VDO TACHOGRAPH

DEAR READER,

Hardly any other instrument in the commercial vehicle cockpit has changed everyday life on Europe's roads the same way the tachograph has. It has made competition in transport logistics fairer, working conditions for drivers safer, and the management of fleets mo e efficient. And it has bee doing so for 100 years. Because that is how far back the history of the VDO tachograph goes.

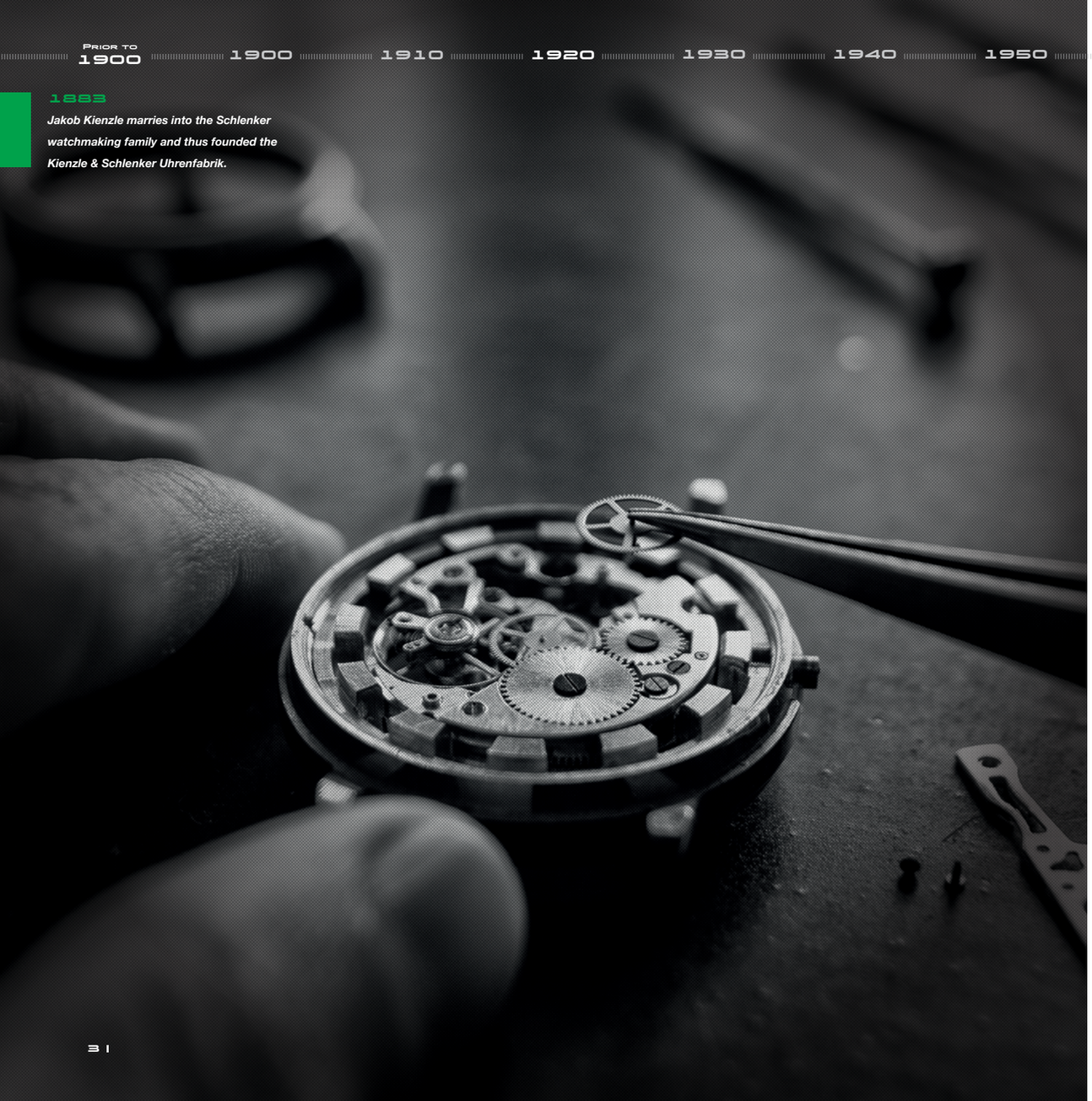
Its roots lie in the Black Forest, or more precisely in Villingen, Germany, where 1,300 of our Continental colleagues are still manufacturing, among other products, the latest models of the tachograph, the DTCO. It was here that Dr. Herbert Kienzle, the father of the VDO tachographs, invented the Autorex clock at Kienzle Uhrenfabrik. He found the necessary knowledge for the development of such a sensitive instrument within his own family. He comes from a watchmaking dynasty based in Schwenningen, Germany, so he inherited the knowledge of the importance of precision and the feeling for measuring times, distances and speeds from them.

