

Differences in Brake Data Results on Ministry of Transport Roller Bank Testers Such as: Maha, Ryme, with Different Distance between Rollers and Roughness of Rollers

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Abstract: This study gives a comparison between what occurs when braking on a MOT (Ministry of Transport) brake tester. The results from this research and the exhaustive comparative study carried out by the mechanical engineering staffs at the mechanical laboratory at MOT stations in cities such as: Elche, Pilar de la Horadada and Orihuela from Alicante region [2] have led to the following main conclusions: this paper demonstrates that MOT brake testing results can vary depending on parameters variation such as: distance between rollers, roller diameter, roughness of rollers and velocity of the brake test.

Key words: Braking, MOT brake roller tester, roller tester, tyre pressure.

1. Introduction

This research deals with the study of the influence of MOT (Ministry of Transport) testers characteristics in the longitudinal braking test results. Six different MOT brake testers have been analysed, using the same vehicle for the test.

When a vehicle is taken to an MOT testing facility, this includes a brake test made on a roller bed to check the brake circuit. This research analyses how far the MOT brake tester parameters studied affect the measurements taken on the roller bed. The aim is to know if MOT brake tester correctly assesses the condition of brakes 100% efficiently or it can be obtained different results depending on the MOT brake tester used.

Therefore, the study is to find out a vehicle's braking capacity by measuring slippage on a brake tester at MOT centres, compare the measurements with other from other similar ones taken when none other

parameters from the vehicle vary. Finally results are used to assess the reliability of the machine in testing brake systems.

2. Testing Method

The vehicle used in the research was a Volkswagen Passat, diesel. It is equipped with advanced ESP (Electronic Stabilisation Programme) and the ABS (anti-lock braking system). ESP detects critical situations and acts fast to stop skidding before it begins. ABS stops wheels locking.

The test on the brake roller tester at the MOT centre is carried out by placing the vehicle on rollers. The emergency brake should not be actuated. The car stops on the roller bed [1]. Then the rollers rotate at 3-5 km/h of speed. This velocity is indicated in the "MOT procedure manual" [2] from Ministry of Industry, Tourism and trade of Spain (2006) [3]. Brake pedal will be pressed until 100% of slippage is obtained.

Each of these measurements was obtained by taking the average of ten braking data sets with the same conditions; dispersion of each group of brake

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measurements was less than 3%.

As can be seen in the pictures below, the brake testers have different characteristics

Tests on the three MOTs were performed with the same tyre: *Dunlop 215/55R16* tyre, with the same tyre pressure: 1.7 bar, to know that the differences obtained in the measures were not due to this parameters.

3. Results

The measurements obtained from tests were the brake measured from each wheel and the parking brake, and efficacy of each wheel.

A comparative analysis was made of the braking measurements for the same test carried out with different MOT testers, to see differences.

The six brake testers have different distance between rollers, roller diameter and roller roughness but all of them have the same rejection threshold because the minimum efficiency for all MOT brake testers is 50%.

Moreover, it has been demonstrated mathematically

that differences between roller testers might change brake force measurements. Finally, it has been checked if experimental data vary the same way as it is mathematically expected to do.

Then, a car could pass or not the test due to the brake tester used. Therefore, drivers could choose the MOT brake testers that offer higher probability to pass the brake exam. Finally, some vehicles with lower brake system conditions could pass the exam and be on the Spanish roads unsafely.



Fig. 1 Vehicle on the brake roller tester at the MOT centre of Pilar de la Horadada, Spain.

Table 1 3 MOT brake testers at Elche city.

MAHA RS2 MBT 4000		
Roller diameter (mm)	Distance between rollers (mm)	Velocity of the test (km/h)
202	430	2.3-4.6km/h
MAHA IW7 Serie MBT 7000		
Roller diameter (mm)	Distance between rollers (mm)	Velocity of the test (km/h)
265	475	3-6 km/h
MAHA IW2 RS5		
Roller diameter (mm)	Distance between rollers (mm)	Velocity of the test (km/h)
202	400	5 km/h

Table 2 1 MOT testers at Orihuela City.

