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PECULIARITIES OF PERFORMING EXPERT RESEARCH OF SRS CAR PASSIVE SECURITY SYSTEM FOR ESTABLISHING THE REASON NOT CAUSE THE FRONT BRAKE LOCK

Issues that arise from experts during the performance of court automotive expert assessments (expert researches) of technical condition of automobiles are considered, namely: SRS passive safety systems. The sequence of carrying out elemental research of the passive safety system of the SRS of cars on establishing the reasons for failure of the front (front) airbag of the passenger during a traffic accident is presented. The urgency of this paper is due, on the one hand, to the mass installation of airbags on cars of different brands, which are intended to protect the driver and passengers of vehicles from injuries during a collision, and on the other hand, frequent cases of not triggering airbags in the collision, associated as both for technical and operational reasons, resulting in serious injuries to the driver and passengers in the event of a collision. The increase in the level of constructive safety of the car, above all, is ensured by strengthening the requirements for the development, installation of structural elements and systems that provide protection of life and health of road users. Given the diversity of sources of risk factors for road accidents, constructive safety is divided into active, passive and after emergency. The examination of the technical condition of the SRS passive safety system is essentially a study of the vehicle electrical system requiring safety measures, since damage to the insulation of wires, shorting of individual circuits of electrical wires, and the introduction of extraneous current to the connectors can lead to the deployment of airbags during research.

Keywords: traffic collision, vehicle, passive safety system SRS, tensile safety belts, airbags, diagnostics of the SRS passive safety system, Road Accident Analysis, elemental research of the SRS passive safety system.

Formulation of Research Problem. The constant increase in the capacities and speeds of cars, the density of traffic of automobile flows, significantly increase the probability of occurrence of motor vehicle collisions (MVC). Therefore, there is a constant problem of improving cars in the direction of reducing the consequences of an accident.

According to the reports of the patrol police of Ukraine, it follows that in 2018 there were 150120 accidents in the territory of Ukraine, including 24294 road accidents with the victims – in which 3350 people were killed and 30884 people were injured. Reducing consequences of road accidents is ensured by the structural safety of the vehicle, the requirements of which are stipulated by regulatory documents, namely: ECE rules (they are the guest base); ISO (International Organization for Standardization) standards; EU (European Community) Directives; MVC; GOSTs etc.

Increasing the level of structural safety of the car is primarily due to the increased requirements for the development, installation of structural elements and systems that protect the life and health of road users. Considering the variety of sources of accident risk factors, it is customary to divide structural safety into active, passive and after emergency. Active, passive and after-accident safety are complex features that determine a car's ability to meet the accepted road safety standards. If we take the whole set of measures to ensure road safety 100%, then about 50-60 % of road safety is determined by the functioning of the active safety system, about 30% – the system of passive safety, less than 10-20 % – the system after emergency safety. The complex of the system «man-car-road-environment» when operating in road conditions can be represented by the open circuit of automatic control (see Fig. 1¹).

The initial input characteristic of the system «man-car-road-environment» is taken to be the speed of movement of the car V_a , the secondary is the action of force F_1 characterizing the emergency and the action F_2 of the collision object while MVC. In an accident, there are three phases: initial (approximation), climax (vehicle contact with the object of collision and moving the vehicle to a final stop), and the final one, the end of which is determined by the cessation of dynamic and any other impact on the car.

¹ *Gudkov V. A. Bezopasnost' transportnyh sredstv (avtomobili) [Safety of vehicles (cars)] / Ju. Ja. Komarov, A. i. Rjabchinskij, V. N. Fedotov : ucheb. posob. dlja VUZov. Moskva : Gorjachaja linija-Telekom, 2010. 431 s. [in Russian].*

