AMC POWER OUTPUTS REVEALED

Text & Graphics
by
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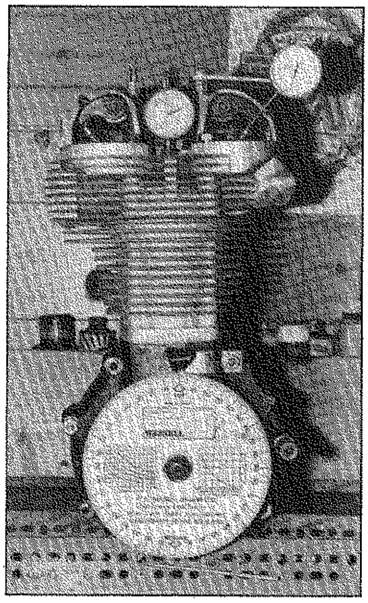


IN THE HEYDAY of the British motorcycle industry, detailed figures of engine performance were hard to come by. Even the Associated Motor Cycle Company Ltd (AMC) was notoriously secretive. Now that the factories are gone, more of the facts are emerging and among the archives of the AJS and Matchless Owners Club are some of the power figures AMC would not reveal, including a full set of power curves for the 1960 model range. I have reworked these curves in two ways.

Firstly, into torque curves for the three 500cc engines. To begin with, I should perhaps explain what is meant by a torque curve (just skip this section if you feel I'm trying to teach Grandma to suck eggs). Look it up in the dictionary and you will see that torque is defined as the turning effort or moment of a tangential force and, in the combustion engine, this applies to the engine's ability to turn a component attached to the end of the crankshaft — usually the engine sprocket!

Assuming the same size back tyre and gear ratio, the force pushing the bike forwards is proportional to the torque generated by the engine, and the speed of the machine is proportional to the engine speed, or revs per minute. A graph of the torque available at various engine speeds can therefore help you determine how a bike powered by that particular engine would behave on the road. It would, of course, be even easier with a graph of the force pushing the bike (properly called the *Tractive Effort*) against the road speed. There would be a curve for each gear, four, therefore, for all postwar four-stroke Matchlesses; this set of curves is called a *Tractive Effort Cascade* and is very informative. It also takes up a lot of space! As the graph for each gear is the same shape as the torque curve, multiplied and squashed sideways according to the gear ratio, we can manage with just the torque/speed graph. The torque shown is the maximum available at each speed, ie, at full throttle.

