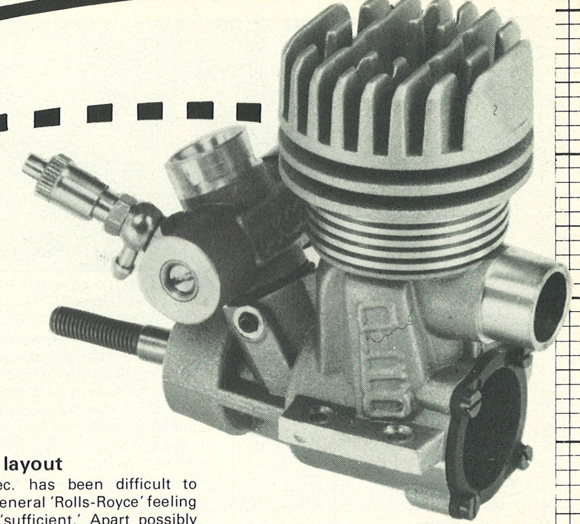
ENGINE TEST No. 5

by Mike Billinton



PICCO 21

DURING TESTING of this 3½cc glow-plug two-stroke engine, performance figures were laid down which made some sense of the string of successes achieved by the *Picco* during the recent season of ⅛ Open class car racing; and these figures do nothing to ease the competitive situation already existent in this hair-raising performance area!

The move around 1977 by *OPS* engine designer G. Picco (the 'P' of OPS) to produce a separate line of engines under his own name was always going to be of interest, though not necessarily a sure-fire route to commercial success. However, typical Italian drive and enthusiasm have overcome the many problems to the point that during 1979, the then new *Picco* 21 appeared in competitive form.

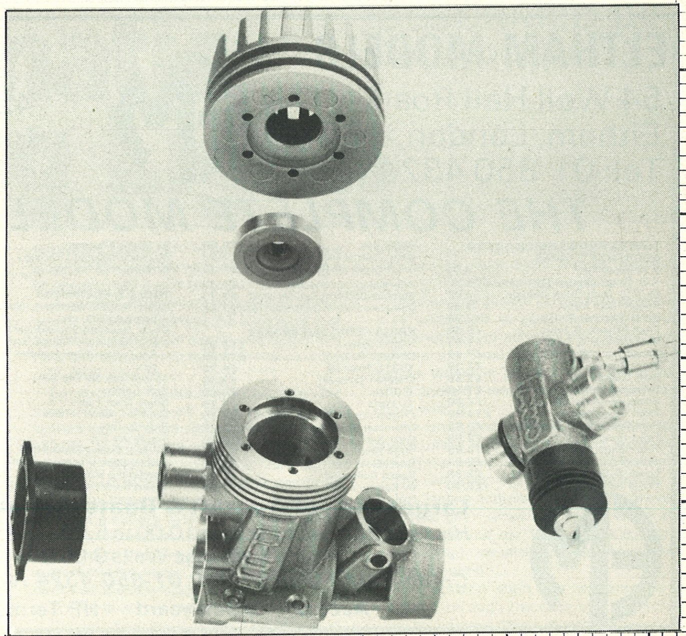
Though no new version has appeared since that date, some detail changes to crankshaft and cylinder head have resulted in a much more reliable engine. A new connecting-rod is also promised as a further reliability point, but for this test the standard quite slim rod was used (with no problems). The crank metallurgy was altered in the face of earlier breakages, whilst the crankpin itself was modified by provision of a diagonally drilled lubrication hole into the induction bore. This feature (not found in other engines tested in this series) appears to work on the centrifuge principle . . . in that fuel/air mix present at the mainshaft end of this hole will rapidly be forced to eject at the outer (crankpin) end. Pursuing this principle further, some users have modified the shaft by grinding a trough around this hole (where it breaks through into the induction bore), with the resultant hope that this larger 'catchment' area will more certainly allow the centrifuge effect to take place. The original shallow cylinder head — having a machined black anodised finish, was replaced during 1980 by a taller more solid aluminium alloy casting having bead-blast finish. The vertical finning now being more widely spaced and each fin being tapered; the heat transfer properties of this head (resulting from these detail improvements) are now almost as good as can be obtained without recourse to water-cooling.

