Mike Billinton

OPS 3.5 cc engine test

Mike Billinton looks closely at an Italian Super Car engine

The Open 1/8 circuit International competition class is still the scene of intense rivalry between the virtual 'Professional' teams involved. Engines continue to be important, of course, but increasingly relevant is the controlled way they are put to use. Rolling road dyno's; 'on board' telemetry to ensure correct use of power bands, gear ratios, fuel settings etc. are all beginning to emulate full-size practice, and these complexities are adding yet more to the already high cost of 1/8 racing.

The subject of this test shows that OPS - a major force in Italian manufacture of racing engines - are apparently not prepared to be left behind even though the competition on the engine front itself is as fierce as ever.

This laudably combative attitude is clear with recent 'OP 8800' 3.5cc car engine, which sports a relatively new crankcase casting visually adding a new and definite sense of 'architectural' quality to their existing long-standing range, whilst at the same time giving a more rigid mounting base - a feature which is becoming increasingly widespread as RPM's rise to yet higher levels as the means of pursuing yet more HP.

Mechanical Points

The new emphatic external appearance is paradoxically matched to internals which appear in danger of disappearing altogether, the sieve-like brass liner for example has so many ports as to threaten its mechanical viability (though this test proved quite otherwise!).

These comprise:

1 Massive Exhaust port at a high timing of 180° and spanning 120° of liner circumference with, in effect, 8 Transfers and 1 large Boost at 124° timing. Boost is angled up 50°, Main transfers up 17°, and the 4 new 'thin transfers' are angled up 35°. In addition, the high silicon aluminium piston (3 gm. weight) has a port cut into either thrust-face walls to allow gas quicker access to liner transfers than is normal.

The intent overall is clearly to ensure gas flow is not impeded at the aimed-for high RPM's, otherwise the whole exercise becomes pointless.

The hardened steel crankshaft is equally a 'tour de force', featuring a bridging strut halfway across the Induction cut-away - lending considerable strengthening support to a relatively weak and stressed area. Opening of

Strong single-piece crankcase with extra mounting lugs at front main bearing are becoming essential to cope with very high RPM stress.

the

Induction port into lower crankcase is 'flowed' - again to assist gas flow.

Finally, the photo does not reveal that the Induction cut-away 'out-of-balance' is offset by several holes drilled lengthways into front end of crank at opposite side to the main cut-away.

Aluminium connecting-rod is finely machined from solid, with phosphor-bronze at each end and with 1 lubrication hole to each on the pressure sides of crankpin and gudgeon pin bushes.

The 3.5cc Super slide carburettor has 9 mm. bore, with mounting spigot having surrounding steel sleeve, presumably fitted to resist (and maintain) the considerable securing pressures provided by the twin-clamp pinch-bolt style of carb. fixing to crankcase. This is clearly aimed at rock-solid security at new elevated 3.5cc RPM's.

A measure of the OPS concern about air leaks affecting fuel mixtures, is the fact of the several small 'O' rings fitted to the carb. and its mounting into crankcase, surprisingly even 2 on the clamp bolt itself!

The Throttle slide is of hardened steel.

The large and effective heat-sink cylinder head is fitted with 6 bolts, and clamps the combustion chamber insert to top of liner at largish .019 in. (.48 mm) squish clearance.

A resultant low Effective compression ratio of 6.9/1 leads to very cool operation on low-nitro fuels and open exhaust, but becomes viable and correct with the EFRA regulation tuned pipes and 25% Nitro fuels for which the OP8800 is designed.

Finally, there is the interesting move away from short stroke to a Stroke/Bore ratio virtually 1/1 - in spite of the known high RPM envisaged. The fact is that the longer the stroke the more port area increases relative to cylinder capacity and given port timings. Increasing inertia forces prevent use of too long a stroke, but there are clear breathing advantages from moving away from short strokes if reciprocating weights can be kept down (as in this engine).