Since then, the tachograph has undergone constant development and supports drivers, fleet operators as well as public authorities in complying with and monitoring rules and laws. In this booklet, we want to briefly trace the transformation that the tachograph has undergone over the last century to become the central compliance instrument in freight transport.

I am, however, sure that journey is far from over. At the Continental site in Villingen, we will continue to shape the future of the tachograph with a passion for precision and in the tradition of Kienzle Uhrenfabrik – hopefully for another 100 years.

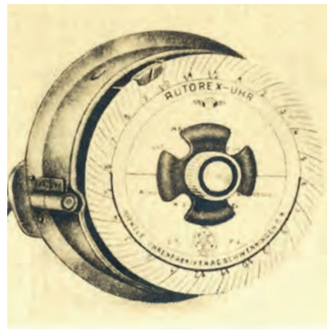
Sincerely

Dr. Ismail Dagli
Head of Business Area Smart Mobility
Continental Automotive



1883

Jakob Kienzle marries into the Schlenker watchmaking family and thus founded the Kienzle & Schlenker Uhrenfabrik.



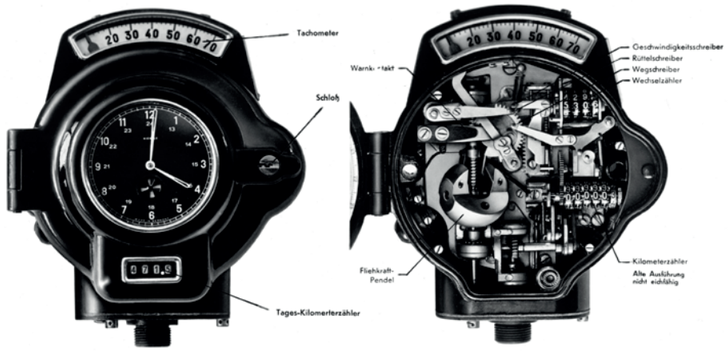
AUTOREX CLOCK
THE BEGINNINGS

The tachograph differs f om other instruments such as the tachometer in that it not only measures the speed of driving, but also records it. This is why the Autorex clock developed by Kienzle Uhrenfabrik in 1923 can justifiably be called the immediate precursor of the VDO tachograph. And it also looked like it: round and with needles – unlike modern tachographs, which disappear in a radio-shaped recess in the dashboard. The display of the Autorex clock used a spring-loaded stylus, the so-called vibrating pendulum, which recorded the driving and stopping times of a vehicle on a small diagram disc. Both the display and the recording were thus combined in the same system. In its further development, the Autograph (1926) also recorded the distance traveled.

THE CENTRIFUGAL PENDULUM PRINCIPLE

The mechanical models of the tachograph until the 1970s consisted of the same basic components: a clockwork, various measuring systems, a connection to the vehicle drive, a diagram disc. For the measurement of speed, however, diffe ent technologies have been used over the decades.

The so-called centrifugal pendulum principle was used until the 1950s. Here, two pendulum weights driven by a shaft rotate as flywheel masses a ound an axis. Their distance from the axis depends on the speed of the drive: the higher the speed, the greater the centrifugal force, the greater the distance and thus the amplitude on the diagram disc. The advantage of this technology is that the necessary scale and diagram divisions were relatively easy to define, because the te - perature had no effect on the system and i could operate without major frictional losses. At the same time, however, the measuring range was limited, the display accuracy could be disturbed by driving vibrations, noise levels during operation were high and this technology required an extraordinarily high level of precision during manufacturing.



THE HIGHER THE SPEED, THE GREATER THE CENTRIFUGAL FORCE.

1928

With the spin-off of Kienzle Taxameter und Apparate AG in Villingen, the company separates the apparatus business from the watchmaking business.

1929

Trademark registration of "VDO" after the merger of Deutsche Tachometer-Werke and Offenbacher Tachometer-Werke to form Vereinigte DEUTA-OTA (VDO).

TCO 1
THE FIRST OF ITS KIND

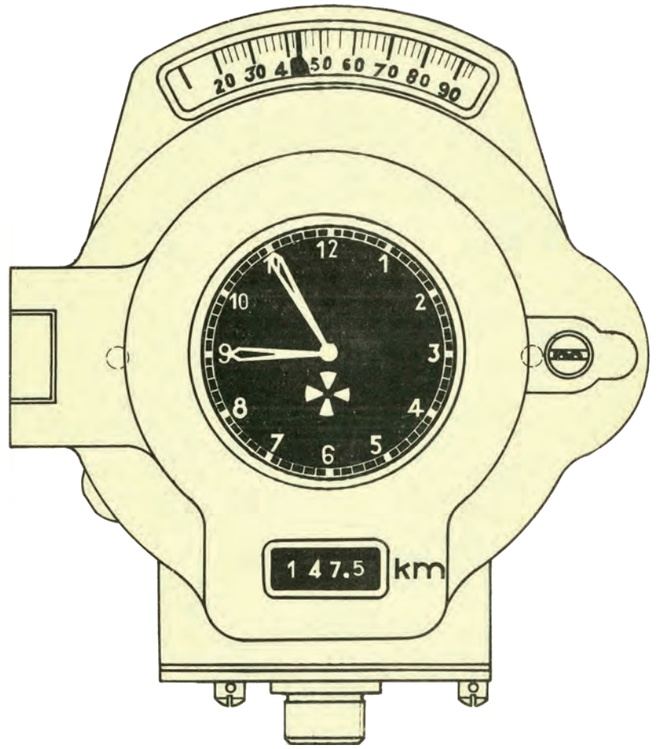
After the Autorex clock had laid the foundation, one step was still missing to reach the fully functional tachograph: in addition to the driving and stopping times, the driving speed had to be measured and recorded. In 1927, the time had come: the first mode of the VDO tachograph family, the TCO (for tachograph) was initially launched in small numbers. The TCO 1 still lacked a distance recorder, but this was quickly remedied.

