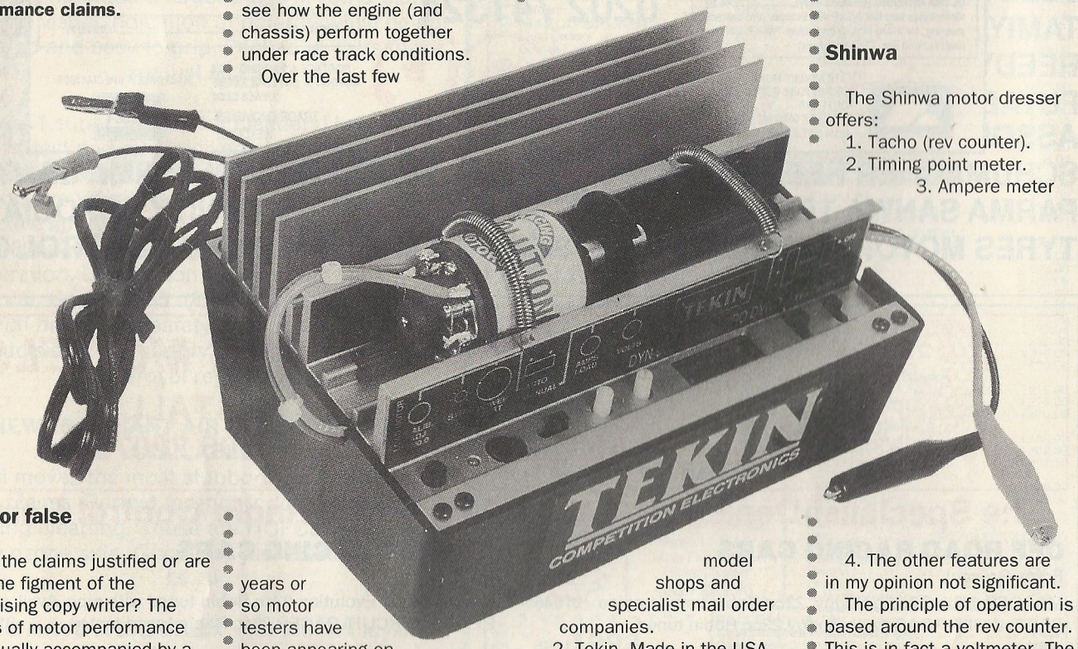
DYNO-TECHNOLOGY

Geoff Driver delves into the world of motor testing – can the latest generation of dynps help you win on the track?

From time to time articles have appeared in RCMC on how to get the best from the electric motor that powers your buggy or circuit racer. For the most part the advice has centred on maintenance, magnetising the magnets and how to choose the best brushes.

The basic design of motors has not changed significantly for more than a decade, and we all know that most motors available on the market are from a very limited range of producers in Japan, Hong Kong and Taiwan. A dazzling array of labels eventually finish on the motor cans are accompanied by a similar dazzling array of performance claims.



True or false

Are the claims justified or are they the figment of the advertising copy writer? The claims of motor performance are usually accompanied by a list of race successes. These results are of course indisputable, but are the race successes due to the perlormance of the motor? Look down the charts and you may see this or that motor taking the majority of places. This may be due to the motor in question being the finest available, or more likely it may be the motor given away to the majority of drivers. In which case it becomes no great surprise to discover that the motor in question takes a substantial slice of the tech. charts.

How can we, the mere mortal drivers work out why this or that motor wins a race. Is it the motor, driver, banery or were the heavenly stars lined up in a special way?

How about motor testing to provide the definitive answer on motor performance. This would remove factors such as driver ability, mass give aways or any other variables.

I am not pretending that motor testing on its own is the ultimate answer. Consider the formula one teams. They carry out masses of engine tests, but they still follow a substantial programme of track testing to see how the engine (and chassis) perform together under race track conditions.

Over the last few years or so motor testers have been appearing on the market. Can these help you determine motor performance in an objective way, or are they yet another gismo to hype out the opposition.

I decided to look at three motor testers. I choose three completely different types of tester each with its own unique method of operation and in completely different price brackets. There are many makes I could have looked at but as my budget was limited I set a limit on three. I have mentioned some of the alternative testers at the end of this article.

The testers I looked at were:

1. Shinwa Motor Dresser. Made in Japan by the Shinwa Technical Lab. Co. This was cheapest of the testers and is available from a wide range of model shops and specialist mail order companies.

