ABOUT THE RELIABILITY OF THE STEERING SYSTEM OF A FORESTRY VAN

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Abstract

The capacity and quality of an auto vehicle service in the conditions of continous development o car fleet depends substantially on the operation characteristics of the steering system, as one of the elements tath assure the active safety in traffic. The steering system must assure the auto vehicle a good manageability, steering an stability by running during driving. To be able to accomplish these demands, the steering system components have a hight reliability during the entire period of usage. The maintenance and preservation of these qualities on a as long as possible period have been emphasized with the help of reliabillity indicators and parameters through adequate trials and experiments, developed on a 3,5 t utility cars lot.

Key words: steering system, reliability, pivot-nut-bearing

INTRODUCTION

In the conditions of continuous increase in the number of vehicles and their speed of travel, a very important part is the steering system of the vehicle.

The steering system of a vehicle must meet the following main requirements:

- to have a high yield - friction losses in the steering mechanism, spherical joints and bearings to be as small as possible - so the effort needed to change the direction is not great. At the same time, shocks from the runway they not to transmit at steering wheel, and be as low as possible in the steering system;
- to ensure an equal number of turns of the steering wheel for the same ray, of turning right or left;
- to ensure a minimum tilting of the steering wheels, so that their running on the surface of the road does not slip;
- not to allow wheels oscillations in a horizontal plane;
- the construction has to be as simply as posibly, allowing adjustment and easy maintenance and to provide safety in operation.

Reliability of the steering system can be appreciated directly by the way of how de requirements are primarly formulated.

MATERIAL AND METHOD

The subject of experimental research was established components of the mechanical steering system which equips a 3500kg utility car.

Table 1

Technical and constructive characteristics of the studied vehicle

Technical Characteristics		**Unit of measure**	**utility vehicle 3,5 t**
Dimensions of gauge	total length	mm	5200
	total width	mm	2020
	the hight without cargo	mm	2540
wheelbase		mm	3200
Gauge front/ behind		mm	1700/1700
Minimum Ground Guard		mm	220
vehicle weights	own	kg	1800
	total	kg	3500
	useful	kg	1700
Steering system		Steering Wheel and the steering column	The steering column consisting of two shafts connected to each other by elastic flanges
		Steering box	Snail globoidal and triple reel
		The steering transmission	bars formations and steering levers; steering trapeze is formed in front of front axle.

The tracking of the steering system's operating state has been achieved, in the case of a 3,5 t van on 73 pieces. The tracking time interval was extended to 1.5-2.0 years with a maximum route between 80000-250000 km, so an average annual route of 40000 to 150000 km was achieved.

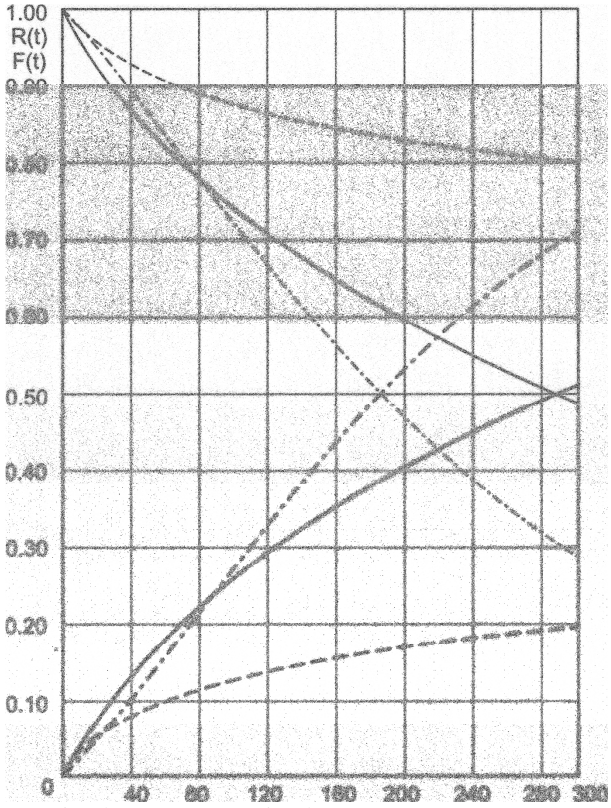
The steering system studied consists of the following three subsystems:

- Steering Wheel and the steering wheel shaft;
- The steering mechanism, or steering box, which is of the type snail globoidal and triple reel;
- The steering transmission from bars and steering levers, constituting steering trapeze.

Estimation of the values of the indicators and the reliability parameters was done using the Weibull distribution model, with graphical parameters being set using the Allan Plait diagram, being an operative method and with a sufficiently high accuracy for the objectives pursued.

RESULTS AND DISCUSSION

The steering system was designed for a utility vehicle model 3.5 t which was used in mechanical loading conditions less regarding of road system, instead very requested to the exploitation the steering system during the movement.