The special precision of this first and ll subsequent tachographs was based not only on the precision mechanics know-how from Villingen, but also on the round Kienzle diagram disc. It consisted of tear-resistant paper with a wax coating, which was pressed in by the tips used in the writing system, so that the color of the base paper shone through. A precise clockwork ensured that the disc rotated. That way, the TCO 1 was the first to gather the variouw data from speeds, driving and rest times as well as the distance traveled in one continuous diagram.

TCO 2
THE CALIBRATABLE SUCCESSOR

With the successor model TCO 2 in 1933 at the latest, all the design features that were to become typical for tachographs from then on had taken shape, even though the exterior would change several times.

Compared to the TCO 1, wear-free sapphire pins were now used on an improved recorder guide. In addition, the model had optimized speed measurement as well as its own distance recording, which is reflected, among other things, in the trip meter below the dial in the cover. By the way: the TCO 2 was the first calibratable Kienzle tachograph and was built until 1963.



1938

Due to the differentiation and further development of the product portfolio, it made sense to rename the company Kienzle Apparate AG Villingen.

TCO 6
A HIT SERIES

Hardly imaginable today, but the first tachograp models were still mounted on the outside of the instrument panel. This changed in the mid-1930s with the TCO 6 and 7 models, which were the first to be completely round and could therefore be installed in the instrument panel of a commercial vehicle. From 1936, commercial vehicle manufacturers were also able to use the tachograph as a factory-fitted featu e. The first of these we e the trucks by Krupp, which had tachographs of this design as standard. Another new feature was the speed display around the clock.

FIRST RULES FOR LONG-DISTANCE FREIGHT TRANSPORT

At the beginning of the 20th century, there were no specific traffic laws for motor vehicles: the car was luxury item reserved for the rich and powerful, and they simply had to abide by the same rules that applied to horse-drawn vehicles. But when, at the beginning of the 1930s, delivery traffic also became m e and more motorized and the number of trucks on Germany's roads increased, it was time for the first "Law on Long-distance Freight Transport by Motor Vehicles". It was passed in 1935 and stipulated, among other things, that transport companies as well as freight and forwarding agents had to be licensed by the government and needed to join the "Reichs-Kraftwagen-Betriebsverband" – the German motor vehicle business association. This association was responsible, among other things, for ensuring that the transport tariffs were adhered to. In the event of violations, extensive sanctions loomed, including the withdrawal of the licence.

In the years leading up to the beginning of the Second World War, further regulations were passed that also affected f eight transport: the "Working Time Regulation" from the Ministry of Labor made it compulsory to keep a logbook – or alternatively to install a tachograph in the vehicle. And the "Regulation on the Operation of Motor Vehicle Companies in Passenger Transportation" prescribed the use of a tachograph in all buses and coaches in non-scheduled service from 1939 onward.

EFFICIENCY IN TRANSPORT

Precisely because there was not yet a legal obligation to monitor vehicles, potential Kienzle customers still had to be convinced of the added value of the tachograph 100 years ago. In the world economic crisis of 1928/1929, they probably also had other worries. But this was precisely the first app oach to pointing out the benefits of the tachograph: e - ciency. Because resources and raw materials were scarce and/or expensive, the information on the distance traveled, the speed as well as travel and stop times could be used to entice drivers to a more economical driving style. This argument was reinforced a decade later, when, in the months before and during the Second World War, greater emphasis was placed on the economical use of imported raw materials such as crude oil and rubber to benefit self-sufficient German econo .

In order to substantiate this argument, Kienzle carried out extensive test runs during this period, travelling the same route with the same vehicle at diffe ent maximum speeds – as evidenced by the records of the tachograph. The result: a lower maximum speed had hardly any effect on the driving time, but a dramatic effect on fuel consumption, up to 30 pe - cent less. Added to this were less tire wear and less frequent maintenance and repair. The tachograph has therefore made a significant contribution to efficien in transport.

