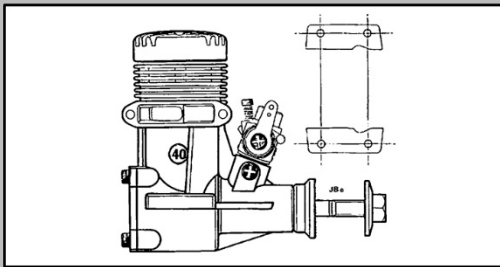


O.S Max-40 FP R/C

INSIDE ENGINES O.S. MAX 40FP

BY MIKE BILLINTON



The largest example from the O.S. FP family of engines, the MAX 40 FP has the lowest bore stroke ratio. The fine quality casting is obvious, and certainly an important selling point.

•The recent creation of the FP range of engines by that most prolific and long- respected of model engine manufacturers, O.S. of Japan, is an indication of their well-attuned sense of changing marketing realities.

Although deliberately conceived as low cost units, these .20, .25, .35, and .40 cu. in. R/C sports engines nevertheless maintain the high O.S. constructional standards, and possession of one of these gems can still generate a pleasing sense of pride of ownership.

As this report suggests, the balance of qualities offered here by O.S. now leans much more towards reliability and longevity than towards the opposing pole of sheer power. This suggests that owners of FP engines may find them enduring well into the 1990s.

Of the four capacity sizes currently available in the FP range, the largest (at .40 cu. in. and having the lowest Stroke/Bore ratio at .868/1) was chosen for this test. This is certainly still a very popular engine size, maybe because the resultant moderately proportioned aircraft are free of the problems associated with intimidatingly large Giant Scale aircraft on the one hand or, infuriatingly small R/C models on the other.

In similar ways, the extremes of model engine size have their problems of scale, so it is not surprising that the .40 cu. in. engine size has a long history of sitting snugly on that nice point of balance between those extremes.

The O.S. Max 40FP (as with all engines from this manufacturer) hits one in the eye immediately when the box is opened; casting quality is still exemplary. Whether that's what an engine needs to perform well is of course another matter, but it undeniably is an important sales point, and in any case, any manufacturer who can put that amount of care into the initial die casting process is inevitably likely to take that same attitude into the rest of the engine and O.S. do!

MECHANICAL POINTS

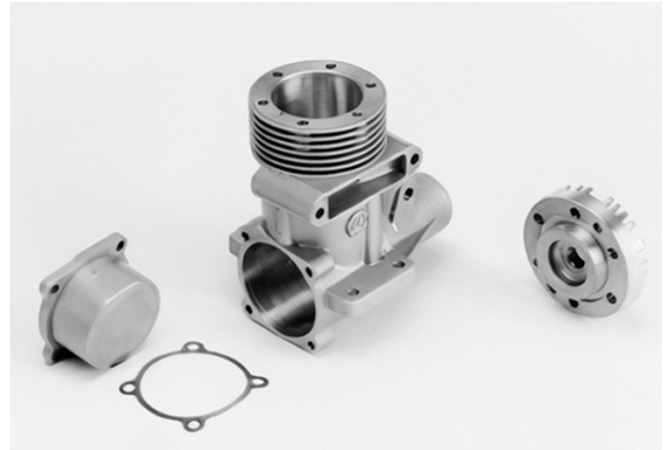
Pursuing that economic route mentioned earlier, the main casting is in one piece and supports both crankshaft and cylinder liner. The reversion to a plain bearing crankshaft (eliminating the normal twin ball-bearing support) is also in keeping with this philosophy, though the O.S. workmanship is such as to prevent this move appearing as a disadvantage! In sheer power terms, however, and where direct comparison is possible, the extra friction does have an effect and O.S. has accepted a power loss at this point in return for cost reductions and enhancement of engine life often resulting from plain bearing support.

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Also of relevance is the crankshaft bore at 8.8mm and carburetor bore at 5.5mm...for a 6-1/2cc engine quite small, and so all three points serve to restrict performance at higher rpm.

