УДК 531:535

G. V. Banzak, PhD, **E. A. Morozenko**

Odessa state academy of technical regulation and quality, c. Odessa

ANALYSIS OF WAYS AND METHODS DEVELOPMENT OF METROLOGICAL MAINTENANCE OF CONTROL AND DIAGNOSING TECHNICAL CONDITION OF VEHICLES

In clause ways and methods development of metrological maintenance of control and diagnosing technical condition of vehicles are considered, and also is shown, that technical, economic or technical and economic criteria should be put in a basis of a choice means of technical diagnostics of controllable parameters. And technical and economic criteria in the form of minimization the total resulted expenses or total specific expenses for operation, maintenance service and repair are preferable.
Keywords: motor transportation enterprises, maintenance service, metrological maintenance.

Introduction. The system approach to questions of management motor transportation enterprises (MTE) demands to consider a control system of quality maintenance service (MS) and repair as an integral part of management. The control system of quality MS and repair serves for maintenance at the set level of factor of technical readiness, non-failure operation, durability of vehicles, their effective use with the minimal financial and labour expenses. Thus, the control systems quality of vehicles is based on a complex of the actions including technical, economic, and others interconnected action on maintenance of tasks in view, directed on achievements of a high degree of quality.

The problem of quality at MS and repair of vehicles in many respects is defined by a level of metrological maintenance (MM). One of effective ways increases of operational parameters of vehicles is application of technical diagnosing. Technical diagnosing assumes definition of a technical condition of object of diagnosing with the certain accuracy. Therefore for maintenance of quality systems MS and repair of vehicles is necessary to use principles of metrological maintenance.

One of principal causes of decrease in efficiency of operation vehicles are [1, 2]: imperfection of a design of units, units, systems of vehicles; an insufficient level of maintenance service, repair and equipment means technical diagnosing of processes of maintenance service and repair of vehicles; non-observance of requirements on maintenance of necessary accuracy and unity of measurements. All the set forth above factors are object of research special branch of the knowledge carrying the name «technical diagnosing» and studying attributes of malfunctions vehicles, methods, means and algorithms definition of their technical condition without disassembly and besides technology and the organization of use systems diagnosing in processes of operation of a rolling stock [3]. Works of leading scientists of Sergeev A. G., Arinin I. N. are devoted to the given actual direction. However in works of the given authors of a technique purpose of admissions on controllable parameters do not consider an additional component of an error, therefore it is necessary to develop a technique of purpose of the admissions, allowing to define values of maximum deviations by criterion of maintenance mistakes of the first and second sort in view of the specified component.

The purpose of the given work is the offer of a technique on which ways of a choice of means the measurements based on maintenance of demanded values mistakes of the first and second sort, or the set completeness of the control, do allow to optimize their choice by technical and economic criteria with the purpose of maintenance of peak efficiency of the sold monitoring system and diagnosing.

Basic part. For maintenance of optimum values of the specified characteristics of developed system of diagnosing it is necessary to solve by development of metrological maintenance following problems [1-3]: choice, substantiation of accuracy and reliability of measurements; normalizations of limiting, supposed values of controllable parameters and management of characteristics of reliability at operation; typifications of accuracy control and diagnostic methods; estimations of influence of an operating time of vehicles on change of metrological parameters of the control and diagnosing.

The problems solved at diagnosing and the control which is a special case of diagnosing, depend on a stage of operation of motor vehicles [1] and are resulted on fig. 1.

Now separate techniques are developed for the decision of these problems. However the decision

