Russian national non-commercial vehicle safety rating system
RuNCAP

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Abstract. The article is devoted to the need to introduce an independent rating system for assessing the safety of cars RuNCAP in the Russian Federation. The introduction of this system will make it possible to more fully take into account the Russian operating conditions when assigning ratings to passive and active safety. RuNCAP will contribute to the wider adoption of intelligent driver assistance systems and their efficiency. The development of RuNCAP is proposed to be carried out taking into account the analysis of the features of the accident statistics for the Russian Federation. The article also presents the development strategy of RuNCAP for the coming years.

1. Introduction
The car is a source of increased danger. Therefore, it is subject to mandatory certification. In different countries, certification is carried out in different ways, but the basic principle remains the same: certification sets the minimum requirements for the safety of the structure and includes checks of cars for compliance with international and national regulatory documents.

In addition to mandatory certification, since 1997, independent rating systems for assessing vehicle safety have appeared. First of all, they began to check and evaluate the achieved level of passive safety. With the advent of electronic systems for optimizing tire adhesion, such as anti-lock braking system (ABS), electronic stability control (ESC) or traction control system (TCS) etc., they began to take into account the active safety aspects of vehicles in their overall rating.

The most famous safety rating systems are EuroNCAP (The European New Car Assessment Programme [1]), ANCAP (assessment program for new vehicles sold in Australia and New Zealand), LatinNCAP (assessment program for new cars sold in Latin America and the Caribbean), ASEANNCAP (new car assessment program for Southeast Asia), JNCAP (Japanese new car assessment program), GlobalNCAP (international platform for collaboration between new vehicle assessment programs). It is obvious that there is no single rating system in the world. National and regional ratings have some similarities, but, at the same time, they are purely individual, suitable for the respective market.

In addition to safety assessment systems, there are also complex systems for assessing the consumer properties of cars, used, in particular, by journalists of popular automotive publications. However, the results obtained significantly depend on the conditions of the tests, methods, techniques and applied comparison criteria.

For different countries, these conditions, methods and criteria may differ significantly. In particular, the test conditions for India and Russia clearly cannot be the same. The most popular
European rating system for assessing the safety of new cars EuroNCAP [1] also cannot be applied in Russia or can be applied with a large number of limitations.

2. Organization of RuNCAP
Attempts to create Russian methods and test methods have been made for a long time. In particular, attempts are known to create techniques for the publication of "Autoreview" to determine the level of passive safety of cars (ARCAP) [2], resource, fuel consumption and other parameters.

In November 2018, an agreement was signed between the Central Scientific Research Automobile and Automotive Engines Institute NAMI, the Federal Agency for Technical Regulation and Metrology (Rosstandart), “Autoreview” LLC and the Federal State Budgetary Educational Institution of Higher Education “MADI” on the creation of a consortium to form a working group to develop a Russian rating system for assessing vehicle safety. The new structure, called RuNCAP, will have to eliminate the shortcomings inherent in the existing assessment systems, as well as take into account the Russian characteristics of operation and factors of interest to the Russian consumer.

At the same time, the European and American experience of such tests will in no way be denied, but will be used in full, taking into account the adjustment of the conditions and the elimination of the identified shortcomings [9, 10].

The development of RuNCAP is supposed to start with systems that characterize the safety of a car, without pretending at the first stage to assess its consumer qualities.

Work will be carried out on a new alignment of emphasis and taking into account the weight of the elements that affect the overall security picture, which are specific to Russia. In particular, special attention will be paid to the functioning of certain safety elements in the dark, at negative air temperatures, on unlit roads, in mud, rain, snowfall, fog etc.

At the same time, it is unacceptable to sacrifice the objectivity and reliability of these assessments. And this is the main difficulty in creating test procedures. Striving for absolute objectivity leads to costs for the development of the testing and metrological base. The development of RuNCAP will require a revision and significant expansion of the testing base of the NAMI test center.

3. Analysis of accident statistics in Russia
Russia has completely unique statistics of road accidents, not at all the same as in Europe or the USA. Based on the statistics of road accidents, which began to be published on the website www.stat.gibdd.ru [3], methods and test conditions will be developed that are specific to Russia, and also, possibly, to its different regions separately. An example of the analysis of such statistics, carried out using a specially developed technique on a representative sample, is shown in Fig. 1. It can be noted that a relatively large number of accidents with injured and dead occurs in severe road and climatic conditions.
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Figure 1. Analysis of traffic accident statistics on the territory of the Russian Federation in 2018
(type of accident - hitting a stationary obstacle)

4. Test procedure of AEBS by RuNCAP
The first fruit of the activities of the RuNCAP working group was the emergence of a method for
determining the effectiveness of the automatic emergency braking systems (AEBS). Research tests
were carried out to refine the technique. [4, 5, 6, 7]. The effectiveness of the AEBS is checked in the
daytime and at night using a special target that simulates the rear of the car (Fig. 2). The test result is
evaluated in credit points. During the test drive, the vehicle's movement parameters are recorded,
video recording of collision warning signals and video recording of braking are also carried out (Fig.
3). This technique can be found in detail on the website of the Association of Automotive Engineers
(AAE) [8].