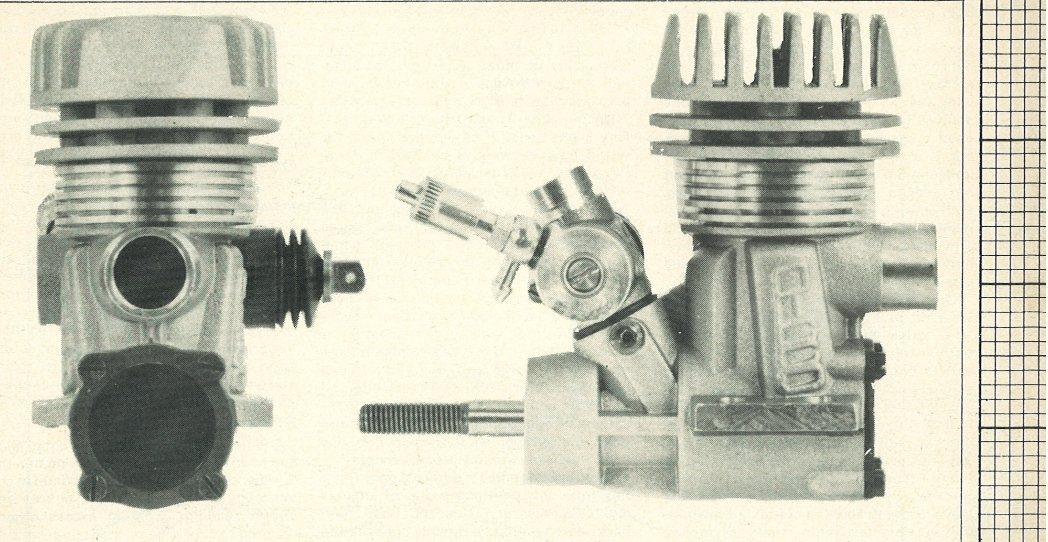
Mechanical layout

Material spec. has been difficult to obtain, with a general 'Rolls-Royce' feeling that they are 'sufficient.' Apart possibly from the shaft though, customary specs. seem to have been used throughout.

Crankcase: A gravity cast aluminium alloy one-piece unit with same attractive finish as cylinder head. Very substantial at main stress points. Carburettor location by two Allen grubscrews is more positive than most. It has one exhaust and four transfer passages — two of them being the front boosts which are quite shallow at .070in. (1.6mm) compared with the two main side transfers at .090in. (2.3mm).

Below: major non-reciprocating parts, note the combustion chamber button, clamped in place by the heatsink head.

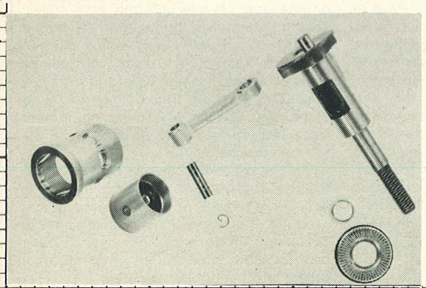




ACTUAL SIZE

The case is honed to receive cylinder liner. There is no oil return hole at base of induction tract to draw back escaping fuel from front bearing as with some other engines. A black phenolic backplate is used. For this test the French hi-speed bearing as supplied by *PB Racing* was fitted to crankshaft — its Tufnol cage being less likely to disintegrate at very high rpm.

Crankshaft: sized at the popular 12mm OD, and machined from solid chrome steel, with aforementioned lubricant hole in crankpin. Shaft is easy sliding fit in ball-races. Crankweb is partly cut-away in crescent shape for counterweighting of piston and rod. Induction bore is a fairly restrained 8.5mm ID.



Left: gudgeon pin is retained by tiny wire circlips, best removed whilst held inside a polythene bag.

Liner/piston: has modern five-port ABC style (i.e. two boost ports, two transfer and one exhaust). It adopts the relatively unusual feature of having piston flush with top of liner at TDC. Thus there is no cylinder head insertion — rather the head sits on top of the liner. This makes the liner much shorter, and in this *Picco* the top flange is also unusually thick (3½mm), so the result is a very rigid compact cylinder assembly. Given that brass is not a strong metal, then this part is less likely to 'move around' under mechanical and thermal stresses.