2. Tekin. Made in the USA. Imported by a few companies. Available from them by mail order. Due to its higher price not stocked by so many model shops although no doubt available to order.

Contains more electronics than the Shinwa, and offers different facilities.

3. RSR Dyno. Made in the USA. At the time of purchase this was not available in the U.K. although this has now changed. I bought mine direct from the USA. The most expensive unit of the three. Must have a P.C. compatible computer available to operate it. Yet a different way of operating to the other testers.

Although this article inevitable compares the features of the three testers, I recognise that they work in different ways and in some instances they measure different things. So it may not be fair to compare like with like.

Shinwa

The Shinwa motor dresser offers:

1. Tacho (rev counter).
2. Timing point meter.
3. Ampere meter
4. The other features are in my opinion not significant.

The principle of operation is based around the rev counter. This is in fact a voltmeter. The measured voltage is generated by a small magnet fixed to the shaft of the motor under test which is allowed to rotate close to a small coil of wire. The faster the magnet rotates the higher the voltage produced. The tacho is calibrated to show revs per minute, the maximum motor speed indicated is 50,ooo r.p.m. At the same time as the motor is having its r.p.m. measured an ammeter is used to show the amount of current being drawn by the motor from its supply nicad. The maximum motor current that can be displayed is 7 amp.

The tacho meter should be more accurately described as an indicator. The scale is not linear and the point where most high performance motors run, from around 30,000 to 40,000 r.p.m. the meter needle moves across only 4mm of the scale. It is impossible to accurately determine the actual motor r.p.m. However if a comparative test is all that is required then this tacho will probably suffice. It is worth remembering that you could probably knock up something that could give similar comparative results with a small DC motor (acting as a generator) and a voltmeter.

The ammeter will also give a useful indication of a motor current consumption under no load conditions. It is worth noting that high performance motors can easily draw 30 (in fact some I have looked at draw well over 50) amp. on start up. If you are thinking of using a moderately sensitive analogue meter capable of handling 10 or 20 amps and then subjected it to a load of 50 plus amps the meter needle will hit the limit stop with a force akin to an express train and the needle is likely to finish up like a crooked banana. So the only current that we can usefully measure with the Shinwa is the running no load current. Handy perhaps but not enormously useful. The other feature is the timing adjuster. This had me a bit puzzled for a while. I must admit still not being too clear how this bit works. The purpose is to let you find the motor zero timing point. The only problem I see is that they provide 4 ranges on the meter scale catering for 8,6, 4 minute or modified motors. Which scale you go for is really anyone's guess.

The principle is to get a motor running in the tester at between 8000 to 10,000 R.P.M. adjust the meter to give a mid scale reading and then rotate the end bell of the motor until the meter needle moves to the furthest right position. I suppose this may be useful if the label has fallen off the motor. However as all motors are made in the same way the zero point will always be the same and it is just a matter of working it out by looking at the relative position of brushes and magnets.

Operation

The tester is quite easy to set up. The small magnet is secured to the motor shaft and the motor is dropped onto the locating bracket. Three screws are tightened and the motor is held firmly in place. There are a mass of swaches and buttons on the operating panel, this with the three meters makes the Motor Dresser look a bit complicated. This is really not the case.

The controls offered are:-

1. Timing adjuster (already mentioned)
2. Motor speed adjuster.
3. Tacho range switch (scales of 20,000 and 50,00°)
4. A timer adjuster to control the amount of time to run the motor continuously, for example when running in.
5. A switch to start the motor timer.
6. A 5 amp protector.
7. Main onloff switch.

The Motor Dresser has the ability to test from 28mm to 36mm diameter motors.

Main draw backs

The amount of usable information is limited. For the most part the Dresser checks no load performance. The information provided is unlikely to be very accurate this is because the analogue meters have pretty condensed scales and even if the unit was accurately calibrated they would be dmicult to read.

The small magnet which is fitted to the shaft to allow readings to be taken is very easily lost, although spares are readily available.

The instructions are more to do with operation than interpretation of the results. I feel that a lot more information on what to do with the gathered data would be useful.

The Shinwa machine is a little easier on the pocket...

In its favour

It is compact, looks quite smart and is relatively cheap. It will provide the very basic of information quickly. Instructions are clear and easy to understand.

It is possible to use the Motor Dresser as a charger when connected to a 12 volt supply. By adjusting the motor speed control it is possible to vary the current (indicated by the ammeter), but there is no automatic cut off feature other than the motor running timer. Similarly Shinwa say that it is possible to use the unit to act as a banery discharger. This does seem to me as taking a sledgehammer to crack a walnut.

