# EVALUATING PERFORMANCE

As a reader of this magazine, you are likely to be a Honda enthusiast and want to increase the performance of your car, whether it be to improve the engine's power output, upgrade the brakes, sharpen the handling, or to stretch the envelope in some way. Our technical partners at CPL Racing are on hand each issue to provide useful insight and guidance to help this progression.

*Aside from that 'seat of the pants' feeling, have you ever considered how increases in performance can be measured to quantify the improvements in the areas in which they have most affect on the car? We shall attempt, in this article, to show some of the ways by which a Honda owner can do just that and we shall show some examples of quantified performance increases.*

To begin with, let us take a look at engine performance, whether you have just added some bolt-on parts yourself or have had a specific performance upgrade pack fitted to your car by a professional, you should always have the electronic control unit (ECU) recalibrated by a professional tuner on a dynamometer. The dyno will allow the tuner to measure the effects on both power and torque and, at the end of the tuning session, you should be provided with a print-out showing the specific output of your vehicle across the entire engine speed range.

It should be highlighted that the dyno graphs from one vehicle cannot be compared with those of another vehicle, even with the same modifications, where testing was carried out using different measuring equipment (such as a different dyno). Similarly, you cannot compare the power output of the very same car as read on one dyno, to how it will read on another dyno. This is because even the same measuring equipment in a different location or using a different test method is likely to give different results. This can be demonstrated by analysing the following pair of dyno charts:

Charts 1 & 2 show the very same car, with the same modifications and both are tested on the same make of dyno, yet due to different test methods being used, different figures result. If back-to-back comparisons are required, then these should be carried out using exactly the same test equipment (i.e. dyno) and the same test procedure and conditions. We shall discuss this later on.

Interpretation of results is an area of common misconception. As an example, study the graph comparison #3, which shows two Honda vehicles possessing peak power outputs in the 190bhp range. At first glance, you might think that both cars would perform similarly, but take a closer look at the difference in torque figures from between 3,000rpm and 7,000rpm.

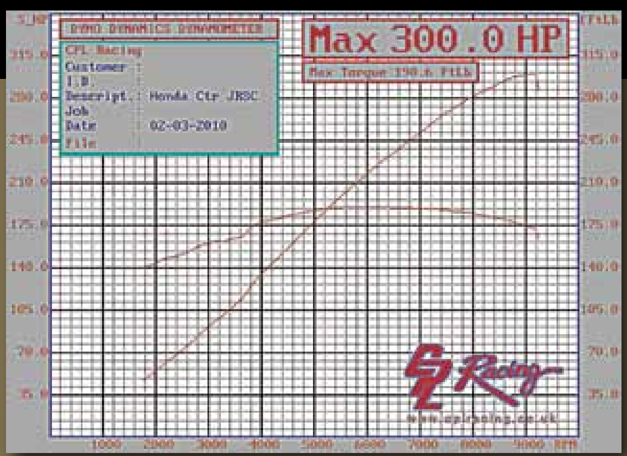
Hopefully, you can see on chart 3 that although, at peak power, both appear equal, the car depicted by the blue line has considerably more power and torque throughout the mid-range of its delivery and, in reality, this car will outperform the car shown with the red line.

Once a good ECU system is fitted, such as the Hondata engine management systems commonly fitted to Honda models, there are also other benefits. For example, a good engine management system will provide a facility to data-log the vehicle's sensors. With data-logging, comparisons in 0-60mph, 60-100 mph and other data can be evalutated before and after engine modificaitons. Charts 4 & 5 are examples of two screenshots from one data-log using a Hondata Flashpro, showing the time taken to get from 60mph to 100mph:

If you look at the difference in the these illustrations, you can see that it took 7.592 seconds to accelerate the car from 60-100mph. If more modifications are then added to the same car, further data-logs can be taken to quantify and measure the improvements.

Increased performance through braking is another measure that can be shown via data-logging in the ECU. A simple test from 60-0mph can be performed before and after braking upgrades, from adding something as simple as a set of braided brake lines, fluid and pads right through to a full-blown big brake conversion kit. Obviously, if you can slow the car from 60-0mph in a shorter time, then its performance will have increased.