Performance

Propeller RPM checks revealed two points: firstly, that general performance levels were improved above previous OPS 3.5cc engines tested by this writer; and secondly, that the usual small Taipan 7 x 6 and 7 x 4 propellers used for comparative reasons between various 3.5 cc racing engines are now really too large a load to match the new, higher RPM's.

As can be seen the highest propeller RPM reached on pipe and 25% Nitro of 26,700 is now somewhat below best pipe resonance point of 30K RPM and even more behind the further potential of this OPS to move on to 37K RPM. This deficiency in the writer's set-up will be made good in future 1/8 car tests. In this test the normal torque and HP curves will therefore need to be taken at face value without the usual comparative prop RPM's as back-up.

An additional caveat is the reminder to many readers that these particular tests are solely measurements of Torque and derived HP at various fixed RPM points - at wide open throttle and thus are unable to reflect 'acceleration performance'. As such they are strictly quite divorced from reality - certainly as regards any particular carburettor performance. On the other hand, it is reasonable to assume that an engine pushing hard at fixed RPM at say 1.7 HP, will accelerate if the particular load is reduced, unless of course the tuned pipe configuration prevents that. Therefore the HP curve can fairly be considered to represent a very large number of individual fixed points, with the engine 'accelerating' in upwards steps of say, 10 RPM.

What is certainly not being tested here is any effect of gradual opening of throttle on HP as RPM's increase, though there must be many people in both model and full-size racing worlds who do not 'feather the throttle' in this theoretically more correct way whilst accelerating, on the contrary throttles are often instantly banged fully open at sometimes an inappropriately low RPM point, leading to engine hesitation as carb. velocity slows below satisfactory levels.

Truly effective power testing is only available from comprehensive 'rolling road' installations - examples of which are known of in the model car world, and more publicised results from these would certainly be of more benefit to interested competitors.

Test 1. Open exhaust

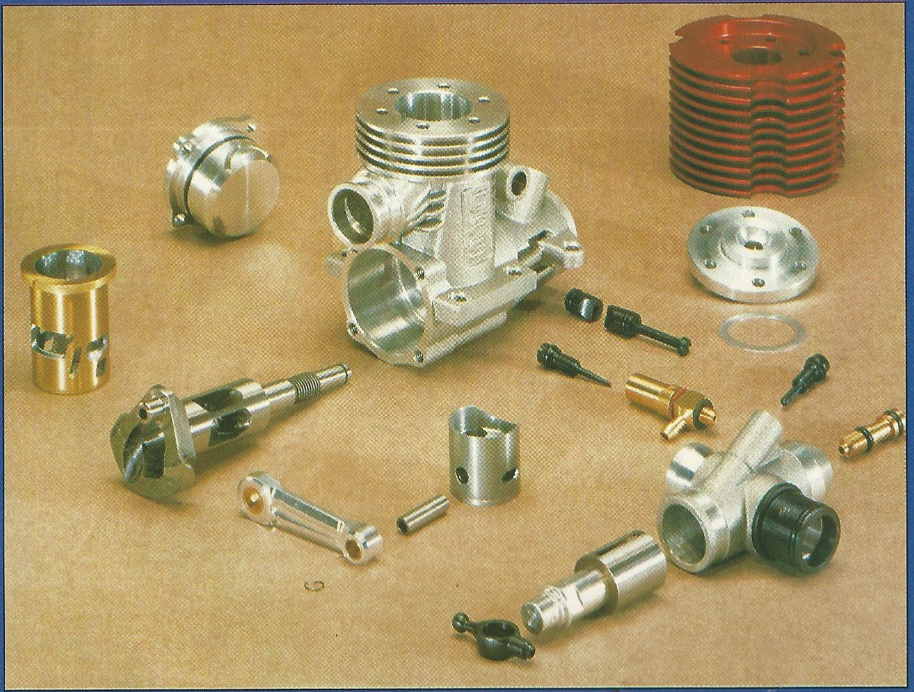
Fuel 5% Nitromethane; 12% ML70 synthetic and 4% Castor oils; 79% Methanol. Plug OPS cone type Nr. 9230.