THE FIRST NATIONAL LAW

At the beginning of the 1950s, the number of fatal traffic accidents had reached a worrying height – many caused by exhausted professional drivers. In order to encourage them to drive more carefully, to prevent accidents and thus to ensure greater safety on the roads of the Federal Republic of Germany, the Bundestag passed the new paragraph 57a of the Road Traffic Licensin Regulations. According to this, all trucks with a gross vehicle weight of more than 7.5 tons, buses with 14 or more seats, and tractors with 25 horse power or more had to be equipped with a calibratable tachograph that was in continuous operation during the entire journey.

The name of the driver, the starting point and date of the journey as well as the status of the odometer at the beginning and end of the trip had to be recorded on the diagram discs. And the vehicle owner had the obligation to store the diagram discs for one year to be able to show them to the relevant authorities on demand.

TCO 8
NOW AN OFFICIAL CONTROL INSTRUMENT

The expected mandate to install tachographs in commercial vehicles motivated the developers in Villingen in the early 1950s to further improve their tachographs. 1952 saw the launch of the TCO 8, in which the speed scale was significantly enlarged and thus more clearly designed. In addition to the classic one-day-one-driver version, the tachograph was also offered as an automatic seven-day device, with a change counter as well as driver change registration. This meant that the diagram disc did not have to be changed every day if a driver was on the road in the same vehicle for a whole week. The device also kept an eye on speed changes at intervals of 10 km/h and thus provided information about the driving style: the fewer changes for the same driving distance, the more evenly and thus more resource-efficient was the journey.

TCO 11
THE START OF THE EDDY-CURRENT TACHOGRAPHS

In parallel with the TCO 8, the Kienzle development department was also working on the first tachograph based on the eddy-cur ent principle. The first small series of the TCO 11 was produced in 1954, subsequently put through its paces and further improved in the years that followed. In 1960, the TCO 11-4 was presented as the world's first fully developed standard model of an eddy-current tachograph. By the time of the IAA in 1963, the Villingen experts had succeeded in developing a time-corrected diagram disc that eliminated another possibility of manipulation.

In addition to the TCO 11, the TCO 14 was also developed during these years, a tachograph which used the eddy-current technology for speed registration as well. Usable as a universal device in a wide variety of engine and vehicle types, it provided drivers with important information about their driving style: if the needle was in the green range of the device's color scale, the engine was being treated with care. Those who drove permanently in the red could cause lasting damage to the vehicle.

THE EDDY-CURRENT PRINCIPLE

In contrast to the centrifugal forces that were used in the old pendulum system of the tachograph, the new measuring system from the 1970s onward was based on the force of a magnetic field. ith the eddy-current principle, the speed is transmitted via a shaft to a rotating magnet, which also rotates and generates an eddy current. This moves a metal disk, to which an axle is attached, against the resistance of a calibrated spiral spring and thus controls a needle over a dial. The amplitude no longer depended on the distance of a pendulum from an axis but on the strength of the magnetic field and the counterfo ce of the spring.

However, because the conductivity of both the magnet and the measuring drum are directly influenced by th ambient temperature, a built-in compensation material needs to counterbalance this effect. This is one eason why the eddy-current technology initially was not able to establish itself in commercial vehicle applications even though it had already been perfected at the beginning of the 20th century: the magnetic materials available in 1910 were not yet sufficient to generate the necessa mechanical force for the recording mechanism.

TCO 15
ONE MODULAR SYSTEM, MANY OPTIONS

In 1970, the TCO 15 replaced the models of the 1950s. It was also called a modular tachograph, because it was offe ed in diffe ent variants and its normal speed registration could be combined with diffe ent functions depending on the customer's wishes: speed registration and/or time group registration, bar or step display, one-day or seven-day recording, one or two drivers. All models were equipped with an electronic clockwork and the recorded data on working and driving time as well as the distance traveled could now be analyzed electronically for the first time

UNIFIED RULES FOR EUROPE

Until the end of the 1960s, many European countries had passed their own laws on mandatory tachographs for commercial vehicles. However, these regulations were so diffe ent and the increase in interregional and international transport was so high that, at the beginning of the 1970s, the European Economic Community (EEC) saw an urgent need for harmonization. The goal: a level playing field in th European transport industry.

First, in 1969, EEC Regulation No. 543/69 on the "Harmonization of Certain Social Legislation in the European Community" was adopted, which laid down rules on driving personnel, total driving time and distance as well as driving, working and rest times. In addition, a tachograph was to record this data automatically. Finally, in July 1970, the "Regulation on the Introduction of Recording Equipment in Road Transport" (No. 1463/70) came into force in all member states. According to this, all trucks with a gross vehicle weight of 3.5 tons or more and all buses with nine or more seats had to be fitted with a tachograph. The transitional periods were generous: new registrations had to comply with this regulation from 1975 onward, older vehicles from 1976 onward and vehicles that already had an older tachograph model on board could wait until the end of the decade.