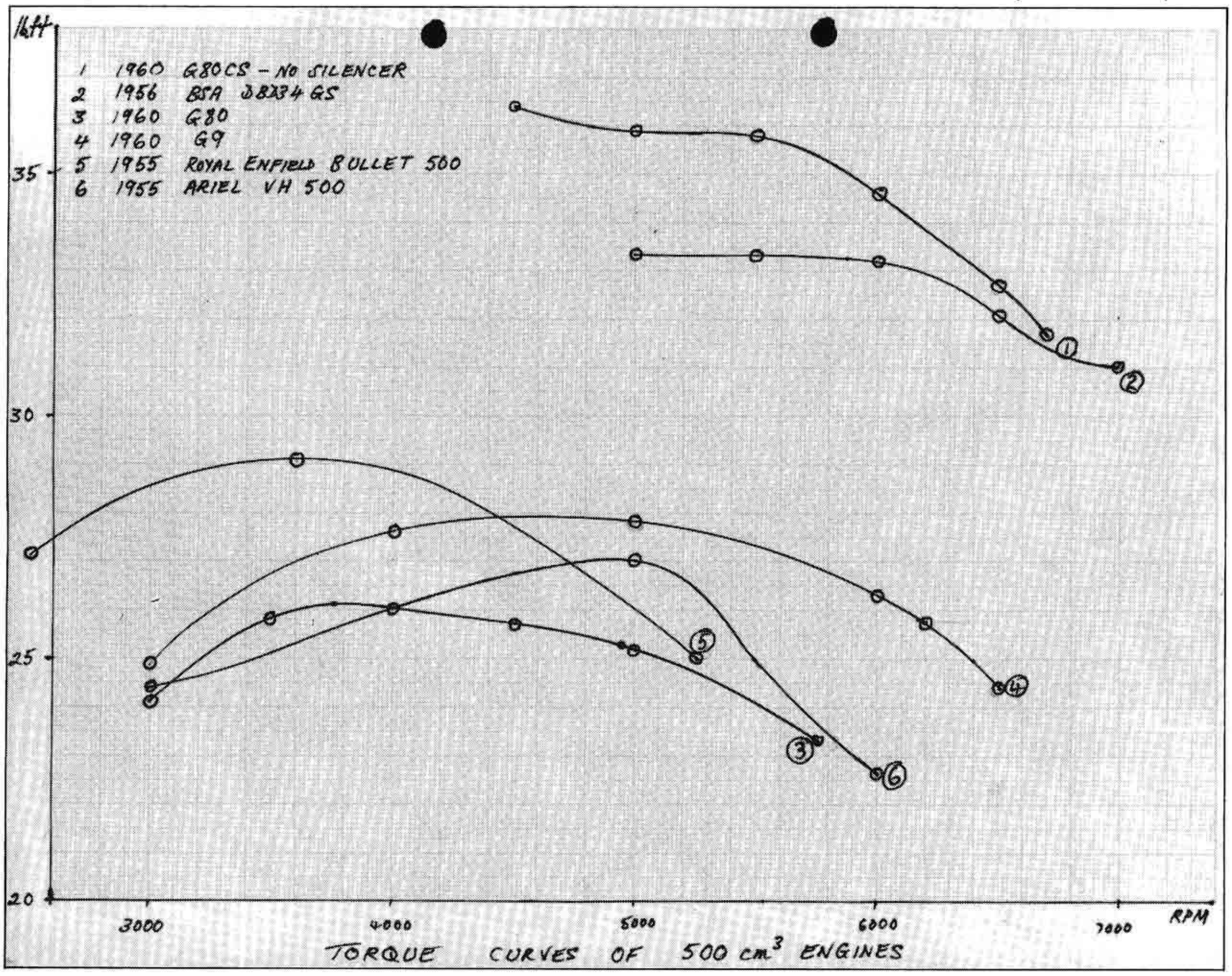
I have chosen to look at the 500cc engines because AMC produced three quite different engines in that capacity: a highly successful scrambler, a touring twin and a touring single. I have also selected the figures available for comparable engines made by other manufacturers of the day; the curve for the Goldie is accurate — it's for engine no DBD 34 GS 2464, tested on 10 September 1956 — while the curves for the Enfield Bullet and Ariel Red Hunter are more approximate. Apart form the obvious comparisons of which produces more (and where!), there are some interesting lessons to be learnt.

The Goldie and the G80CS produce near enough the same maximum power, but the Goldie does this with a silencer... well, a sort of silencer. Even taking into account the G80CS's beneficial association with one CJ Williams, and the relatively recent discovery that the 1½in Amal GP carb is too big for the Goldie, it is most instructive to see how much mid-range torque the BSA engineers had to sacrifice to attain the required maximum power. Are you *sure* you want a race-tuned engine in your road bike?

Of the three road singles, the Ariel produces the most torque at high speeds, the Enfield has most torque at low speeds and the AMC motor has a fairly flat torque curve. The valve sizes and lifts are virtually identical; the valve timings and compression ratios much the same. So, why the differences? Good question. Aha, you say, it must be because long-stroke engines are more torquey — the Ariel's stroke is 95mm, the G80's 93mm and the Bullet's 90mm! Or perhaps the carburettor size is the determining factor — the Ariel has a 1¹⁄₁₆in carb, the Bullet a 1⅛in and the Matchbox a 1⁵⁄₃₂in. The real reason? I wish I knew. The answer probably lies in the details of the inlet port shapes and the different exhaust systems; there again, it might all come down to small differences in the valve lift curve, particularly near the inlet closing point.