of one separately taken problem without taking into account their interrelation reduces quality of systems diagnosing. For the decision of a problem diagnosing, it is required to expand a range of diagnostic parameters that leads to complication and rise in price of systems diagnosing. In the same consequences can result unreasonable increase of accuracy of measurement of parameters at a likelihood estimation quality of the monitoring system and diagnosing without taking into account cost systems technical diagnosing (STD). Separate consideration of the above-stated questions is caused first of all by complexity of received functional dependences between characteristics of spent measurements and criteria of efficiency of metrological maintenance.
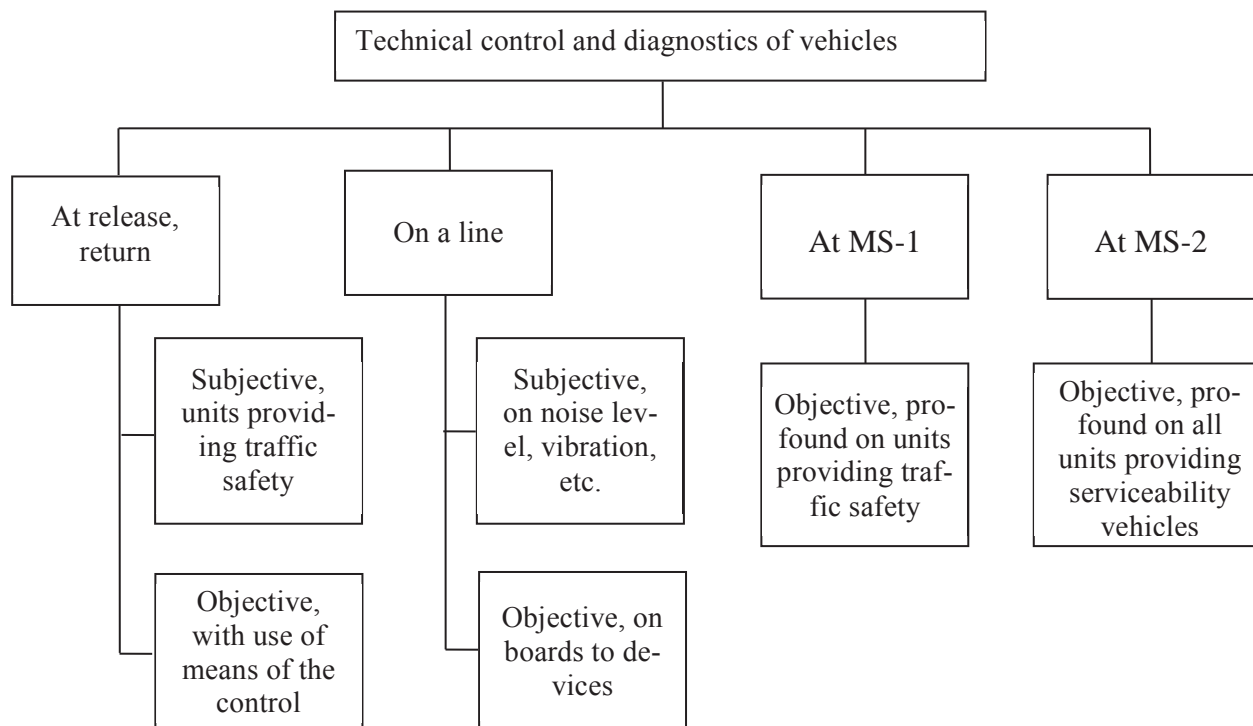

Figure 1 – Classification of kinds diagnosing used at definition technical condition of vehicles

The technique of choice STD of controllable parameters of the vehicles, described in work [1], on the basis of requirements of unambiguity, stability, sensitivity, informatively and adaptability to manufacture to controllable parameters is known. The named technique includes following stages: 1) the analysis of statistical data on operational refusals and malfunctions with the purpose to reveal the least reliable components and to establish most often repeating malfunctions; 2) an establishment of the scheme of structurally-investigatory communications; 3) a choice of a technique of search of malfunctions and algorithm of diagnosing.

However the given technique is developed on the basis of technical criteria and does not consider influence of mistakes of the first and second sort and loss, as a result of these mistakes, and also cost of sold system of diagnosing. Therefore, it does not allow optimizing choice STD of controllable parameters for maintenance of peak efficiency in view of demanded reliability and cost of a technical condition of vehicles.

Integral part of process of diagnosing is localization of malfunctions, t. i. their search and elimination. Thus search of the given up elements is conducted not before refusal, and in its assumption. Therefore algorithmization of search should be based on logic and a likelihood basis in view of functional communications between parameters of vehicles [1].

The structure of parameters, mainly, is defined by a method of search of the given up element. Methods of detection of refusal are subdivided into two kinds: 1. A method of display of faults at which the given up elements by means of gauges are automatically displayed; but at complex designs the diagnosed unit it possesses low efficiency; 2. A method of search where the given up element is defined by performance under the certain plan of some measurements. Two greater groups of search – combinational and consecutive distinguish [2-4].

At a combinational method the technical condition of vehicles defines on the basis of the set number of the control operations made in the any

order. Here malfunctions come to light after performance of all planned measurements by comparison and the analysis of the received results, t. i. on the basis of the analysis of results of a combination of measurements. The given method has important lacks – greater time expenses and consequently is seldom used.

During carrying out of consecutive search control operations are made when due hereunder, providing their most rational sequence. Thus the received values of parameters are estimated directly after performance of measurement and if the condition of system or unit is yet clearly certain the following under the order of measurement is carried out. The order of measurement can be strictly fixed (the ordered unconditional search) or to change depending on results of the previous measurements (conditional search). Average of the measurements necessary for localization of malfunctions, in the second case is less, than in the first, but all the same the logic of search at the ordered method is more complex. In this case efficiency of procedure of search also is estimated by means of size of probability of correctly diagnosing, depending from mistakes of the first and second sort. The mistake of the first sort arises, if the place of refusal is localized with an insufficient degree of a detail, and a

mistake of the second sort – at incorrect definition of a place of refusal.

