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Tachograph - Monitoring Device for Greater Road Traffic Safety

Abstract

The tachograph, as a monitoring device, will play a key role in improving road traffic safety. This sophisticated device records and tracks driver activities, including working hours, rest and breaks, helping to ensure compliance with driver working conditions regulations. Accurate driving time tracking reduces the risk of driver fatigue and potential road accidents.
Speed monitoring and driving performance analytics provided by the tachograph contribute to increased safety. Along with the warning system, tachographs enable quick reactions to potential risks, providing an additional layer of protection for drivers and other road users. In addition, integration with technologies such as GPS enables efficient route tracking, route optimization and reduction of transportation costs.
Taking into account all these aspects, the tachograph is not only a means of monitoring, but also a key partner for companies that want to improve driver safety, reduce risks on the roads and achieve efficiency and compliance with road traffic regulations.

Key words: tachograph, monitoring device, road traffic safety

1. Introduction

A tachograph is an electronic device used in traffic to monitor and record the work of truck or bus drivers. The main function of the tachograph is to record data on driving time, rest, work and other driver activities, which ensures compliance with regulations related to driver working conditions. [12].

In the dynamic landscape of modern transportation, where technological advances are rapidly changing, one of the key innovations that has shaped the industry is the tachograph. This sophisticated device is not just a technical instrument, but represents a fundamental evolution in the monitoring of driving activities and vehicle management. With their ability to accurately record driving time, rest and driver work, tachographs not only contribute to compliance with legal regulations, but also improve road safety, reduce transport costs and improve the efficiency of vehicle fleets. [13].

The application of the tachograph system makes it possible [1]:
- Planned fleet management,
- Programmed preventive vehicle maintenance,
- Creation of exploitation ganttogram,
- Overview of individual costs (fuel, lubricants, vital assemblies and aggregates, car tires...),
- Work control and driver behavior during transportation and more,
- Accurate determination of the speed of the vehicle during the expert investigation of a traffic accident.

In the world of continuous transport of cargo and passengers, the question of working hours of truck drivers is becoming more and more important. Truck drivers play a key role in global logistics, but challenges arising from long drives, frequently changing schedules and working time regulations raise questions about the balance between driver safety, efficiency and well-being [6].

The tachograph records the time the driver spends behind the wheel, the time of rest and breaks, which ensures compliance with legal work restrictions. This is essential for road safety and good management of driver resources [8].

The subject of truck drivers' working hours is not only a question of the organization of the working day; it also covers aspects such as road safety, legal regulations and the impact on the physical and mental health of drivers. Through the analysis of the working hours of truck drivers, it is investigated how the industry adapts to the challenges brought by the dynamic working environment of road transport, looking for solutions that support optimal productivity, safety and well-being of drivers. [6].

2. Working hours of road vehicle drivers

The tachograph records the time the driver spends behind the wheel, the time of rest and breaks, which ensures compliance with legal work restrictions. The above is essential for road safety and good management of driver resources. Which offers a detailed view of driver working hours for legal compliance [1].

Working hours of drivers are prescribed in Regulations and national laws. Regulation (EC) No 561/2006 on harmonization of certain social legislation related to road transport and Regulation (EU) No. 165/2014 on tachographs in road traffic and the Act on working hours, mandatory breaks for mobile workers and recording devices in road transport (NN 75/13, 36/15, 46/17, 152/22).

Daily driving time must not exceed nine hours. However, the daily driving time can be extended to a maximum of 10 hours and a maximum of two times a week. Weekly driving time is limited to 56 hours and must not exceed the longest weekly working time prescribed by Directive 2002/15/EC.

he total driving time during any two consecutive weeks must not exceed 90 hours, i.e. the average over 4 months must not exceed 48 hours. The total driving time, both daily and weekly, includes the duration of driving in the territory of the European Union Z or a third country. These restrictions aim to ensure the safety and well-being of drivers and contribute to the regulation of working conditions in road traffic, taking into account the provisions of Directive 2002/15/EC.