The other curves are for BMEP (*Brake Mean Effective Pressure*) against *Mean Piston Speed*. For the non-technical, these are basically the torque curves, but modified to take account of the engine size, so that a 250 can be fairly compared with a 650. BMEP is proportional to the torque divided by the engine size. So long as they are both four-strokes, if a 500cc engine produces twice the torque of a 250cc engine, you can deduce that it has the same BMEP as the smaller unit. If it produces more than twice the torque of the 250, it has a higher BMEP, and if less than twice as much, a lower BMEP. BMEP is therefore an indication of how well an engine works at a particular speed.

In general, if an engine is modified to give higher BMEP, in other words, if it is tuned, it will only do so over a narrower range of speeds. This can be overcome to some extent by clever development



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work and to a greater extent by adopting a more complex design, for example, changing from two pushrod-operated valves per cylinder to twin overhead cams and five valves per cylinder. A top-class racing engine may produce as much as 210lb/sq.in at the peak of the curve; at the other extreme, the little side-valve unit in a concrete mixer might not manage as much as 40lb/sq.in.

Mean piston speed is proportional to the stroke and to engine speed, so that a 500cc Norton ES2 engine with a stroke of 100mm running at 5,000rpm, has the same mean piston speed as a 125cc Honda with a stroke of 50mm running at 10,000rpm. Mean piston speed is often used to indicate how highly stressed an engine is; this approach is over-simplified but will serve our purpose in this instance. It is generally reckoned that going over 3,500ft/min is likely to lead to reduced long-term reliability: still acceptable for racers, but less and less so for road bikes as you get nearer to the 4,000ft/min mark. Above this limit, you are entering the realms of short-term unreliability.

The above is more or less true if the stroke is nearly equal to the cylinder bore, but engines with the stroke substantially longer than the bore can safely run at higher piston speeds. (For a more precise approach you can apply the *Lanchester Correction*, ie, divide the mean piston speed by the square root of the stroke/bore ratio. This is only done when using maximum mean piston speed to compare stress levels, so the piston speed figures on the graph have not been subjected to Dr Lanchester's correction.)

I did try plotting all ten BMEP curves on one sheet, but it ended up looking like a plate of spaghetti and was about as informative, so I've decided instead to split them between two graphs. Looking first at the 350 and 500cc singles, it is fascinating to see how close the curves for the G3 and G80 are. The odd thing is that the engines aren't all that similar, despite having so many parts in common: different valve timing, relative valve sizes, stroke/bore ratio, combustion chamber shape, and so on. They could have been as different as the Bullet and Red Hunter are, so I can only conclude that they are as similar as they are because that is how the Collier brothers thought a touring single should be. (I attribute their characteristics to the Colliers and not to later development engineers because the long-stroke singles didn't change much at all after 1945.)

I have power figures for 1946 and 1955 for the G3 and G80. The increases in power over the years are almost entirely attributable to the increases in compression ratio permitted by improvements in the fuel that was available during that period. I say almost because from 1946 to 1955 the G3 gained a little more power than one would expect from just the ratio increase. All the other changes match, or fall just short of the increase to be expected from the change in compression. This is not intended as a criticism of the postwar AMC engineers: if you wanted a faster bike you could buy a twin! If the G3 or G80 was fast enough then there was, and is, a lot to be said for a touring single, Collier style.

