

# STUDY ON THE FRICTION BETWEEN THE WIPER BLADE AND THE WINDSHIELD

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**Abstract:** *The windscreen wipers are used to assure a better driver visibility, to clean the frontal window-glass of the cars, but they can clean also the back window-glass. Usually the windscreen wiper mechanism is mounted in the lower part of the windscreen (because is more space). The paper presents the wiping performance test and evaluation the windshield wiper blade after the water and dry friction between this and the windshield, with different speed. After tests will be done, the results will be collect and compare, but in the paper present only the representative charts.*

**Key words:** *wiper mechanism, windshield, friction, wiper blade.*

## 1. Introduction

The windshield wiper mechanisms have as main purpose to assure optimal visibility conditions. They have to accomplish a series of conditions about cleaning area, but the long live for wiper components too. So, the windshield wiper blade must be made from a quality material for a long utility without deflection, striation, or any deflections [1-4].

The study of the friction between the wiper blades and windshield is a permanent concern and challenge, from theoretical and practical point of view. The subject is experimentally approached in this paper, by using a test stand (*Tribometer type TRM 5000*) with an adequate computer program (*TRIBO software*). The study was performed using the research facilities from the University of Konstanz (Germany).

## 2. Technical Requirements

The working operation of the windshield wiper mechanism is the reciprocating

motion of wiper blade from one limit line of effective wiping area to the other line. The part of a glass surface which is wiped off with wiper blade operation (effective cleaning surface) is composed by two zones (M and S), as shown in Figure 1 [5].

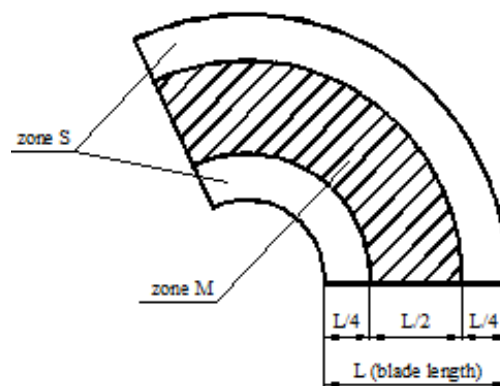


Fig. 1. *The effective cleaning surface*

Table 1 shows the number of un-wiped marks after wiping test shall not exceed the limit, where the terms used for evaluation have the following meanings:

<sup>1</sup> Schaeffler Romania.

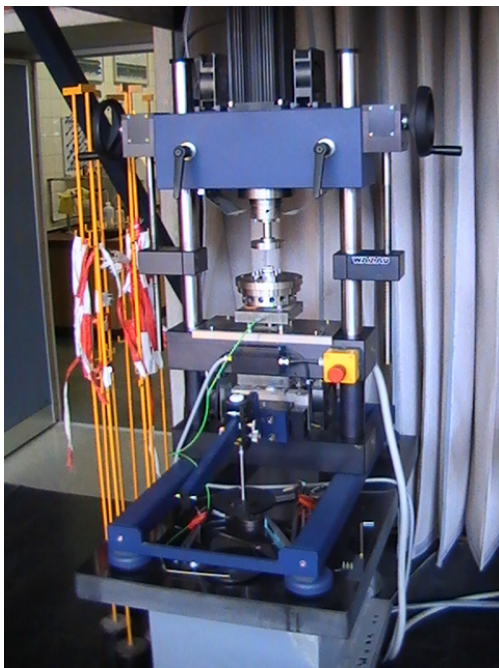
- heavier line - un-wiped area of width below 1 mm in a fine linear shape;
- wide line - un-wiped area of width about 1 ~ 20 mm in a band shape; it includes a group of fine and heavier lines and un-wiped membranes;
- hair line - un-wiped area of below 0.5 mm in a very fine linear shape;
- zone M - shaded portion of area wiped by blade movement (see Figure 1);
- zone S - wiped area other than Zone M (see Figure 1).

