



AN INFLUENCE OF THE OPERATING CONDITIONS ON THE RELIABILITY OF SELECTED ELEMENTS OF BRAKING SYSTEM

Szymon SALAMON - Adam IDZIKOWSKI
Politechnika Częstochowska

Summary: New exploitation systems need to have information about feature's reliability behaviors during the time, by using it with the desirable level of reliability in different conditions. For needs of this article there was taken a try of studies on the influence of the work conditions, intensity of using and local and climatic zones on the durability and reliability of braking system. On the basis of the researches it was found that there is a big influence of the using conditions on the durability of elements of braking system. Decisive meaning has as well the influence of the intensity class's using which is more important than the climatic and local zones one.

Key words: braking system, durability, operating conditions.

INTRODUCTION

Contemporary braking systems of the heavy vehicles thanks to step-by-step evolution applied in those vehicles solutions is much more different than the really first one comes from before 50 years. Changes in this domain were caused rather by the exploitation practices than the growing fast requires of highway law. In some direct situations the durability of braking system rotate on its efficiency and effectiveness specified by the regulations which was insufficient. In motor trucks, buses and truck-tractors usually is being used pneumatic system of start brakes. Those vehicles need considerable braking powers which are not possible to poses from the hydraulic mechanism of start. With the heavy vehicles more often are being used pneumatic systems that have more complicated level than the hydraulic systems well known from the motor-car. The conclusion is that the part and parcel of braking system in motor trucks is pneumatic system which needs a special care.

In order to researches of the influence of operating conditions on durability of braking system elements we should estimate that durability of this single element in a particular class of the intensity of using.

THE CHARACTERISTIC OF THE BRAKING SYSTEM WORK CONDITIONS

The basic technical condition that has to vehicle fulfilled is the right efficiency of braking. It is express by the indicator which depends from the sum of the braking forces on the wheels and permissible mass of the vehicle. The right amount of the indicator of the braking efficiency doesn't mean that vehicle has an efficient braking system.

To carry through the researches in range of operating (work) conditions efficiency on the durability of braking system elements there must be estimated durability of particular element. This durability of single element must be done in particular classes of operating efficiency and in local and climatic zones as well. With this durability we simply understand the value of random variable what means run from the first damage. By damage we understand the loss of mechanic qualities. The durability of every braking system elements in operating intensity is being seen in the Table 1 (look at Tab. 1). The durability in climatic and local zones is being seen in the Table 2 (look Tab. 2).

**Tab.1.** The durability of selected elements of braking system in operating intensity classes.

Code number of the element	The number of the operating intensity classes				
	1	2	3	4	5
44001	100350	171950	283950	366110	499210
38035	89640	95850	102590	133600	139030
40040	80500	88900	96900	131100	128200

Source: S. Salamon: *The reliability researches of the car braking system. Not published doctor's work.*

Tab.2. The durability of selected elements of braking system in climatic and local zones.

Code number of the element	The number of the operating intensity classes				
	V	IV	II	I	III
44001	109140	87160	131350	136700	140500
38035	87510	94170	65520	101270	125120
40040	72480	70750	91950	93480	99960

Source: S. Salamon: *The reliability researches of the car braking system. Not published doctor's work.*

The durability dependence's of the elements: 44001, 38035, 40040 in the operating intensity of the classes functioning and the indicator of corrugating of the terrain can be decrypted by the linear dependence. The equations of those dependences are being shown suitably (look Tab. 3 and 4). The diagrams of simple linear regression are being seen on the 1 and 2 pictures.

Tab.3. The equation of linear regression of selected elements of braking system in operating intensity functioning.

Code number of the element	The equation shape
44001	$T = 97592 \lambda_m - 55662$
38035	$T = 13653 \lambda_m + 64356,5$
40040	$T = 13760 \lambda_m + 56960$

Source: S. Salamon: *The reliability researches of the car braking system. Not published doctor's work.*

Tab.4. The equation of linear regression of selected elements of braking system in the indicator of corrugating of the terrain functioning.

Code number of the element	The equation shape
44001	$T = -320743vSTK + 154648$
38035	$T = -235210vSTK + 119400$
40040	$T = -221980vSTK + 109030$

Source: S. Salamon: *The reliability researches of the car braking system. Not published doctor's work.*

