Road or track testing, other than for fine tuning, is extremely difficult. This is not to say it's impossible, but there are many factors, all working against you, on top of which it is not easy to maintain the high level of skill and consistency that is essential.

Many years ago we tried an experiment to see how effective fine tuning at a track could be, using very basic equipment. This involved a friend's 250 cc two-stroke twin, which had been lightly modified for production racing and would be set up at a track, with a series of tests devised to get the carburation at its most efficient. We had access to a proving ground, which is similar to a race track except, having travelled down the main straight, it was possible to turn off and loop back to the pit area. It meant we didn't have to do full laps – a major saving in time, fuel and engine wear, the first of the things that conspire against you (especially if the weather changes during the course of the test, or the engine is running close to a dangerous condition like detonation).

We spent a day preparing the bike in the workshop, making access easier to parts we knew we'd have to adjust, putting marks on the ignition rotor and the twistgrip (so we need not measure things on the day, we could simply use the pre-measured reference marks), and getting a selection of spark plugs and jets ready.

The tests would involve timing the bike between markers, using a stop watch and the bike's tacho. The rider would have to be very consistent in his line, approach speed, throttle position and riding position, otherwise the tests would not make valid comparisons. The initial runs gave us some baseline figures for acceleration times and terminal speeds, starting at various combinations of throttle opening and engine speed. We then tried to optimise the ignition timing and spark plug grade. With the pre-marked rotor this was quick and easy to do. It also gave us some valuable practice in the test procedures.

We found we could measure small changes. More reassuringly, we found we could go back to a particular set-up and repeat the results. This is important during a long series of tests because if something else changes (typically a shift in wind direction or strength) you must go back to a known reference point so you can assess the effect of the new conditions. It's also important that the rider isn't asked to do anything difficult, such as acceleration runs through corners, because as he gets practice, he will get better.

Continuing the tests, we moved on to main jets and needle positions and, having gone too far, were able to go back to the best settings and at the end there was a consistent improvement in the bike's performance. This had taken two days' work, one at the track and one in the workshop, plus travelling and plus the work needed to put back the various bits and pieces we'd removed to make trackside adjustment easier. We could have done all this in one day in a test house. And someone with more experience would have run a final set of track tests: with one step richer mixtures, retarded timing and cooler plug grades.

The result, in the bike's next race, was more or less as the tests had suggested. There was a small but consistent improvement in its lap times. It qualified a few places higher than it usually did and halfway through the race, the rider felt the ominous vibration and momentary lack of power caused by detonation, before he could pull in the clutch lever. In that fraction of a second, the engine had holed both pistons – an unusual feat in itself as one piston usually suffers before the other(s).

The conclusion is that given a suitable amount of space and time and not-too-variable weather, plus a consistent rider, it is possible to work out a set of tests to optimise the machine's transient performance, but better ways are available.

13 Aftermarket jet kits

See Figs. 6.17, 6.18, 6.19, 6.20, 6.21, 6.22 and 6.23

There are various aftermarket kits available for most popular models, often in stages to suit different states of tune (eg high-flow air filter, filter plus 4-1 exhaust, etc). Marketed by firms like Dynojet, Dial-a-Jet, K&N, Cobra (both developed by Dynojet) and Factory, they are often offered with a particular type of air filter or exhaust system (see Fig. 6.17).

Most contain main jets, air jets, needles and sometimes a drill bit to open (or some epoxy resin to close) the vent hole in the piston slide. A different type is made by Dial-a-Jet, whose kit contains a separate power jet for each carburettor (see Fig. 6.18). It takes its supply from the float drain plug, through a fuel jet to a mixing block with 5 air bleeds on a rotating chamber. Turning the chamber lines up each air bleed in turn. From here the mixture goes to a delivery nozzle clipped into the bellmouth or airbox hose. This can make the existing fuel

Fig. 6.17 Parts of an aftermarket jet kit, supplied by Dynojet. They include a selection of main jets, air jets, new needles, new piston valve springs and a drill bit to enlarge the piston vent hole

Fig. 6.18 Aftermarket kit supplied by Dial-a-Jet, consists of a power jet which takes its fuel supply from an adaptor in the float bowl drain screw, which also contains the fuel jet

The fuel is supplied to the black mixing chamber shown, which has a 5-way adjustable air bleed, and from there to the fuel nozzle. The nozzle is positioned in the airstream by boring a hole in the intake trumpet, pushing the nozzle through and cable-tieing the unit to the bellmouth

Fig. 6.19 Main jets vary in their internal dimensions but the type is usually identified by the thread size and the shape of the head. However different makes may not flow the same amount of fuel even though they are meant to be of the same type, so choose the correct *type* and stick to one *make*