*The effective cleaning surfaces*

Table 1

| Zone M    |              |           | Zone S    |              |           |
|-----------|--------------|-----------|-----------|--------------|-----------|
| Hair line | Heavier line | Wide line | Hair line | Heavier line | Wide line |
| 3         | 1            | 0         | 5         | 2            | 0         |

The testing stand, which is based on a tribometer type TRM 5000 (shown in Figure 2), can use for simulation the friction and the wear proceeding to the friction solicitation plane. There can be analyzed the water friction (with more lubricant agent), wet or without lubricant fluid agent (the dry friction).

Fig. 2. *Tribometer type TRM 5000*

The principle of the experiment is to apply a force on the rotation axle of the wiper arm, and this is pushed down on the

fixed sample (i.e. the windshield). The both components (wiper arm with blade and windshield) are emplaced perpendicular on the rotation axle. The normal force is realized with a lever system that can be variable by displacing a rider weight at 0 to 5000 N.

The rotation drive is possible with a transmission without regulation step by a servomotor with 1 rpm ÷ 8000 rpm (rotations per minute).

The testing stand has in structure the driving motor and the loading components. All ensembles are fixed and guiding on two vertical supporting columns, because their position can be arranged on the vertical.

Also the windshield and the wiper arm can be in a closed basin that can get hot to 250 °C. In the time samples, there are continuously verified the nominal force (with a sensor), the basin temperature (with a NiCr-Ni resistance), and the quantity of the material wear.

The wear is evaluated by measuring the difference between the superior and the inferior samples. The measure is carried without contact, with an inductive sensor for measuring the linear dimension.

The friction is measured by a sensor that captures the driving motor. The measured signals are amplified and guided to the command unit, where will be further processed.

### 3. Experimental Work

The testing stand is connected to a desk computer where is installed the TRIBO software, which collect and transform the experimental data in digital format.

The input data for the experiment are represented by the normal force, the rotational speed and the ambient temperature, while the output measures are the torque, the friction and the wear of the wiper blade.

The rotation speed of the servomotor can be established in accordance with the user requirements. There can be used three different rotation speeds, corresponding with the specific operational regimes of the windshield wiper mechanism.

The arrangement of the wiper blade assembly on the wiper arm, and the normal force is similar to the real case.

The information about the friction between windshield and wiper blade can be collected from more contact points. Three contact points are used in this experiment: the middle of the wiper blade, where the wiper arm is connected (corresponding to the zone M), and the two wiper blade extremities (corresponding to the zone S).

To verify the measure value in real time, there is an analog output mode, which allows the connection to a voltmeter. The values of the input data for the experimental study are indicated in Table 2.

*Input data for testing*

Table 2

| The measure         | The range                       | U.M. | Analog OUTPUT tension |
|---------------------|---------------------------------|------|-----------------------|
| <b>Normal force</b> | (0 - 5000) N                    | N    | 5 N = 10 mV           |
| <b>Wear</b>         | ±1 mm                           | µm   | 1 µm = 10 mV          |
| <b>Torque</b>       | ± 0 Nm                          | Nm   | 1 Nm = 1 V            |
| <b>Temperature</b>  | (ambient temperature ÷ 1000) °C | °C   | 1 °C = 10 mV          |

Throwing out the motion of the servomotor is possible (commanded) after an initial determined time, or if the initial established wear is exceeded.

### 4. Results and Conclusions

The experimental results are captured considering the operating time of the servomotor of 30 seconds. The following graphics show the water friction between the wiper blade and the windshield, with three speeds (slow, medium and fast), for each of the three above mentioned contact points: the middle of the wiper blade (Figure 3), the blade extremity near the rotation axle of the wiper arm (Figure 4), and the blade extremity away from the rotation axle (Figure 5).

Afterwards, Figures 6-8 show the experimental results for dry friction between wiper blade and windshield, in the same points of interest.

The graphics from Figures 9 and 10 show the results (water friction, and dry friction respectively) for all three contact points, considering only the medium speed.

From the comparative analysis, the following conclusions can be formulated: low speed will result in fine friction (similar, high speed will result in hard friction); at the beginning of the experimental tests, the friction frequencies are rare, while towards the end they are more dense; the better friction is obtained in the contact point from the middle of the blade, while the slight friction is for the extremity away from the rotation axle.