Again in pursuit of manufacturing economies, the rotation of cylinder liner 30 brings the side exhaust out diagonally backwards with the result that the gudgeon pin can now traverse unported sections of the liner, therefore no circlips and piston grooves are needed to prevent ejection of pin into ports. Instead Teflon end pads are used to minimize liner wear. This move does have ramifications on gas flow because the bottom entry of each of the three Schnuerle induction passages (two Transfer one Boost) is now equally (unobstructed as compared with the normal geometry which finds the crank-web impeding entry to the front port above it (whether in side or rear exhaust layouts). This normally compensated for by extra work (economics again) on piston and/or liner cutaways.

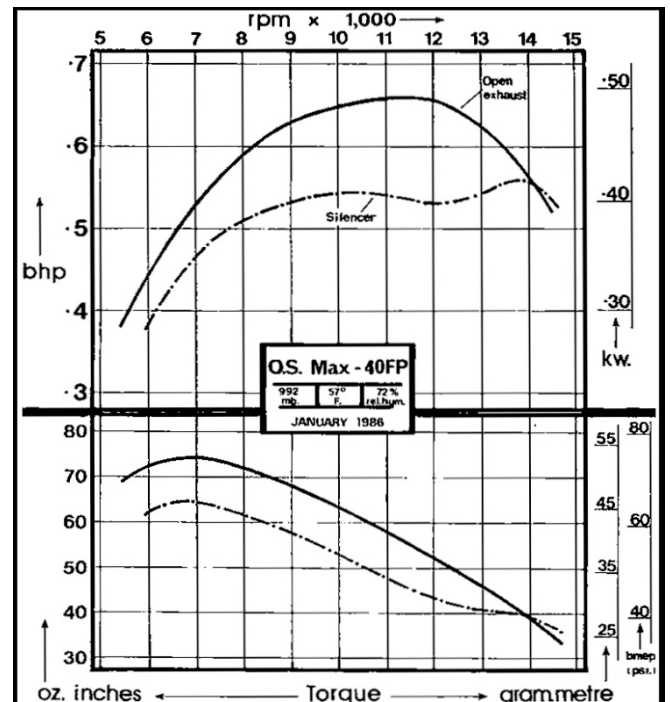
This emphasis on long life and economy combined also lies at the heart of the FP engine because the piston/liner has been taken back to ferrous technology but with a difference. The finely produced cast iron plain unringed piston runs in a steel liner which is coated using the O.S. "Nikasil" process, more normally found on the brass liners of O.S. racing engines. As commented on later this match has resulted in a very hard wearing combination. O.S. confidence in their CNC machinery has allowed them also to pursue the more economic route of grinding both liner and piston to their finished running size, rather than using the more time consuming honing process. The connecting rod is milled to a generous cross section in aluminum alloy, and the reliability of this item is further enhanced by the phosphor-bronze bushings fitted to both little and big-ends. Die-cast in aluminum alloy, the six bolt cylinder head features the more durable brass insert plug thread together with a top-hat combustion chamber and sharply tapering squish band at 10. A standard O.S. 3A carburetor is fitted. It is designed on simple lines, with air bleed needle control which covers the range from idle up to mid throttle opening, and the usual main



The top flange of the crankcase is pinned to prevent rotation of the liner. Cylinder head has brass insert for the plug.

fuel control needle valve. As usual these two control functions overlap and interact at around 1/4 throttle so the normal advice applies to first set the main needle slightly rich with throttle at fully open position with engine running on say 11 x 5 propeller; and only then adjust idle needle at small throttle/low rpm.

A normal throttle stop is also fitted. Although one of the motives behind fitting of this uncomplicated carburetor is economic, it must be said that it's easy to adjust style and adequate response makes it perfectly suitable for any sports flying



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operations plus there are certainly many fewer parts to go wrong, maladjust, or mislay.

