

## THE CORRECTNESS FUNCTION OF INTELLIGENT DEVICE RECORDING IN ASPECT USED AND THEIR SAFETY

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### **Abstract**

*The duty of applying recorders in the road transport was implemented in states of the European Union on regulations (EWG) no. 3820 / 85 on harmonisations of some social welfare legislation referring to the transport, which was changing with regulation (EWG) no. 3821 / 85 on recorders applied in the road transport. The preamble unequivocally that in order to ensure effective control of the recording devices used in road transport, they must be reliable, easy to use and constructed to minimize any possibility of fraud. The duty of implementation of the digital tachograph is also considered in the context of improving road safety. Through the analysis of the records of the registering devices can be defined in each specific case of speeding by more than the allowable value in the area. Technical requirements for your device recorded in the resolution, which defines the main parameters, are measured, among things other, the traversed path length of the car, speed, time driving, other periods of work, politeness of the driver and the correct operation of the check authorized for those authorities. The duty of States-members of the European Union is identify organizations that will conduct research and verification of the recording equipment together will also introduce solutions that improve their security. This article contains responsibilities after part rest on the drivers of vehicles takes the issues of system security and optimum performance of recording devices and consequences may arise from non-compliance with regulations and them subjecting to tachograph manipulation.*

**Keywords:** *transport road, card driver, digital recorder, manipulations digital recorder*

### **1. Introduction**

The duty of applying digital recorders in the road transport was implemented 1 May 2006 in all vehicles about the total permissible mass above 3.5 ton and buses about number of sites 9 including the driver. There were frequent infringements of drivers in order to implement the substantial change this way in analogue tachographs. As the switch or the pulse generator, he caused such devices that drivers could disturb the work of the tachograph and modify courses of vehicles and in the event of the lack of the idea for the possibility of manipulations it has often been finished with throwing away or becoming dilapidated record sheet. Implementing digital tachographs at first made it difficult for the manipulation the practice but frequent cases of the interference brought to the need to conduct continuous researches. These examinations also showed that different manners of the manipulation, which they indeed are using, existed in the road transport sector. That kind of action and attempts of the manipulation constitute the serious threat to the safety road, exerting also inadmissible, adverse impact to the fair competition and working conditions of drivers. Thanks to better protecting the digital tachograph compared with

his analogue equivalent even, very attempts of the manipulation of the system can more easily be detected what should act as a deterrent.

## 2. Structure of the digital recorder

Structure of the digital recorder (Fig. 1) is standardized he must meet EU requirements as well as is connected to socket DIN (Deutsche Industrie of Norms).