1981

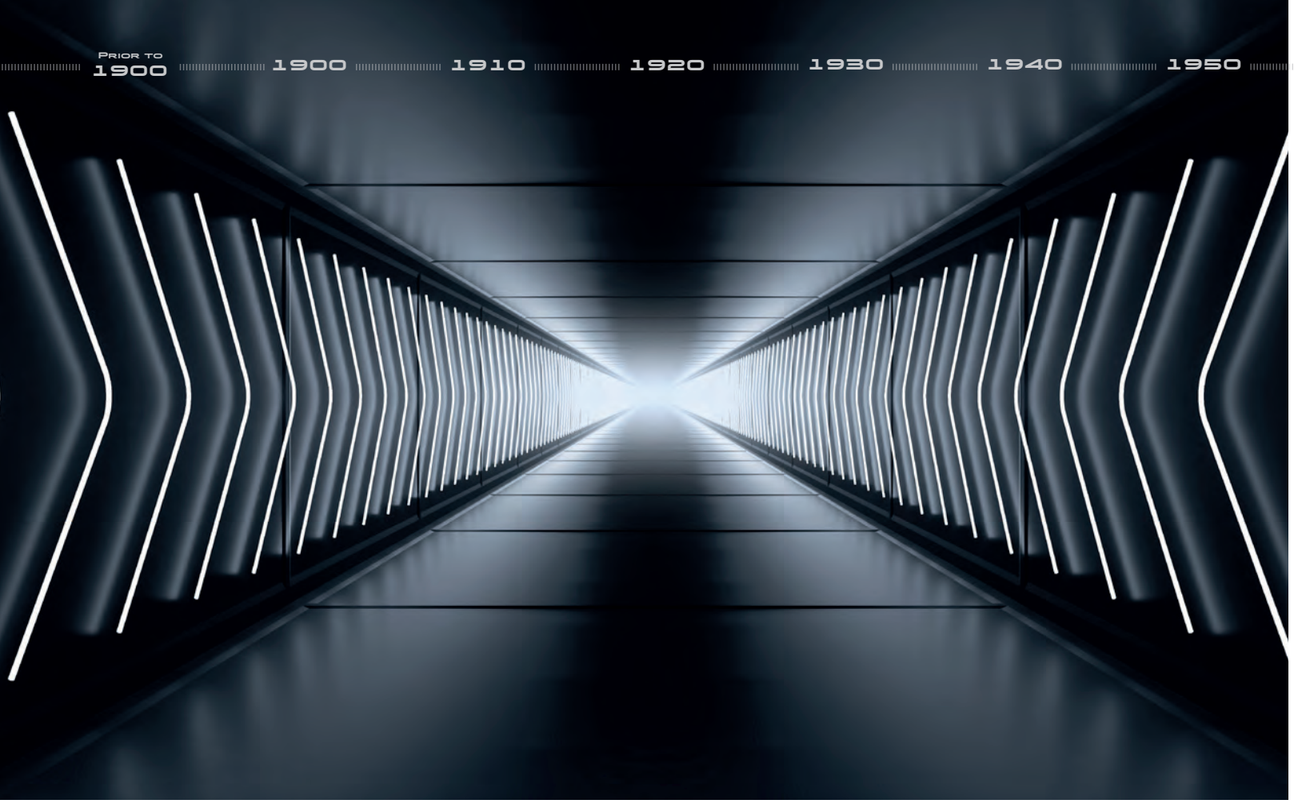
After almost a century in family hands, Kienzle Apparate GmbH for the first time enters a corporate environment and becomes part of Mannesmann AG.

TCO 1311
THE FIRST EUROPEAN TACHOGRAPH

The most important further development of the Kienzle tachograph in the 1970s was the TCO 1311 – the first tachograph designed in acco dance with the special requirements of the current EEC regulation that could and should be used throughout the European Community. It was first p esented at the IAA in 1973 and went into series production in mid-1974, just in time for the specified changeover deadlines. The EC tachograp recorded the distance and speed traveled as well as the working, driving, rest and presence times as well as their interruptions. Furthermore, it registered every enclosure opening, so that access to the diagram discs could also be traced without any gaps. The TCO 1311 also took a step forward in technical terms and benefited f om a pulse generator mounted on the gearbox output shaft, which electronically transmitted the mechanical rotation of the engine to the tachograph – with positive effect on the measuring accuracy. This Kienzle Tachograph Sensor (KITAS) is still in use today. In addition, the now missing shaft made it much easier to install the device.

KTCO 1318
ELECTRONIC CONTROL, MORE FUNCTIONS

In the mid-1980s, fully electronic control finally made its way into the tachograph: the compact tachograph KTCO 1318 came with additional coded data inputs and outputs, which made additional functions possible for the first time. For example, incoming pulses could be checked for potential manipulation attempts. At the same time, other devices could be supplied with information on speed and distance information via the data outputs.



