YOUNG FORUM
Mechanics Transport Communication
Academic journal http://www.mtc-aj.com
ISSN 2367-6558 (print)
ISSN 2367-6612 (online)
volume 8, issue 1, 2019
article № 1767

DYNAMOMETER MEASUREMENT OF THE EFFECTIVE PERFORMANCE PARAMETERS OF A REAR-WHEEL DRIVE VEHICLE

Yordan Dermendzhiyski, Slavcho Bozhkov
drmendzhiyski@gmail.com, stbozhkov@vtu.bg

Todor Kableshkov University of Transport, Geo Milev str. 158, 1574 Sofia,
Department of Transport Equipment
BULGARIA

Key worlds: *dynamometer, effective data, power, torque, rear-wheel drive, vehicle*
Abstract: *The dynamometric automotive measurement is rendering the effective automotive parameters such as: static power measurement at constant rpm, static power measurement at constant speed, static power measurement at constant tractive force, dynamic power measurement with adjustable acceleration, towing power measurement etc. The dynamometric automotive measurements and tests have high level of flexibility in use due to extensive variety of operating modes, covering all fields of application. Moreover there are essential possibilities of precision calculation of the parasitic losses of the dynamometer, of the vehicle's drive train and the tire to roller friction and flex losses. These include tachometer testing with up to ten freely selectable test points. The distance measurement is included stopwatch function for measurement of acceleration between optional speed markers as standard. The additional option may be optional load simulation with freely programmable load profile, optional driving simulation with freely programmable speed profile, option of storing programmed profiles in database In this report is presented the practical measurement of the effective performance of rear-wheel drive. All this guarantees the highest degree of accuracy of the dynamometric tests. This paper considers experimental results obtained during automotive tests with automotive dynamometer of the German company "MAHA".*

1. Introduction.

The research equipments and test benches and the corresponding researching and practices are the base for increasing the student's qualification [1]. The modern automotive engineers and constructors [2] must know the process work of the automotive units and assemblies. Dynamometer is a force measuring device, torque, and power. For example, engine power can be calculated by simultaneously measuring the torque and rotation speed. Dynamometers are used to provide a simulated road load. Also contribute significantly to the development of internal combustion engines. Their use has greatly contributed to the controllable management, combustion behavior and tribology.

1. Device of the measurement equipment Single roller dynamometer "MAHA"

In addition to being used to determine the torque or power characteristics of a machine under test (MUT), dynamometers are employed in a number of other roles. In standard emissions

testing cycles such as those defined by the US Environmental Protection Agency (US EPA), dynamometers are used to provide simulated road loading of either the engine (using an engine dynamometer) or full powertrain (using a chassis dynamometer). In fact, beyond simple power and torque measurements, dynamometers can be used as part of a test bench for a variety of engine development activities such as the calibration of engine management controllers, detailed investigations into combustion behavior [3,4] and tribology [5].

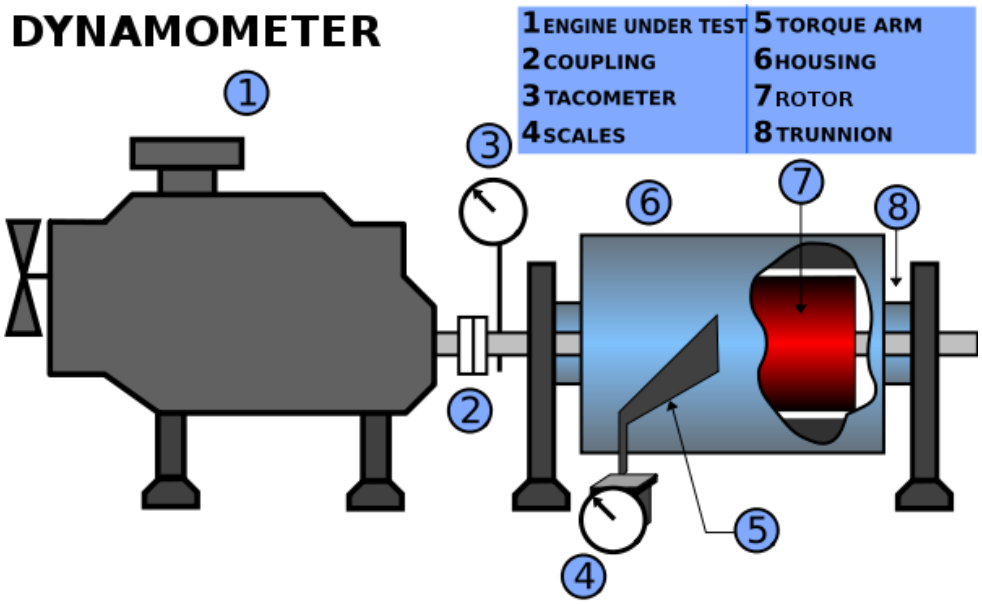

Figure 1. Dynamometer diagram

In an engine dynamometer (fig.1), water flow, proportional to the desired applied load, creates resistance to the engine. A controlled water flow through the inlet manifold is directed at the center of the rotor in each absorption section. This water is then expelled to the outer dynamometer body by centrifugal force. As it is directed outward, the water is accelerated into pockets on the stationary stator plates where it is decelerated. The continual acceleration and deceleration causes the dynamometer to absorb the power produced by the engine. Through this transfer of energy the water is heated and discharged [5].