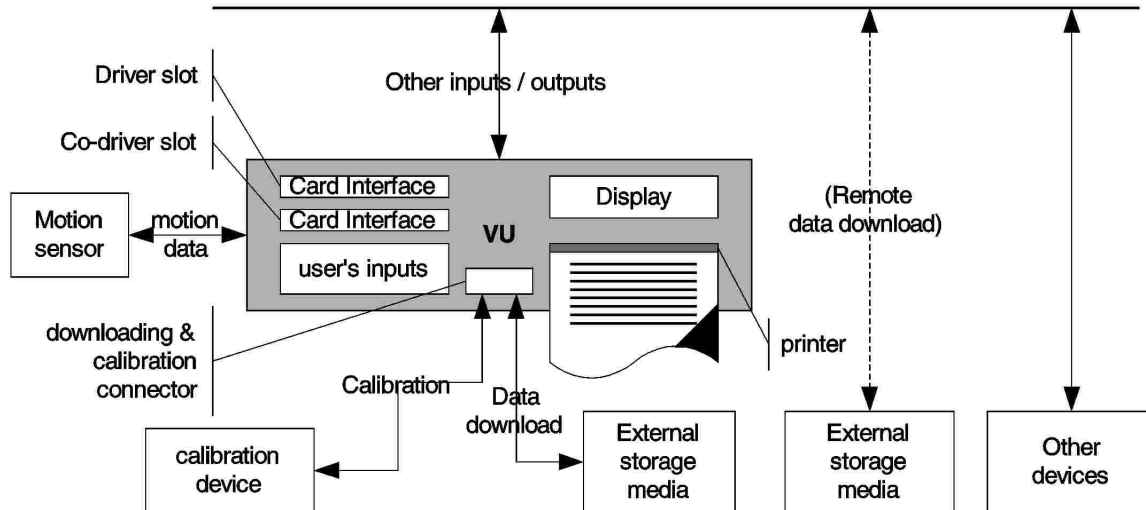


Fig. 1. Digital recorder

The Tachograph has two readers of smart cards, the display and the printer. Entries to readers are on an outside panel, printer writing out reports for the driver and test institutions, display, on which important information is being shown among others about working hours and the approaching period of the rest. Component parts of the device are carried out of materials about the sufficient permanence and the mechanical strength and about stable electrical properties and magnetic. Any changes in component parts of the device or the kind of applied materials for their production, before leading into the production, should be introduced for approving by bodies, which approved the certification of approval the device type.

## 3. Cards of the digital recorder

Smart cards are integrating STC participants (System of Digital Tachographs) in all European Union member states. STC participants, in relation to using cards to tachographs, were divided in four groups to which the following types of cards were assigned: for driver, test, workshop and enterprises. Issuing cards by member state is included with particular procedure (Fig. 2). The first card to tachographs, given to the petitioner, he has the card number equal of the sequence number, and the number of replacing and the number of refreshing are placed on "0". Numbers of cards of all impersonal cards to tachographs, given to one review body, for one workshop or one transit company, they have the same 13 first digits and differ in further alphanumeric characters in the number.

The system of cards moreover is programmable. Using the cryptography should ensure the highest level of the functionality and satisfaction. Cards consist of physical elements (bases of the card and the module – of the integrated circuit and joints), and of programmable elements of operating systems (of SCOS and the applet Card 2.0 Java.). Numbers of cards are staying sent through with Poland Manufacturing Company of securities within 26 days of the submission of an application. According to the Art. of 16 sec. 3 Council regulations No. 3821 / 85 on recorders

applied in the road transport, the driver can continue the ride without the driver card in the maximum period of 15 calendar days or in the long period, if taking the vehicle to the base is necessary, provided that he can prove the impossibility introducing or using the card during this period.