All cylinder ports are angled up — exhaust approximately 8°, transfers 15° and boosts 52°. The internal liner surface is not honed, but is taper-ground (1 thou. tight at TDC) to a high finish prior to chroming. For correct matching fits the high-silicon piston is externally honed when necessary . . . again not a very common practice. The piston itself has gudgeon pin bosses extending up to the .092in. thick crown. Resultant weight is four grammes (.14oz). The combination of finishing processes used in this cylinder/piston assay though a little unusual, is quite logical and happens in any case to be one of the better ways to obtain a good accurate finishing on the high-silicon alloys.

Cylinder head. In two parts — the very rigid and finned six-bolt heatsink part — and a combustion chamber 'button' which approaches almost total simplicity. Being located laterally by a close fit in top of crankcase, this simple turned thick alloy 'disc' represents minimal cost and time in preparation. Apart from glow-plug washer, if must be the easiest part to produce in the whole engine! Far from being the least important though . . . it is set at .009in. squish clearance. 'Reading' piston top after the test runs indicated that this figure is about right for low nitro fuels but maybe a bit close for nitro above say 25 per cent.

Connecting-rod. Machined from solid aluminium alloy followed by what appears to be a 'tumble' finish or maybe even wire-wool burnishing. It is bushed at big-end only with a lubrication hole (1.2mm as is crankpin's) at top of big-end eye going 45° down into bush, and thus feeding oil to the high-pressure area of rod/crankpin interface. This hole and the hole in crankpin pass over each other once per revolution — but with what effect it's difficult to be certain. Visual inspection of these most vital bearing surfaces after the test runs showed nothing amiss. No news must be good news here! Little-end is unbushed, but is a fine close honed fit against the gudgeon pin. One lubrication hole at top of rod feeds to low-pressure zone of pin/little end bearing interface. The gudgeon-pin itself is of hardened steel — fine ground and circlip located in piston. Bored hollow almost all through — for lightness and crankcase compression seal.

Carburettors. Two slide versions were supplied with the engine, 9mm and 7mm. (The latter actually measuring 7.2mm). Both incorporate rubber sealing bellows and 'O' ringed needle valve assemblies. For convenience the fuel nipple is fully rotatable. The mid/low range jet screws axially in line with slide valve and, in conjunction with an adjustable needle which screws into the end of slide, gives wide-ranging control of mixture strength from idle to mid-throttle point. Thereafter the main needle valve exerts full control of fuel/air mixture. This very practical main needle assembly is angled away from the carburettor throat to give adequate operational clearance all round.

Power tests

Maintaining comparisons with previous tests, but also continuing investigations into effect of differing combinations of fuel/equipment, the following three power curves were arrived at:

1. Open exhaust. Five per cent nitro. Eighteen per cent castor and *Picco's* nominal 7mm carburettor of 40sq. mm actual cross-section.

2. Only change here is addition of the *AMPs* minipipe silencer to above equipment. This simple change has not been conducted before in this Test series.

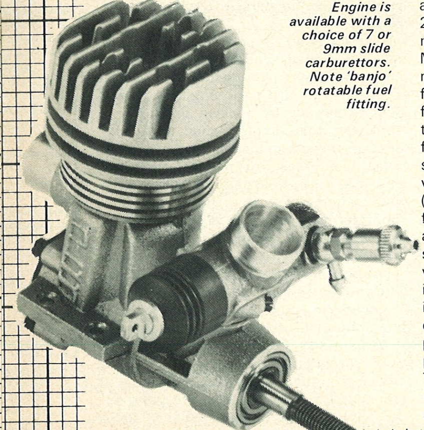
3. Full-house — *AMPs* minipipe. Fifty per cent nitro. Fifteen per cent ML70 oil. Large *Picco* slide carburettor of 9mm (of 63sq. mm area). (*PB Slide* carburettor used in previous tests is 9½mm diameter and has 70sq. mm area. If used it might have given a very slight boost in power, but as the *PB* would have required a bush to fit *PB* to *Picca* case, it was decided to use the manufacturer's own large size carburettor.

Test 1. The worrying thing about this finding was that torque and rpm figures were immediately on a par with some previous test figures where other engines were using full-house equipment! To reach 1bhp with this inoffensive set of gear meant that the Minipipe tests to come were now approached with some trepidation.

