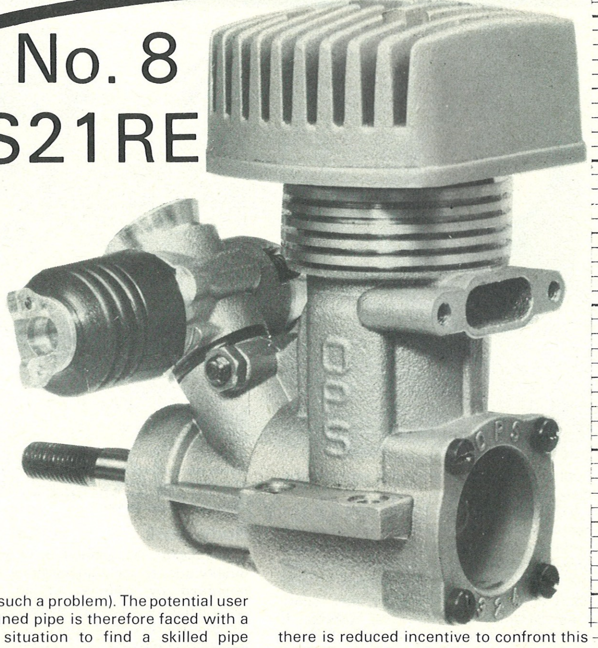
ENGINE TEST No. 8 OPS21RE

by Mike Billinton



THE OPEN CLASS CAR ENGINE test has on this occasion two points of particular interest: firstly, there is the evidence of continual changes undertaken by leading manufacturers operating in highly competitive areas in their natural desire to improve the performance of their products. That these changes are often small and undramatic should cause no surprise for, in engineering practice, this is frequently the more effective route. Secondly, a full tuned pipe of twin-cone style has here been matched to an engine of high performance having exhaust port timings specifically suited to such a pipe. Strictly this is a first look at such a combination during this series of tests.

This 'second generation' *OPS* Rear Exhaust racing unit was newly released in early 1982, and would appear to supplant the 1976 side exhaust version, though for two possible reasons the earlier engine still finds considerable favour amongst top competitors. 1. The rear exhaust layout poses problems in accomodating the appropriate full tuned pipe lengths (up to a max. of 14in. from plug to extreme end) and it becomes all too easy to make do with a shorter than desirable pipe length. The inevitable result is poor low rpm performance allied to an amazingly high (and vicious) peak power point at elevated rpm. (The 'half-length' Minipipe does not of course present such a problem). The potential user of the tuned pipe is therefore faced with a difficult situation to find a skilled pipe bender to arrive at some elaborate 270° configuration which would in any case sit uneasily in the average car layout.

To their credit *OPS* have recognised this problem and, in keeping with their previous policy of providing much of the extra specialist gear needed by the Open car operator, have recently made available a suitable exhaust manifold giving adequate overall pipe length.

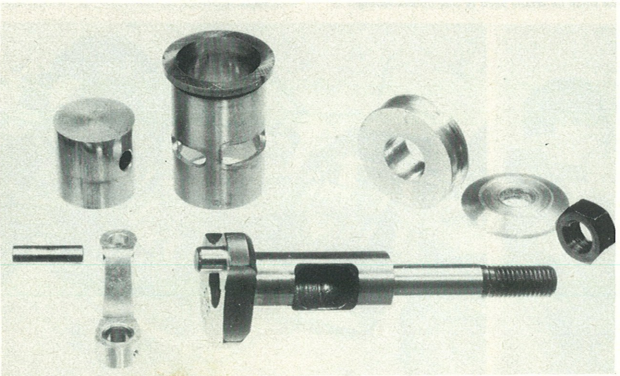
Nevertheless, whilst the minipipe or side-exhaust motors remain available, there is reduced incentive to confront this particular problem. Solving it presupposes that an individual decision has been made to opt for the higher power (though necessarily narrower bandwidth) of the average tuned-pipe. Here the pressure of competition provides the spur, with the result that the tuned pipe proper is finding its way onto the circuits in spite of its known drawbacks in car use.