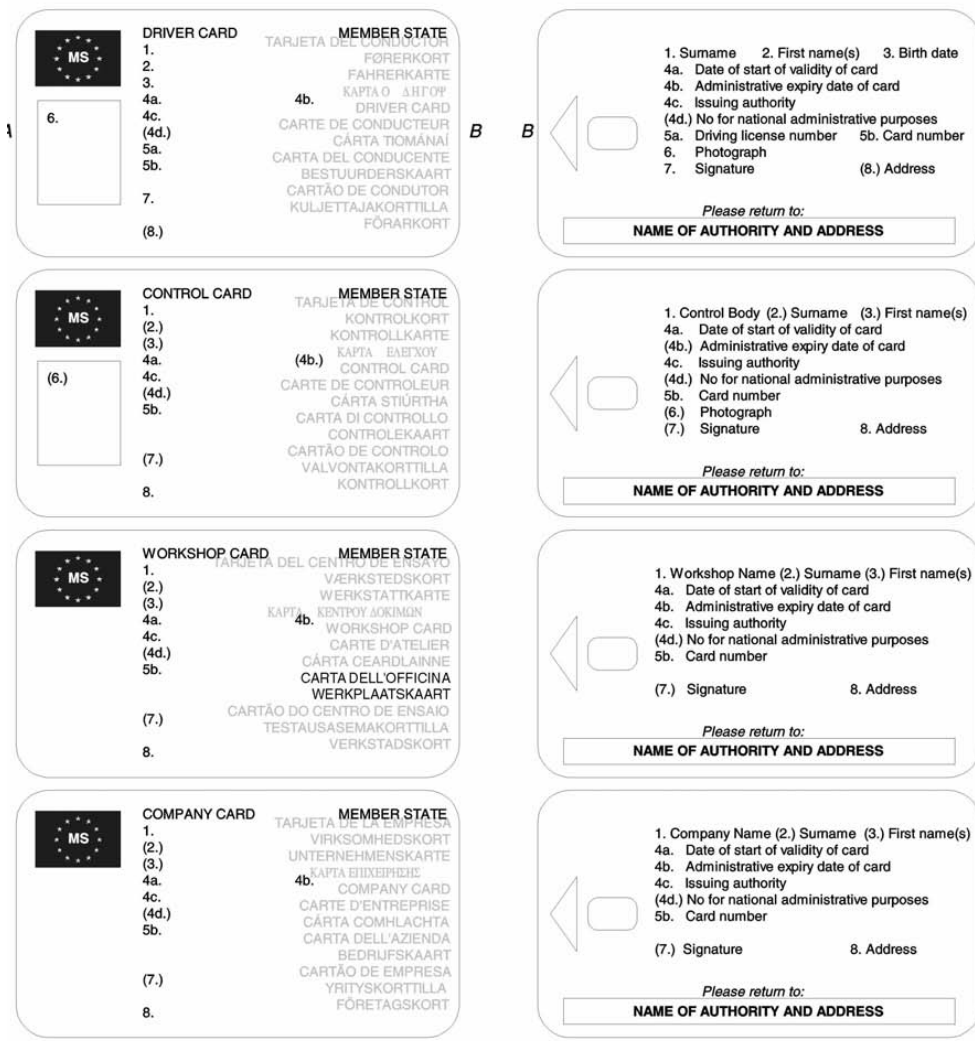


Fig. 2. Templates for Community cards to tachographs (the obverse and the order slip)

Templates for cards are being issued for a period of 5 years except for the card workshop annual period.

A standard DES (Demonstration) is a base of the cryptography of smart cards and RSA (the name derives from the first letters of surnames of inventors: Rivesta, Szamira and Adlemana). The DES Standard was created by engineers in late years 60. In the more late time he was renamed to Lucifer (Lucifer) what constituted the specific play on words (English word cipher is denoting the code). The function of the encryption is accepting two types of the input: the plaintext and the key. The plaintext in case of DES must be 64 beat, and the key is 56 beat. Processing the plaintext into the encrypted figure is covering three phases. At first a preliminary permutation which is moving bits is taking place, creating permute input. Next, the circuit is working of sixteen iterations of the same function, in which they are accessing functions permuted and placing. The result of the last iteration consists of 64 bits, constituting the function of the entrance plaintext and of the key. Left and the right side are staying exchanged, creating the preliminary result. He is staying subject of the permutation, which is the reverse of the preliminary permutation. The 64-bits is an outcome of this all action cipher text. However, the idea of the cryptosystem with the

public key was elaborated while crucial Rivesta discovering. It consisted in replacing the algorithm Diffie-Hellman. The Rivesta concept is based on a problem of the disintegration of substantial amounts to prime numbers. The public key is being generated by accumulating by oneself two large, randomly chosen first numbers. Next a next substantial amount is being chosen about determined properties, constitutes the encryption key. The public key is being created based on the encryption key and the recalled product of the first numbers. It is possible easily to calculate the private key, if the first numbers creating the product are known applied at creating the public key. They are well known to the owner of the pair of keys; however, crypt of laboratory analyses can get them only thanks to solving a problem of the factorization of substantial amounts.