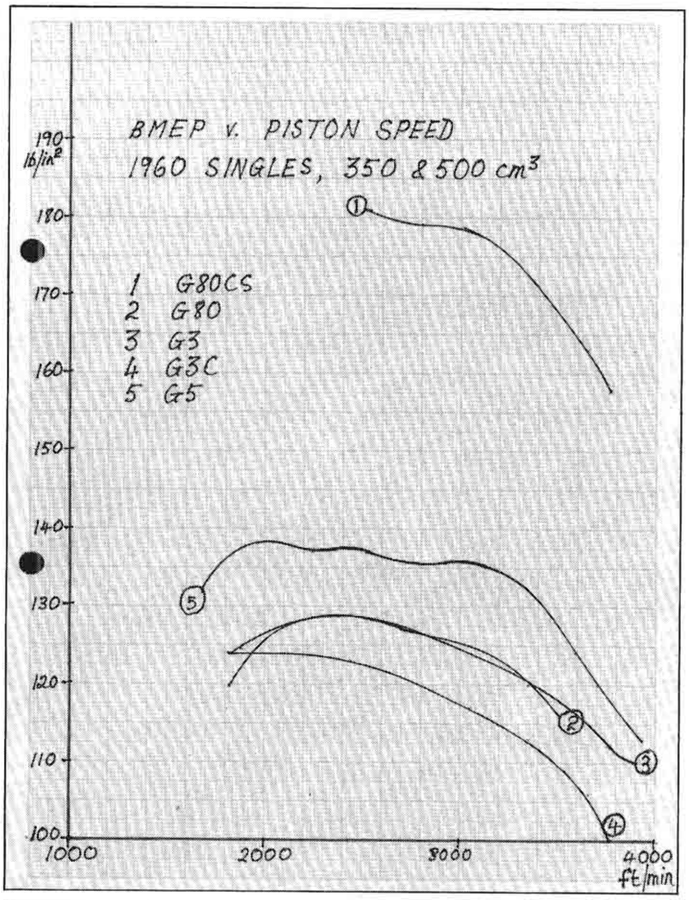
It's also interesting to see how the more modern design of the G5 means the lightweight 350 is superior throughout the range to the older G3. What a shame that by the time they had it properly sorted out, hardly anyone wanted to buy a pushrod 350 single, and those who did were mostly traditionalists who would prefer the heavyweight G3, or maybe a B31 or a Velo.

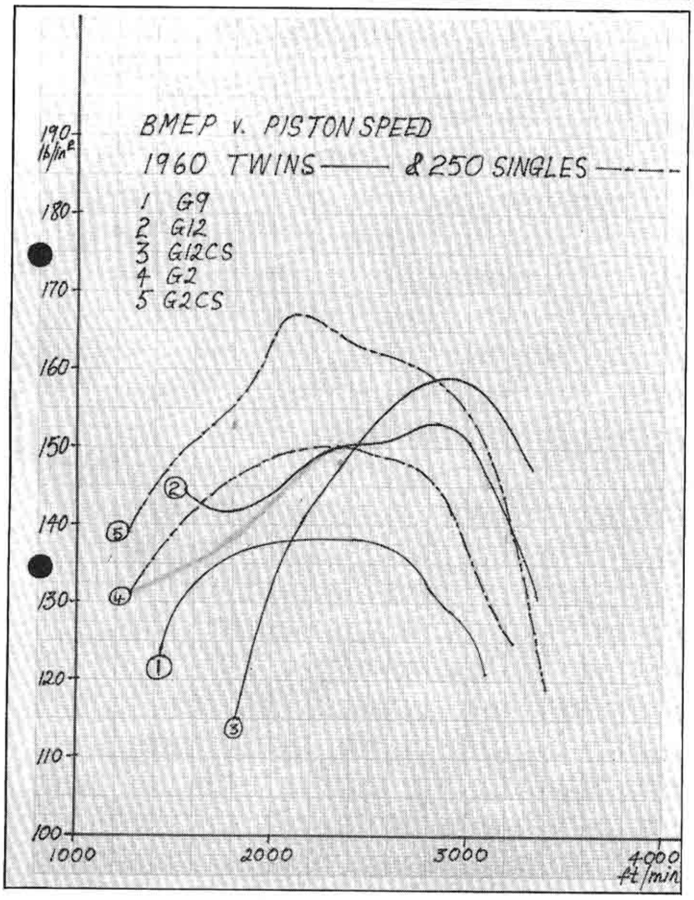
The details for the twins are equally revealing. The curve for the G9 shows how a gentlemanly tourer should behave and it is very similar to the curve for that king of tourers, the BMW R50/2, but with more power. The BMW's 26bhp pushed its 415lb up to 92mph, but the G9 goes no faster despite its producing 30.7bhp; the BMW has narrow flat handlebars, narrow tank and footrests set well back while all the Matchless's extra power is absorbed by additional aerodynamic drag. If this sounds unlikely to you, just consider the fact that sticking your elbows out while flat on the tank can knock 2mph off the top speed! You can also see why Bruce Main-Smith has so often said he preferred the standard G12 to the CSR which he ran as a staff bike while working on *Motor Cycling* magazine. The cooking version is markedly superior below 2,430ft/min, corresponding to a road speed of 74mph on the 4.8 to 1 top gear.