FTCO 1319
ROUND IS OUT, FLAT IS IN

At the beginning of the 1990s, the tachograph from the Black Forest approached its current flat form: as the FTCO 1319 flat tachograph, it could be integrated asily into the dashboard of a commercial vehicle from 1992. Instead of disappearing under a cover, the diagram disc now was fed through a retracting mechanism into the tachograph where it was then brought into the correct position.

1991

The Mannesmann Group becomes majority owner of the VDO Adolf Schindling AG, the second-largest automotive supplier in Germany after Bosch.

1997

Mannesmann combines the actually quite different product portfolios of VDO and Kienzle in the field of vehicle instruments to form Mannesmann VDO AG.

MTCO 1324
THE DIGITAL ERA BEGINS

The IAA in 1997 marked an important turning point in the history of tachographs. On the one hand, the old round shape was finally a thing of the past with the modular tachograph presented there, the MTCO 1324, which fitted into the standa dized radio compartment. Vehicle designers were looking forward to the new creative freedom. The digital age also started then with the display of all driving data on a digital display – this marked the end of the separation between the recording and the display device. But the days were also num-bered for the diagram disc as a mechanical storage medium.

In addition to the MTCO, the company presented a first version of the digital tachograph DTCO, which com-plied with all the planned requirements stipulated by the new EC regulations. It stored up to twelve months of data on a chip.

ROAD SAFETY

In the 1950s at the latest, another benefit of th Kienzle tachograph became clear: safety. The speed limit of 50 km/h within city limits was not (re)introduced until 1957, the generally valid maximum speed outside of cities only followed in the 1970s. In addition, the driving and rest periods for professional drivers were not regulated at all until then. The result: rising numbers of accidents and casualties in road traffic – not in equently caused by exhausted drivers.

Politicians hoped that the introduction of mandatory tachographs would provide a technical support for accident prevention, at least for the commercial vehicle sector. In 1953, the trade magazine “Lastauto und Omnibus” (Trucks and Buses) assigned “educational value” to the tachograph because it allowed both police and fleet operators to mo - itor drivers' compliance with the rules. The tachograph was thus an instrument of safety engineering.

REGULATION FOR THE DIGITAL AGE

With the development of the tachograph towards a digital recording device storing data on chip cards, the laws had to be adapted accordingly. Originally, the changeover to the new generation of devices was targeted for the year 2000, but it took a good decade to negotiate and the deadline was missed by all of six years. The new EC regulation No. 561/2006 on digital recording equipment came into force on May 1, 2006. Since then, all new vehicles that are subject to a tachograph mandate must be equipped with a digital tachograph. The vehicles affected we e, as in the first Eu ope-wide regulation, those trucks over 3.5 tons maximum mass including trailers/semi-trailers and vehicles used to transport more than nine persons, including the driver.

2001

Following the Mannesmann takeover by Vodafone, Siemens assumes the business and continues it as Siemens VDO Automotive AG.

2007

Continental acquires the entire Siemens VDO Group and has been continuing the core business with vehicle technology for commercial vehicles in Villingen to this day.

DTCO
COMPLETE COMPUTER SYSTEM IN RADIO FORMAT

The first generation of the digital tachograph DTCO is a complete computer system with an integrated display for menu navigation and user guidance, printer, real-time clock, front-panel test, diagnostic and information interfaces, CAN interface as well as interfaces for connecting with the instrument cluster. On the market since 2006, it is still in widespread use. It stores all the information about drivers and journeys in an internal mass storage with a capacity of up to one year. In addition, driver-related data such as working, driving and rest times are recorded on chip cards for a period of 28 days.

Access to the tachograph data is clearly regulated for all necessary control processes: driver activities, events, incidents and vehicle changes are stored on the driver card. A company card allows the read-out of the vehicle data from the mass storage as well as data from inserted driver cards. Control cards enable authorities to access information relevant to the law. And workshops can use a special workshop card to unlock the digital tachograph's calibration function for testing and inspection purposes.

DTCO 4.0 AND 4.1 DIGITAL AND SMART

Since 2019, the second generation of the digital tachograph by VDO was on the market with the DTCO 4.0, also known as the smart tachograph. In addition to comprehensive data recording and enhanced data security, it also features GNSS (Global Navigation Satellite Systems) positioning. By means of DSRC remote communication (Dedicated Short Range Communication), control data can also be retrieved during drive-by.

Its successor, the DTCO 4.1, will celebrate its premiere in 2023 – exactly 100 years after the Autorex clock recorded the driving and stopping times of a commercial vehicle for the first time in the Black Fo est. In addition to the classic tachograph data such as working, driving and rest times etc., this tachograph will not only automatically record border crossings and better document cabotage tours as well as posting of drivers in particular. It will also provide the basis for many other functions, from loading and unloading of the vehicle to optimized freight allocation and harmonized European tolling – in other words, a truly smart tachograph.