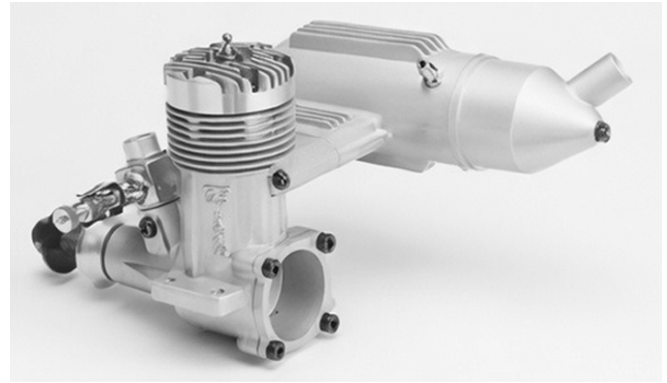
RUNNING IN

This aspect deserves a separate mention because of the problems posed by the ferrous piston/liner combination.

As many engine users during the last few years have become increasingly accustomed to the thermally quite differently acting ABC setups (low expansion piston running in higher expansion brass liner), so there is almost a need for a relook at the handling requirements of the Iron/Steel combination. It is possible today that some modelers have never seen such a strange arrangement!

Simply put, in the normal ABC engine the piston is virtually incapable of tightening up in the cylinder bore, irrespective of the amount of heat involved. In the Iron engine (having similar expansion rates for both piston and liner) the reverse holds true...it is very difficult to prevent the piston from expanding faster than the bore. The problem is magnified during the early running in period, though the fact remains a fundamental one throughout the life of the engine and any change to hotter fuels after running in requires a further period of careful running to adjust engine to the new heat balance.

By contrast the ABC engine happily survives radical change to heat output. The O.S. nickel coating with silicon impregnation process provides a lower friction surface than untreated steel, and so results in both a longer running-in period and very likely a longer "running out" one. This lower friction surface does not however prevent the inevitable thermal expansion problems and tightening up of the hotter piston in the cooler bore was a continual threat during the first one half hour of running. During the first one half hour flat out two stroke fuel settings were definitely not advisable; on the contrary, it was necessary to run engine at one half to three quarter turn rich on main needle control to provide sufficient internal fuel cooling and power reduction combined in both a longer running in



The heavily finned silencer on the O.S. Max 40 FP gives good cooling. The outlet position can be rotated if desired.



The O.S. 3A carburetor has few parts by normal standards, but performs well.



Internal moving parts are to the usual high O.S. standards. Iron piston has high quality internal milling to reduce weight.

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the cooler bore was a continual threat during the first one-half hour of running. During the first one-half hour flat out two-stroke fuel settings were definitely not advisable; on the contrary, it was necessary to run engine at one half to three quarter turn rich on main needle control to provide sufficient internal fuel cooling and power reduction combined in order to adequately control the heat output at this time.

At **around** three quarter hour running time the piston/liner had arrived at a free and stable enough thermal state to justify moving on to the torque tests. All of this contrasts vividly with the instant top performance available from most ABC engines, though this needs qualifying because there are other bearing surfaces within any engine which benefit from care in the initial runs, quite apart from the piston/liner itself.

POWER TEST 2

O.S. Silencer. Fuel plus as Test 1

A simple expansion chamber silencer (with 8.5mm. outlet) is supplied as standard. A pressure nipple for fuel feed and of course the usual O.S. high quality construction are featured.

The overall effect of the silencer was to reduce Torque by around 8 oz. ins. and rpm by between 500 and 800 rpm. From 12.300 rpm upwards, performance surprisingly started to recover from its normal decline, until at 14.000 rpm it was back on a par with the Open exhaust figures, Torque figures, rpm on given loads, and the quite important subjective impressions all showed that the recovery was a genuine one and really can only be attributable to a tuned exhaust effect. In practice it appears of limited value for normal sports aircraft use because 9x4 or similar load propellers would be required at these higher rpm that's rather too small for the average 40 sports/beginners model, whilst the hassle level would be quite high for many operators. The more natural and relaxed area for the 40FP appears to be between 8.000 and 11.000 rpm and the O.S. advised propeller sizes 11x5 or 11x6 rotate nicely within this range.

