Ensuring the safety of transportation of goods for the needs of industry and agriculture taking into account the climatic and territorial characteristics of Russia

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Abstract. To ensure the safe transportation of agricultural products and raw materials, it is necessary to regularly monitor the condition of the vehicles used for this. This article analyzes the current statistics on the fleet of vehicles in Russia, taking into account technical malfunctions at the end of 2020, as well as the prospects for the development of a safety control system for the structure of vehicles in operation. An updated position on the issue of making changes to the design of vehicles is presented. The monitored safety parameters of the vehicle structure are considered and described in detail. Conclusions are made about the most informative, less costly and, as a result, more effective means of control. It is indicated that the type and main technical characteristics of the means of technical diagnostics are not legally defined. Fulfillment of the requirements of the technical regulation of the Customs Union "On the safety of wheeled vehicles" 018/2011 will cover a significant stage in the life cycle of a vehicle.

1. Introduction

It is essential to monitor the condition of vehicles used for transporting goods for the needs of industry and agriculture. The condition of the vehicle should be regularly assessed and maintained.

Since 2007, Russia has recorded a steady downward trend in the number of road traffic accidents, despite the growth of the vehicle fleet (Figure 1). According to many experts, one of the reasons affecting the safety of a vehicle is the diagnosis of a good condition, which is checked during a technical inspection. The obligation to maintain the vehicle in good condition rests with the owner or the operating persons and largely depends on the quality of maintenance and repair, on the quality of the components used in this case. At the moment, there is a dangerous situation when car owners do not provide vehicles for a real technical inspection, and there is also a tendency to ignore the requirements for repair and maintenance. In our country, the norms for the frequency of technical inspection are one of the most liberal in Europe. Based on the above, a revision of the frequency of the technical inspection is required depending on the operating time (mileage) [3].
Since 1987, Russia has been a party to the 1958 Geneva Agreement establishing safety requirements for the construction of wheeled vehicles (WP.29). Also, the Russian Federation joined the Vienna Agreement of 1997, which established the requirements for technical inspection of vehicles participating in international traffic. In addition to international agreements, the Treaty on the Eurasian Economic Union has been in effect since 2014, according to which uniform principles and mandatory requirements in standardization, metrology, accreditation, conformity assessment, supervision (control), elimination of technical barriers and general safety are established. Based on the Agreement on common principles and rules of technical regulation in the Republic of Belarus, the Republic of Kazakhstan and the Russian Federation, a base of technical regulations was created, one of which is the technical regulation of the Customs Union "On the safety of wheeled vehicles" (TR CU 018/2011), approved by the decision Commission of the Customs Union dated 09.12.2011 No. 877, which has been in effect since 2015 [4].

2. Results
The main instrument for the implementation of technical regulations of the Eurasian Economic Union is interstate standardization. Within the framework of the technical committee for standardization "Road safety" ITC278 developed GOST 33997-2016 "Wheeled vehicles. Requirements for safety in operation and methods of verification", which was included in the evidentiary base of TR CU 018/2011, on the basis of updating by the decision of the EEC Board dated 25.12.2018 No. 219 and began to operate from 01.01.2020 as mandatory for all interested parties [5].

With the entry into force of the EAEU from 01.07.2021, GOST 33670-2015 must be used only for assessing the conformity of single vehicles, and for re-equipment it is worth developing and / or revising interstate standards for examination and control methods, taking into account the existing practice.

According to the State Traffic Inspectorate, at the beginning of 2021, the fleet of vehicles by categories is distributed as follows: cars - 78.54%, trucks - 10.47%, trailers and semi-trailers - 5.94%, motor vehicles - 3.7% and buses - 1.35%, and in terms of service life: 29.79% - less than 5 years, 21.27% - 5-10 years and 48.94% - more than 10 years.

An analysis of the statistics of accidents due to a technical malfunction shows that before the transfer of authority to conduct a technical inspection to organizations accredited by the professional association of insurers (PCA), there was a systematic decrease in accident rates for this reason, and, since the transfer of authority, the number of accidents increased sharply, and the severity of their consequences increased [1, 6].
With the strengthening of supervision and the normal functioning of the system, the accident rate due to unsatisfactory technical condition can be reduced to a minimum determined by the frequency of sudden undiagnosed failures of vehicle components.