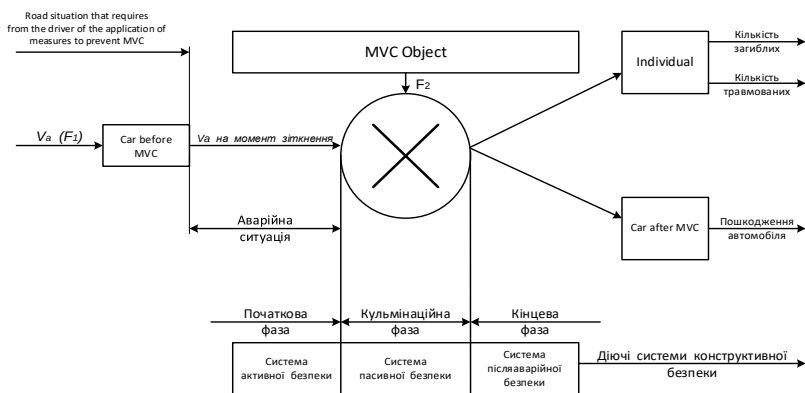


Fig. 1. Ensuring the security of the complex of the system «man-car-road-environment»

Thus, the passive safety system of the car is aimed at reducing the consequences of an accident at the moment of collision of vehicles, and the solution of the question of the reasons for the failure of the airbags is relevant in the investigation of cases related to an accident and their consideration in court. Testing the technical condition of the passive safety system SRS is essentially a study of the electrical system of the car, which requires compliance with safety measures, as damage to the insulation of the wires, short circuits of separate electrical wires, introduction of third-party current to the contact sockets can lead to the operation of airbags when conducting research. Electrical wiring of the SRS passive safety system can be detected by the characteristic yellow insulation¹.

Analysis of recent main research. O. I. Stabrovskiy, A. B. Razumov, V. Zhilinsky, V. I. Orphan, V. K. Vakhlamov, M. G. Shatrov, A. A. Yurchevsky and others. were engaged in the study of the passive safety system of SRS.

The **Article Purpose** is to conduct an in-element study of the passive safety system SRS of a modern vehicle.

Consider the sequence of studies of the passive safety system SRS car on the example of expert practice.

Main content presentation. Hon. Prof. M. S. Bokarius Kharkiv Research Institute of forensic examinations received a court order appointing a forensic auto-technical examination of the technical condition

¹ Ekspertne doslidzhennia systemy pasyvnoi bezpeky avtomobilia «SRS» [Expert study of the passive safety system of the car «SRS»] : zvit NDR (zakliuch.) / MiuU, LNDiSE ; ker. O. i. Stabrovskiy; vykon. : A. B. Razumov, H. V. Zhylynskiy. 011U002597. Lviv, 2011. 80 s. [in Ukrainian].

of the KIA-Carens car to resolve questions about the technical condition of its passive safety system and to determine the reasons for its failure.

The examination is assigned in a civil case on a lawsuit brought by a driver of a KIA-Carens P. car to an official representative in Ukraine for the sale of KIA cars. The driver of the KIA-Carens P., driving along the Kiev-Kharkiv-Dovzhansky highway, while choosing within the safe speed limits, did not take into account the traffic situation and the condition of the vehicle, thereby losing control of the car's movement, not coping with his driving and made an exit on the distribution lane, then left on the opposite side of the highway, where he collided with a car VAZ-2103, which was moving in the opposite direction.

Because of an accident, a passenger in the front seat of a KIA-Carens car was fatal and died on the scene of a road accident. In the statement of claim, the plaintiff stated that the passive safety system of the KIA-Carens car was technically malfunctioning at the time of the traffic accident, since the front (front) passenger airbag did not work when the vehicle collided, which in turn led to the death of the passenger, which was in the front passenger seat. Expert inspection of the KIA-Carens car was carried out at an official service station to resolve the issues. The inspection was carried out in the presence of representatives of the owner of the car and the car dealership where the KIA-Carens car was purchased.

External review of the KIA-Carens study showed that mechanical damage was concentrated in its front, namely, a deformed front, a power unit displaced from its structural installation and deformed power elements of the car frame from impact loading directed load back.

According to the manufacturer, the passive safety system of the KIA-Carens SRS car according to its VIN code, it was found that the car under study is equipped with: front (front) driver's airbag and front (front) passenger airbag, as well as devices for pre-tensioning the seat belts. driver and front passenger (see Fig. 2 below), which was also installed during visual inspection in the passenger compartment, namely on the steering wheel cover and on the right side of the front passenger compartment on vni inscription «SRS AIRBAG», testifying to install front airbags driver and passenger.