MAHA IW2 RS2		
Roller diameter (mm)	Distance between rollers (mm)	Velocity of the test
202	400	5 km/h

Table 3 2 MOT testers at Pilar the la Horadada city.

RYME FRLNET		
Roller diameter (mm)	Distance between rollers (mm)	Velocity of the test
202	400	5.5 km/h
RYME FRU4		
Roller diameter (mm)	Distance between rollers (mm)	Velocity of the test
270	485	5 km/h 3 km/h

3.1 Braking Data Rejection Threshold

On the other hand, the braking force required to stop the vehicle on flat ground, whatever the tyre pressure, is always greater than that required on the roller tester, due to the fact that to stop moving the vehicle forward motion inertia must be counteracted [5], which does not happen on a brake roller tester.

The minimum brake efficiency to pass the MOT test is 50% for vehicles as stated in the directive 96/96 CEE [2], and the manual of MOT inspection of vehicles [3].

The efficiency is:

$$E = \frac{F_{total}}{m * g} * 100 \quad (1)$$

where, E = % of efficiency, Minimum = 50%; F_{total} = sum of braking forces of all wheels; m = maximum permissible vehicle mass in kg; g = gravity acceleration.

The minimum brake force on each front wheel to pass the test has to be:

$$F_{tot} = E\% * m * g / 100 = 50 * (890 \text{ front axle} / 2) / 100 = 222.5 \text{ daN}$$

On rear wheels:

$$F^{tot} = E\% * m * g / 100 = 50 * (615 \text{ front axle} / 2) / 100 = 153.75 \text{ daN}$$

3.2 Results and Discussion

Tests have been performed using 6 MOT brake testers, with different roller diameter and different distance between rollers, to analyze the influence of this parameter in brake data obtained.

From Elche city:

MOT Brake tester MAHA IW2 RS2 MBT 5000

MOT Brake tester MAHA IW7 Serie MBT 7000

MOT Brake tester MAHA IW2 RS5

From Orihuela city:

- MOT Brake tester MAHA IW2 RS2

From Pilar de la Horadada city:

- MOT Brake tester RYME FRLNET
- MOT Brake tester RYME FRU4



Fig. 2 MOT brake tester MAHA IW2 RS2 MBT 5000.



Fig. 3 MOT brake tester MAHA IW7 Serie MBT 7000.



Fig. 4 MOT brake tester MAHA IW2 RS5.



Fig. 5 MOT brake tester MAHA IW2 RS2.



Fig. 6 MOT brake tester RYME FRLNET.

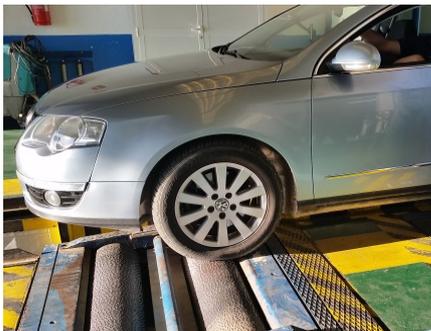


Fig. 7 MOT brake tester RYME FRU4.

Force data for each tyre at the six MOT testers are provided in figure.

Different force measurements were obtained by the sensor in six MOT testers indicated with the same **Dunlop** tyre with the same tyre pressure in the 4 tyres.

In the front axle the Maha IW7 MBT 7000 provided higher brake data values. The difference between the highest value (370 daN) and the lowest value (250 daN using a Ryme FRU4) is 32.4%.

The rear axle provides lower percentage of difference between measurements. The difference between the highest value (250 daN using Maha IW2 RS2) and the lowest value (205 daN using a Ryme FRLNET) is 18%.

So it can be concluded that this difference was obtained due to the variation of distance between rollers and roller diameter.