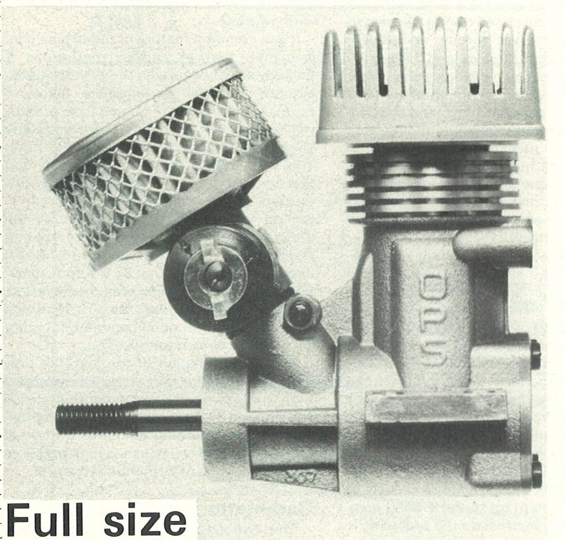
The eventual outcome of the tuned pipe versus minipipe battle is uncertain, and is related (amongst other things) to the nature of available tracks; two-speed transmissions, etc. It is a good bet that the minipipe will always prove hard to beat on grounds of compactness and ease of handling — these virtues going a considerable way to offset its power disadvantage.

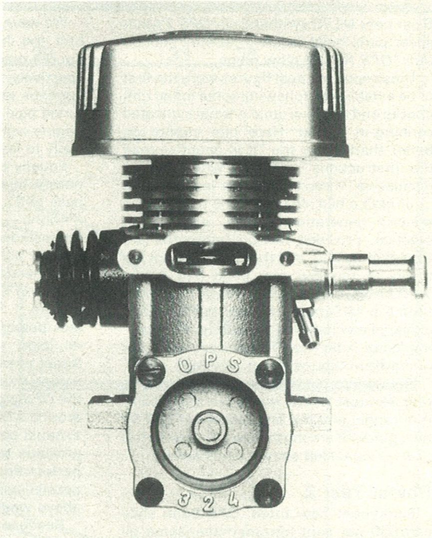
2. The rear exhaust engine responds well if its cooling requirements are given careful attention — and less well when this area is overlooked as the relatively weak rear cylinder wall *can* bow forwards under mechanical stress and thermal expansion. The piston in the RE engine is reluctant to follow such movement because of the rigid constraint of both crankpin and gudgeon-pin and extra friction is an occasional result. This frequently manifests itself as a highly polished area just below the piston crown slightly biased toward thrust side.

The piston in a side exhaust engine is not affected in this particular way, and rotates about the gudgeon pin and crankpin axes to accommodate any untoward crankcase and liner 'movements.'

Below: reciprocating parts of the OPS21RE proven design, has stood up well in competition since its inception.







Full size

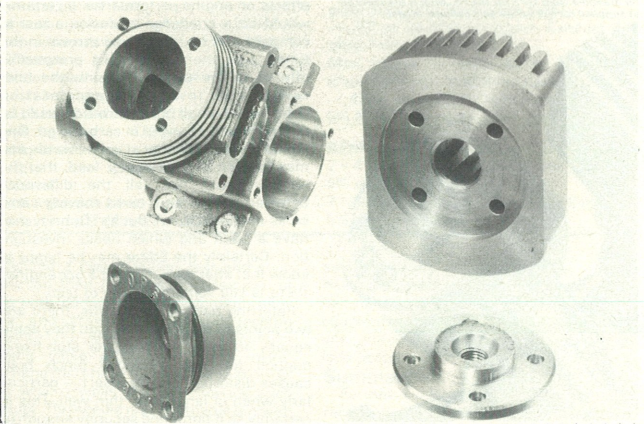
The 'ball and socket' little-end a feature of certain *Cox* two-stroke units would equally be unaffected whichever engine layout was used.

On the assumption that this effect is mainly a thermal one, then a solution is to arrange for asymetric cooling by directing as much as possible of the cooling air to the rear of cylinder (around exhaust port in particular) *and* blanking off the front of the cylinder so that minimal cooling occurs in this already cool area. It will be appreciated that this boost/transfer side of the engine is kept at quite low temperatures by virtue of the considerable cooling effect of methanol vapour passing through the transfer passages. The asymmetry of air cooling suggested should lead to equalisation of temperatures around the cylinder, although all heat engines can benefit from such an approach. It can be seen that reciprocating engines having *very* close piston/cylinder fits (as in the ABC style here) are the most obvious beneficiaries.

Mechanicals

In many respects this new motor is similar to the 1976 side exhaust unit (detailed in 'Model Cars' — Summer 1981) so it may be more instructive to see where the specific developmental changes have occurred:

Below: familiar OPS style heatsink head is used on this new engine, as is the combustion chamber insert which clamps between head and case.