#### **4. Manipulations of the tachograph**

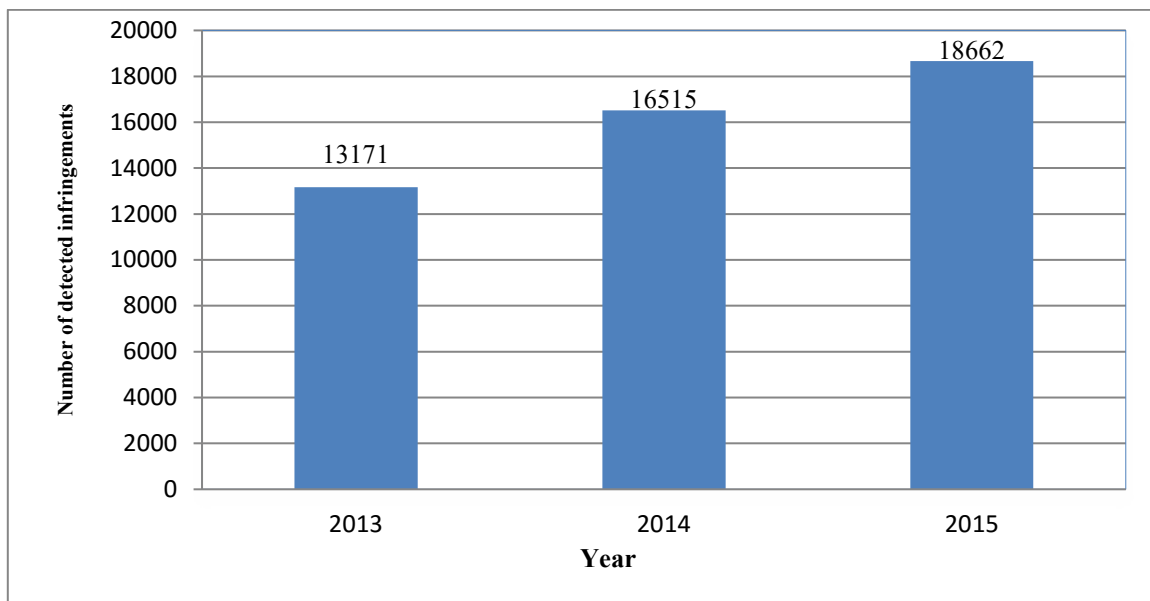
Implementing digital tachographs only to a little extent made it difficult for the manipulation the practice. Frequent cases of the interference brought the manipulation to the need to conduct continuous researches above attempts towards the system of the digital tachograph. These examinations also showed that different manners of the manipulation, which they indeed are using, existed in the road transport sector in order to cheat the tachograph, in particular the system of the digital tachograph. That kind of action and attempts of the manipulation constitute the serious threat to the safety of the road traffic and individual participants, exerting also inadmissible, adverse impact to the fair competition and working conditions of drivers. Thanks to better protecting the digital tachograph compared with his analogue equivalent even very attempts of the manipulation of the system can more easily be detected what should act as a deterrent. Against widespread opinions circulating in the environment of drivers applying magnets, of switches, double pulsar and of other solutions of this type is not a practice not for the inspection. The detection of use cases of these devices and preventing using them constitute the continuous process, which requires the permanent commitment. Along with the technological progress, a number of the possibility of the interference in the system, and hence possible threats is increasing. Therefore, the substantial role is falling to everyone for entities employed into ensuring the system security of the tachograph, in it for officers of inspection services, authorised for workshops and fitters and entrepreneurs observing the rules and drivers.

The inspection transport road as the service appointed to inspections is carrying out guidelines, which are aimed at an improvement in the safety of the road traffic every year. The issue is well-known to the manipulation of the digital tachograph from the beginning of activity but still new ideas are exerting the pressure, for which examinations and the exchange of experiences are resulting with international other structures (BAG – Bundesamt für Güterverkehr). At present, the service is set mainly to the issue concerning the arbitrary interference in the recorder and the undue use. Below results of road checks conducted by Provincial Inspectorates of the road transport were presented. Data contains the number and types of detected infringements in the recorder (Fig. 3).