First finding here was the very cool operation - such as to necessitate use of continual current to glow-plug even when operating at full throttle and high RPM's. Contributory factors are the low comp. ratio mentioned, the large heat-sink head, and very likely the cone-type plug, which previous tests have shown to deal much more effectively with heat dissipation from one of the most heat-intensive points in the engine.

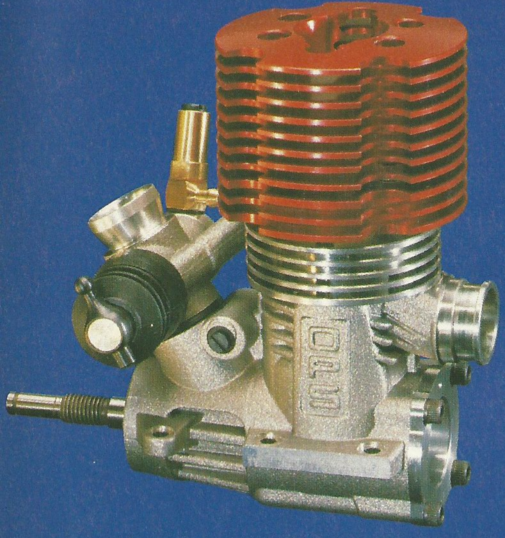
Second finding was that the large carb. bore inhibited adequate fuel flows if standard suction fuel tank height was attempted. 30 ins. gravity head was required to generate sufficient pressure to ensure slightly rich running.

Open exhaust/low nitro. results are known to be irritatingly non-relevant to most modellers needs. For dyno. testing purposes they serve mainly the desire to make further direct comparisons between differing engines, particularly in situations where different styles of tuned pipe may be the major cause of engine superiority rather than inherent engine qualities. In addition they provide a simple, less demanding running-in regime for an engine, and one allowing operator a useful familiarisation period before 'unleashing' the full works.

In this configuration then, maximum Torque of 47 oz.ins. occurred at 21,300 RPM with highest HP of 1.27 at 28,600 RPM. HP decline thereafter was gentle, suggesting that the hoped-for superior breathing at high RPM's was working.



All parts are of high quality in keeping with OPS design aims. Note 2-part carb. pinch bolt and its double 'O' rings. Carb. insert also has 2 'O' rings around steel sleeve... likewise the brass secondary jet at right! Most dynamic action centres around complex crank and sieve-like brass liner with its 10 port openings!



The OPS Super 3.5 has a refined, statuesque appearance worthy of long-standing OPS marque.

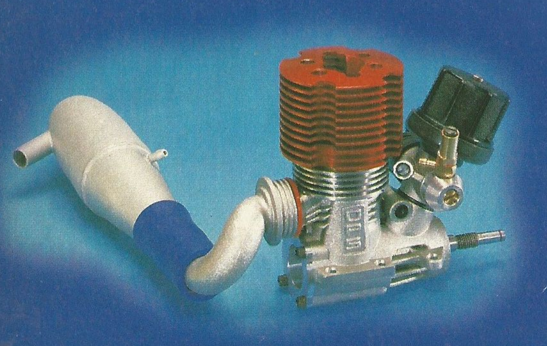
Test 2. OPS pipe (EFRA Nr. 066). Fuel 25% Nitro;

same oil content as Test 1; 59% Methanol. Same plug.

The tuned pipe used here is the longer of two supplied for test, and therefore is a likely candidate for 'medium' RPM band operation. Effective 'resonant' length from plug to first max. diameter is 194 mm using the curved exhaust manifold, and is a dimension suggesting max. power around 31K RPM.