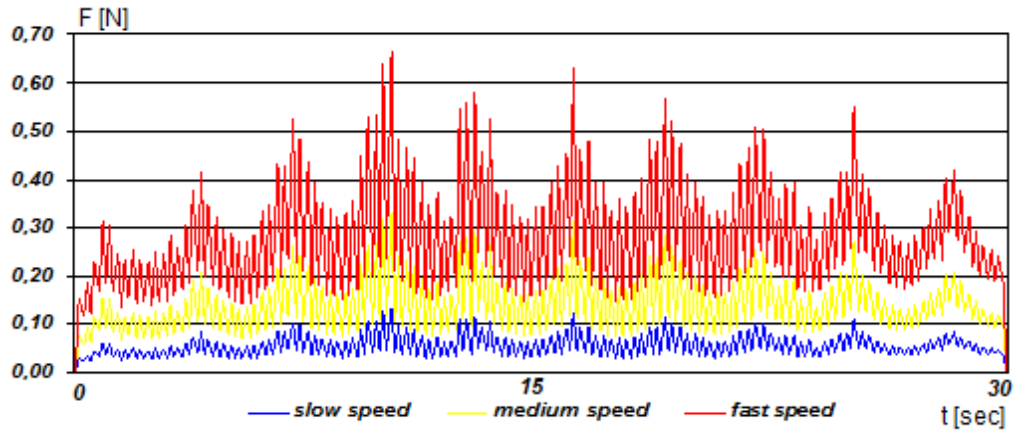


Fig. 3. The friction in the contact point from the middle of the wiper blade

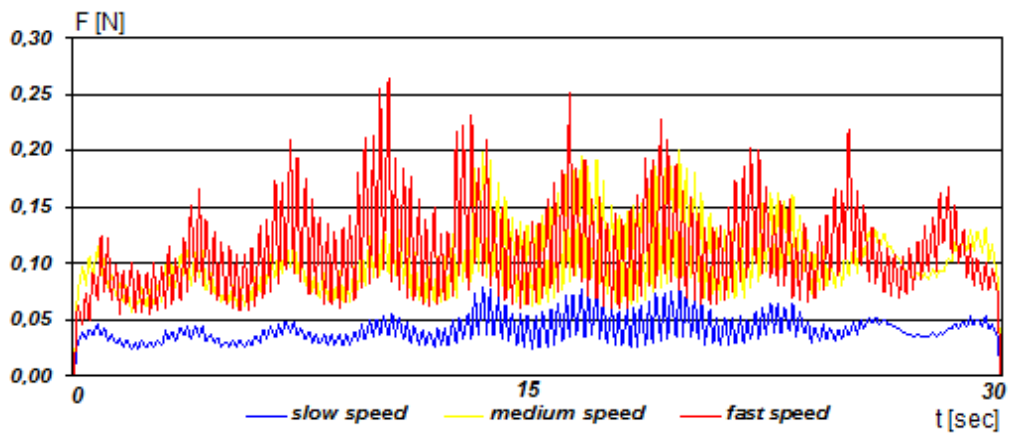


Fig. 4. The friction in the contact point from the wiper blade extremity near the rotation axle

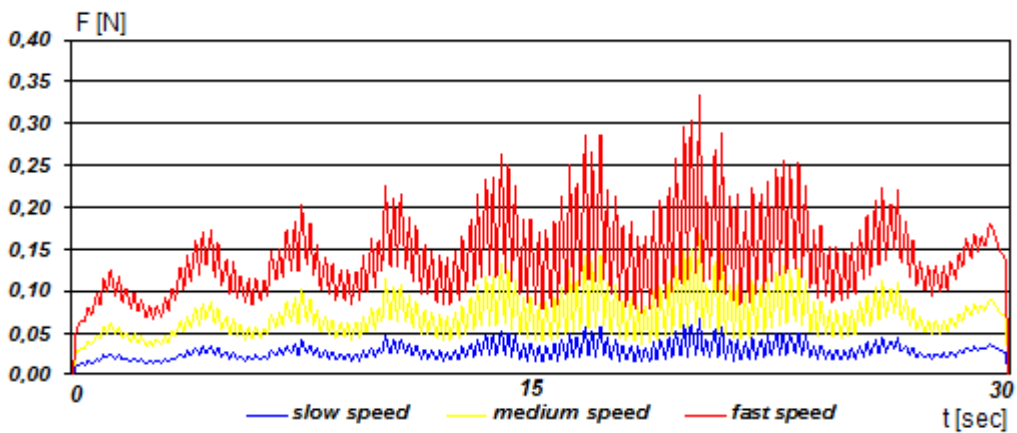


Fig. 5. The friction in the contact point from the wiper blade extremity away from the rotation axle

