Truth, Lies, and Dyno Runs

Part 1

A popular thread that continues to surface in various enthusiast forums is related to the results attained from various chassis dynos. In the following paragraphs, I'll attempt to explain the various types of chassis dynos and their operating principals, how they're used in the field, and how to interpret the results. *I know that you're thinking, "oh boy, the VP of Dynojet is going on a sales pitch", and that couldn't be further from the truth. I'm an avid automotive enthusiast, and no, that doesn't mean I just plop down cash for the latest exotic car. I've made thousands of dyno runs, tuned 1000's of automotive ECM's, designed and fabricated my own turbo kits, and made hundreds of passes at the strip. I hope to educate the sometimes confusing subject of chassis dynos and how they're used in the field.*

There are generally two types of dynos that are used for performance verification and tuning, "inertia type loading", such as the Dynojet 224x or 248, or "electric type loading", such as a Mustang 250, 1100, Dyno Dynamics, or Dynojet 224xLC / 424xLC. Traditionally Dynojet has offered the inertia loading dynos, whereas Mustang Dynamometer and Dyno Dynamics have been electric type loading dynos.

The major differences in the two types of dynos are their principals of operation. A true inertia dyno (such as the Dynojet 224x or 248) uses large steel rollers that contain mass. This mass is fixed, it can never change, and for those that remember high school physics, Force = Mass x Acceleration. Based on the time that is required to accelerate a mass (the steel drums in this case), you are effectively measuring force. Ok, so now that we have force, how does an inertia dyno come up with horsepower? Simple, force (lbs) multiplied by speed (ft/sec) effectively yields horsepower. Since every Dynojet dyno on the face of the earth has a mass that has been precisely quantified using a proprietary process, and that value is stored in the dyno software for each dyno, not only are the horsepower numbers consistent every morning, noon and night, but each and every Dynojet is relative to one another. Go ahead, take your car to 25 different Dynojet dynos, run it up, and I personally guarantee the horsepower will repeat to within 1/2 HP (no one else would dare make that claim). What if the numbers aren't the same between the 25 Dynojet dynos, well, it's quite simple to explain, and you need look no further than the vehicle. Most modern powertrain management systems have a lot of authority when it comes to how much power they ultimately put to the wheels. Capturing OBD2 parameters such as spark advance, engine coolant temperature, inlet air temperature, mass air flow, and other critical PID's provide the insight required to determine why the vehicle did, or did not repeat.

So let's take a step back before we move on and look at this from a practical perspective. As an enthusiast, you may be wondering, "what are the variables that exist when I dyno my car on a Dynojet, there has to be something". I would respond, "**A Dynojet dyno operator CAN NOT change the data that determines what the power reading will be (remember the physics thing?). What ever power is being put to the drums will be measured and displayed, period."** Once that power has been measured, there are two ways to look at it, corrected or uncorrected. Since every Dynojet dyno is equipped with electronics that measure the atmospheric pressure, temperature, and humidity, the results are able to be analyzed as a "corrected value". This allows an "apples to apples" comparison when testing in regions that are at different altitudes, which affects the atmospheric pressure, and different temperature. This is also important for comparing results at the same dyno shop, for example, here in Las Vegas our atmospheric pressure stays relatively consistent, but our temps vary from 38 degrees to 118 degrees. So the same car with no changes will certainly make less power on the hot day compared to the cool day, but applying the SAE CF allows us to make an "apples to apples" comparison. If you take anything away from the last few sentences, it would be to ask your dyno operator to make sure that he is showing you SAE corrected HP figures, and before I get off my soap box, I will say that there are certain Dynojet dyno owners who apply the "STD" correction factor, and that's not proper to do. The STD CF is an older standard that yields slightly higher HP numbers, so don't allow yourself to fall into the trap (just use the SAE CF!!).

Ok, lets move on to "electric type load chassis dynos". These types (Mustang, Dyno Dymamics) of dynos utilize rollers that usually have very little mass, hence they're not a true inertia chassis dyno. In order to present any type of physical load on the vehicle, there needs to be a PAU (power absorption unit). Typically this PAU is in the form of electrical coils that utilize eddy current technology (think of this as a big electric brake). Now having a big electric brake is all very nice, but we need to use a chassis dyno to measure power at the end of the day. Since the mass of the rollers isn't known (like a Dynojet), there needs to be a means to measure power, so how this is done is with a torque cell, or sometimes referred to as a strain gauge. As the big electric brake absorbs power, the strain gauge is actually measuring torque. Now here is the kicker, the strain gauge really doesn't know the difference between 2 ft-lbs or 200 ft-lbs until you calibrate the device, so in doing this, you're introducing a potential margin of error and inconsistency. This would apply to any "loading type dyno" that uses eddy current load control and a strain gauge, even our own 224xLC which is a hybrid inertia / electric load style dyno. The strain gauge needs to be calibrated to make it consistent and repeatable, but there are other user defined (by the dyno operator) variables that makes things very interesting. Once the strain gauge is calibrated properly, the dyno operator must enter certain parameters about the test vehicle that determine the rate of acceleration the dyno will allow, and are ultimately directly responsible for the power and torque readings that are displayed on the graph (WOW!). At this point you may have connected the dots and are either appalled, or still rather comfortable with the dyno graph you have in your hands. The question that pops up, “my car made 280 rwhp on a Mustang dyno, what would it make on a Dynojet”, should be countered with the statement, “I’m not sure, but I do know this, you’d most likely get 10 different numbers on that same Mustang dyno, let alone another Mustang dyno that’s installed in the field”. Now this isn’t meant to bash Mustang dyno or Dyno Dynamics, but some dyno owners just can’t resist “tuning the dyno”, instead of tuning your car. If you’re “measuring stick” isn’t consistent day in and day out, then how can you be certain your tuning and modifications are actually working? If these dynos are set up properly, they can provide relatively consistent and repeatable results. For what it’s worth, we do not allow dyno operators to adjust “certain parameters about the test vehicle” on our hybrid electric brake / inertia 224xLC dyno.

So, in any case, there are a couple ways that even when testing on the same model Mustang dyno or Dyno Dynamics dyno (or even the same exact unit) that the numbers are subject to a few variables. These variables are ultimately responsible for the power numbers reported from the test session.

Then the argument comes out, "well, I need to have my car tuned on an electric load type dyno". This is not necessarily the case, I'd be more concerned with the ability of your tuner / calibrator. A car that needed a "ground up mapping session", ie. complete development on a stand alone system or "zero map", then a loading dyno would be VERY beneficial. When you do testing on a loading type dyno, ask your "tuner" to supply you with a plot of calculated load, along with as many other parameters you can get your hands on (spark advance, MAFv, IAT, etc). Log these types of parameters on a loading dyno, and then on an inertia dyno and let me know what you find. As an enthusiast, I would urge that you arm yourself with this type of data, it’s much more important than concerning yourself about which dyno you should test on. Tuning, or refining an ECM calibration is one discipline that requires specialized tools, but for “no bull shit numbers” there is only one consistent means of measurement, and that’s a Dynojet dyno. I’ll go into detail on this subject another day, so until then, enjoy your chassis dyno experience.

*** For the record, Dynojet has offered “loading type automotive chassis dynos” since 2003, although a majority of the 1400 Dynojet automotive dynos in the field are “inertia only”. Currently there are about 200 224xLC and 424xLC’s in the field, the “LC” designation indicates that it’s an electric load type dyno. The LC dynos that we offer can be operated in either mode, inertia only, or inertia combined with eddy current load absorption.

Dan Hourigan
Vice President, Dynojet Research, Inc.