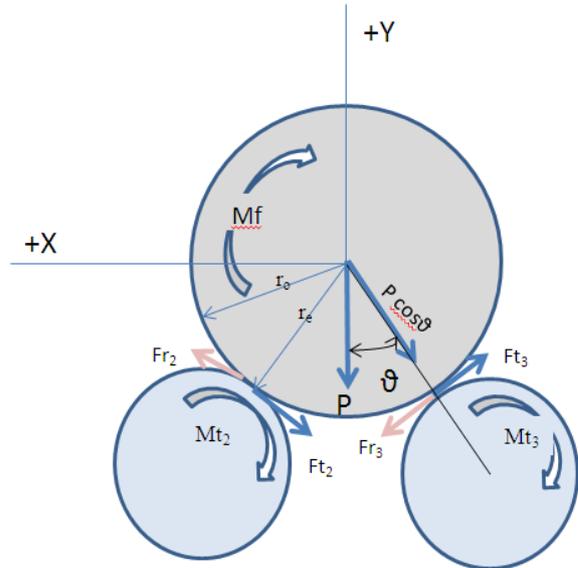


Fig. 8 Parameters in the brake test on rollers.

It has been proven that a vehicle will have the highest possibility of passing the test using the MOT brake tester MAHA IW7 Serie MBT 7000 in the first place. And in the other hand using the MOT brake tester RYME FRU4 the vehicle will have a lower possibility to pass the exam.

3.3 Mathematical Demonstration

To study the influence of: the distance between rollers, roller diameter and the roughness, firstly we have to analyze mathematically the parameters affecting the braking.

Because there is not advance I.

$$\alpha = 0 \tag{2}$$

$$Mf = 2 Mt - 2 \frac{\mu P r_e}{\cos \theta} \tag{3}$$

where, M = sum of moments; Mf = braking torque applied to the vehicle wheel; Mt = roller tractor torque, $Mt_2 = Mt_3 = Ft * r_{roller}$; μ = rollers roughness; P = weight on the wheel; Re = effective radius of the wheel = 332 mm; $\cos \theta$ = angle between the symmetry axis and the line between wheel-roller centers.

Parameters that vary from one MOT tester to other one are:

- Angle between the symmetry axis, due to the distance between rollers and Roller diameter

- μ = Rollers roughness

In order to calculate how much would vary the measurement due to a variation of distance between rollers (L) and roller diameter (ϕ), considering the wheel radius, for a 215/55 R16 tyre, is 321 mm.

If, θ angle = \arcsin ((distance between rollers/2)/(radius of tyre + radius of roller))

Table 4 presents % differences in brake test due to the distance of rollers.

For 1.7 bar tyre pressure 8% of difference in brake data measurements could be obtained due to the different distance of rollers and roller radio, as it can be

seen in Eq. (3): $\frac{\mu \cdot P \cdot r_e}{\cos \theta} 2^*$, If Mt is constant.

3.4 Varying Distance between Rollers

In Fig. 13, we see that the increase of distance between rollers and roller radius, affects the brake measurements at MOT-brake testers between 14-32% with 1.7 bar tyre pressure.

Maximum difference of measurements in each wheel:

So we can conclude that roller roughness variation (and contact patch variation due to roller radius) can vary results between 6-24%.

Table 4 Angles values at each MOT tester when tyre is inflated with 1.7 bar of pressure.

Diameter (ϕ) and Length (L)	MOT- ϕ 202/L400	MOT- ϕ 202/L430	MOT- ϕ 265/L475	MOT- ϕ 270/L485
	Maha: IW2 RS5, IW2 RS2, Ryme FRLNET	Maha IW2 MBT 5000	Maha IW7 MBT 7000	Ryme FRU4
Roller diameter	202	202	265	270
Distance between rollers	400	430	475	485
Sin	0.4739	0.5095	0.5237	0.5318
Arcsin	28.29	30.63	31.58	32.13
Cos	0.88	0.86	0.852	0.847
1/cos	1.1356	1.1628	1.1737	1.1806