IDLE SPEED

Using the 11x5 Top Flite maple propeller, silencer, and 10% Nitro, fuel, a safe idle speed of 2.100 rpm was easily and quickly reached.

Further reduction down to 1.800 rpm was possible, but proved less reliable.

SUMMARY

In some respects these new, more economic O.S. engines appear (apart from the Schnuerle porting) to be a throwback to earlier design principles...however, their application within very high construction standards could equally be seen as a realistic new direction for the general purpose model engine, and one more accurately focused to the needs of today's beginner and average sports flyer. Further-more the O.S. instruction leaflet is unusually comprehensive, almost booklet in scope, and which also seems directed at the operator's current needs.

The writer's experience of the 40FP differs from their advice in degree only that the running-in period was a little more protracted than their comments suggested. In every other respect the beginner will find all their questions answered. They will also have in their possession an uncomplicated, reliable and long lived "value for money" engine from a pedigree source.

O.S. Max-40FP Two-stroke.

Dimensions & Weights:

Capacity: .3949 cu. in. (6.472 CC.)

Bore: .834 in. (21.18 mm.)

Stroke: .723 in. (18.36 mm.)

Stroke / Bore ratio: .867/1

Timing periods Exhaust 142°

- **Transfer** 116°

- **Boost** 82°

- **Induction opens** 41° ABDC

- **Closes** 38° ATDC

- **Total** 177°

Exhaust port height: .20 in. (5.08 mm.)

Combustion chamber volume: .045 cu. in. (.75 cc.)

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Cylinder head squish: .014 in. (.35 mm.)
Squish band angle: 10°
Squish band width: .146 in. (3.7 mm.)
Crankshaft dia.: .4722 in. (12 mm.)
Crankshaft bore: .348 in. (8.8 mm.)
Crankpin dia.: .2162 in. (5.5 mm.)
Crankshaft nose thread: .247 in. x 28 TPI
 (1/4 UNF)
Gudgeon pin dia.: .1967 in. (5 mm.)
Connecting rod centers: 1.299 in. (33 mm.)
Carburetor bore: .216 mm. (5.5 mm.)
Mounting holes: 17.5 mm. x 40.5 mm. x 3.3 mm.
 holes
Width between bearers: 1.25 in. (31.5 mm.)
Width: 1.9 in. (48.4 mm.)
Length: 2.83 in. (72.0 mm.)
Height: 3.22 in. (82.0 mm.)
Frontal area: 3.87 sq. in. (24.9 sq. cms.)
Weight / Bare: 8.5 ozs. (241 gms.)
 with Silencer 11.0 ozs. (312.4 gms.)
Piston: .4 ozs. (11.3 gms.)

Performance:

Max. BHP .657 @ 11,900 rpm. (Open Ex./10% Nitro.)
 .560 @ 13,800 rpm. (Silencer/10% Nitro.)
 Max. Torque 75 oz. in. @ 6,870 rpm (Open Ex. 10% Nitro)
 65 oz. in. @ 6,710 rpm. (Silencer 10% Nitro)

Rpm on Standard Open Ex. Silencer propellers:

12 x 6 Graupner	8.910	8.350
10 x 8.3 Graupner (3 blade)	9.200	8.570
11 x 8 Zinger	9.222	8.745
11 x 5 Top Flite	10.660	10.160
10 x 6 MK Glass	11.400	10.640
10 x 4 Zinger	13.200	12.430
9x4 Zinger		13.820

Performance Equivalents:

BHP/cu. in.	1.66
BHP/cc	.10
Oz. in/cu. in.	189.92
Oz. in/cc	11.589
Gm. meter/cc.	8.27
BHP/lb.	1.23
BHP/Kilo.	2.72

BHP/sq. in. frontal area .169

Manufacturer: O.S. Engines, Osaka, Japan
USA Distributor: PO Box 721, Urbana, Illinois
 61801 Great Planes Model Mfg. Co.



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