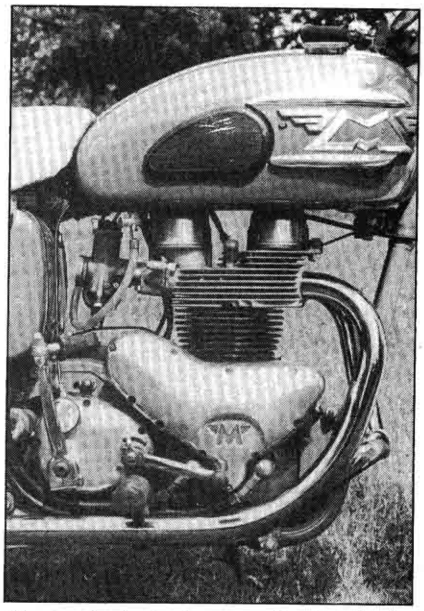
It's very clear that the CS/CSR engines were developed as competition units, for which the deficiency at low speeds doesn't much matter. For modern road use, however, a conversion to standard G12 engine specifications could well give you a much nicer bike to ride without changing the appearance; in fact, I can't help thinking that the CSR models sold for their looks as much as for their performance and AMC might well have sold more machines if the tuned motor had been offered as optional rather than standard.

Finally we come to the 250cc unit. The touring version clearly shows itself to be half a G9. It produces a bit more power but, not having to share a carburettor, doesn't have the bends in the inlet manifold to cut the volumetric efficiency. The scrambler seems to have been a pretty good engine, hampered by the cycle parts, as was so often the case with AMC machines. I have seen the weight of the G2CS quoted as being 321lb, which makes it about 7lb lighter than a G80CS! No wonder people bought a Greeves or Dot instead. The weight problem explains why the G2CS doesn't produce the same BMEP as the G80CS; any more tuning would have narrowed the power band, making the bike difficult to ride with only a four-speed 'box and all that weight to haul around. There again, tuning may have been limited by the gearbox being unable to cope with too much power — it certainly had a reputation for being fragile, even in ordinary road use.

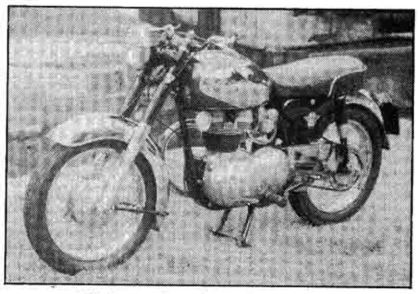
Looking back, it's hard to see what AMC had to hide, as their engines were well up to contemporary standards. All they achieved through their secrecy, and worse still their refusal to supply road-test machines to the press, was to hide the best features of their bikes from prospective purchasers! The grapevine ensured that the public knew all about their worst features — the ones of which AMC had every reason to feel ashamed — like the leaky, tin, primary chaincase and the inadequate front brake. A pity, because those faults were by no means unique to AMC machines and were eventually corrected anyway. Too little, too late was the pace of change after 1950 and without the marketing flair and innovative engineering of Harry and Charlie Collier, the AMC concern was bound to fail.







The standard twins have a perfect "touring" power curve. CS and CSR units sacrifice low speed tractability.



ABOVE: *Unit singles, though derided, actually ended up with a very effective engine.*

BELOW: *G80CS puts out the same maximum power as a Gold Star — but at a cost.*