----------R(t) Steering box; F(t) Steering box
- - - - - - - - -R(t) spherical articulation; F(t) spherical articulation
- • - • - • - •R(t) pivot- nut- bearing; F(t) pivot- nut- bearing

Fig. 1. The reliability and non reliability functions for some components of the steering system to the utility vehicle 3,5 t for first cycle of operation
Working time [x10^3 km]

The experimental researchs have been made in the first cycle of operation, so until the appearence of the first defection to a studied

component. This way of working being motivated due to the high average running times in this exploitation cycle.

In Fig. 1 is presented the variation curves for the reliability function R(t) and the distribution function working time F (t) in depending with the working time, from which it results the high level on safety in operation of all experienced components.

Thus, to the group of parts pivot- bearing the reliability function has the value of 0,90, spherical articulation 0,92 and steering box 0,865 at working time 40000 km, and at 300000 km each of them still achieve an acceptable level of reliability in the order mentioned before of 0,29, 0,80 and 0,49, what can be considered a very positive result.

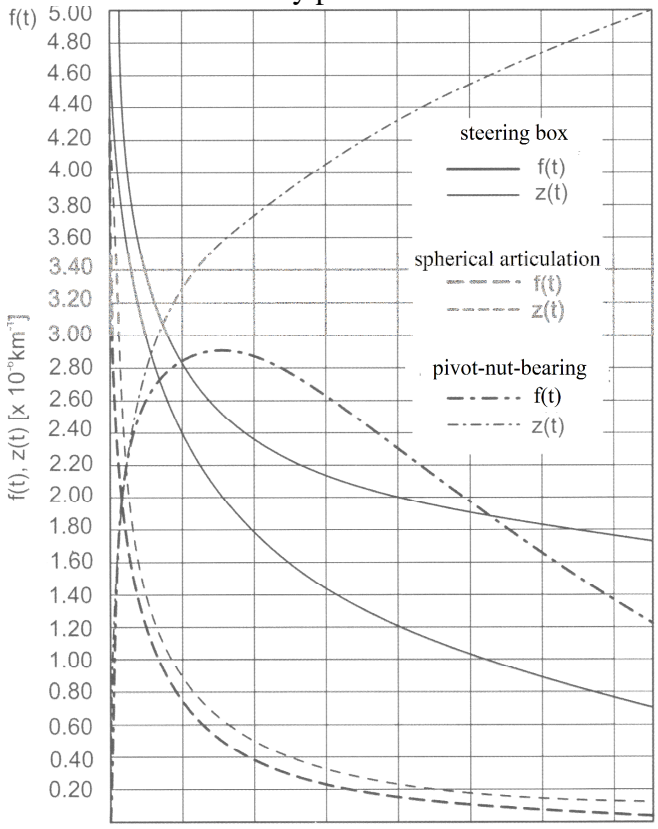


Fig. 2. The function of probability density of the working time and the intensity of malfunction for some components of the steering system to the utility vehicle 3,5 t for first cycle of operation Working time [x10^3 km]

This fact indicates that in the case where within the manufacturing enterprise as a result of technicals analysis, technologicals and of management thorough, suitable measures are taken, can be achieved favorable results for an acceptable level of reliability. The positive behavior of the steering system who equipped utility vehicle 3,5 t is emphasize in

Figure 2. In figure it can be remarked that and the intensity of malfunction z(t) and the function probability density of the working time, or decreases with increases the working time, or eventually have a slow growth in the first stage, how is in the case of z(t) for pivot- nut- bearing, realizing to the 300000 km route barely 5 •10-6km-1.

The favorable working conditions of the steering system components mounted on utility vehicle 3,5 t are well reflected and through the values of Weibull distribution parameters how and through the sizes of numerical reliability indicators and especially through the average working time.

Table 2

The values of the Weibull distribution parameters and the numerical reliability indicators for the steering system components of the utility vehicle 3,5 t.

The component name	**The Weibull distribution parameters**		**The numerical reliability indicators**		
	β	**η_v**	**m_v**	**σ_v**	**v**
pivot- nut- bearing	1,2	250000	235000	197470	0,84
spherical articulation	0,5	58000000	11600000	-	-
Steering box	0,8	450000	510000	-	-

The representation of the indicator curves and of the reliability parameters, it was based on the Weibull model with data for the utility vehicle 3,5 t.

In order to assess the reliability of the ensemble; steering system of the utility vehicle 3,5 t, based on the reliability logical scheme and the dependence between the reliability indicators have esstablished the reliability indicators and parameters having as the Weibull distribution parameters the values $\beta = 0,9$ şi $\eta = 130000$ km.

CONCLUSIONS

In case of the steering system which equipped the utility vehicle 3,5 t, after eliminating some of the technological manufacturing deviations of the reference value, respecting totally the prescriptions of dimensional deviations, the shape, position and the materials quality, there were obtained good resultates in improving the reliability of this system.

Through this experiment made at the utility vehicle of 3,5 t, it could be observed the importance of complying with the manufacture conditions and also of the stipulations regarding a rational exploitation with the preventive maintenance work at the scheduled periodicity.

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