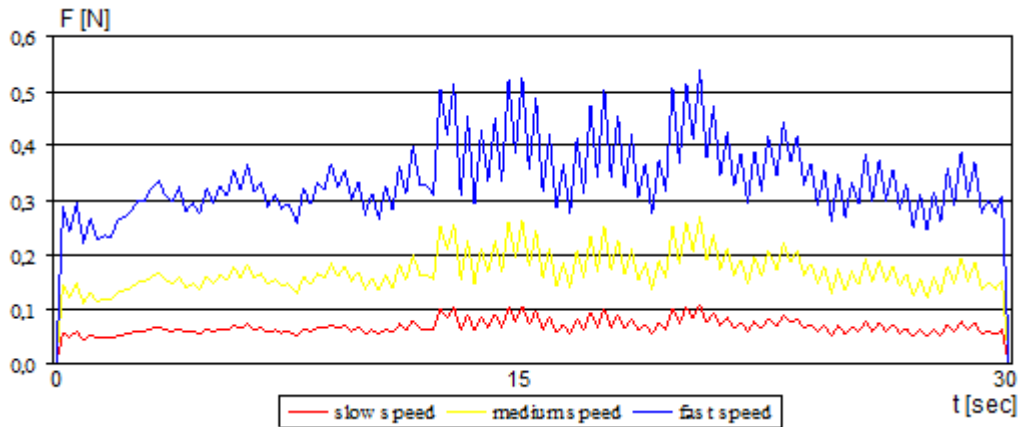


Fig. 6. The friction in the contact point from the middle of the wiper blade

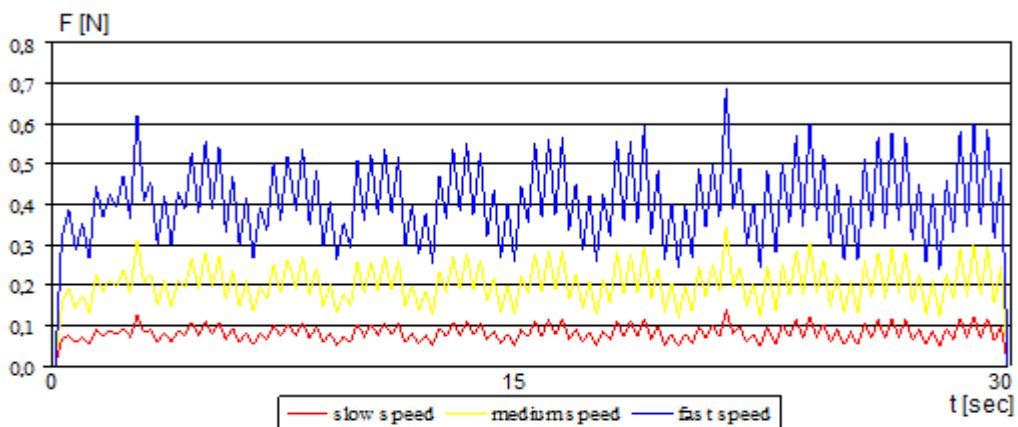


Fig. 7. The friction in the contact point from the wiper blade extremity near the rotation axle