After a driving period of four and a half hours, the driver shall take an uninterrupted break of at least 45 minutes, unless he is taking a rest period. This break may be replaced by a break of at least 15 minutes, followed by a break of at least 30 minutes, each of which is distributed over the period in a manner consistent with the provisions of paragraph 1.

The driver takes daily and weekly rest periods, starting a new daily rest period within every 24 hours after the end of the previous daily or weekly rest period. If the driver takes a rest period of at least 9 hours but not more than 11 hours within those 24 hours, then this is considered a reduced daily rest period. The reduced daily rest period can be extended to a regular or reduced weekly rest period. A driver may have a maximum of three reduced daily rest periods between any two weekly rest periods.

In exceptional situations, within 30 hours after the end of a daily or weekly rest period, a driver who is part of a multi-member crew must take a new daily rest period of at least nine hours. In any two consecutive weeks, the driver shall take at least two regular weekly rest periods or one regular weekly rest period and one reduced weekly rest period of at least 24 hours. However, any reduction is compensated by an identical period of rest, which is taken continuously before the end of the third week after the week to which it relates.

A weekly rest period begins at the latest after the completion of six 24-hour periods from the end of the previous weekly rest period. Any rest that is taken as compensation for a weekly period of reduced rest and is added to another rest period of at least nine

hours. When the driver chooses to do so, daily rest periods and reduced weekly rest periods outside the seat may be taken in the vehicle, if it has a suitable place for each driver to rest when the vehicle is stationary. A weekly rest period taken in a fortnight may count towards either of those two weeks, but not both[9].

3. Record of Working Time

Records of working hours and mandatory breaks of mobile workers are kept manually or using a monitoring device. In accordance with Regulation (EU) No. 165/2014, obligations and requirements for tachographs in road transport are specifically prescribed. These devices, in connection with their production, installation, use and testing, must comply with the norms prescribed in the aforementioned Regulation, as stated in Article 1 [5].

On the basis of Article 9 paragraph 5 and Article 31 paragraph 6 of the Act on working hours, mandatory holidays for mobile workers and recording devices in road transport ("Narodne novine", no. 75/13, 36/15 and 46/17), the Minister of the Sea, Transport and Infrastructure adopts the Ordinance on the transfer of data to the central database of tachographic data and the method of keeping records of the working hours of mobile workers and establishes the SOTAH platform which will enable the keeping of central records of the working hours of mobile workers[11].

The record of working hours of mobile workers refers to data recorded using tachographs and tachograph cards which includes, but is not limited to the following [10]:

- information about the identity of the driver and his tachograph card,
- data on the driver's activities,
- data on the distance traveled, vehicle speed and times,
- vehicle identification data and tachograph device,
- data on control, calibration and repair of tachographs, including identification of the tachograph workshop,
- data on malfunctions, errors, manipulation attempts and other events related to the tachograph and tachograph cards.

In addition to the above data, when using SOTAH, information is recorded that includes, but is not limited to[10]:

- data recorded by the driver of a vehicle equipped with an analog tachograph on the tachograph slip, as defined in Article 33, paragraph 5 of Regulation (EU) No. 165/2014,
- data on the download of tachographic data and their transfer to SOTAH,
- data on the driver's activities for the period when the driver is not driving the vehicle,
- data on analyses, checks and other activities related to the use of SOTAH.