Test 2. Fitting the *AMPs* minipipe (now becoming a little less than brand-new) caused no surprises in its relative effect — the main point of interest being the indications throughout the rpm range of a more peaky motor response to the pipe than has been the case with any previous engine . . . and the only significant difference the *Picco* has from this previous group of engines *(OS/OPS/Webra/ST)* is the wide twin boost ports — that lie directly opposite the minipipe across the cylinder. On this low-nitro equipment the bhp result equalled the highest figure to date (*Webra* at 1.2 on 50 per cent nitro). It did this not by producing a similar torque figure but by maintaining a slightly lesser torque to a higher rpm point.

For survival's sake rpm's were not allowed to go above 36,000 during the first two tests, because (as with previous tests) the motor had to be conserved for the harsher full power runs; otherwise comparative findings would be misleading if a rebuilt engine became necessary.

Test 3. The previous two runs threatened an exceptional power result with the addition now of a 9mm carburettor *and* 50 per cent nitro. Torque increase was large — as is usual with this fuel — and strictly the 25 per cent increase here was the only meaningful difference from Test Two. Minor irritants though were swelling of needle valve 'O' rings (with hi-nitro) making fuel adjustments difficult, also a marginal fuel supply in any case being pumped through by the Minipipe pressure line to fuel tank (as noted in earlier Tests). Plus a slightly unstable running characteristic when operating at certain high rpm points (25 and 32,000 approximately). Whether fuel supply problems associated with adverse pipe resonances, or the resonances themselves at those rpm points were the cause was not easy to assess; but in any case the problem was small and intermittent. It is the intention in the next engine test of this series to monitor actual pressure values in the air supply line from pipe to tank just to see what is happening. The peaky response of the *Picco* when matched with the *AMPs* minipipe was again apparent, and on sailing to the top of the main peak, a best-yet bhp figure in this class was reached — 1.46 at 28,600 rpm. 'Peakiness' was relative however, because even at 38,000 a secondary pipe peak allowed 1.1bhp to be developed. Certainly, of the engines tested so far, the Picco, better than most, maintained strong torque figures even within the post-35,000 area.



Engine is available with a choice of 7 or 9mm slide carburettors. Note 'banjo' rotatable fuel fitting.

Other Test points

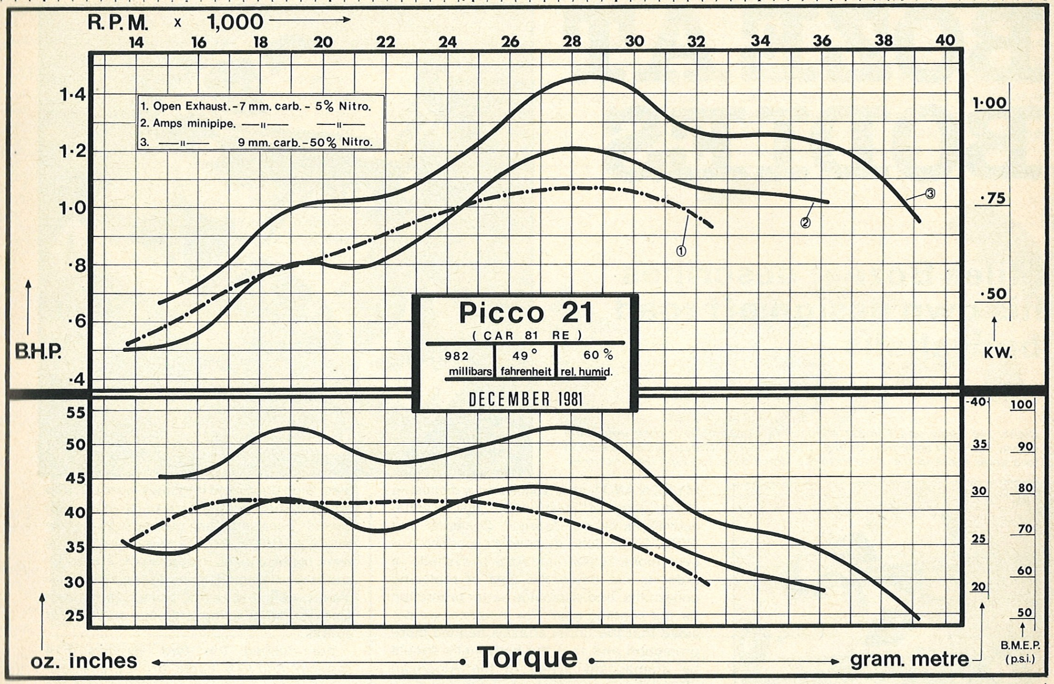
Pressure and temperature being lower than standard required that bhp figures be corrected by a small multiplier factor of 1.03. Glow-plugs used throughout were *OPS* long reach 1½ volt unshielded; and these only needed replacing during some of the high-nitro runs above 28,000rpm. Squish band clearance was not altered for these top power runs — and the resultant 'moon-cratering' of piston-top and squish band (though contact was just being avoided) may have been a major cause of plug decimation.