FAIR AND SAFE COMPETITION ON EUROPE'S ROADS - THE EU MOBILITY PACKAGE

Better working conditions, a level playing field and g eater safety on roads – these are the goals of the European Union's Mobility Package. With it, new regulations come into force, which are being successively implemented since 2020. In addition to improvements on rest periods, which will benefit drivers in particula , the EU Mobility Package primarily regulates the obligations to provide verification o cabotage journeys and the posting of driving personnel.

In order to control and enforce these standards, the new smart tachograph of the second version will come into use. By August 2025, new vehicles and those currently used in cross-border transport of 3.5 tons or more must successively install it. What is new is that commercial vehicles with a total weight of more than 2.5 tons that are used in cross-border traffic must be equipped with t smart tachograph (second version) by 2026.

THE TACHOGRAPH DATA PAVES THE WAY FOR FURTHER DEVELOPMENT AND THE FUTURE OF EFFICIENT AND SAFE TRANSPORT LOGISTICS.

TREASURE TROVE OF DATA WITHIN THE VEHICLE

In addition to efficiency and safe , the tachograph offers another benefit, which has gained in value ove the decades: data. For, the information collected in the tachograph could be systematically evaluated since the 1950s and used for a variety of purposes – starting with the reliable clarification of liability in the context of legal proceedings. With the precise evaluation of the diagram discs, exact speeds, acceleration as well as braking values could be reconstructed in the event of an accident.

In addition, the data obtained from the system served the first inte ested companies in optimizing their fleets When, in the 1980s, the vehicle data was directly and digitally recorded, the first elect onic fleet managemen systems emerged, such as the FMS 1330 by Mannesmann Kienzle, which made use of the electronic tachograph and recorded, stored and processed a wide range of vehicle information centrally. This data was not only used by the drivers for orientation purposes, but it also provided the basis for fleet companies for mo e extensive processes, like dispatching, maintenance, remuneration or controlling.

Today, the driving data recorded in the tachograph has dual meaning: on the one hand, it fulfills the legal requirements of the European Union regarding the recording of driving and rest times. On the other hand, the data stored in the tachograph is valuable raw material for all fleet operators. The tachograph data thus pave the way for the further development and the future of efficient and safe transport logistic

TODAY, THE TACHOGRAPH IS THE CENTRAL CONTROL UNIT FOR FREIGHT TRANSPORT AND THE TRANSPORT INDUSTRY ON THE ROAD.

Interview on the future of the tachograph

WITH MATTHIAS KLICHÉ

Matthias, what is your job in connection with the tachograph at Continental?
Officially, I am the Head of Legal Requirements in the segment that designs and manufactures hardware, software and services that enable commercial vehicle fleets to comply with laws and legislation. But if I had to describe my tasks, I see myself as a translator between technology and politics when it comes to safety in freight transport. For, these two rarely speak the same language. In this respect, I have had countless discussions over the years and, in doing so, learned a lot about the history of the tachograph.

When you look back on the last 100 years, what was the most important contribution of the tachograph for you?
Quite clearly: road safety. If you look at how many trucks used to be involved in accidents due to exhaustion or similar causes, you get quite nauseous. In this respect, the tachograph has certainly made its most important contribution in improving road safety and in defusing the truck as a "hazard risk".

And what role does the tachograph play in international freight transport today?
Today, and this is the second important point, the tachograph is more than just a recorder of driving and rest times. It supports fair competition in the transport industry and, as of this year, it will serve two additional applications that have nothing to do with road safety per se. For, the regulations laid down in the first EU Mobility Package on cabotage and the posting of drivers is purely driven by economics. As a result, the tachograph has been upgraded and is now the central control unit for freight transport and the transport industry on the road.