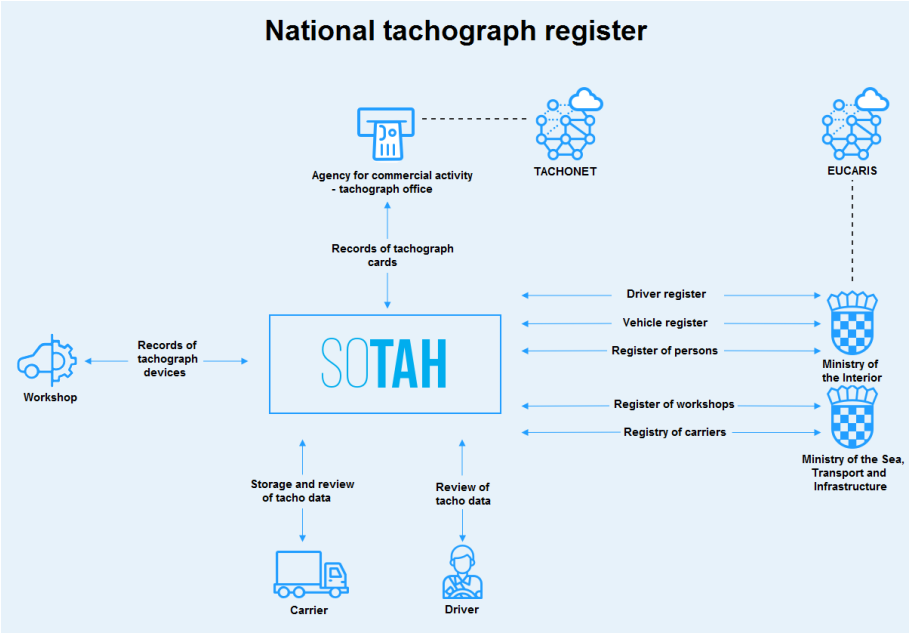

Figure 1. Scheme of SOTAH [15]

Scheme 1 shows the SOTAH platform and all stakeholders who must participate in data exchange. Carriers are obliged to transfer all data from the tachograph to the Tachograph Data Processing System (SOTAH) that relate to activities performed by the carrier or for the carrier. They are also required to record the driver's activities for the period when the driver is not driving the vehicle. Likewise, the carrier has the obligation to take over and properly archive the record sheets and printouts used in the individual vehicle, organized by date, and archive them according to the prescribed date. Before selling, destroying the vehicle or in the case of returning a rented, leased vehicle without a driver or a test vehicle, the carrier is obliged to transfer all tachographic data to the System for processing tachographic data (SOTAH)[15].

The data submitted to SOTAH are [14]:
- Data downloaded from digital and smart tachographs,
- Data taken from driver and workshop tachograph cards,
- Data recorded on the analog tachograph sheet.

Also, all record sheets from the vehicle should be transferred to the archive. The carrier has the obligation to record all the driver's activities in the SOTAH system for the period when the driver was not driving the vehicle, including sick leave, vacation, other absences and the like [15].

This record also covers situations when the driver drives a vehicle that is exempt from the application of the Act on working hours, mandatory breaks for mobile workers and recording devices in road transport. All tachographic data and records transferred to SOTAH are kept for at least three years after the end of the period to which they relate[15].

SOTAH will enable[15]:
- collection, processing, storage and preservation of tachographic data,
- overview of driver activity data,
- recording the driver's activities and issuing a driver's activity certificate to ensure the implementation of Commission Decision 2009/959/EU,
- analysis and verification of data on driver activities for the purposes of planning checks and supervision.

4. The development of tachographs - a claim to greater security

This sophisticated device is not only a technical instrument, but represents a fundamental evolution in monitoring driver activities and vehicle management[1]. With their ability to precisely record driving time, rest and driver work, tachographs not only contribute to compliance with legal regulations, but also improve road safety, reduce transport costs and improve the efficiency of vehicle fleets[2].

Tachographs are key partners in maintaining compliance with laws related to driver working conditions. By accurately recording working hours, rest and breaks, tachographs help drivers and companies ensure compliance with regulations, reducing the risk of overexertion and increasing road safety [18].

The digital tachograph is a newer generation device and is installed in all newly manufactured vehicles, while analog tachograph devices are still present in all older vehicles[5]. According to the design, there are the following types of tachographs [18]:
1. Analog tachograph,
2. Digital tachograph,
3. Smart tachograph of the 1st generation,
4. Smart tachograph of the 2nd generation.

