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Dynos

Academic Skills ACHA4005

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1. Introduction

This report will explain what a dyno is, how it works, what a dyno is used for and how a dyno can be used to improve a cars performance/efficiency. Dynos can be found usually very local to a person, often situated in a garage that specialise in remapping of performance cars, or cars that owners are looking for a little more power or potential efficiency gain with its fuel usage.

1.1 Aim

This report's aim is to know how a car is set up on a dyno and what is involved in preparing it, learn how to read the characteristics of the car using a dyno graph and understand what you can do to increase performance.

1.2 Objective

To understand a dynos usage, how it works and what it is used for.

2. What is a Dyno?

A dynamometer, usually referred to as a rolling road or dyno, "a stationary chassis dynamometer that allows to perform tests of technical diagnosis of light ground motor vehicles with single axis drive. The power stand is equipped with the necessary additional tools to determine the engine speed as well as after rotation speed of rollers the actual driving speed of the vehicle and overdriven distance are determined." (Vilnis Pirs, 2012). The car is strapped down to the floor, this is done by using either ratchet straps or chains that are attached to secure points on the car then to mounting points that are sunk into the floor, this means that the car will stay in its position while it is ran on the dyno, a large industrial scale fan is placed in front of the car to make sure it has enough air flowing into the radiator and intake to stop the car overheating. This imitates the air the car would receive while driving along a road but while it Is stationary on the dyno. Once the car is correctly set up on the dyno, this then allows the car to be ran in different gears and at a vary of speeds to determine engine horsepower, torque, and the mixture of air to fuel that the car produces out of the exhaust. This information then allows the operator to make tweaks to the existing map file of the car to increase the power or improve its efficiency. This is all done while the car is stationary.

3. How dynos work

Dynos determine the characteristics of a car by looking at how quickly the dyno rollers rotate and how much resistance the car gives towards the rollers. "The chassis dynamometer collects data through the vehicle's tire rotation." (Jose Garcia, 2012). The rollers are mounted on free moving bearings with little to no resistance letting them spin freely, the rollers are attached to an accelerometer which determines how quickly the rollers are rotating registering their speed, the rollers also have a break which can be applied to them at a vary of different strengths, this imitates how a car would act on the road. If the break on the rollers is set wrong it can cause false readings for example: if the break is too light it will read a much higher power, if the break is set too heavy it will a much lower power, this means it's very important to set up the dyno correctly depending on the specifics of the car (Tune, 2017).

3.1 Relevant sensors used in car dynos

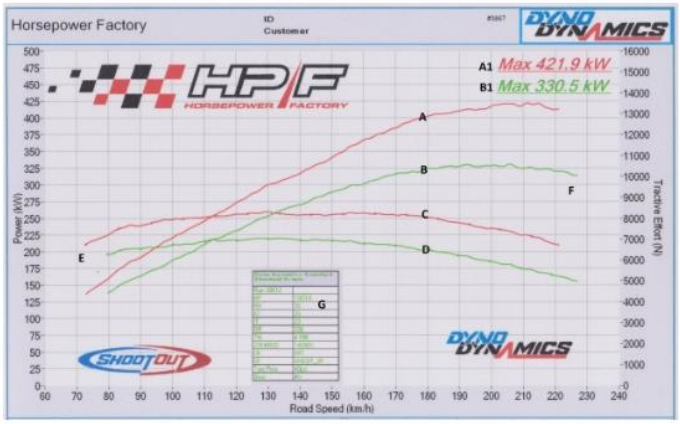
The car is attached to a vary of sensors such as a lambda/AFR (air fuel ratio) sensor, "enables the detection of the exhaust gas air fuel ratio, both lean and rich of stoichiometric. This A/F sensor was developed from a lean mixture sensor, which has a proportional output to the exhaust gas air fuel ratio in the lean region only, by widening the detection range to rich air fuel ratios to 12:1." (Kazuya Mizusawa, 1997), which is inserted into the tail pipe of the exhaust. This will tell the operator the

amount of fuel that Is left over in the exhaust fumes. RPM (revolutions per minute) of the engine, which can be attached with a small clamp onto a HT lead. Air intake temperature sensor determines the temperature of the air that is entering the engine. This is very important as the colder the air that goes into the engine the more power it will produce and the more efficient it will be. Cars that are produced after the early 90s will come commonly fitted with a OBD port. This allows the car to be plugged into the dynos software which can make use of all the cars inbuilt sensors such as: crank angle, coolant temperature, oil temperature. These can be read and used by the operator to understand more characteristics of the car.