Crankcase is now a sand-casting (previous model die-casting) cylinder now exhausts rearwards. No pressure tapping under crank housing — reflecting minimal use of this high-pressure fuel supply method because of tendency to flood stationary engine. Low-pressure tapping is still available on the backplate. Cylinder liner is a tighter push fit into honed case. Front induction opening reduced in width, thus altering crank timing whilst using original 323 crank. An even later crank (not tested here) has improved flow lines at the start of the induction bore.

Liner. Exhaust timing is nominally similar to the earlier 160° car liner (though actually measured here at 162°). Transfer and boost port now identically timed at 126°, whereas earlier boost was 120° and transfer was 123°.

Cylinder head insert. Whole of the squish band is now tapered at 5° (in earlier model, outer band was flat, and inner was tapered 5°). At 0.004in. squish with one gasket as supplied and fitted, the **Effective** compression ratio as measured in this test engine was a unit higher at 11:1.

Crankshaft. Due to crankcase change noted above, the earlier crank is used here to give a 5° later opening point and 3° earlier closing and thus a reduction in total induction period of 8°.

Together these various small detail changes have resulted in a definite change to performance (as detected in this test engine), with the open exhaust torque figure being lifted by 14 per cent and bhp maximum being reached 2000rpm higher.

Power test 1

Equipment used: open exhaust/5 per cent nitromethane/12 per cent castor with

6 per cent ML70 synthetic oil/*OPS* 7½mm slide carb/head squish .004in./suction tank/*OPS* RC250 glow plugs.

These open exhaust figures were the first to be established following some initial rpm checks and the now quite normal truncated running-in period. Here one cannot do better than follow the "if in doubt — read the instructions" method, where *OPS's* dismissive "if you wish to run-in the engine ... it isn't a bad idea" sets the tone for the modern generation of ABC engines. In practice, provided mixture strengths are kept slightly rich, and that loads are not too heavy at too low rpm point (say below 10,000rpm) during the very early moments, then the ABC motor remains the most forgiving of mechanisms to operate. The limiting factor is far more frequently the matter of crankpin lubrication at very high rpm.

The torque band produced by this new rear exhaust motor now covers a greater rpm range, and the bhp maximum of 0.97 now places it among the top performing trio of engines tested so far in this series.

Power Test 2

Equipment now fitted: *OPS* 9mm slide carb/50 per cent nitromethane/same oil as above/same plugs/head squish now raised by 0.008in. to .012in.total clearance/fuel tank pressurised by pipe/*OPS* tuned car pipe fitted at 10¾in. length (piston face to end of rear cone's tail pipe inside quietening can). This is equivalent to 205mm if using the *OPS* measuring points of 'plug to maximum diameter of pipe.'

The writer regrets (like others) the profusion of differing methods of measuring pipe length — all serving to make quick and easy to understand comparisons between motors and pipe systems difficult — and confusing to evaluate. Pending a universally agreed 'standard,' then the minimum requirement is to at least name the points from which measurements are taken. Naturally there are convincing reasons for the various methods used!

We were not surprised during this test to find the highest yet torque and BMEP figures reached of 60oz.in. and 117psi respectively, because extrapolating from previous test results, a combination of full tuned pipe/50 per cent nitro/and a racing engine with adequate exhaust timing, was likely to lead to this strong position.

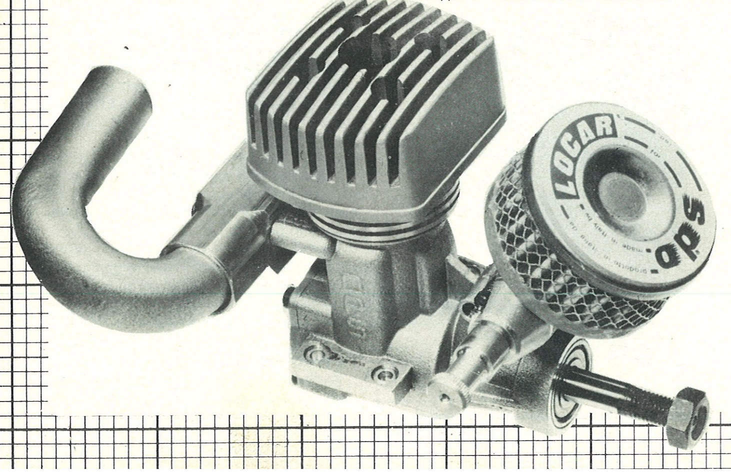
Equally these high figures occur over a narrow band some 3000rpm wide and at its peak of 23,500rpm, the *OPS* R/E reached 1.46bhp — just equalling the best figure so far recorded with the *Picco* 3.5.