Thus, technical inspection has ceased to be an effective tool for increasing the safety level of vehicles in operation. The number of documented diagnostic cards entered into the Unified Automated Information System for Technical Inspection does not correspond to the number of practically performed works and the actual throughput of more than 5.5 thousand operators of technical inspection [7].

It is necessary to involve the expert community to develop accreditation criteria and confirm the competence of technical inspection operators, which should take into account the minimum cost of providing the service, the operator's production capacity, photo and video recording and the identification and subsequent ban on the work of unscrupulous employees and founders.

The existing system of technical inspection in Russia requires modernization through the formation of state policy. Strengthening state control over the procedures for its implementation and taking measures to exclude falsification of the result of technical inspection, will save the lives of citizens and reduce the number of insured events.

Thus, during the operation of road transport in Russia, a number of problems arose that require an early solution. Among them: - proper technical inspection with the identification of unauthorized re-equipment, - lack of sufficient infrastructure of technical inspection points to check the technical condition in operation, as well as accredited persons and experts for the constituent entities of the Russian Federation, - untimely renewal of the fleet, including the replacement of vehicles released for the market Japan ("constructor", "cuts", lighting equipment, calling emergency and emergency services), to structures that meet modern safety requirements and state support - uncontrolled maintenance and repairs (service) of vehicles in operation, outside dealer stations.

An integral part of the vehicle operation process is the need of car owners to modernize the structure. So, during the period of the technical regulation of the Customs Union, about 200 thousand safety certificates of vehicles conformity to safety requirements are issued annually by the technical supervision departments and there is a steady tendency towards an increase in these indicators. It is estimated that the number of vehicles in which design changes have been made is at least twice higher, and there is a steady upward trend in these indicators.

From the terminology point of view of the proposed terminology, making changes to the design (re-equipment) is an adaptation of a wheeled vehicle:
- to the specific conditions for the performance of transport work (operation);
- to specific types of passenger and / or cargo transportation (specialization);
- to individual needs and tastes, in order to optimize (improve) the technical parameters that satisfy the desires of the end user for the use of a unique design ("stylization" or "customization");
- to extend the service life of an existing vehicle, including in the absence of discontinued components (modernization) while ensuring road safety [8].

Changes to the vehicles design are carried out in two cases: the creation of a single vehicle before release into circulation in the form of individual technical creativity (tuning), or in the form of additional equipment or so-called "re-equipment" at the operational stage (modification). The main criterion for classifying an impact as a retrofit is the maintenance of the original support system or base vehicle.

Re-equipment in Russia has become widespread, and the main reasons for the "re-equipment" are:
- insufficient nomenclature of vehicles for the intended purpose;
- limited opportunities of subjects;
- significant service life of the fleet;
- termination of the production of components.

What unites international experience and ours is that everywhere expert organizations are involved in the assessment - testing laboratories or inspection bodies (TÜV, DEKRA, etc.) According to ISO
verified measuring instruments, certified software, certified auto components are used, and a complete vehicle checked for operational safety during technical inspection.

By analogy with international experience, as well as taking into account the climatic and territorial characteristics of Russia, a whole chain of organizations is involved in the approval process, including services, technical inspection points, accredited persons and authorized traffic police departments. (Figure 2).

The presented block diagram implies two visits to the road safety department and to the laboratory, one before the change, and the second after. In this case, admission to operation is carried out on the basis of a certificate.

![Algorithm for the procedure for registration of design changes at the operational stage in the Russian Federation](image)

**Figure 2.** Algorithm for the procedure for registration of design changes at the operational stage in the Russian Federation

For conformity assessment during conversion, the accredited person's engineering personnel use the following assessment methods: expert judgment, calculation method and experimental method. That is, if one method is not enough, then the next one is consistently applied. The use of this set of methods makes it possible to effectively assess the safety of the vehicle structure, increase the accuracy and validity of the examinations and tests carried out.