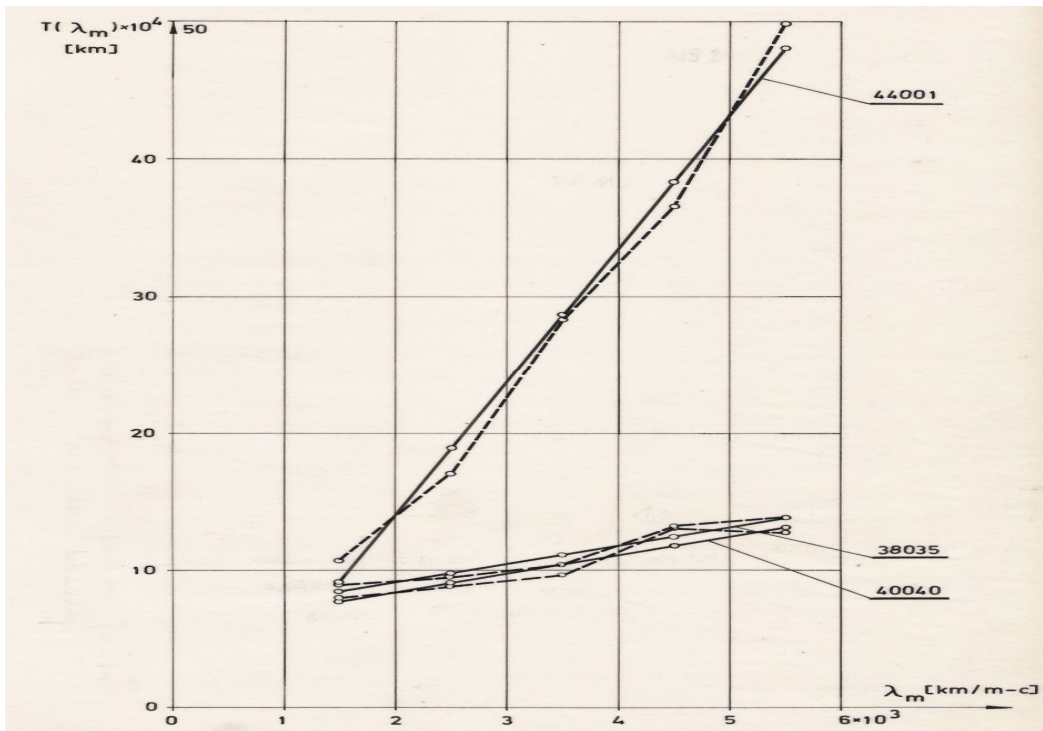


Fig. 1. The influence of operating intensity λ_m on durability of braking system's element
Source: S. Salamon: The reliability researches of the car braking system. Not published doctor's work.

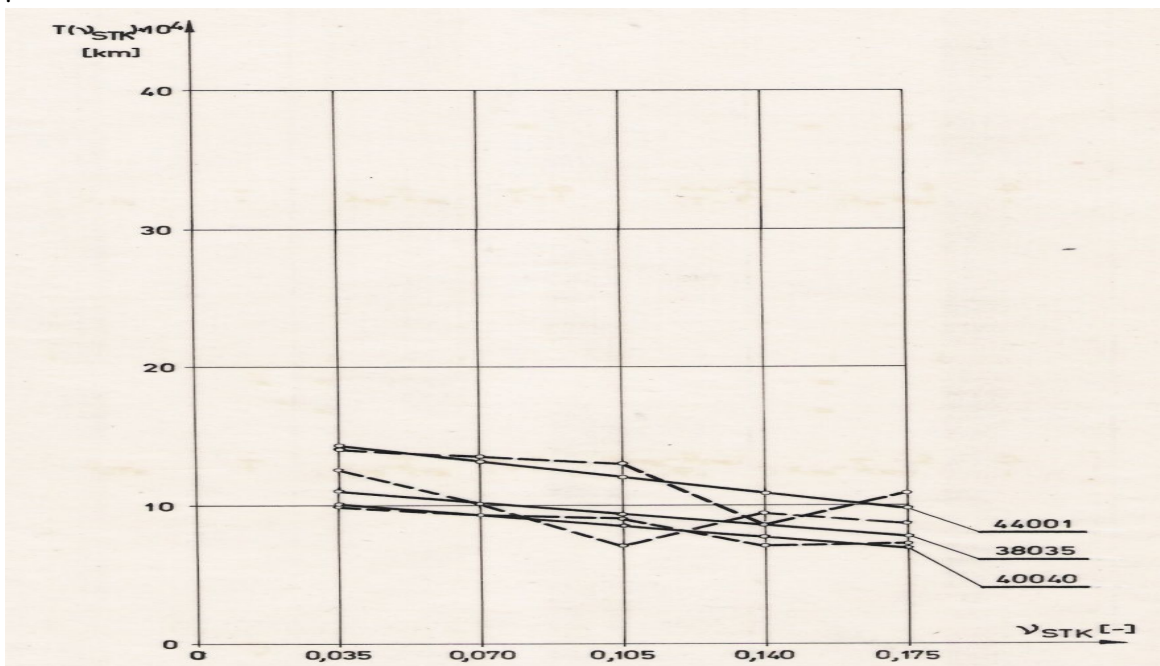


Fig. 2. An influence of hypsographic factor STK on braking system's element durability
Source: S. Salamon: The reliability researches of the car braking system. Not published doctor's work.

An empiric analysis dependence $T = f(\lambda_m)$ shows the not to much of random oscillations around the straight linear regression. The empiric dependence $T = f(v_{STK})$ shows big random oscillations around determined straight linear regressions [3].