Test stand function

Static power measurement at constant RPM

- Static power measurement at constant speed;
- Static power measurement at constant tractive force;
- Dynamic power measurement with adjustable acceleration;
- MAHA towing power measurement guarantees the highest degree of accuracy when measuring power [6];

Precision calculation of the parasitic losses of the dynamometer, of the vehicle's drive train and the tyre to roller friction and flex losses

- Tachometer testing with up to ten freely selectable test points
- Distance measurement included
- Stopwatch function for measurement of acceleration between optional speed markers as standard
- Optional load simulation with freely programmable load profile
- Optional driving simulation with freely programmable speed profile

- Option of storing programmed profiles in database [6]

Software analysis (fig.2)

- Continuous graphic display and recording of up to 16 freely selectable parameters per performance measurement cycle on one measurement screen;
- In addition to the current performance measurement cycle, fade-in of up to three stored cycles on the measurement screen for optimum comparability during calibration work;
- Two circular dial displays for RPM and speed as well as current oil temperature display;

ensuring constant control of key parameters during performance measurement

- Determination of wheel power, power dissipation, engine power and torque;
- Circular dial display of motor power, RPM, speed and tractive force during simulation cycles;
- With radio remote control as standard for complete control of the dynamometer from within the vehicle;
- Cooling fan switched on and off either at the control console or with the radio remote control [6,7].

Figure 2. Software analysis received data

2. Measured values

Figure 3 shows a graph of measurement with dynamometer “MAHA 1050”.

The received data is from vehicle BMW 330 propelled with diesel engine. The power of the engine is 147,2 kW and 200,2 hp. The power transmitted to the drive wheels (rear axle) is 120,4 kW or 163,8 hp. The transmission power losses from the rear wheels is 26,8 kW or 36,4 hp.
Maximum power is achieved at 3535 min^{-1} / 164,9 km/h.
Maximum torque is 419,5 Nm.
Maximum torque is reaching at 2205 min^{-1} / 102,7 km/h.