In the event power maximised at 30K RPM, with a further surprise in the form of a very wide flat band of torque being available from 24K to 30K... surely of some significance to users who operate single-gear cars. Fall-off in torque is precipitous in the post-30K area, so the provision by OPS of the shorter pipe thus seems clearly aimed at those tracks and/or gearings which would allow 'eventual' rises in RPM up to 35K or more RPM. Actual final best HP in long pipe set-up fell just short of a strong 1.8. Previous tests suggest that 2.0 HP would follow fairly easily from use of higher Nitromethane content of 50%. As some readers may know however, these particular tests are now being conducted with use of the EFRA regulation fuel of 25% maximum Nitro. content.

Shown here with OPS air filter and pipe.



OPS 3.5 cc Super Car

Weights and Dimensions

Capacity	.21157 cu.in. (3.4669 cc.)
Bore	.647 in. (16.44 mm.)
Stroke	.6435 in. (16.345 mm.)
Stroke/Bore ratio	.9946/1
Timing periods	Exhaust - 180° (angled down 20)
	Transfer - 124° (angled up 17°, 35° & 60°)
	Boost - 124° (angled up 50°)
	Front induction - Opens 35° ABDC
	- Closes 62° ATDC
	- Total period 207°
	- Blowdown 28°
Compression volume	.35 cc.
Compression ratio	Geometric 10.9/1
	Effective 6.9/1
Exhaust port height	.260 in. (6.61 mm) (at centre.)
Cylinder head squish	.019 in. (.48 mm)
Cylinder head squish angle	- 2.5°
Squish band width	.14 in. (3.56 mm)
Carburettor bore	.353 in. (8.99 mm)
Crankshaft diameter	.5115 in. (13.0 mm.)
Crankshaft bore	.393 in. (10 mm.) (tapering.)
Crankpin diameter	.1975 in. (5.02 mm)
Crankshaft nose thread	.245 in. x 28 T.P.I.(1/4 UNF)
Gudgeon pin diameter	.157 in. (4.0 mm)
Connecting rod centres	1.18 in. (30.0 mm)
Engine height	3.974 in. (100.94 mm)
Width	1.724 in.(43.8 mm) (across lugs)
Length	2.488 (63.2 mm) (Backplate to front bearing)
Width between bearers	1.219 in. (30.98 mm)
Mounting hole dimensions	1.732 in. x 1.417 in. x .126 in. holes
	(44.0 mm x 36.0 mm x 3.2 mm holes)
Weight -Bare:	11.55 ozs. (327 g.)
With OPS 066 pipe/manifold/filter	14.1 ozs. (400 g.)
Crankshaft weight	1.25 ozs. (36 g.)
Piston weight	.10 ozs. (3 g.)

Performance:

Max. BHP:
1.78 @ 30,080 RPM (OPS pipe @ 194 mm/25% Nitro)
1.75 @ 36,800 RPM (OPS pipe Q 182 mm/25% Nitro)
1.27 @ 28,600 RPM (Open exhaust/5% Nitro)

Max. Torque:
60 oz. in. @ 27,200 RPM (OPS pipe/194 mm/25% Nitro)
57 oz. in. @ 26,000 RPM (OPS pipe/182 mm/25% Nitro)
47 oz. in. @ 21,300 RPM (Open Exhaust/5% Nitro)
RPM's on Standard propellers

	Open Exhaust & 5% Nitro	OPS/EFRA pipe & 25% Nitro	OPS/EFRA pipe & 25% Nitro
7 x 6 Taipan	18,940	17,700	17,940
7 x 4 Taipan	24,100	26,700	26,000
Performance Equivalents			
BHP/cu.in	6.00	8.41	8.27
BHP/cc	.366	.513	.505
BHP/lb	1.76	2.02	1.99
BHP/Kilo	3.88	4.45	4.37
Oz. in./cu.in	222.1	283.6	269.4
Oz. in./cc	13.5	17.3	16.4
Oz. in./lb	65.1	68.2	64.8
Nm./cc	.097	.124	.118