Состояние элементов			
ILLUMINATED	LAMP-O	FR WASHER & WIPER	RR WASHER & WIPER
AIR BAG(DRIVER'S)	DEPOWER	CLUTCH LOCK	CLUTCH LOCK
EVAP. GAS CONTROL	EOG-O	SEAT WARMER	WARMER-O
KEYLESS-BURGLAR	AL+T+OL	FOG LAMP(FR)	FR OGO-O
EMISSION-3	EURO-3	IMMOBILIZER	IMMOB-O
ILLUM. KEYFOLD	ILLUM. IGNITION	LUMBAR SUPPORT	LUMBAR-O
ONE TOUCH TRIPLE	ONE	2ND SEAT TYPE	6+4
			RR SUSPENSION
			LAMP-HUBS
			AIR BAG(PASS)
			RR OGO-O
			AUDIO REMCON
			ELKS RINGE TRIM
			REMOTE-O
			W/LEAT
			DOOR BOLDTS
			BLACK

Fig. 2. Information from the site www.kia-hotline.com regarding the complete set of passive safety system SRS of the test car KIA-Carens with airbags (AirBag).

Expert examination of the KIA-Carens found that the front (front) driver's airbag is in the activated state – the airbag is in the activated state; the front (front) passenger airbag is in the inactive state – the airbag is in the idle state. When opening the upper part of the front panel of the car interior along the lines of its rupture when activating the front (front) airbag, it is established that the airbag is in the folded state (see Fig. 3-4 below).



Fig. 3. General view of the KIA-Carens driver's front airbag activated.



Fig. 4. General view of the KIA-Carens passenger front airbag not activated.

The investigation of civil case materials revealed that in the investigation of the circumstances of an accident in the framework of criminal proceedings conducted a forensic transport and trace examination, according to the conclusions of which, in the collision of the KIA-Carens and VAZ-2103 cars interacted with the front parts and the angle between their longitudinal 180 axes, the conditions for the operation of both front airbags are fulfilled, as evidenced by the activation of the front (front) airbags of the driver of the KIA-Carens vehicle being tested.

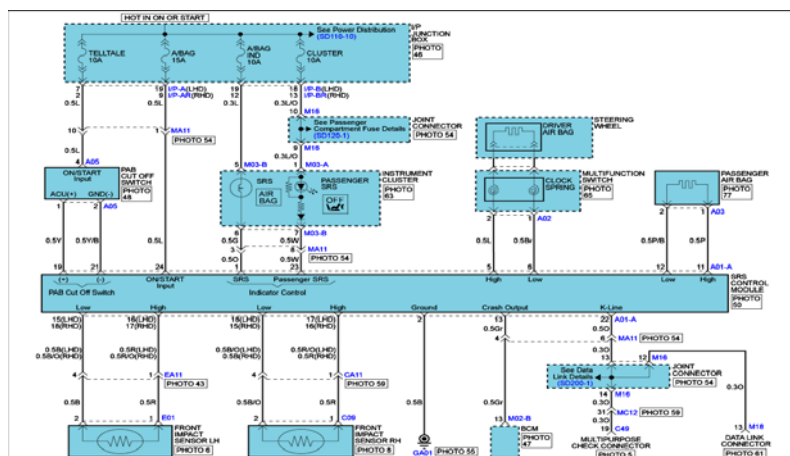


Fig. 5. Schematic diagram of the passive safety system of the vehicle SRS KIA-Carens.

Significant damage to the KIA-Carens car, such as circuit breakage, failure of the fuse box in the engine compartment and battery, made it impossible to diagnose the passive safety system of the vehicle's SRS using diagnostic equipment.

In connection with the above, an elemental study of the components of the passive safety system of the SRS of the KIA-Carens was carried out.

The electrical diagram of the KIA-Carens passive SRS system is shown below (see Figure 5 below).