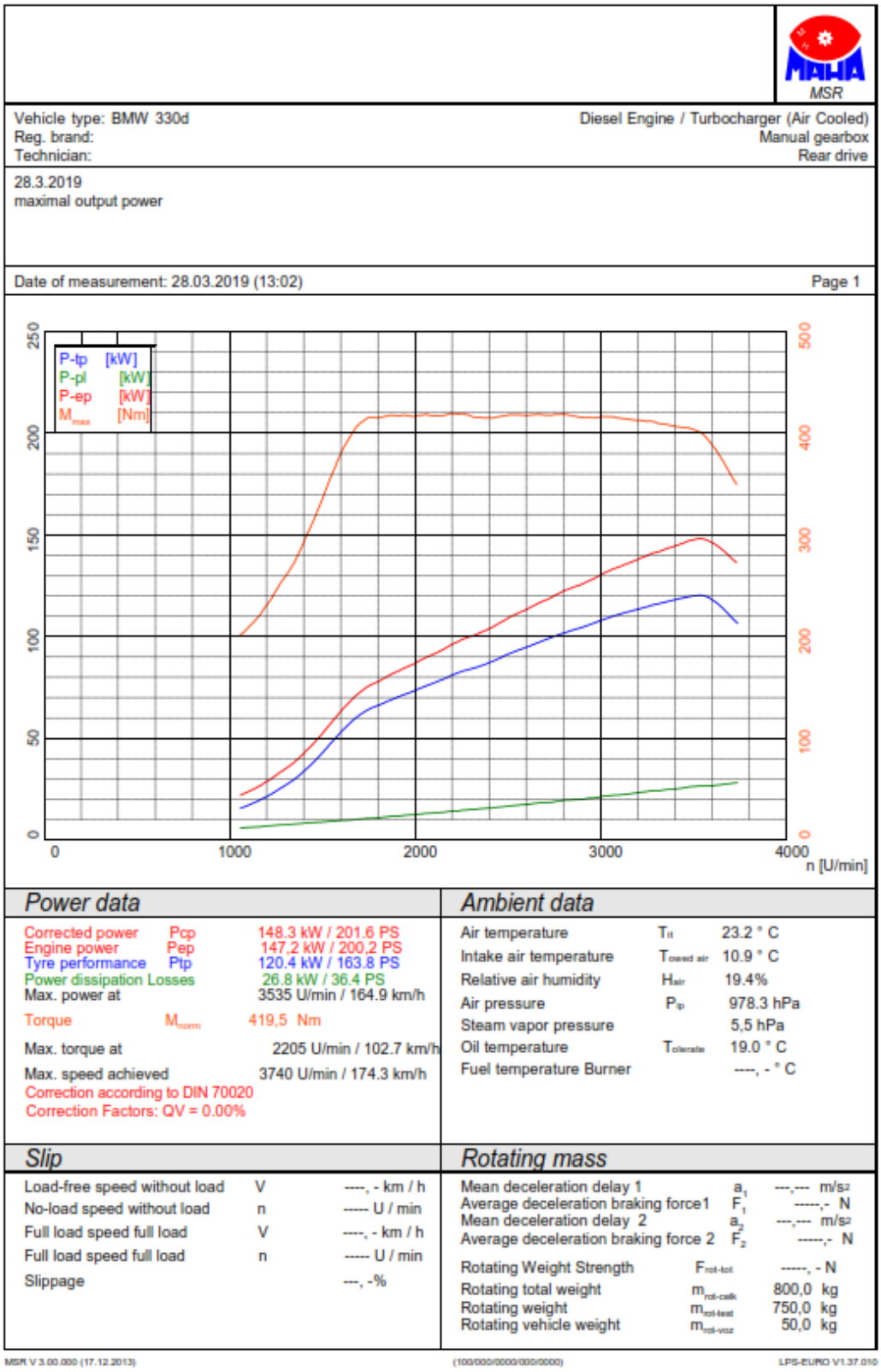

Figure 3. Functional measurements

The measurement is carried out at air temperature T_{air} = 23.2 C^{o} and relative humidity H_h = 19,4 %.

Figure 4 shows a graph of measurement with dynamometer “MAHA 1050”