On the basis of the results of researches we can put forward the conclusions below:

1. Exists clear influence of operating conditions on the durability of braking system's elements,
2. An influence of the operating intensity classes means more than climatic and local zones.

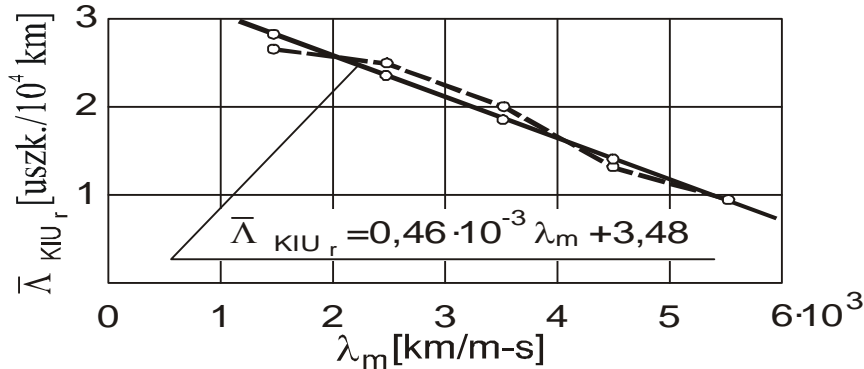


Fig. 3. The dependence of the average value of damage stream from the operating intensity λ_m
 Source: S. Salamon: The reliability researches of the car braking system. Not published doctor's work.

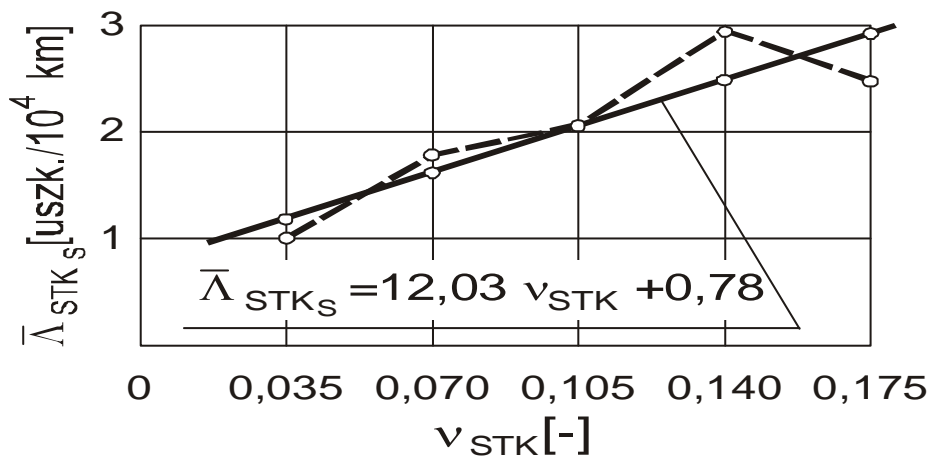


Fig. 4. The dependence of the average value of damage stream from the indicator of corrugating of the terrain v_{STK}

Source: S. Salamon: The reliability researches of the car braking system. Not published doctor's work.

DISCUSSION

The weak link determinates the reliability of the technical object. Assigned of the weak links and inserted specified technical or constructional changes can cause removal. This will lead to higher reliability of technical object. From the practice point of view the weak link - in dependence of the complexity level – can be named [3]:

1. service and operating system,
2. the set or the vehicle system,
3. the set's and the system's element.

CONCLUSION

1. Work conditions characterized by the operating intensity classes and local and climatic zones considerably influence on the braking system's damaged stream.



2. The reliability of braking system mostly is being determined by the low reliability features of the sets: drum break, break lever, pneumatic conduits, compressor and the pressure regulator with the safety valve.
3. The medium stream parameter of set's braking system damages is the highest for: drum break, break lever, pneumatic conduits, compressor and the pressure regulator with the safety valve.
4. Without failure run from the first damage of braking system and between the next can be enough decrypted by the exponential distribution.
5. The weak links of the Star motor truck brand are (on the level of set's complexity):
 - drum break,
 - break lever,
 - pneumatic conduits,
 - take-off break mechanism,
 - the pressure regulator with the safety valve,
 - compressor.
6. Analysis of the weak links exists of a braking system showed, that weak links group on elements more loaded by the working factor, for example: frictional strap of the break shoe.
7. To make the reliability of braking system higher some changes in range of production and attend quality as well as constructional and material changes must be put.

BIBLIOGRAPHY:

1. T. WRZESIŃSKI, Hamowanie pojazdów samochodowych, Wyd. II WKŁ, Warszawa 1992
2. E. BAŁAZIŃSKI, Współczesne układy hamulcowe ciężkich pojazdów użytkowych: autoEXPERT 4/97
3. S. SALAMON: Badanie niezawodności układu hamulcowego samochodu. Niepublikowana praca doktorska