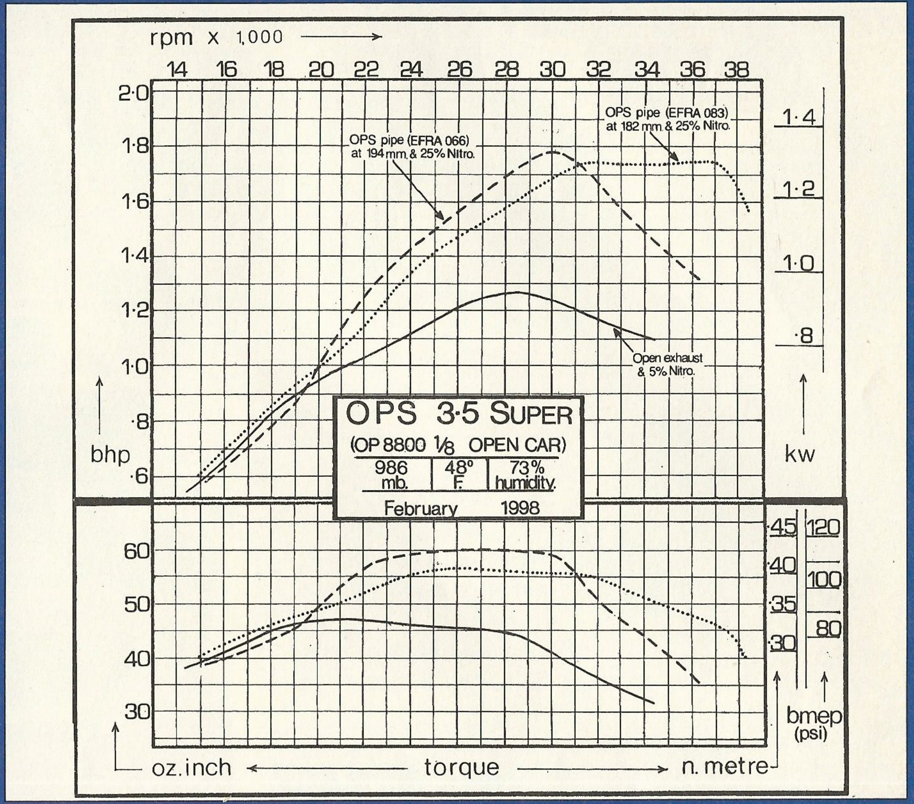
Manufacturer:

OPS srl.
via Matteotti, 128,
20041 Agrate Brianza (Milan)
ITALY

Test 3. OPS pipe (EFRA Nr.083.) Same fuel/plug

Hoping to verify here the likely OPS intention of reaching to higher RPM's with the shorter pipe, the 12 mm. length reduction now allowed these to rise significantly up to 37K before decline set-in. Somewhat surprisingly, actual HP remained slightly below the best figure of Test 2, and was now pitched at 1.75 at 36,000 RPM. However, the very useful flat band of HP between 31K and 37K. would, given adequate track length and correct gearing, allow the engine to unwind up to 37K approx. whereas with the longer pipe it would be much less likely to do so.

Throughout all the 65 separate full-throttle runs, only one of the OPS cone plugs (medium heat) was consumed - and this was as usual during one of the earlier runs on tuned pipe and 25% Nitro. whilst engine was 'bedding down'. Later operations seem rarely to cause plug failure where engine set-up is relatively cool.



Summary

The power results of Tests 1 and 2 are significantly superior to previous OPS engines tested by this writer, and reflect the considerable detailed work on internal breathing ability as well as a degree of tuned pipe development which of itself is providing a surprising amount of wide band flexibility. The relative cool running resulting from the 'soft' set-up suggests that long-term reliability will be high, or alternatively if tuning to a 'harder' condition by tighter squish and/or higher compression ratio, then a definite power increase would follow.. but at a cost to that very desirable reliability.

As operated here in accord with manufacturers advice the OPS 3.5 Super ended the test in exemplary condition. RRCI