The Tekin Dyno

Made in the USA. Once again

a stand alone unit that is portable and can be used anywhere as long as you have the batteries available.

The Tekin Dyno measures motor speed in revs per minute which is displayed on a LCD, so it is very easy to see. Current is measured during the test and this is also displayed in numerical form.

The principle of operation is that the motor under test is connected mechanically to a load motor. The load motor can have differing loads connected to the brushes in the form of resistors so providing a range of differing load conditions on which to measure the motors performance. The principle is simple enough. The load motor is used as a generator to produce electricity and this power is fed to different value resistors. The lower the resistance of the load resistor the greater the load on the motor. It should be possible to get a pretty good indication of power consumed compared to power produced. This will give an indication of motor efficiency. Of course a perfect motor will give 100% efficiency, there is no such thing yet. Power is lost in electrical and magnetic inefficiencies as well as mechanical frictional losses such as bearings, brushes and even the aerodynamic losses of the armature. These losses show up as heat, and it is something we will have to live with even after we have super conductors. Some very large mains powered motors can achieve very high levels of efficiency, 80-90% and above. Our small motors are far less satisfactory and only manage around 60 or so percent efficiency if we are lucky. Now all of this can be determined from the Tekin Dyno as long as you have the time, a calculator and something to write with.

The basic dyno comes without a load or"slave" motor. You can buy a motor from Tekin for this job or set up a 27 turn motor as described in the instructions. The slave motor is then fixed in position on the tester bed.

The motor under test is fitted to bed of the machine and held in place. A coupler is used to connect the load motor shaft to the tested motor. The only thing to be careful of is the R.P.M. sensor which rotates past an opto sensor mounted on the bed of the unit.

Switches on the front panel control what happens and the results are read on a single liquid crystal display The display will indicate, power, R.P.M., volts and amps. The switches are On/ Off, volts/ amps/R.P.M., other controls are for volts setting, amps load, an Auto/Manual switch and a PowerlTest button. Finally a load motor calibration and a Syns.

LED

A fairly daunting set of controls at first sight but as in the previous tester once you start work on a motor it more of less falls into place. You will requre a separate power source of 12 volts and 25 amps, which would seem best to come via a car battery.

The motor mounting system in the Tekin Dyno is a little crude but does the job.

What option

In manual mode it is necessary to choose the options. The amp load can be dialled in (up to 20 amps). The volts control will need to be set (usually to 5 volt).

However, the first thing to measure is no load amp consumption. This is done by simply running the test motor with the switch set to amps and reading off the result. R.P.M. would be the next check with the coupler in position and the switch set to R.P.M. run the motor and read off the result.

If you want to check motor performance against a load then the load motor will need to be set up to produce an output into the load resistors. If comparative results are all that you reauire then it is probably simpler to forget about the load motor and just check no load performance.

Auto mode produces a number which can be used as the basis of a power and torque calculation. The tester is initially calibrated and then run with the load motor in position. The number that appears in the display is used to provide the data for calculations.

If you are happy to use the power number and forget about the sums then the calculator can be left behind. Of course it then becomes a purely comparative test with no really meaningful data.

It is the quickest way to get a result under load conditions which some people might maintain are more realistic track conditions.

Maln drawbacks

Price, it is a lot more than the Shinwa tester, and you will need a separate power supply in the form of a car battery. The data provided is that taken at the moment of reading, i.e. probably when the motor is running flat out. In real terms this is not a complete picture of motor performance, just a snapshot of one specKic range of its performance. To get really useful data additional calculations are necessary. I have some reservations about the principle of connecting a motor as a load.

Despite what may be said, the load motor will vary in its characteristics over time. The magnets will go off, brushes, springs and bearings will all wear, so the dynamic characteristics cannot always guaranteed to be identical from test to test. I know that Tekin will maintain this will be the case as the machine is calibrated each time it is used, but even this assumes that the user carries out perfect calibration at each occasion. It may be the best price/ performance option available for this type of tester, but I still have some doubts about RC motors as good load devices.

In favour

It does provide an easy to read range of information. The instructions are comprehensive. Data provided is likely to be quite accurate as long as the calibration is carried out properly. The unit is small, fairly easy to use and weighs less than 3 lb.