Summary

The final power figures were higher than had been anticipated even allowing that the *Picco* is clearly (from results to date) in the top league. However all rpm figures and torque readings were in excess of any reached to date at same load points, and so the only way to escape from this result is to assume that this particular test engine was an exceptional sample and/or other engines tested so far were below standard, which is probably stretching matters too far in either direction. If, as is felt in this case, the test engine is a representative sample, then strictly *Picco 21's* should be first everywhere. But of course power alone is not the only criterion (but goodness it helps!); the way that power is distributed relative to gearing and speed; conditions of usage; pipe styles; varying team efforts, etc., etc. all have a possible levelling effect. Rarely on the field then, is one comparing 'like with like' though it is there that the true 'engine tests' are taking place. Dynamometer tests by comparison are quite limited in their capacity to duplicate all the likely stresses of a violent racing programme.

In an attempt to throw more light on comparative performances 'in the field' it is intended in the next report to conduct a series of test runs on the Dyno using one engine and several different pipe styles. That is, a pipe test rather than an engine test. Much specialist work is occurring in this area — sufficient to distort the findings of these engine tests to date, and it may be necessary at some future stage to fix on some new set of top-power equipment more in keeping with gear likely to be the norm in the near future.

For the present, it seems likely that the *Picco* will represent a difficult marker to beat — at least on sheer max. power grounds. It is also sensibly rugged both in design and appearance; and — just a bit of a provocation to other established manufacturers of much longer standing.



PICCO 21 CAR

Dimensions and weights

Capacity — .2103cu. in. (3.447cc)
Bore — .6517in. (16.55mm)
Stroke — .632in. (16.05mm)
Stroke/bore — .97/1
Timing periods —
Exhaust 162°
Transfer 128°
Boost 126°
Front induction —
Opens 32° ABDC
Closes 60° ATDC
Total 208°
Combustion volume — .30cc
Ex. port height — .220in.
Compression ratios —
Geometric — 12.49/1
Effective — 8.49/1

Cylinder head squish — .009in.
Squish band angle — 0°
Squish band width — .102
Carburettor sizes —
Picco 7.2mm (40sq. mm area)
Picco 9.0mm (63sq. mm area)

Mainshaft diameter — .472in. (12mm)
Crankpin diameter — .1966in. (5mm)
Gudgeon pin diameter — .159in. (4mm)
Induction bore — .334in. (8.5mm)
Con rod thickness — .140in. (3.5mm)
Con rod width — .275in. tapers to .230in.
Con rod centres — 1.18in. (30mm)
Overall height — 3.4in.
Overall width — 1.7in.
Overall length — 2.9in.
Mounting holes — 16 × 36mm with holes of 3mm
Weight — 10½oz (with 7mm carb and no prop driver (.297 kilo)
Piston weight — .14oz (4 grammes)
Frontal area — 4.47sq. in.

Performance

Max. bhp — 1.46 at 28,600rpm (Amps minipipe/50 per cent nitro/9mm slide carb)
1.20 at 28,800rpm (AMPS/5 per cent nitro/7mm slide)
1.07 at 29,000rpm (open exhaust/5 per cent nitro/7mm slide)

RPM — standard propellers

8 × 6 Zinger — 14,600;
7 × 4 Zinger — 25,010: open ex/5 per cent nitro/7mm slide.

Performance equivalents

BHP/cu. in —	6.94
BHP/cc —	.423
Oz in./cu. in. —	247
Oz in./cc —	15.08
Gm metre/cc —	10.73
BHP/lb —	2.22
BHP/kilo —	4.9
BHP/sq. in. frontal area —	.326

Manufacturer

Picco Gualtierangelo, Monza, Italy.

UK Distributors

PB Racing Products Ltd., Downley Road, Havant, Hants.