Two possibly self-cancelling reservations need to be made by anyone wishing to pursue a comparison between these two motors: 1. The *Picco* was tested using the less powerful, though wider band, *AMPS* minipipe silencer (around 12 per cent lesser power than *OPS* tuned pipe). 2. Offsetting this is the likely uplift in power had the *OPS* pipe been shortened to give a peak around 27,000rpm; that is, near to the open exhaust peak and where several results in previous tests indicate that superior pipe performance will also be likely. The possibility is that both motors 'improved' as above would reach up to the 1.6bhp area.

Readers may appreciate the problems in arriving at precise comparisons in a developing situation such as the tuned pipe/racing motor combination represents, and it is for this reason in the main that open exhaust on low nitro runs are still continued as one means of comparison between engines. Even here though there are dangers, in that the design parameters best suited to superior tuned pipe performance do not necessarily lead to the best open exhaust performance (or vice versa). The best exhaust timing for the two-stroke engine is a particular case in point, and the most marked example the writer has seen of this anomaly has been the respective open exhaust and tuned pipe performances of the *CMB90* Marine racing engine — where power almost halved when operated without pipe.

It is a common feature of tuned pipe performance that at certain rpm areas a braking effect occurs as the adverse pulse actually reduces performance below a norm, and prevent the engine from breathing freely at very high rpm. There was some slight evidence of this with the *OPS* here. This was audibly much more obvious than the actual figures for torque and rpm indicated, and the major reason for not carrying on further up to 40,000rpm (as the earlier side exhaust unit had done) was that sufficient information had been accumulated up to the 36,000rpm mark. Possible engine demise was thus averted, there being some value after all in retaining the test engine in good condition for comparative, or re-run purposes.

At the termination of the test, the only meaningful signs of the high power and high rpm's reached were a slightly cratered squishband — the likely cause being disintegrating glow plug elements on two of the runs — and the polished high pressure area at top of piston mentioned earlier.

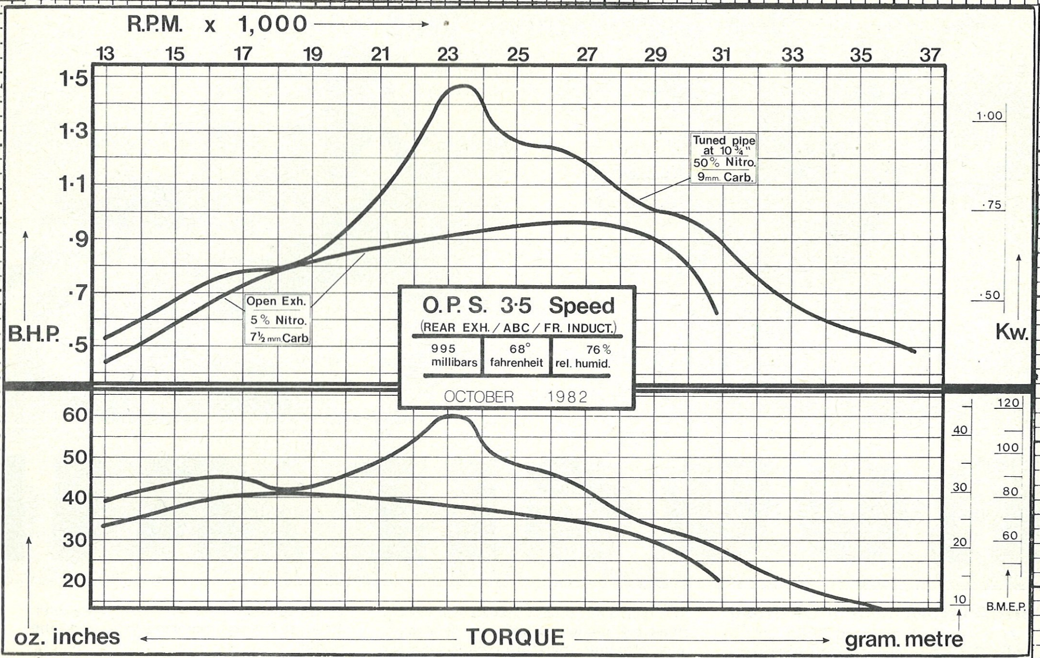


New manifold from OPS for the RE, filter is the same as that supplied for the earlier side exhaust model.

