# RISING TO MEET NEW CHALLENGES

**Chris Pickering** learns how the latest advances in test equipment are helping the motorsport industry evolve

**SOMEWHERE**, right now, an engine is screaming away in a dyno cell. Whatever hour of the day or night it is locally you can guarantee someone on the planet is running through a test procedure. And of course it's not just engines. Suspension rigs, gearbox test units and driver-in-the-loop simulators are all likely to be churning away somewhere.

Quite apart from their endless endurance and vastly lower salary requirements, machines can do things that human drivers physically can't. Lap after virtual lap they can re-run the desired sequence of events with total accuracy. Probes and sensors can be inserted into every available orifice and their readings recorded to the last decimal place.

Added to all this you have the familiar raft of track testing restrictions. Cars and drivers alike are now prevented from logging additional hours on the track in many series, forcing the teams to look to laboratory testing even when the real-world equivalent would be perfectly feasible.

For all these reasons, developing and manufacturing automotive test equipment has long been an industry in itself. For this month's Special Report we take a look at this sector, starting, appropriately enough, with engine testing.

## ROTRONICS

One of the most prevalent pieces of automotive test equipment is, of course, the rolling road dynamometer. Capable of being adapted in minutes to suit anything from trucks to single-seaters, it's a staple addition


**ABOVE** The Rotronics Autoscan Fi rolling road dyno has been supplied to a number of motorsport clients (Photo: Lohen)


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to the engine tuner's armoury.

French company Rotronics has supplied its Autoscan Fi test bench to a number of motorsport clients. Like most rolling road dynos it relies on a roller system to provide the rotating surface that contacts the wheels. However, in this instance, a single large diameter roller sits level with the ground plane, in place of the traditional twin roller setup, which places one either side of the contact patch, usually somewhat below the ground level. This means the system can accommodate competition cars with very low ground clearance while maintaining their normal ride height and attitude.

This single-roller system also helps to provide more natural tyre deformation characteristics, explains Rotronics' Christophe Defude: "It's very important to get the right tyre characteristics, because they play a large part in the car's stability and the accuracy of the measurements. It's particularly critical with racing tyres, which work in a narrow temperature range under complex distortion."

Another key part of the Rotronics system is the Fi technology – or perhaps more correctly the philosophy behind it. Fi stands for *Faible Inertie*, which loosely translates to low inertia. As Defude points out, shaving grams (or even kilograms) from the rotating components helps to

> *"Lap after virtual lap they can re-run the desired sequence of events with total accuracy"*

reduce the system's inertia, which in turn greatly improves its response. As it turns out, this is particularly important for lightweight cars, because it allows very low coasting loads to be simulated.

The downside to reducing mechanical inertia is that it makes the electronic control system even more critical. Fortunately, Rotronics has the solution, explains Defude: "Our electronics are able to control the brake with a very responsive road law and recreate the circuit or road conditions, in relation to the linear speed of the vehicle. It means the system is able to simulate the vehicle mass, aerodynamic effects and tyre drag very accurately, even under heavy acceleration."

**ABOVE** TMG's unique transmission testing system has been adapted for other applications

The Autoscan system also comes with a very powerful cooling fan as standard. Linked to the control system, it can shift air up to 45,000 $m^3$/hr, which is particularly relevant to motorsport applications with large cooling demands.

## TMG

Thanks to cars like the TS030, Toyota Motorsport GmbH (TMG) has very much returned to the limelight as a constructor of late. However, the bulk of the company's activities continue to centre on testing and consultancy. Most recently, TMG has set about adapting its unique transmission testing system for other applications.

This comprehensive test rig was originally developed to test Formula One gearboxes. The aim was to validate overall design concepts and gearbox reliability, as well as to observe more subtle effects like coating and lubricant performance.

The rig that TMG devised combines gearbox dynamometer functionality (using one input and two output electrical motors) with suspension simulation, hardware-in-the-loop technology and temperature conditioning. It was an ideal setup for testing F1-style gearboxes, with very high-revving engines, but less suitable for more mainstream applications. Now, however, Toyota has modified the input dynamometer to greatly expand the range of torque and engine speed that can be simulated.

Previously peak torque was just below 500 Nm with peak revs at 22,000 rpm; ideal parameters for F1 transmission development but out of normal usage patterns for other gearboxes. TMG's solution was to introduce a step down ratio which provides peak torque of 1,200 Nm with peak revs of 9,000 rpm for a testing solution more suited to other forms of motorsport and high-performance automotive development.

And it's not just the operating range that's changed. Further upgrades to the system have expanded its use beyond gearbox analysis. Modifications now allow driveshafts to be tested in isolation, using one output dynamometer to simulate drive while the other recreates resistance from the wheel. Another actuator moves the dummy suspension through the vertical axis to simulate realistic driveshaft angles. This means it's possible to test driveshaft designs before the gearbox has even been built.

## MOOG

It all used to be so simple. Driver development would take place in real cars, while mechanical testing would be split between track time and laboratory trials. All very straightforward. Except with the advent of professional quality driving simulators in the late nineties that began to change. These days almost all circuit familiarisation takes place in the virtual world (at least for top level categories like Formula One). Similarly, driver-in-the-loop test facilities allow physical components to be integrated into a simulated test. ▶