4.1. Analog tachograph

Analog tachographs represent the older generation of tachographs that were used in vehicles for transporting goods and passengers. This device is integrated into the vehicle's dashboard and, in addition to the basic speed indicators, is equipped with buttons for adjusting work activities. Also, there are variants of analog tachographs that are used as independent devices, subsequently installed in the vehicle's dashboard[3].

Record keeping with this type of tachograph is done on a medium called a tachograph slip. The tachograph record records activities within a 24-hour period[5].

Drivers are obliged to use tachograph slips every day while driving, starting from the moment they pick up the vehicle. It is important to note that the tachograph slip is not drawn before the end of the daily working hours and must not be used longer than the period for which it is intended[8].

Figure 2. Analog tachograph [23]

The analog tachograph, shown in Figure 2, represents an older generation of devices that are still present in all older vehicles. They are not installed in new vehicles.

4.2. Digital tachograph

The digital tachograph system results from the effort to achieve maximum objectivity in the collection and operational use of data, similar to the analog tachograph. It was developed in order to overcome the established weaknesses of the analog tachograph, especially its potential occasional abuse, and to improve the storage and transmission of data. This digital technology aims to create a reliable system that enables precise monitoring of the driver's work activities, reducing the possibility of data manipulation and improving operational efficiency in road transport.[2].

The digital tachograph records all data in its internal memory and on the driver's card. The device itself has the capacity to store data for a period of at least 365 days. Users can get a printout of data about driving, working hours, holidays, events and possible errors on the tachograph directly from the device. This technology enables accurate monitoring and documentation of driving activities, providing relevant information for fleet management, compliance with regulations and improving road safety[4].

Figure 3. Digital tachograph [22]

Figure 3 shows a digital tachograph that has the ability to store long-term data, thus providing the possibility of analyzing driving performance over a long period of time. This image highlights the beginning of modern technology that enables precise record keeping of driving activities, contributing to regulatory compliance and improving road safety.

4.3. Smart tachograph

The primary purpose of the smart tachograph, which represents a new generation of mandatory digital recorders in the vehicle, is the implementation of European Union legislation on driver driving and rest times. In addition, the smart tachograph includes advanced technologies such as satellite positioning, short-range communication and connectivity with other applications via an Intelligent Traffic System (ITS) interface[19].

One of the key features of a smart tachograph is the automatic recording of the start of the journey and the destination location. In addition, this device enables control authorities to remotely access certain tachographic data via wireless data transmission. Integration with technologies such as satellite tracking enables precise monitoring of driving activities, and connection with other applications contributes to better coordination in road traffic. The smart tachograph thus becomes a key tool for complying with regulations, increasing efficiency and improving the monitoring system[16].

4.3.1. Smart tachograph of the 1st generation

According to Regulation 165/2014, dated June 15, 2019. all newly registered vehicles that must have a built-in tachograph will be required to have a Smart tachograph installed. This means that all new heavy goods vehicles with a maximum permissible mass of more than 3.5 tonnes, all new buses and all new towing vehicles with a maximum permissible mass combined with a trailer of more than 3.5 tonnes must be equipped with a smart tachograph[8].

The smart tachograph is a digital tachograph of the latest generation that has the following additional functions [17]:

- GPS – marking the position of the vehicle at the beginning and end of the driver's working hours (when inserting and removing the card) and every 3 hours of continuous driving,
- DSRC - Data collection by surveillance, via contactless access over a short distance. In this process, data on potential errors that indicate possible manipulation are extracted, especially in the context of non-compliance with the driver's working hours.

The entire smart tachograph system is designed to reduce the possibility of tampering with the tachograph. In addition, it allows data to be downloaded while driving, which makes it easier for controls not to have to stop vehicles unnecessarily, except in case of certain suspicion of manipulation [17].

