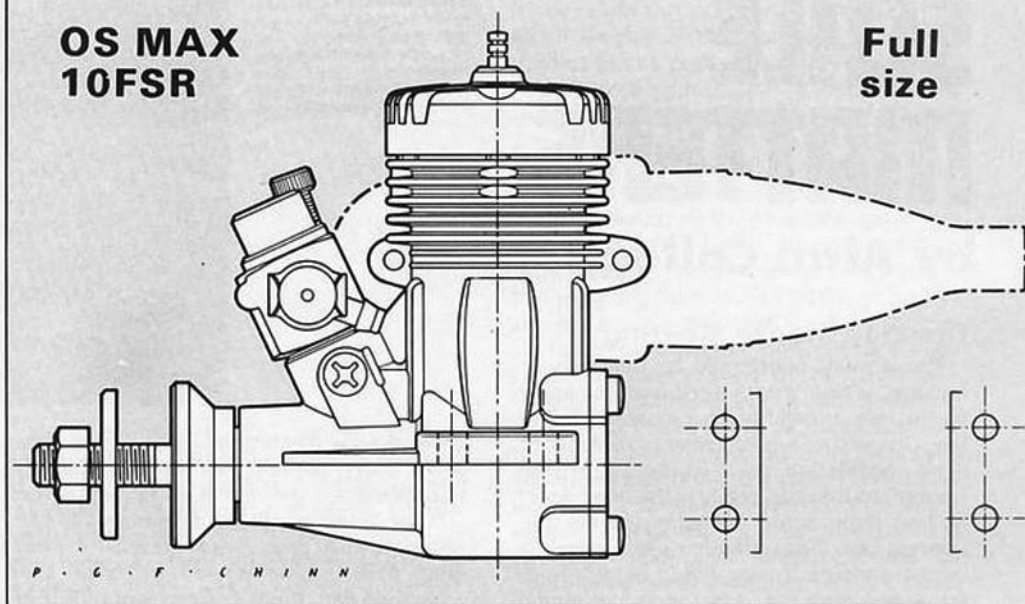
The engine ran happily on a wide variety of fuel mixtures, both commercial and 'home brew'. For initial running-in, we used a straight 3/1 mixture of methanol and castor-oil and a 7½ × 3¼ Bartels epoxy-glassfibre prop. After a quick spot-check on rpm early in the running-in process, it was found that the engine picked up over 1,000rpm in the space of 30 minutes' running time. A switch was then made to 5 per cent nitromethane fuel prior to embarking on the actual testing.

As one might expect of its more modern Schnuerle-scavenged design, the Max-10FSR proved to be a great deal more powerful than earlier O.S. engines of similar swept volume, such as the crossflow-scavenged Max-10. Typical prop rpm recorded on mild (5 per cent nitro) fuel, with the standard silencer fitted, included 11,400rpm on an 8 × 4 Robbe glassfibre-nylon prop, 12,400 on an 8 × 4 Cox glassfibre-nylon, 12,500 on a 7½ × 4 Zinger maple, 13,200 on a 7 × 4 Zinger maple, 15,000 on a 7½ × 3¼ Bartels glassfibre-epoxy and 16,500 on a 7 × 3½ Bartels glassfibre-epoxy.

One of the more gratifying aspects of the tests was the surprisingly modest power loss attributable to the OS-761 silencer. Clearly, this is very well matched to the characteristics of the Max-10FSR. As the performance graph shows, it had a negligible effect on the engine's maximum torque. Only when the engine approached the very peak of its power curve, was there a discernible loss. In terms of prop revolutions, the reduction was of the order of only 200-300 rpm on the prop sizes most likely to be used.

The power available on mild fuels is, obviously, fully adequate for most purposes, but where the user may wish to raise output over the whole rpm range, the use of a 'racing' grade mixture will contribute a useful increase. Our findings indicated that such fuels do not noticeably raise the bhp peaking speed. Instead, there

OS MAX 10FSR



is a marked increase in brake mean effective pressure, as a result of which the engine is substantially faster on all props. Among the actual prop rpm recorded (less silencer) on 40 per cent nitromethane, were 11,400 on an 8 × 4 Zinger maple, 12,400 on an 8 × 4 Robbe glassfibre-nylon, 13,500 on an 8 × 4 Cox glassfibre-nylon, 13,750 on a 7½ × 4 Zinger maple, 16,200 on a 7½ × 3¼ Bartels glassfibre-epoxy and 17,600 on a 7 × 3½ Bartels glassfibre-epoxy.

The maximum gross power output recorded on 40 per cent nitro of 0.275bhp is, of course, very good indeed. Running qualities of the Max-10FSR, on both mild and hot fuels, were also good. The engine held steady speeds, showing little or no tendency towards loss of power as it warmed up, and vibration levels were modest.

The throttle worked surprisingly well. We say 'surprisingly' because, alone among O.S. carburetors, the 10FSR's carb has no provision for adjusting the mixture strength

at idling speeds, although it does have a measure of automatic compensation built-in to prevent the mixture from becoming too rich at idling speeds. Above the throttle barrel, the carburettor inlet is bored 5.5mm, whereas, below it, it is reduced to 4.8mm. This has the same effect as a notched barrel: the tendency for crankcase depression to draw too much fuel as the throttle nears the closed position is counteracted by the admission of extra air. On test, the Max-10FSR idled quite happily as low as 2,600rpm on an 8 × 4 Cox nylon prop, rising to 3,200 on the 7½ × 3¼ Bartels glassfibre-epoxy. Recovery to full throttle was reliable and mid-range control was very good.*

No problems of any kind were encountered with the Max-10FSR and, completely dismantled at the conclusion of the tests, the engine was found to be in excellent condition. The No. 8 glowplug survived the entire test programme, including a series of high speed runs of up to 21,000rpm.

Below: distinctive feature of 10FSR is its thick-walled cast steel cylinder liner with integral Schnuerle ports and passages.