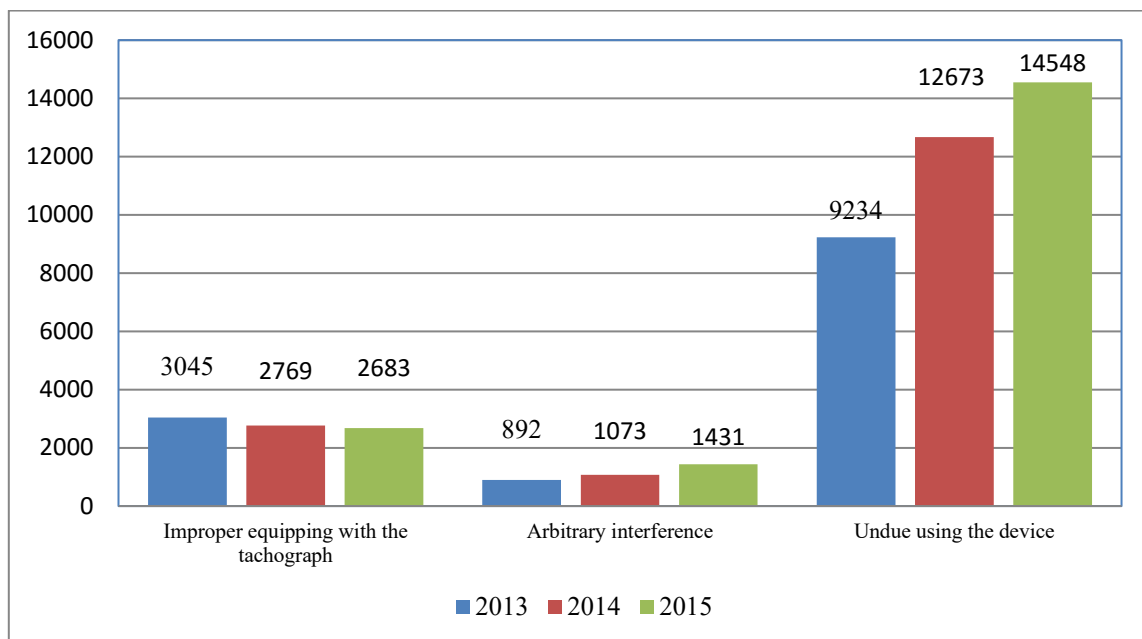
Conducted analysis is indicating the height of detected manipulations in the digital tachograph at the turn of three final years. The upturn is showing that the digital device is susceptible to retuning what is colliding with the fundamental assumptions among others road safeties. On the graph (Fig. 4), we are observing the slight decrease in the issue of improper equipping and a sudden increase in undue using the device, in the main measuring cup caused with applying the not-approved type tachograph record sheet or nonintended for the given recorder.

It results from final actions of inspectors that verifying bodies will increase the pressure particularly on manipulations of this type. The problem of the manipulation to a considerable degree can be solved thanks to the Commission regulation (EC) No. 561 / 2014 from determining 4 February 2014 that vehicles about the permissible mass not exceeding 7.5 ton used for the transport of materials, the equipment or devices for use for the driver on-the-fly, used in the distance to 100 km from the base of the enterprise, on the assumption that driving such a vehicle

doesn't constitute main filling the driver should not be applicable to the norms of working hours included in the Regulation (EC) 561 / of 2006. An assembly was also considered in vehicles of sensors of the weight which they had in order to limit performing carriage of goods with exceeding norms from above determined after all for the vehicle. Amongst reasons for announcing the new regulation, they also pointed out to the need of increasing the number of performed road checks, to which these are review bodies after all were obligated, by enabling to effect mobile inspections, thanks to the possibility of the communication from a distance between the tachograph, but the testing vehicle. A need of creating mobile applications facilitating the possibility of reading of data by the driver was stressed what is supposed much to help in of following restrictive times to do their reading after all. An also great stress was put to the responsibility which on workshops making the official prototype test of very tachographs, of their control – in order to prevent of conflict of interest, which is appearing among workshops, but shipping companies.



*Fig. 3. The Graph presenting number of detected infringements in 2013-2015*



*Fig. 4. The Graph showing the type of infringements in 2013-2015*

## 5. Main problems with verification of digital tachograph

Since the installation of the recording equipment in the vehicle up to a moment of its commissioning some actions must be done, which result in the introduction of a new vehicle-tachograph set to European digital system. According to the provisions of the European regulations (Council Regulations (EEC) Nos. 3820/85, 3821/85, 2135/85, and Commission Regulation (EC) No 1360 with Annexes) every digital tachograph before entering the system is subjected to the activation and calibration procedures. Moreover, the installed and activated vehicle-tachograph set must be periodically checked regarding its conformity with the metrological needs specified in the relevant regulations (Annex 1B to the Commission Regulation (EC) No 1360/2002). It can happen that during the operation of the recording equipment a necessity of repair or replacement, and, in an extreme case, even withdrawal of its damaged elements occurs. For these reasons, a network of the professional workshops is needed, which will provide a satisfactory basis for the digital tachograph servicing.