Max Difference 4%

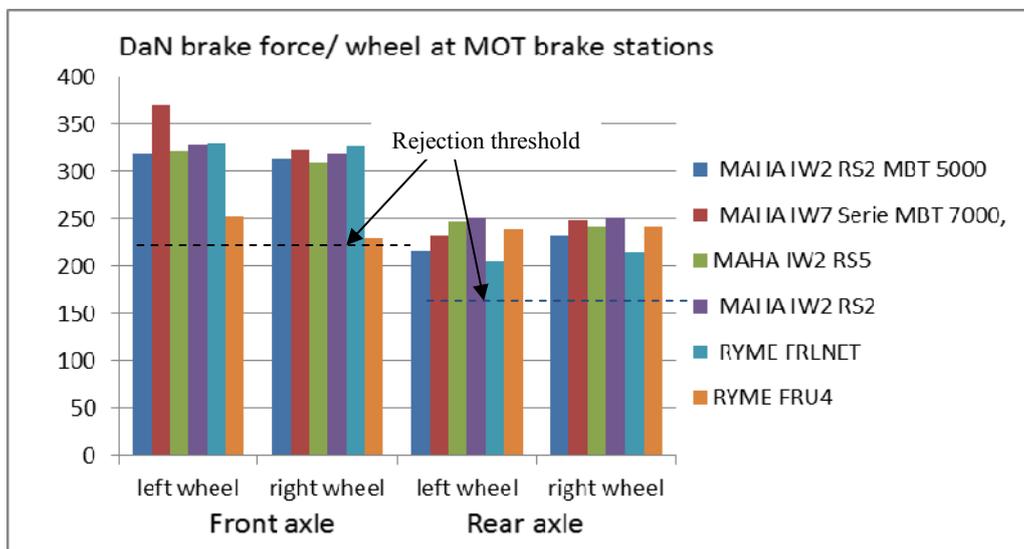


Fig. 9 daN of Brake force measured by 6 MOT brake testers.

Table 5 Maximum difference of brake data at MOT brake tester of each wheel.

	Front axle		Rear axle	
	Left wheel	Right wheel	Left wheel	Right wheel
	32.08%	29.97%	18%	14%

4. Conclusions

When the vehicle has been subjected to MOT testing equipment, an objective brake test would be expected, one not influenced by any other parameter. We only need to know if the brakes are in good condition or not.

The braking state is checked by measuring brake effectiveness. Efficacy must overcome a rejection threshold of 50%, which is the same for all Spanish MOT brake testers independent of the characteristics of the individual MOT brake test used.

We have obtained much experimental data which varies each time a parameter to study its influence on the measurement obtained is altered. So that, it has been demonstrated that depending on other factors, extrinsic to the brake system, the vehicle would exceed or not the threshold and it could not pass the test with brakes.

According to previous researches, the braking required to stop the wheel increases as tyre pressure increases at whichever MOT brake tester is used, when the same *Dunlop* tyre is used. Therefore, I was checked tyres pressure was the same in all measures.

Thus, it has been demonstrated that the measure of brake obtained at MOT testers depends on the condition of the brakes, but also on the tyre pressure and the time of testing on a MOT brake roller tester, the distance between rollers, the roughness of rollers and the weight on the wheel.

We can conclude that the same vehicle with the brake system in perfect condition can pass or fail the brake test, depending on which of the MOT testers were used because of the distance between rollers, or depending on the roughness of the rollers with the same tyre pressures. So it can be concluded that these parameters affect the brake measurements at MOT test

centers and distort the results of the brake test.

Thereby, we can cast doubt on the suitability of a brake roller tester to determine whether the brake system is in good condition.

In order to obtain better results from mot brake testers we recommend that all Spanish MOT stations should have the same distance between the rollers, the same roller surface, the same roller diameter and always control tyre pressure and the weight on the wheel. The better solution would be to use a mot brake tester without drag of the vehicle wheels.

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