By optimization of accuracy of measurements it is necessary to consider, that depending on their influence on results of the control it is necessary to measure separate parameters with a various error [1]. The size of this error will depend on parameter which reflects technical condition controllable systems of vehicles (for example, on the systems defining technical and economic parameters, a level of traffic safety, and operational characteristics of auto vehicles). For the account of the importance of separate parameters in this case in works [1-3] the way of definition of an admissible error of measurement as is offered to a part of a field of the admission on controllable parameter by means of factor ϕ^n, where $\phi = 1,6$ – factor of transformation; n – the order of transformation corresponding a category of accuracy of measurements. In work [1, 4] the analysis of categories of accuracy of systems of vehicles, which results is lead, are resulted in tab. 1.

1. A choice of means of measurement on factor of the specification, based on comparison of accuracy of measurement and the admission on controllable parameter.

Table 1 - Categories of accuracy components of the car

System (unit) of vehicles	The engine	Electric equipment	Frame, cabin	The back bridge	The forward bridge	Steering management	Brake system	Trunks	System of illumination and the signal system	Transmission
Category accuracy	3	3	4	3	2	2	2	2	2	3
The order transf.	2	2	1	2	3	3	3	3	3	2

2. The choice of measurement means by a principle of the faultlessness control [1] assumes definition of factor of specification on the basis of maintenance of the set probabilities of mistakes of the first and second sort.

3. The choice of means of measurement on technical and economic parameters is preferable at the operational control and diagnosing of vehicles as allows to consider, both metrological characteristics of means of measurements, and technical and economic parameters of operation vehicles.

4. It is known [4, 5], that with increase in an operating time of vehicles, dispersion of values of

the controllable parameters describing a technical condition of systems of vehicles increases. Thus metrological characteristics of diagnosing on these parameters change. Thus, not considering area of small operating time, requirements to metrological parameters of diagnosing should raise.

Conclusions. The analysis of existing techniques of development of metrological maintenance of vehicles has shown that the question on optimization of metrological maintenance of diagnosing of a technical condition of the vehicles which are being operation on the basis of maintenance of a maximum level of quality of spent diagnosing was

not considered. There are no techniques allowing to choose STD controllable parameters by criteria of reliability, cost, productivity of the control. Also not solved questions are the account of probabilities of mistakes of the first and second sort at greater operating time of vehicles, and as consequence of this change of investigated characteristics in cases of the direct and indirect control, and also over carrying out of diagnostic operations. Besides there are no the mathematical expressions, allowing to estimate sizes of mistakes of the first and second sort in conditions of repeatability and reproducibility at realization of standard methods of measurements at carrying out of diagnostic operations.

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Г. В. Банзак, к.т.н., **Є. О. Морозенко**

АНАЛІЗ СПОСОБІВ І МЕТОДІВ РОЗРОБКИ МЕТРОЛОГІЧНОГО ЗАБЕЗПЕЧЕННЯ КОНТРОЛЮ І ДІАГНОСТУВАННЯ ТЕХНІЧНОГО СТАНУ АВТОТРАНСПОРТНИХ ЗАСОБІВ

У статті розглянуті способи і методи розробки метрологічного забезпечення контролю і діагностування технічного стану автотранспортних засобів, а також показано, що в основу обирання засобів технічної діагностики контрольованих параметрів мають бути покладені технічні, економічні або техніко-економічні критерії. Причому вважаються за кращі техніко-економічні критерії у вигляді мінімізації сумарних приведених витрат або сумарних питомих витрат на експлуатацію, технічне обслуговування та ремонт.

Ключові слова: автотранспортні підприємства, технічне обслуговування, метрологічне забезпечення.

Г. В. Банзак, к.т.н., **Е. А. Морозенко**

АНАЛИЗ СПОСОБОВ И МЕТОДОВ РАЗРАБОТКИ МЕТРОЛОГИЧЕСКОГО ОБЕСПЕЧЕНИЯ КОНТРОЛЯ И ДИАГНОСТИРОВАНИЯ ТЕХНИЧЕСКОГО СОСТОЯНИЯ АВТОТРАНСПОРТНЫХ СРЕДСТВ

В статье рассмотрены способы и методы разработки метрологического обеспечения контроля и диагностирования технического состояния автотранспортных средств, а также показано, что в основу выбора средств технической диагностики контролируемых параметров должны быть положены технические, экономические или технико-экономические критерии. Причем предпочтительными являются технико-экономические критерии в виде минимизации суммарных приведенных затрат или суммарных удельных затрат на эксплуатацию, техническое обслуживание и ремонт.

Ключевые слова: автотранспортные предприятия, техническое обслуживание, метрологическое обеспечение.