Figure 2. Test maneuver according to RuNCAP method (day lighting conditions)
Figure 3. An example of parametric record of test run (the condition of area surface - is dry asphalt, the speed of approach is 70 km/h, light conditions are “Day” type):

- $V_1$ - is longitudinal velocity of an object at time of possible collision warning moment;
- $V_2$ - is an object speed at time of collision with the "target";
- $D_1$ - the distance between the object and the "target" at warning time of a possible collision;
- $D_2$ - the distance between the object and the "target" at the time of automatic braking start;
- TTC1 - time before collision at possible collision warning moment;
- TTC2 - time before collision at the moment of automatic braking beginning;
- the moment of visual signal switch on during the detection of an obstacle (orange bar);
- the moment of switching on brake signals on test object (red vertical line);
- the moment of collision of an object with a “target” (blue vertical bar).

5. Development strategy of RuNCAP

In the future, the RuNCAP rating system will be supplemented by taking into account the effectiveness of the AEBS on other types of targets (pedestrians, cyclists), as well as, in the longer term, in difficult road conditions (surfaces with a low adhesion coefficient, rain, snow, mud, fog, glare headlights, etc.). In the future, it is planned to evaluate the effectiveness of parking assistance systems, adaptive cruise control systems etc.

Also, a crash test (a series of crash tests) will be introduced into the RuNCAP structure, the parameters of which are currently being discussed and agreed by the interested parties. The conditions for conducting crash tests are selected taking into account the statistical data published by the traffic police in open sources [3]. Also, additional, specially collected statistical data are involved in the work to form and substantiate the parameters of the passive safety tests.

In contrast to the certification system, the RuNCAP rating system shows not only that the vehicle has passed the minimum safety threshold of the structure. It will allow one to compare the actual achieved level of safety of different vehicles. In the future, using RuNCAP, it will also be possible to assess the consumer properties of vehicles.

With the development of vehicle design, RuNCAP will improve in harmony with the entire automotive industry and science. With the advent of new driver assistance systems, as well as unmanned technologies [6], the independent rating system will also be improved. Also, as the road situation changes, the emphasis in safety assessment will shift, the weight of certain elements will change. RuNCAP will become a “living” system that will constantly be changing.
Significant investments are required to launch this system. The most likely source of these investments may be the state, since the widespread use of RuNCAP meets the goals and objectives of the state. However, one cannot but note the contradiction, which consists in the lack of independence of the assessment due to the participation of the state in the management of RuNCAP. Here the role of professional associations comes to the fore, and, in particular, the Association of Automotive Engineers (AAE). At first, RuNCAP will exist as a committee at the AAE.

6. Discussion
The first RuNCAP test programs are published on the AAE website [8] (including in English), and everyone is invited to participate in their discussion and change.

The first test results of the AEBS with the assignment of a rating score according to RuNCAP were published in the popular Russian magazine “Autoreview” [11].

Manufacturers considering RuNCAP test conditions will naturally have some advantage. Automakers and importers may oppose RuNCAP because it will force them to carry out additional tests and, accordingly, incur additional financial burden. These costs, in turn, will inevitably be transformed into an increase in the price (prime cost) of the car.

However, we encourage carmakers to familiarize themselves with the programs and methodologies and engage in constructive discussions. A broad constructive discussion of RuNCAP will enable its developers to take into account the opinion of manufacturers, as well as to promptly eliminate possible errors and inaccuracies.

Manufacturers could also share their experience in conducting their assessments of the safety and consumer properties of cars, for example, in the framework of AAE conferences.

The development of RuNCAP will require an expansion of the test base, including for the evaluation of unmanned vehicles, ADAS systems and new passive safety systems. And the main technical service for this will be the NAMI test center.

7. Conclusion
The creation of RuNCAP is already a fait accompli, and the only question remains: in what form will its development take place. RuNCAP will allow one to get objective ratings of car safety and create conditions for reaching a new level of marketing development in the automotive industry. Thus, RuNCAP will claim its role in the distribution and self-regulation of the non-commercial vehicle market. RuNCAP development is definitely worth the planned costs.

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