1

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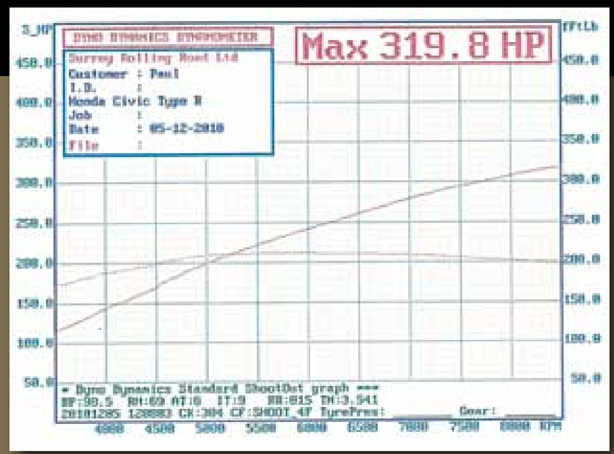


More detailed analysis of engine management systems will be provided in the next edition of Total Honda.

Other aspects can be evaluated using a combination of both dyno power outputs and data-logs. A good example of this is the ability of a short ram air intake to allow an engine to maintain power on the road, as well as on the dyno. Firstly, we would make several dyno sweep tests with the bonnet up so that the air intake is able to receive a cold stream of air from the dyno fan. For each of the dyno runs a corresponding data-log is made, which will include recording of data of the actual air intake temperature. Secondly, another series of dyno runs and data-logs would be made with the bonnet down. Below is a dyno graph showing a comparison of both scenarios and the amount of torque lost due to the high intake temperatures produced with the bonnet down.

The same car could then be taken for a road test for further data-logging, to see which of the test conditions most represents those on the road. The results of this can then be used to determine which dyno test proved more representative of road conditions and, therefore, which power figure is more relevant. Clearly, a well designed intake will maintain equally cool air intake temperatures in either of the bonnet-up or bonnet-down situations and will also maintain the higher level of performance on the road. So, from chart 6, we can conclude that the tested intake is not performing particularly well.

We mentioned earlier that results from two different dynamometers should not be compared. Why is that?

Well, one reason is that power figures are generally 'corrected' for different atmospheric conditions. Atmospheric correction, in itself, is not a problem and is actually good practice. The problem arises in that there are so many different ways and standards that are used throughout the tuning industry, all of which would give varying power outputs.

The reason for atmospheric correction is that a car tested in a location, let's say, at 1,500ft above sea level, will not develop the same power output as a car tested at sea level. Similarly, a vehicle tested on a cold winter's morning in January will not give the same power output of a vehicle tested on a hot July afternoon. The reason for this is that oxygen molecules in the air vary with atmospheric conditions and the more oxygen molecules in the air, the greater power potential will be. To put this in context, a baseline test could be established in a vehichle, taken in January at sea level, then THE CAR could be upgraded, with some good performing parts. It could then be re-tested at 1,500ft above sea level in August, at face value it would appear that the vehicle had made no increase in power at all!

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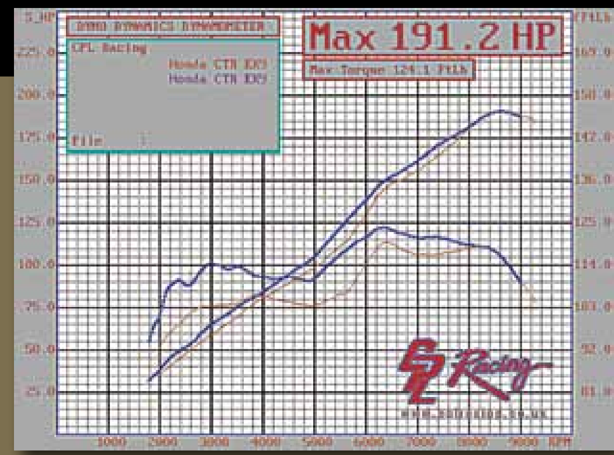