The RSR Dyno

A completely different approach with this unit. Although this could be portable, the amount of kit to produce easy to understand results makes it more suited to workshop use. Firstly you will need a 12 volt supply, but this could be just a 12 volt dry battery as it is used to run the electronics. Then you will need a nicad or substantial mains power unit to power the motor under test. Finally and perhaps more of a problem you will need a computer, in fact you will need a P.C. or comparable

machine. Now I know that this does not rule out trackside testing with all the laptops, palmtops (and perhaps one day fingertops) that are now around, but there is no gening away from the fact that this little e%tra has pushed the RSR dyno in a different orbit when it comes to cost.

The RSR kit comprises a black box which contains the electronics and mount for the motor, a flywheel and hex wrench plus a mains power unit delivering 12 volts DC to run the electronics (mine was a US version running on 100 volts, so something else had to be found). You also get a lead to connect the tester to the computer and a floppy disk that contains the program that makes the whole thing work.

After loading up the program onto the computer (a simple enough job), the motor under test has the flywheel securely fitted to the motor shaft. The motor is placed on the mounting bracket on the front of the Dyno tester with the flywheel fitting into a slot in the front panel of the tester. Holes in the flywheel allow an opto detector to measure motor speed. A single on/off switch on the front panel is operated and we are ready to start.

All of the control is now carried out by the computer.

The menu

A menu allows various selections to be made as regard setting parameters prior to testing. Choosing "Run the Motor" option and the motor springs into life and runs for about 10 seconds.

Up to this point the advantage of having a computer operated unit would seem to be pretty pointless, but now the RSR comes into its own. The information, presentation and usefulness of this tester puts all the others not just in the shade, but locks them in a darkened room.

The RSR measures current flow and motor speed. This does not sound much does it. What it is in fact doing is sampling these parameters very rapidly and storing them. After 10 seconds has passed the programme goes into action and calculates a whole pile of information which is then ready for presentation.

Depending on your computer, the time taken to do these calculations will vary. Using a computer with a maths co-processor ~some little gismo to help with the sums) the calculations took about 6 or 7 seconds. Less well endowed machines will take longer to do the working out, anything up to 30 seconds in fact.

Having now assembled the data the menu display asks you what- information you would like to see. The display can show graphically; power, torque, r.p.m. and efficiency. There are in fact a number of combinations you can choose and it is possible to see just how current consumption relates to torque, R.P.M. and power.

All sorts of information can be seen, for example it is possible to see where brush bounce will start, by changing brushes or springs and doing a re-run you can see if the change was worthwhile. You can check if comm truing was worth the expense. It seems to me that in this one unit we now have a tool that can prove or disprove some of those wild claims of the motor producers.

Of course as with all computer based products it is a small matter to take a print of the display and you will have a record for all time, or to compare to the results the next time you overhaul your motor.

That is not all that this neat outfit can do. Within the software there is a routine that will allow you to work out the best possible gear choice to get the best from motors and cells, and in the latest edition of the software the printer can also produce a label with information of what motor you have tested.

If you want something more than just a graph the test results can be printed out in data form.

There is no doubt in my mind that this software driven machine is giving more easily usable information quicker than any other of the motor testers I looked at. There is one other feature about this tester that I believe makes it the most useful. The fact that the designer has chosen to accelerate a flywheel to get the results says to me that it is the smartest way to gather the info. No load motor with its inherent complications, always the same loading applied to the motors, measurements are taken from the motor performance where it matters most, i.e. acceleration.

I know that all out speed is important, but speed is no good unless the motor can develop useful horsepower. Some of the biggest gains of course are off the line where acceleration is vital and out of corners where again, torque is paramount.

Main drawbacks

Price is high. Not only do you have to worry about the cost of the dyno you also have to consider the cost of a P.C. and a printer.

Not very portable. Especially when you consider having to ship around the P.C. and printer.

Availability. At the time of writing there was only one distributor likely to handle this equipment.

Looks a bit grim, a plain black box, and I was not too struck on the method of holding the motor in place, although it did work admirably.

In favour. The most accurate, definitive results of any of the testers. In my opinion the best method of testing.

Simplicity of use

Useful and easily interpreted information with a really good instruction manual to help. The results can be stored on floppy disk for recall at some later stage or for comparison to other motors.

The addition of the gearing calculator looked quite useful, and with some experience I reckon that could be a winner.

Others....