From the wiring diagram of the passive safety system SRS of the test car KIA-Carens, it follows that control of the passive safety system SRS of the specified car consists of the following main components:

- electronic control unit of passive safety system SRS – SRS CONTROL MODULE.

The SRS passive control unit is structurally mounted in the vehicle's center console;

- front impact Sensors (Right and Left) – FRONT IMPACT SENSOR RH / FRONT IMPACT SENSOR LH.

The right (RH) and left (LH) impact sensors are fixed in the front of the right and left spars of the vehicle, respectively;

- driver's front (front) airbag unit – DRIVER AIRBAG, which is structurally mounted on the steering wheel of the car;

- passenger front airbag unit: PASSENGER AIRBAG, which is structurally mounted in the front panel above the storage box;

- fuse box: JUNCTION BOX, which is located on the left side of the front panel of the car;

- switch of the front (front) passenger airbag, which is located on the right side of the front panel of the car;

- electrical wires that have a bright yellow insulation color in the SRS passive system.

During an expert inspection of the KIA-Carens passive SRS control unit, it found that the housing of the SRS control unit, as a result of the destruction of its mounting brackets, is not fixed at its installation location, and the back left part of the casing of the electronic unit is damaged in the form of deformation.

One of the connectors of the SRS electronic control unit is separated from the unit, the second connector is located at the connection to the SRS electronic control unit.

When disassembling the SRS electronic block, it was visually found that there was no damage in the form of chip destruction.

When examining the SRS fuses, it found that the characteristics of the AIRBAG fuses meet the requirements of the manufacturer.

The multimeter was used to test the integrity of the passive safety locks of the SRS of the KIA-Carens test vehicle.

When checking the connection and the integrity of the electrical circuits of the components of the passive safety system of the SRS of KIA-

Carens, it found that all the connectors of the electrical circuits are securely connected, with the electrical circuit connecting the module of the front (front) airbag to the electronic control unit SRS has no damage in the form of breaking and breaking the circuit.

The integrity of the electrical circuit of the front airbag module to the SRS electronic control unit was checked using a multimeter.

Later, when inspecting the KIA-Carens driver's seat belt and front passenger's seat belt retainers, it found that the plastic parts of the retainers had traces of the plastic part of the retainers, which are signs of pre-tensioning of the driver's and front passenger's seat belts.

According to the algorithm of operation of the passive safety system of the vehicle SRS it follows that when determining the condition of activation, the electronic control unit SRS supplies the starting current to the flares of the devices of pre-tensioning of the seat belts, airbags of the driver and the front passenger.

If the vehicle is equipped with a front passenger airbag switch and is in the «OFF» position, the front passenger front airbag does not work and the front passenger pre-tensioner will operate in any case .

This leads to the conclusion that, as a result of the collision of vehicles, the KIA-Carens Passive Electronic Control System for Passive Safety System of the KIA-Carens applied the starting current to the driver and front passenger seat pretensioners, as well as to the front (front) seat trolley – as a result of which the devices of pre-tensioning of the seat belts of the driver and the front passenger, as well as the front (front) airbag of the driver were activated on the specified car.

During an expert examination of the KIA-Carens front passenger airbag switch, it was found that the decorative panel of the switch, which is fixed on the right side of the front panel of the car interior, is not due to the destruction of the right side of the front panel of the car.



Fig. 6. View of the front passenger airbag switch KIA-Carens.

The front (front) airbag switch housing of the KIA-Carens passenger car has no damage in the form of destruction, and the electrical wiring connector to the switch is securely fastened.

While inspecting the front (front) passenger airbag switch, it is found that the switch is rotated counter-clockwise to the stop (see Fig. 6 below). The front (front) passenger airbag switch allows the driver to decide whether the front passenger airbag should operate.

Subsequently, the design and position of the front passenger airbag switch of the passenger car of the KIA-Carens vehicle under study was investigated to determine what condition it was (OFF or ON).

An anisotropic magnetoresistive (AMP) element is used in the front passenger airbag switch, which changes its resistance depending on the strength of the magnetic field. When the front passenger airbag switch is in the ON position, the magnet moves away from the AMP element and the output current generated by the SRS electronic unit is weak.