The authorised tachograph workshop is an organizational unit approved and certified by the Member State authorised for performing the procedures and functions as follows:

- installation of the recording equipment and its activation,
- tests of the recording equipment,
- inspection of the recording equipment,
- displaying the information data (stored data of the vehicle unit),
- withdrawal of the recording equipment elements.

A basic duty of the authorised workshop is to guarantee that every vehicle-tachograph set leaving such workshop could meet the requirements specified in the Regulation (EC) No 3821/85 of 1985.

According to the Annex 1B of the Commission Regulation (EC) No 1360/2002) of 2002 an installation process is defined as an assembling the recording equipment (a vehicle unit and speed sensor with a necessary wiring (*cables*)) in the vehicle.

In reality, the installation procedure consists of five stages:

- a preliminary inspection of the recording equipment,
- assembling the recording equipment,
- loading the vehicle unit memory with given values of the calibration information parameters,
- sealing with leads the places of the speed sensor installation,
- assembling the installation plate (plaque).

The preliminary inspection of the recording equipment includes:

- a visual inspection – aims at a detection of any possible mechanical defects and checks a completeness of the delivered equipment according to the manufacturer's specification,
- verifying the indication errors: concerning the distance travelled, speed value and time measurement.

In case of the digital tachograph, as distinct from the analogue one, the recording errors for: a length of distance travelled, speed and duration of driving time are not subject to verification. The brand new recording equipment is delivered to the manufacturers of vehicles authorised for servicing the inactive digital tachographs. It means that all parameters have default values. For that reason, a person installing the recording equipment is obliged to perform a preliminary calibration of the tachograph – i.e. to enter the setting values and the vehicle identification data. In case these parameter values are not determined (*available*), the chain type parameters will be marked with “?”, and the numerical ones with „0”.

The installation is the only action when the setting the calibration data without the necessity of using the workshop data card is possible.

After completing the operations necessary for assembling the recording equipment, all connections, breaking of which can cause undetectable interruptions in recording or data loss, should be sealed with leads.

The last stage of the tachograph installation is documenting the results, i.e. printing and assembling the so-called descriptive plaque. The installation plaque must be also sealed with leads unless it is placed in a way making its removal without visible traces impossible.

The tachograph installed in the vehicle should be subject to the activation procedure before leaving the place of installation. The activation of the digital tachograph is a set of actions (operations) resulting in:

- readiness of the recording equipment for operation (i.e. recording the driver's work time performance); the functions for recording and storing the data are being activated,
- activating the tachograph safety functions.

The tachograph activation is automatically performed by the first insertion of the valid workshop data card into the card reader and entering the correct PIN code. During the activation process the matching the speed sensor and vehicle unit occurs. All actions relating to the activation procedure should be carefully performed as repeated use of an incorrect PIN can result in a permanent interlock of the workshop data card.

## 6. Conclusions

Introducing an obligation of applying the digital tachograph in the new vehicles intended for the cartage in 2006 led to action at which they were aimed falsifying or disrupting correct action of the device. In first years few manipulations which were had tested were stated. At present, this problem is escalating particularly in the aspect of the arbitrary interference. Drivers, who are manipulating recorders, are working to their disadvantage mainly. The problem could be terminated by the carrier, which should not have absolute trust in its drivers as well as for printouts from the tachograph. Whereas the carrier should realize how much in reality the driver needs the time for fulfilling the given transit order going in due course. In the context of the manipulation, a workshop technique, which improperly is placing organising during examinations, is another problem what results for three years in numerous checks of Polish vehicles at the territory of the European Union.

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