It should be noted that according to GOST 15150-69 "Machines, devices and other technical products. Versions for different climatic regions. Categories, conditions of operation, storage and transportation in terms of the impact of climatic factors of the external environment "for Russia, it is necessary to take into account climatic features leading to an inevitable rise in the cost of the structure, as well as a shortage of materials and component base for conditions of high and low temperatures. It should also be noted that it is impossible to operate vehicles with high environmental characteristics at extreme temperatures.

In the current TR CU 018/2011, there are no requirements for climatic design. But it is obvious that the critical units, assemblies and systems during the operation of road transport at low temperatures are: - Engine; - Supply system; - Steering; - Transmission; - Chassis; - Brake system; - Ventilation and heating; - Electrical equipment; - Glazing; - Power supply systems. And the main problems in operation are: - Increased wear of parts; - The fragility of materials; Deterioration of the physical characteristics of technical fluids and failure to achieve the specified design parameters.

In this direction, it seems expedient to use the experience of the USSR and modify the standard GOST 16350-80 "Climate of the USSR. Zoning and statistical parameters of climatic factors for
technical purposes "(included in the evidence base TR CU 001/2011 railway transport) and include GOST R 50992-2019" Automobile vehicles. Climatic safety. Technical requirements and test methods "into mandatory application for the purpose of fulfilling the requirements of TR CU 018/2011 by updating the lists of standards.

![Figure 3](image)

Figure 3. Justification scheme for equipping a testing laboratory for evaluating complete vehicles in operation during retrofitting

To ensure the territorial availability of the conformity assessment procedure for the constituent entities of the Russian Federation, a list of equipment is proposed that combines equipment for checking the technical condition of a vehicle in operation and evaluating individual vehicles, which in most cases is available at existing technical inspection points. Thus, it seems expedient to equip the existing technical inspection points with the missing equipment and accredit them with the Rosaccreditation Agency, which is planned to be done within the framework of the technical
inspection reform.

The list of equipment for such accredited persons is based on the principle of a sufficient set of tools for technical diagnostics in operation to carry out safety checks of vehicles in operation during conversion.

The type and main technical characteristics of equipment for performing safety checks on converted vehicles and trailers for them are not legally defined, but should represent the total set of equipment for technical equipment, service stations and testing laboratories for evaluating individual vehicles (Figure 3) [9].

Thus, the presented methodology is available on the technological basis of tests (measurements), in it only tests with a labor input of no more than 8 people × h are permissible, performed on sites of limited dimensions, in real and test modes, without assessing the deformability of the body, with the minimum allowable disassembly component parts.

3. Conclusions

It is essential to monitor the condition of vehicles used to transport goods for the needs of industry and agriculture. The condition of the vehicle should be regularly assessed and maintained. Statistics and world experience show that the re-equipment has become massive.

On the basis of a comprehensive assessment of technical regulation, ways of further improving the system of control and supervision of the structure in operation and re-equipment, taking into account climatic and territorial features, are presented.

The prerequisites for electronic digitalization of processes have been substantiated.

The substantiation of equipping with equipment for performing safety checks of complete vehicles, based on the objects of verification, is presented, which allows organizing monitoring of the capabilities of accredited persons (Rosaccreditation Agency) and developing a national provider of interlaboratory comparison tests.

It is advisable to develop and approve the appropriate procedure for scientific and technical expertise of domestic and foreign diagnostic equipment.

Availability of verified methods and a list of measuring instruments and auxiliary equipment for evaluating the re-equipment makes it possible to ensure the availability and effective control of re-equipped vehicles by subjects, by re-equipping the technical inspection points with the missing equipment with further accreditation as testing laboratories.

It is necessary to develop modern requirements for the technology of work to check the technical condition of the vehicle during technical inspection and, in particular, to work out the issue of introducing into the requirements for the technology of work as mandatory means of technical diagnostics - a scanner of the on-board diagnostics system and a device for measuring the mass and dimensions of the vehicle and recommend suspension and wheel alignment control stand.

Use of equipment type elements for voluntary certification of maintenance and repair services according to OKPD2 codes by workshops carrying out work on making changes to the vehicle design.

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