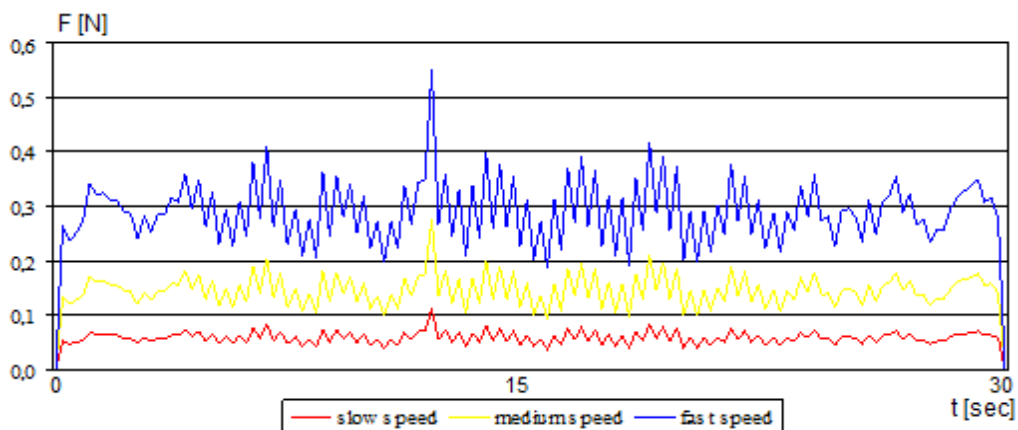


Fig. 8. The friction in the contact point from the wiper blade extremity away from the rotation axle

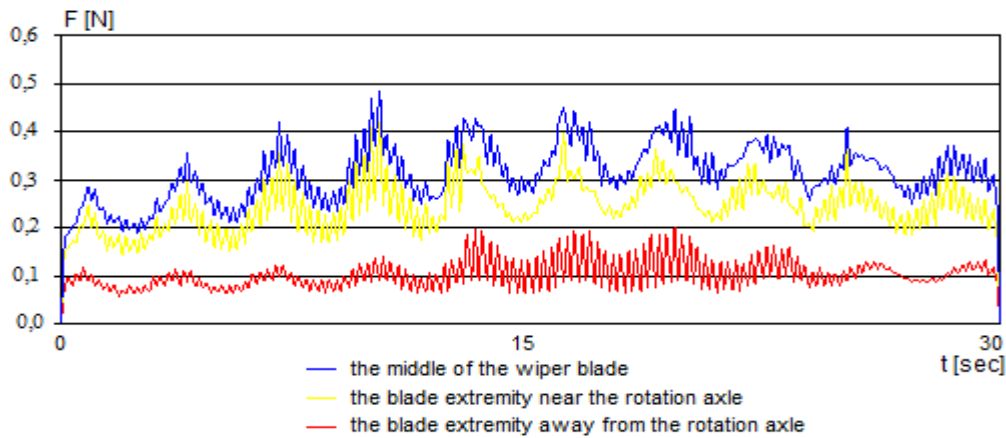


Fig. 9. The water friction in the three contact points of interest

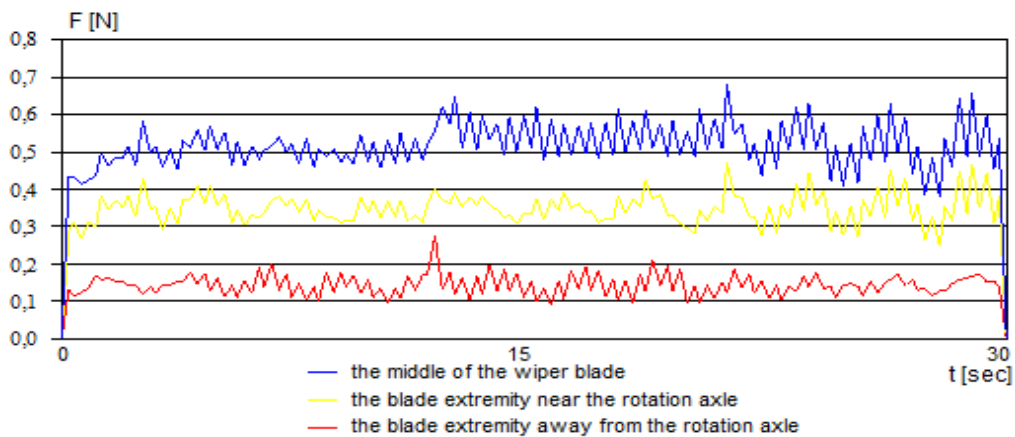


Fig. 10. The dry friction in the three contact points of interest

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