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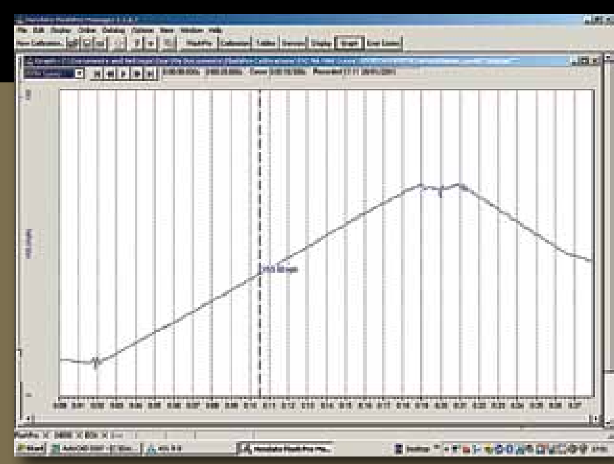

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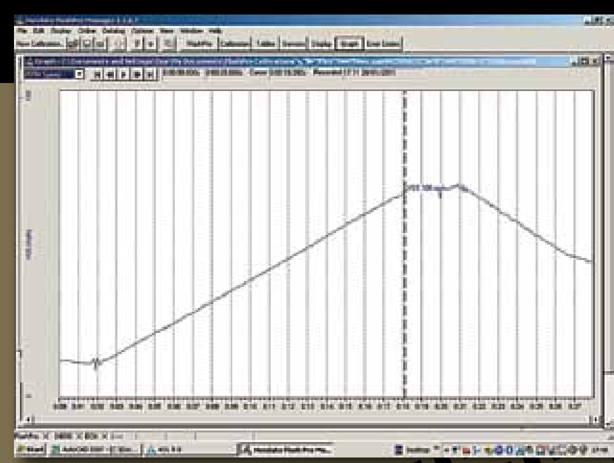

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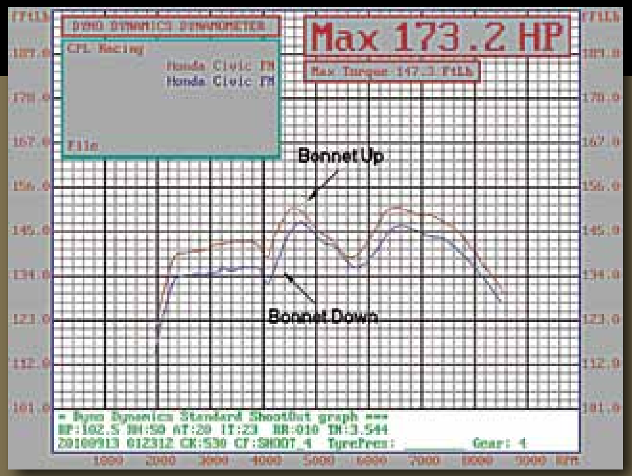


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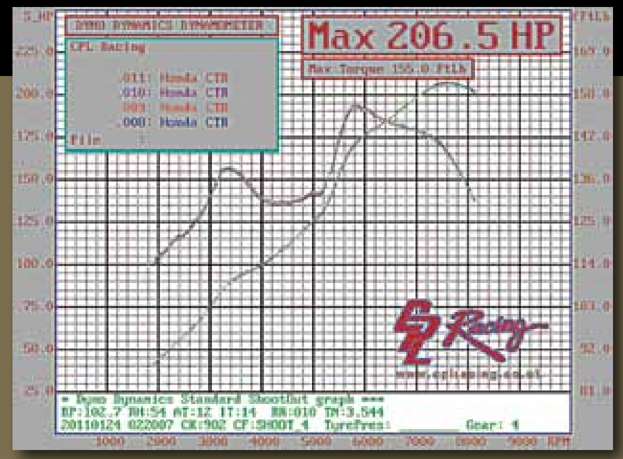


> Atmospheric correction is therefore an essential element of testing.

However, even if both the locations referred to above use atmospheric correction, the power figures are still highly unlikely to give a meaningful comparison. The reason is that, unfortunately, there are so many standards of atmospheric correction in the tuning industry that face value comparisons such as this are usually meaningless. To expand on this further, in an attempt to arrive at a 'standard cubic foot of air', all of the various dyno manufacturers and operators have their own ideas of at how the figure should be arrived.