4. How a car is run on a dyno

Once the car is strapped down and in place and all the relevant sensors are attached you are ready to start running on the dyno. The first thing you need to do is centralise the wheels on the rollers and make sure the car is not going to drift over side to side. This is done by putting the car into first gear and slowly releasing the clutch, then using the steering wheel to gently turn the wheels left to right. This will centralise the car and make sure it is running directly parallel to the dyno rollers. At this point it is good practice to get back out of the car and test all the straps to make sure nothing has come loose. The fan and exhaust extractor can now be turned on and the car can do a power run. This will determine the cars initial power before any adjustments are made. This is done by starting off in first gear to get the rollers moving, then making your way through the gears until you get to the desired gear usually third or fourth. The car is then held at 2000rpm and the throttle is opened to its maximum. The car will start to accelerate. The throttle is held open until the power curve on the graph starts to plateau, then the throttle is released. (Support, 2010). Figure 1 show's how the car's dyno graph should look.

Below is a modified graph marked with A-G to highlight some of the things you will need to understand to be able to read the graph.



A/ This Red line is the 'after tune' power line, it references kW at the wheels on the LH side of the page.

A1/ This is the peak power number recorded from the 'after tune' power run.

B/ The Green line is the 'before tune' power line, it also references kW at the wheels on the LH side of the page.

B1/ This is the peak power number recorded from the 'before tune' power run.

C/ This Red line is the 'after tune' torque line, it references Tractive effort (N) at the wheels on the RH side of the page.

D/ The Green line is the 'before tune' torque line, it also references Tractive effort (N) at the wheels on the RH side of the page.

E/ Indicates the start of the 'power run'.

F/ Indicates the end of the 'power run'.

G/ This box lists various parameters including the Power run number, BP – Barometric Pressure, RH – Relative Humidity, AT – Air Temperature, IT – Intake Air Temperature, RR – Ramp Rate, Shoot-out mode (a fixed dyno mode), Tyre pressure and the gear the car was tested in.

Figure 1 - How to read a dyno graph

On most dyno graphs there is a horizonal straight line that meets the highest point of the power curve. The straight line represents the limit that engine is capable of before causing damage “the straight lines of the performance graphs, however, represent the “safe” limits set by the machine designer in principle therefore it is possible if not always advisable to go beyond those “safe” performance cut off figures” (Plint, 2012) when tuning a car.

5. How to tune a car using AFR (Air, Fuel, Ratio)

The first thing to check after doing the first dyno run and you start tuning is the AFR gauge. This will determine how efficiently the car is running. At light cruise you would want around 13.5 wide throttle open you would want 12.5 acceleration you would want 12.0 and for fuel economy you would want 16.5, (To, 2022). If the readings are off from these values, they would then be adjusted relative to how the car wanted to be tuned. By increasing or decreasing the amount of fuel the car receives and increasing or decreasing the amount of air the car receives. This is done by adjusting things like turbos or superchargers. Changing these variables will be reflected by the AFR gauge. The values can then continue to be adjusted till the desired AFR reading is found.

6. Adjusting timing to tune a car

Tuning can also be done by adjusting the timing but “Timing makes major changes on a/f ratio as well as power. This comes at a trade-off of safety” (OJcool, 2007). Sometimes the advantages of adjusting the timing are not partially beneficial, a possible gain of three to four horsepower by adjusting the timing you run the risk of the EGTs (exhaust, gas, temperature) getting to high resulting in catastrophic damage to the engine. This is usually a risk not taken by many tuners as it can result in the longevity of the engine being lost.

7. Conclusion

Dynos have been used in the motor industry for decades starting out with simple gyros and weight sensors on rollers, to modern day electronically computer run dynos. They will continue to be used throughout car production and tuning with an endless possibility of variables to change within engines, to make them quicker or more efficient and used to develop engines for future production making them more durable and capable or more power.

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