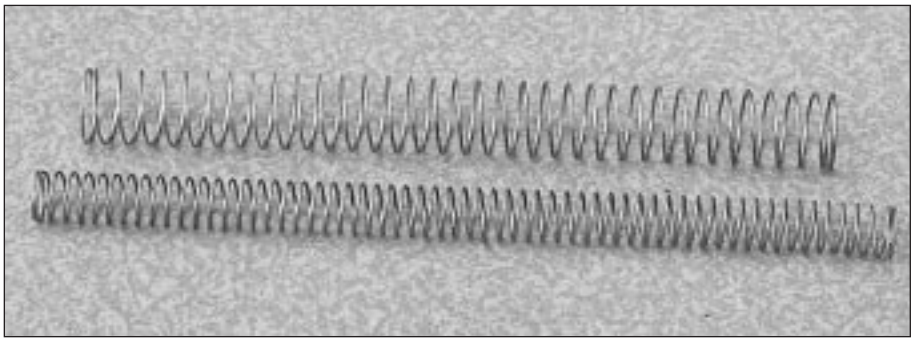

Fig. 6.20 The rate at which the piston valves lift determines engine torque and throttle response. It can be fine tuned by altering the diameter of the vent holes and by using stronger or weaker springs

slope richer by progressive amounts at high loads and speeds but cannot make it weaker (although you can, of course, use a weaker combination of main jet and air jet, and then use the kit to bring in the extra fuel).

The main problem with any of these kits is that you, the customer, don't know how difficult it was to tune a particular engine for a particular set of filters or pipes.

It could be that the kit gets the mixture slope exactly right. It could be that it's right at the top end but drifts off in the midrange. It could be marginal with one type of filter and/or exhaust – with another type or when the filter has been used for a few hundred miles, it might get rather worse than marginal.

Without doing all the work yourself, you won't know and, of course, the point of the kits is to save you the trouble and cost of doing all the work. For anything more than the simplest filter kits, they should be regarded as convenient starting points.

There are a few aspects which you should bear in mind, and which give clues to how well the kit works.

- **Jets** – Don't mix different makes, even if they appear to be the same type. Choose one and stick with that range. The reason is that a #140 made by XYZ may not flow the same as a #140 made by ABC, even though the jets look the same (see Fig. 6.19). If they look different (different length, different taper to jet bore, plastic instead of brass) then they certainly will not flow the same.
- **Air jets** – If the instructions tell you to blank off the main air jet, then you know you're going outside this carburettor's range of adjustment. You'll be able to get the fuelling right at high revs but the odds are you won't be able to keep it right in the midrange. It is probably something you'll have to live with if you want the improved top end and ultimately, if there are further tuning steps like camshafts and valve timing, a midrange hole will probably appear.
- **Air slide vent holes** – If these need changing, leave it until last. Test the other modifications first and approach any changes in progressive steps, rather than simply opening the hole out to the suggested size. Also, using a power drill in plastic is likely to make a hole considerably larger than the bit, so do any drilling by hand.
- **Needles** – Steel needles may not be fully compatible with the original needle jets, especially if the stock needles are the anodised type. They may cause wear in the needle jets after a high mileage – or after a low mileage if some other deficiency makes the piston slides flutter.

Fig. 6.21 The central hole in the piston locates the needle, the offset hole is the vent into the piston chamber

Fig. 6.22 Aftermarket high performance air filters are free-er flowing than the standard items. As they offer less resistance to the air, they create a smaller pressure drop, which in turn means the original carburettor settings tend to be too weak

14 Two-stroke lubrication

See also Chapter 9, Ancillary parts.

Two-stroke oil is either injected into the intake tract from a pump whose output is controlled by the throttle, or it is mixed with the fuel. While running tests it is important to maintain proper lubrication as the power output of a two-stroke is closely related to its piston clearance, which in turn is related to cylinder temperature, which is dependent upon lubrication.

While there has to be sufficient quantity and quality of oil, more is not better. More quantity simply increases carbon fouling at the rings, spark plug, exhaust port, 'power valve' and in the absorption material in the silencer. Too high a quality is, at best, a waste of money. At worst, a high load-bearing competition oil will be too viscous for the oil pump on a small commuter, possibly damaging the pump or not arriving in the engine in sufficient quantity to do its job.

It is necessary to select the right type of oil

Fig. 6.23 Earlier machines had restrictive air boxes, which were often removed altogether or could not be adapted to fit new frames and bodywork, as on this Bimota. The individual filters were better than open bellmouths but would still be in a low-pressure region when the bike was travelling at speed and were prone to partial blockage during wet conditions