To use CPL Racing as an example, we use a Dyno Dynamics 450 lowboy chassis dynamometer. It uses an atmospheric correction standard called ATMC2. This standard is based around 'Boyles Law', which shows that there is a direct relationship between the absolute pressure and the volume of a gas. Basically the ATMC2 standard uses 25degC, 1013mb and 60% humidity as standard conditions, upon which no correction would be applied to the power figures read by the dyno's load cell. If the conditions vary from this, then a correction factor would be applied and recorded.

ATMC2 is only one of many methods of calculating atmospheric correction. Other dyno manufacturers use DIN70020, ISO1585 and others. We are not saying that one calculation method is entirely right and the other entirely wrong, it is just that a different conclusion (i.e. power and torque output) will be the end result.

With this in mind, you might think that, if you use the same brand of dyno and the same correction factor, the power outputs would then be comparable. While this makes things more realistic than using two different makes of dyno, with different atmospheric correction methods, there are other factors to consider. For example, the quality of the testing environment itself plays a big part in controlling the conditions.

At CPL, our dyno cell is designed to simulate, as near as possible, real world conditions, achieved by changing the air in the cell 10 times every minute to keep the conditions stable. We have proved that, even after several hours of tuning and testing, the temperature in a well designed dyno cell will not vary by more than two or three degrees Celsius. This means that the amount of correction applied to the power output varies by only a very small margin.

This factor can be demonstrated by the dyno chart no 7 which shows 11 back-to-back dyno runs on the same vehicle. Look at how consistent the results are, showing the ability of a well designed dyno-cell to provide dependable results.

Compare our test facility, to a dyno, where testing and tuning is carried out with little more than just a fan in front of the car's radiator and an extractor for the exhaust fumes. In the latter scenario, the dyno would correct the power output upwards, as a result of the inadequate conditions in which the car is being tested. Apart from just correction factors, there are many other variances in testing, such as inertia, gearing, acceleration rate, quality of the test equipment and so on, which will affect the power outputs.

Hopefully, you can see that dyno measurement is clearly open to misinterpretation and there is no regulated 'standard', of a type you might find in other industries. Our professional advice, for anyone looking for a testing or a tuning facility, is to select a company that has specifically designed test equipment, such as a suitably designed and built dyno cell and high quality hardware, and that it employs an experienced tuner in your particular make or model of vehicle and your chosen engine management system. If possible, also select a company that has proven its expertise and experience by gaining credibility from participating in racing activities.

By now, you may have a broader understanding of the dyno graph handed to you at the end of your last tuning session, but how could you verify the improved performance of your vehicle for yourself?

As a Honda owner, you can't go out and buy your own dyno to test things, however, there is a way to test and verify performance upgrades for yourself and that is to take your Honda to the drag strip. There is no better than a straight piece of sticky tarmac, with zero fear of on-coming traffic, to test how fast your car really is and to do so against the clock.

After each run made up the strip, you can collect a time ticket, which shows elapsed times at intervals along the track, typically this would be as shown below:

| | |
|---|---|
| 60ft | Elapsed time |
| 330ft | Elapsed time |
| 594ft | Elapsed time |
| 1/8th mile | Elapsed time and speed |
| 1000ft | Elapsed time and speed |
| ¼ mile | Elapsed time and speed |

By using this information, you will be able to see where your car is performing better. Added performance in the first part of the track points primarily at better traction, whereas a higher speed at the top end of the strip is purely down to engine power and weight, with a little bit of aerodynamics thrown in for good measure. Running your Honda at the drag strip, before and after performance upgrades, is an extremely good way of measuring increased performance independently and allows you to compare your car's set-up to that of owners of the same type of vehicle.

CPL Racing and Hondata will be writing a number of technical articles over the coming months which will include a number of dyno charts for illustration purposes. Next time, we discuss engine management systems. We hope that our explanations will facilitate a greater understanding of performance evaluation and dyno chart interpretation but, for further information and examples of dyno charts, please see this link: http://www.cplracing.co.uk/index.php?id=16 ■