When the front passenger airbag switch is in the OFF position, the magnet approaches the AMP element and the SRS electronic unit captures strong current.

After disassembling the KIA-Carens passenger front airbag switch housing, it was found that in the position when the switch is rotated counter-clockwise to the stop, the magnet is at the level of the AMP switch indicating that the front switch (f) is off.) of the passenger airbag of the specified KIA-Carens car at the time of its expert inspection – «OFF» (see Fig. 7 below).



Fig. 7. KIA-Carens passenger front airbag switch (disassembled)

According to the KIA-Carens vehicle operating instructions, it is necessary to insert the main ignition key of the vehicle into the switch located on the right side of the front panel of the vehicle to switch off the front (front) passenger airbag of the specified vehicle. to the «OFF» position. In this case, a corresponding lamp will be illuminated in the vehicle dashboard, informing the driver that the front (front) passenger

airbag has been deactivated and will remain on for as long as the airbag is switched off.

Turning the key counterclockwise corresponds to the OFF position, turning the key counterclockwise corresponds to the ON position. (see Figure 8 below).



*Fig. 8. KIA-Carens
passenger front airbag
switch and exterior trim*

Thus, based on the above study, it should be concluded that at the time of the expert inspection of the KIA-Carens, the front passenger airbag switch was in the OFF position, under such conditions the front airbag the passenger should not work. The results of the above elemental study of the components of the passive safety system of the KIA-Carens car SRS gave the expert reason to conclude that at the time of the expert examination the KIA-Carens car did not have technical failures of the passive safety system SRS, which resulted in the front (front) pillow passenger safety was not activated.

It should be noted that the following requirements must be observed when conducting a vehicle SRS passive safety study:

- it is forbidden to measure the resistance of the airbag module with devices with an internal power source, since the energy of the power source of portable electrical devices is enough for firing airbags;

- It is forbidden to disassemble the airbag modules which have not worked and the contact ring for visual inspection or in-depth diagnosis.

In view of the above, as it is forbidden to carry out measurements of the resistance of the airbag module with internal power supply devices, disassemble the airbag modules which have not worked, for their visual inspection and in-depth diagnosis, then an in-depth study of the front airbag module (frontal) KIA-Carens car was not produced.

Conclusions. Thus, the example of an in-element study of the passive safety system of the vehicle SRS in the article allows experts (specialists) to carry out forensic auto-expert examinations (expert researches) on a sufficient technical level to investigate the technical state of the passive safety system of the SRS and to determine the causes of failure of the front (front). passenger airbags.

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ОСОБЛИВОСТІ ПРОВЕДЕННЯ ЕКСПЕРТНИХ ДОСЛІДЖЕНЬ СИСТЕМИ ПАСИВНОЇ БЕЗПЕКИ SRS АВТОМОБІЛЯ ЩОДО ВСТАНОВЛЕННЯ ПРИЧИН НЕ СПРАЦЮВАННЯ ФРОНТАЛЬНОЇ ПОДУШКИ БЕЗПЕКИ ПАСАЖИРА

Розглянуто питання, які виникають у експертів під час проведення судових автотехнічних експертиз (експертних досліджень) технічного стану транспортних засобів, а саме: системи пасивної безпеки SRS. Наведено послідовність проведення поелементного дослідження системи пасивної безпеки SRS транспортних засобів з встановлення причин не спрацювання передньої (фронтальної) подушки безпеки пасажирів під час дорожньо-транспортної пригоди. Актуальність вказаної роботи обумовлена, з одного боку, масовим встановленням подушок безпеки на транспортних засобах, а з другого, – частими випадками не спрацювання подушок безпеки при зіткненні.

Ключові слова: дорожньо-транспортна пригода, транспортний засіб, система пасивної безпеки SRS, пасивна безпека з натягувачами, подушки безпеки, діагностування системи пасивної безпеки SRS, судова автотехнічна експертиза, поелементне дослідження системи пасивної безпеки SRS.

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