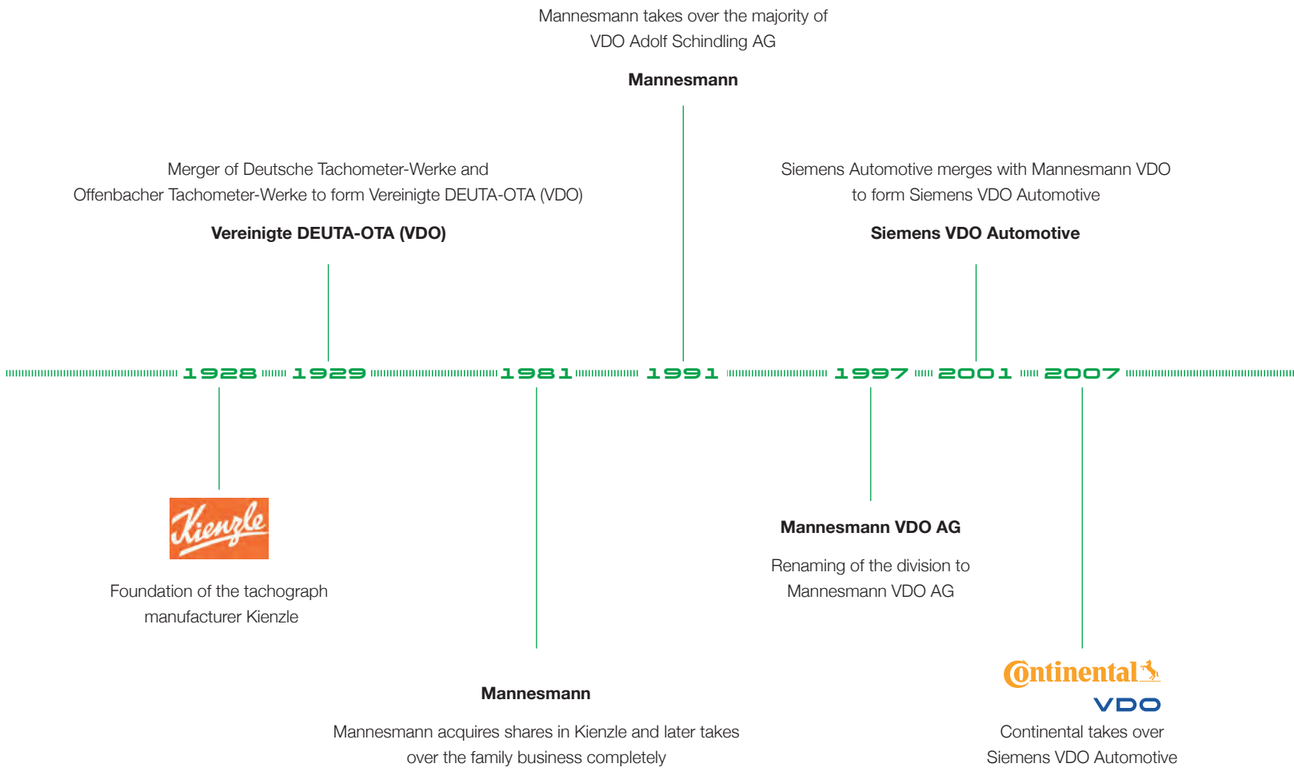
What will happen in the next ten years? Will its tasks change?
A new use case that the colleagues in Brussels have not yet had on their radar is the so-called tachograph toll. This means that tolls can be processed via the European Electronic Toll Service (EETS) using the tachograph, so that there are no more piles of tolling boxes in the cockpit. We already offer this functio today. Another possibility would be to route the eCall function via the tachograph. We already use the new Galileo signal for positioning in our second version of the smart tachograph, the DTCO 4.1. If you combine this information with the vehicle ID from the tachograph and an electronic load consignment, the emergency services already have all the necessary information in the event of an accident so that they can react accordingly and contact the right experts, e.g., for chemical accidents. The tachograph could be an important enabler in such cases as well. However, and unfortunately, the political discussion of this topic is currently moving in another direction. In principle, however, there are many scenarios in which diffe ent types of information can be combined and new use cases for the tachograph can be developed. Quite

often, we take the initiative and show the politicians in Brussels what could be possible with the tachograph in the future.

There are also some people who forecast that, in future, the tasks of the tachograph could be taken over by the smartphone. What do you think?
The European Commission recently conducted a study on this topic. The question is both justifie and technically feasible. However, the core of the tachograph – safety – is not only about road safety, but also about security against manipulation. The tachograph is a high-security application with EAL 4+ (Evaluation Assurance Level), and this level of security would then also have to be implement-ed by all smartphone manufacturers – including recertification for every iOS or And oid update. That would simply not be possible on the smartphone market. Incidentally, the approach of integrating all on-board units (OBUs) including the tachograph via the telematics system already installed in the vehicle (on-board equipment, or OBE for short) faces the same problem. Here, too, the necessary security level is missing, especially since only about 30 percent of the vehicles in Europe are equipped with a telematics infrastructure. In this respect, dedicated hardware will have to continue to be installed in the vehicle.

Is it possible to foresee how the legal situation will develop?
There is already a second and even a third EU Mobility Package. But they are more about implementing Vision Zero on Europe's roads by 2030, for example through initiatives around vehicle and pedestrian safety. And this does not concern the tachograph itself. The first EU obility Package has had the greatest impact here, which are already being implemented.

How do you see the future of the tachograph? Will we continue to use a tachograph, even if there may be fewer or no drivers at all?
The question of the tachograph in the context of autonomous driving is one we are being asked quite frequently. In my view, the tachograph could only really become obsolete in those vehicles that can do without a driver on the entire route – meaning autonomy level 5. But in which situations is that really the case? Maybe the vehicle has to be operated by a human driver for the last two kilometers or when maneuvering – and suddenly the tachograph as a control instrument is indispensable. In addition, we often forget that the tachograph is no longer just a single device, but an entire ecosystem consisting of the tachograph, complementary hardware such as the VDO Link, an entire software platform for efficien fleet management, various workshop solutions and additional services such as the tachograph toll. In this respect, I believe that the tachograph will be around for a very long time. And with a bit of luck, for another 100 years.



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100
YEARS
VDO TACHOGRAPH