The emergence of smart tachographs was primarily motivated by the goal of improving road safety. The possibility of remote download of data by competent authorities enables them to identify vehicles that potentially have problems with manipulations or abuses [17].

Figure 4. Smart tachograph of the 1st generation [21]

Figure 4 shows a first-generation smart tachograph that has the ability to connect to other devices via an Intelligent Traffic System (ITS) interface, enabling integration with advanced technologies such as satellite tracking.

4.3.2. Smart tachograph of the 2nd generation

According to the implementing REGULATION OF THE COMMISSION (EU) 2021/1228 of July 16, 2021, a Regulation was adopted that enters into force on August 21, 2023, that the installation of smart tachographs of the 2nd generation is mandatory in all new vehicles that are released for the first time in traffic on the European Union market.

Figure 5: Smart tachograph of the 2nd generation [20]

Figure 5 shows the 2nd generation smart tachograph. The device has various options, such as a global navigation satellite system, connection via Bluetooth, automatic recording of crossing the border (drivers will not have to stop to manually switch), etc. Visually, this tachograph, unlike other digital or smart tachographs of the 1st generation, is different only by the small Bluetooth sign located on the right above the screen[16].

With the introduction of the smart tachograph of the second generation, carriers will face several novelties, the most significant of which is certainly the requirement for the subsequent installation of this type of tachograph in already existing (registered) vehicles that are used exclusively in international traffic. For the first time in the history of motoring, this kind of request must be fulfilled no later than December 31, 2024. It is important to note that vehicles that participate exclusively in domestic traffic are not covered by this requirement, so the replacement of existing analog/digital or smart tachographs of the first generation is not required for them[8].

The final date for replacing the tachograph is no later than December 31, 2024, in other words, all vehicles in international traffic that are currently equipped with an analog or digital tachograph must be replaced with a 2nd generation smart tachograph. By August 20, 2025 at the latest, all vehicles in international traffic that are now equipped with a smart tachograph of the 1st generation must be replaced by a smart tachograph of the 2nd generation, and by June 1, 2026 at the latest, all commercial vehicles in international traffic whose is the maximum permissible mass between 2.5 and 3.5 tons must install a 2nd generation smart tachograph. Until now, this group of vehicles in the European Union has not been equipped with monitoring devices or tachographs[16].

5. Conclusion

The introduction of modern technology into road traffic brings numerous benefits, and one of the key elements that significantly affects traffic safety is the use of tachographs. The tachograph, as a device intended for monitoring and recording driving activities, has a profound and positive impact on road traffic safety.

Primarily, tachographs are a key instrument in the enforcement of legislation related to driving time and driver rest. Precise recording of working time, rest and driving time enables systematic control and prevents excessive driving time, which directly contributes to reducing driver fatigue and increases road safety levels.

Digital tachographs, especially smart tachographs of the new generation, bring additional features that improve traffic safety. Built-in technologies such as satellite tracking, wireless data transmission and remote access to control bodies make the monitoring of driving activities more efficient. This advanced technology enables faster reactions to potential violations and prevents data manipulation.

In addition, tachographs are crucial in the identification and suppression of manipulations and abuses in driving. Detailed recording of data on driving activities enables control authorities to effectively identify irregularities or potential dangers. By introducing smart tachographs, which enable contactless monitoring and remote data download, an additional level of transparency is achieved and the possibility of non-compliance with regulations is reduced.

Ultimately, tachographs not only ensure compliance with regulations, but also encourage responsible behavior by drivers and carriers. The introduction of this technology achieves an integral safety paradigm that promotes road safety through systematic monitoring and prevention of potential risks.

The impact of tachographs on traffic safety is extremely positive. Through precise recording of driving activities, prevention of manipulations and integration of modern technologies, tachographs become a key tool in creating a safer road environment. The continued development and implementation of these devices will be of crucial importance for the further improvement of traffic safety and the reduction of incidents on the roads.

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