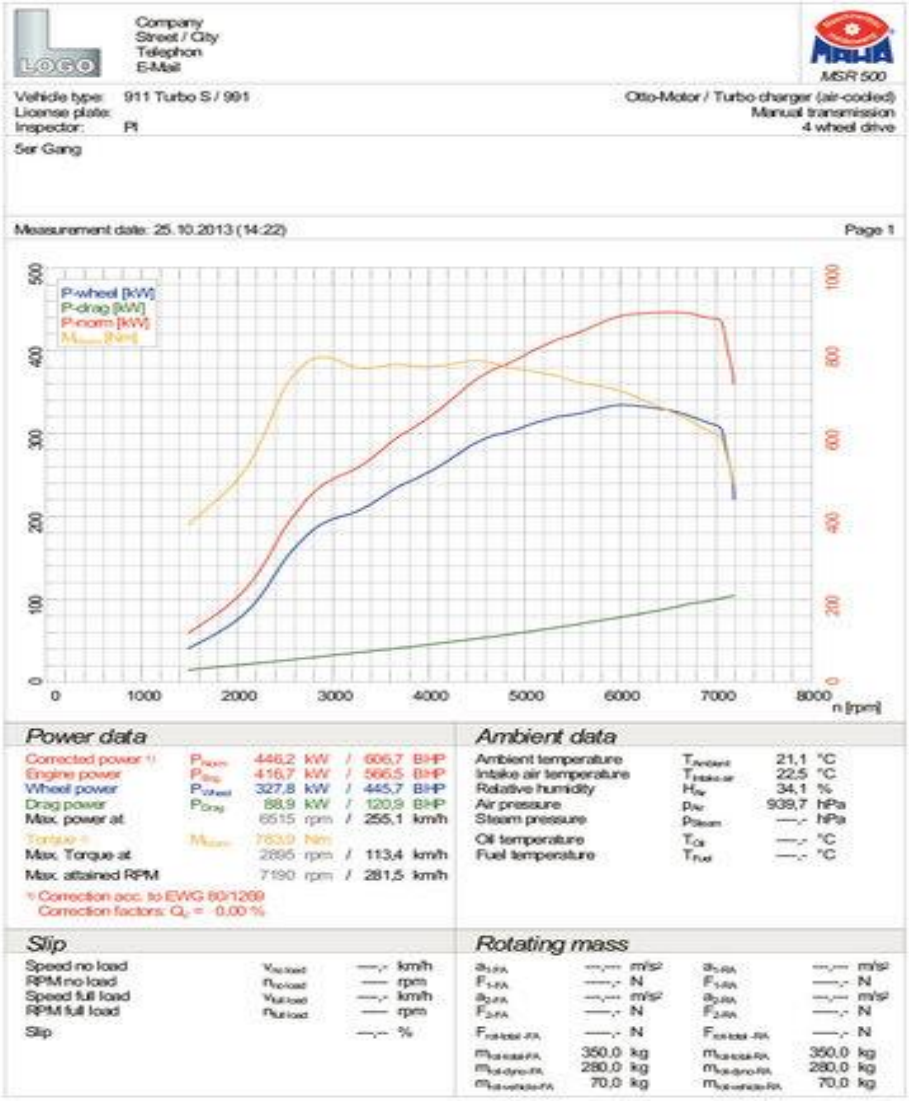

Figure 4 Functional measurements

The received data is from Porsche 911 with petrol engine. The power of the engine is 416,7 kW and 566,5 horse power. The power transmitted to the drive wheels (rear axle) is 327,8 kW or 445,7 horse power. The loss of power transmission from the rear wheels is 88,9 kW or 120,9 hp.
Maximum power is achieved at 6615 min^{-1} / 255,1 km/h.
Maximum torque is 783,9 Nm.
Maximum torque is reaching at 2805 min^{-1} / 113,4 km/h.
The measurement is carried out at air temperature Tair = 21,1 Co and relative humidity Hh = 34,1 %.

3. Conclusion:
Modern stands measure effective automotive performance and allow the development and implementation of new constructive ideas. With the help of these devices, designers get a real idea of a vehicle before it is put into operation.

REFERENCES:

[1] Bozhkov S.T., Stanev L.G., Kunchev L. Equipment CB-1 for rendering the performance of the ICE working with gasoline injection for research and educative-applied aim. International virtual journal for science, technics and innovations for the industry – MTM 2013", Issue 3, ISSN 1312-0226, pp.41-44, Sofia, 2013

[2] Slavcho Bozhkov, Boris Kirilov, Teodor Valev, Evelina Pircheva, Penko Bozhkov, Test Bench SAV-1 for Automated Management of the Automotive Gasoline Fuel Injectors, International Scientific Conference „MACHINERY AND CONSTRUCTION TECHNOLOGIES IN TRANSPORT" - 2018", Academic journal "Mechanics Transport Communication", ISSN 1312-3823 (print), ISSN 2367-6620 (online), volume 16, issue 3/3, 2018, article No 1676, pp.VI-36-VI-41, Todor Kableshkov University of Transport, Sofia, 2018

[3] Мутафчиев, М. Н., Термодинамични основи на Двигатели с вътрешно горене, 2011.

[4] Мутафчиев, М. Н., Двигатели с вътрешно горене, 2009

[5] https://en.wikipedia.org/wiki/Dynamometer

[6] https://www.setra.com/blog/test-and-measurement-dynamometer

[7] https://www.maha.de/cps/rde/xbcr/SID-C43E327B-76A1CEB4/maha_de/BRO_MAHA_POWERDYNO_EN.pdf

ДИНАМОМЕТРИЧНО ИЗМЕРВАНЕ НА ЕФЕКТИВНИТЕ ПОКАЗАТЕЛИ НА ПРЕВОЗНО СРЕДСТВО СЪС ЗАДНО ЗАДВИЖВАНЕ

Йордан Дерменджийски, Слвчо Божков
drmendzhiyski@gmail.com, stbozhkov@vtu.bg

ВТУ „Тодор Каблешков", гр. София 1574, ул. „Гео Милев" 158,
Катедра Транспортна техника
БЪЛГАРИЯ

Ключови думи: *динамометър, ефективни данни, въртящ момент, задно задвижване, превозно средство*

Резюме: *Динамометричното автомобилно измерване определя ефективни автомобилни параметри като: статично измерване на мощността при постоянна честота на въртене, имерване на статичната мощност при постоянна скорост, статично измерване на мощността при постоянна теглителна сила, динамично измерване на мощността с променливо ускорение, измерване на мощността при теглене на ремарке и др. Динамометричните автомобилни измервания и изпитвания имат висока степен на гъвкавост при използване поради голямото разнообразие от режими на работа, обхващащи всички области на приложение. Освен това съществуват съществени възможности за прецизно изчисляване на паразитните загуби в динамометъра, на силовото предаване на превозното средство и на загубите от триене на гумата по ролките на динамометъра. Включва се изпитване на тахометъра с до десет свободно избираеми точки за тестване. Измерването на разстоянието включва стандартна функция на хронометъра за измерване на ускорението между опционалните маркери за скорост. Допълнителна опция може да бъде симулация на натоварването със свободно програмируем профил на скоростта, възможност за съхранение на програмирани профили в база данни. В този доклад е представено практическото измерване на ефективните параметри на автомобил със задвижване на задните колела.*