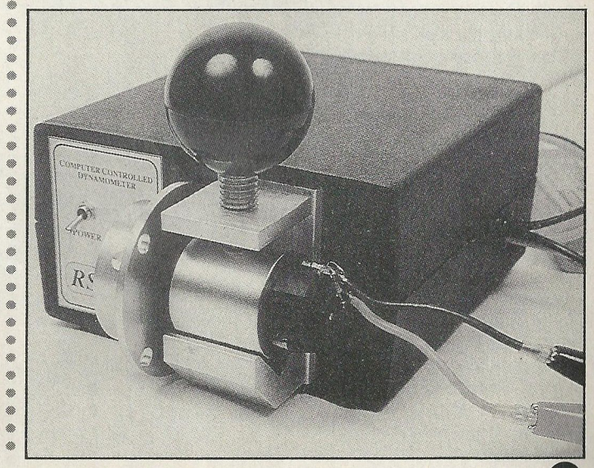
I should say at this point that there are other motor testers on the market. These are just a few:

Shinwa produce a tester that measures stall torque and current.

There are now a number of products available from the USA, which funds prevent me from trying out.

Lavco have the Pro Dyno which allows power and R.P.M. to be displayed on a small LCD. It includes electronic torque sensing, although I am not too sure how this works as details of this were somewhat sparse. A super add on for the Lavco is the CCS which couples the tester to a computer. It seems that Lavco have a system that does much the same as the RSR tester does, but they use a load motor. As I understand it the load motor output is controlled by some fancy electronics to ensure that the load is always the same for any set of specified conditions. This overcomes the problem to some extent of motor/brush deterioration and wear. Once again this system requires the use of a P.C. and printer to get the results in a presentable format. The Lavco tests

Tamiya Technigold otor mounted in the RSR Dyno.



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from 10 to 50 amp in 1 amp steps.

Lavco have been in the business of test gear for quite some time and have an enviable reputation for quality products. Great friends with Mike Reedy who makes a point of using some of their kit at meetings, but then if I was given this sort of equipment I think I would make a point of using it.

On the down side the Lavco equipment is expensive, but then as they say you only get what you pay for.

Maxmod Mini Sport produce a dyno that measures R.P.M. and current and has a variable load in the form of a slave motor. Once again not tested but the manufacturers information offers the following.

A mechanical torque measurement by means of a load cell which is fitted to the floating slave motor. This sounds quite interesting, as long as it can be calibrated.

Optical tacho to produce R.P.M. information.

Instant horsepower read out, no calculations to carry out.

High current load capacity, up to 200 amp spike, 50 amp continuous. I know of no other tester that offers that facility.

Triple digital read-out. 3 LCD modules to give simultaneous read-out of measurements

Variable load control. I think this is a bit unnecessary.

Speed control activator. Allows use of the dyno with your own E.S.C., I guess you could do that with the other testers if you felt like it.

The latest upgrade is the introduction of a meter freeze button. I like this as it will give instant snapshots of R.P.M.lTorque/Power at any point during the test, neat.

On the surface the Maxmod looks quite useful tester, but I am afraid that a proper in depth look at the machine will have to wait to some other time.

Competition Electronics. Not tested.

The Competition Turbodyno claims no slave motor effects on readings, but how they manage this is not revealed. The loading on the slave is stored within the tester, all that needs to be done is select the appropriate loading for the type of motor on test. Eight pre-programmed setups are available. The output produced is a display of efficiency and output wans, this information can be downloaded to a printer which available from Competition Electronics. The torque tester is a dynamic devices that measures torque reaction by means of a sensor connected to the floating slave motor. Competition Electronics claim a capability of 60.000 R.P.M., 16in.oz torque and 30 amp.

Thompson Power. No usable info available.

Summary

In the end is it worth it? From my own point of view I found the information gleaned about the different motors interesting. I can say that some motors are definitely bener than others, and that different brushes and springs do have a measurable effect and that motor cost is not necessarily a reflection of motor quality or performance.

Of course by the time you test the motor the money has already been spent, so you cannot do much about that.

Are these tester going to help you win races?

Not very surprising it is still ability more than this or that motor that will be the most significant in race winning. So unless you are at the top of the heap and have a vast array of motors to choose from, then buying a top spec dyno tester such as the RSR may be unnecessary. I reckon that a few quick trips of practice laps will tell you all you need to know.

If however, like myself you are interested in the technical aspects of motor design and performance then the RSR (and probably the Lavco) will be an essential piece of equipment.

Useful addresses

Shinwa. Available from a number of specialist suppliers and RC models shops such as Pete's Awesome Products.

Tekin. Available through the more specialised shops. Importer Helger Racing.

R.S.R. As far as I am aware Power Products is the only company handling this product.

Competition Electronics. May be found in a few specialist shops, although I know that Power Products have imported these products in the past.