Carburettor

The two *OPS* slide carbs used (7 and 9mm bores) are mechanically reliable, and solidly constructed and were operable over a wide range of varied fuel settings at differing throttle openings. Owners of the *OPS* should have little need to obtain specialist items of carburettor hardware from outside sources as is frequently the case. However the writer recently heard from Pat Doherty of Halifax concerning the increasing number of car carbs that are available — both specialised and manufacturers' items; and commenting on the varied responses obtainable from each. Names mentioned were *OS, Delta, S-G, Picco, Power block, Cipolla, Webra* 1019 Car, *Webra 'Dynamix,' HB, Perry, Martin* variable venturi, *Mikuni* and *McCoy*. The essence being that each may have differing effects on engine performance. It certainly would be a challenge to devise a test to compare that lot, and if one throws in the tuned pipe then a daunting prospect is offered to the tester! Certainly the mid-range and low-speed acceleration (whether at small or full throttle) would be different with changes in carb design. One would like to think that at open throttle and max rpm on any particular load, that the engine could not tell the difference between the various carbs (having same cross-sectional area). But Mr. Doherty may have a point and which needs investigation. Certainly the Editor may be happy to know that after we run out of 3.5cc engines there is still something else to test!

Referring back to *OPS* carbs, there are two points to mention (although they apply equally to other makes): the stub-fixing method (of side mounded pinch bolt) causes distortion of carb insert — particularly when of large bore/thin wall. This is certainly so if tightened securely enough to withstand a dynomometer test and such distortion then prevents easy removal of carb with danger of the aluminium alloy carb and crankcase material locking together. The other point is the difficulty of needle valve adjustment once nitromethane fuels have reached the sealing 'O' ring which swells slightly following such contact. The needle is still turnable but with some difficulty — arguably just what's needed on the competition car to prevent self-rotation. On the dynamometer of course there is a continual requirement to alter and optimise fuel settings at each new load point.



Dimensions and weights

Capacity — .211cu.in. (3.46cc)
Bore — .6538in. (16.6mm)
Stroke — .629in. (16.0mm)
Stroke/bore ratio — .96/1
Timing periods
Exhaust — 162°
Transfer — 126°
Boost
Front induction opens 43° ABDC
Closes 47° ATDC
Total period 184°
Combustion chamber volume — .236cc
Compression ratios — geometric — 15.6/1
Effective — 11.2/1
Cylinder head squish — .004in.
Squish band angle — 5°
Squish band width — 13°in.
Crank diameter — .4723in. (12mm)
Crankpin diameter — .1968in. (5mm)
Gudgeon pin diameter — .1572in. (4.00mm)
Crank induction bore — 9mm
Connecting rod centres — 30mm
Piston weight — .149oz (4.25gm)
Weight overall — 9½oz (.269 kilo)
Frontal area — 4.67sq.in.
Mounting hole spacing — 36mm × 16mm × 3mm holes
Height — 3.4in.
Width — 1.72in.
Length — 2.7in.

Performance

Max bhp — 1.46 at 23,500rpm (*OPS* tuned pipe/50% nitro 9mm slide carb).
— .97 at 26,600rpm (Open Exhaust/5% nitro 7mm slide carb)
Max torque — 60oz in. at 23,400rpm (pipe/high nitro and 9mm carb)
— 41oz. in. at 18,000rpm (Open Exhaust/5% N. & 7mm carb)

RPM standard propellers:
7 × 4 Zinger — 23,600rpm (Open Exhaust/5% nitro & 7mm carb)
7 × 6 Zinger — 17,320rpm (Open Exhaust/5% nitro & 7mm carb)
8 × 6 Zinger — 14,550rpm (Open Exhaust/5% nitro & 7mm carb
7 × 4 Zinger — 25,840rpm (*OPS* pipe/50% nitro & 9mm carb)

Performance equivalents

BHP/cu.in. — 6.92
BHP/cc — .422
Oz in./cu.in. — 284.3
Oz in./cc — 17.34
Gm metre/cc — 12.42
BHP/lb — 2.46
BHP/kilo — 5.42
BHP/sq.in. frontal area — .312

Manufacturer:

OPS, Monza, Italy.

UK distributor

OPS Distributors Ltd., 512 Berridge Road West, Hyson Green, Nottingham.

Summary

Further evidence of the thoroughbred racing ancestry of the *OPS* was revealed by the manner with which the 3.5 R/E sailed through this set of figures. These *OPS* car engines (whether side or rear exhaust) remain impressively reliable pieces of machinery inspiring much confidence when operating on the dynamometer.

Their track record indicates equally robust performance out where it really counts.