Best Practice in der europäischen Fahrzeugüberwachung

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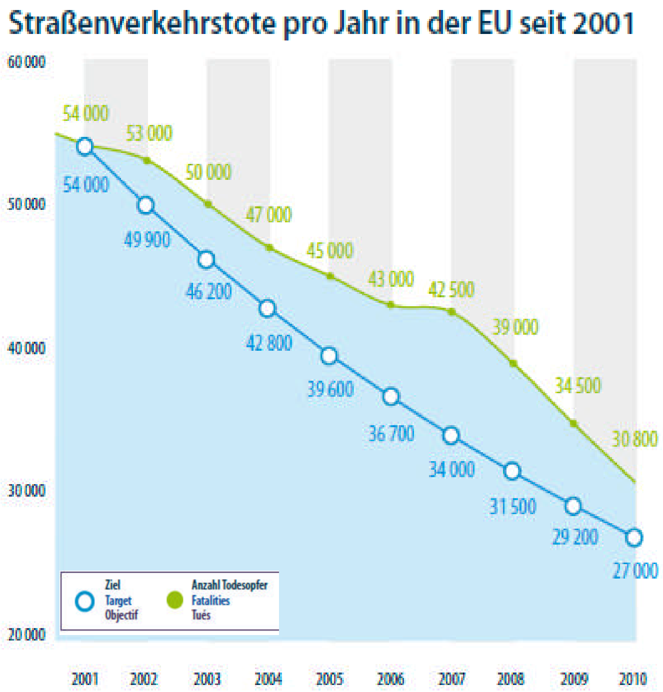
Verkehrssicherheit in Europa

Ziel Deutliche Reduzierung der Verkehrstoten (Halbierung)



Maßnahmen in Europa

Zentrale Maßnahmen der EU

- EU-Charta bis 2010
- Road Safety Programme 2011 - 2020

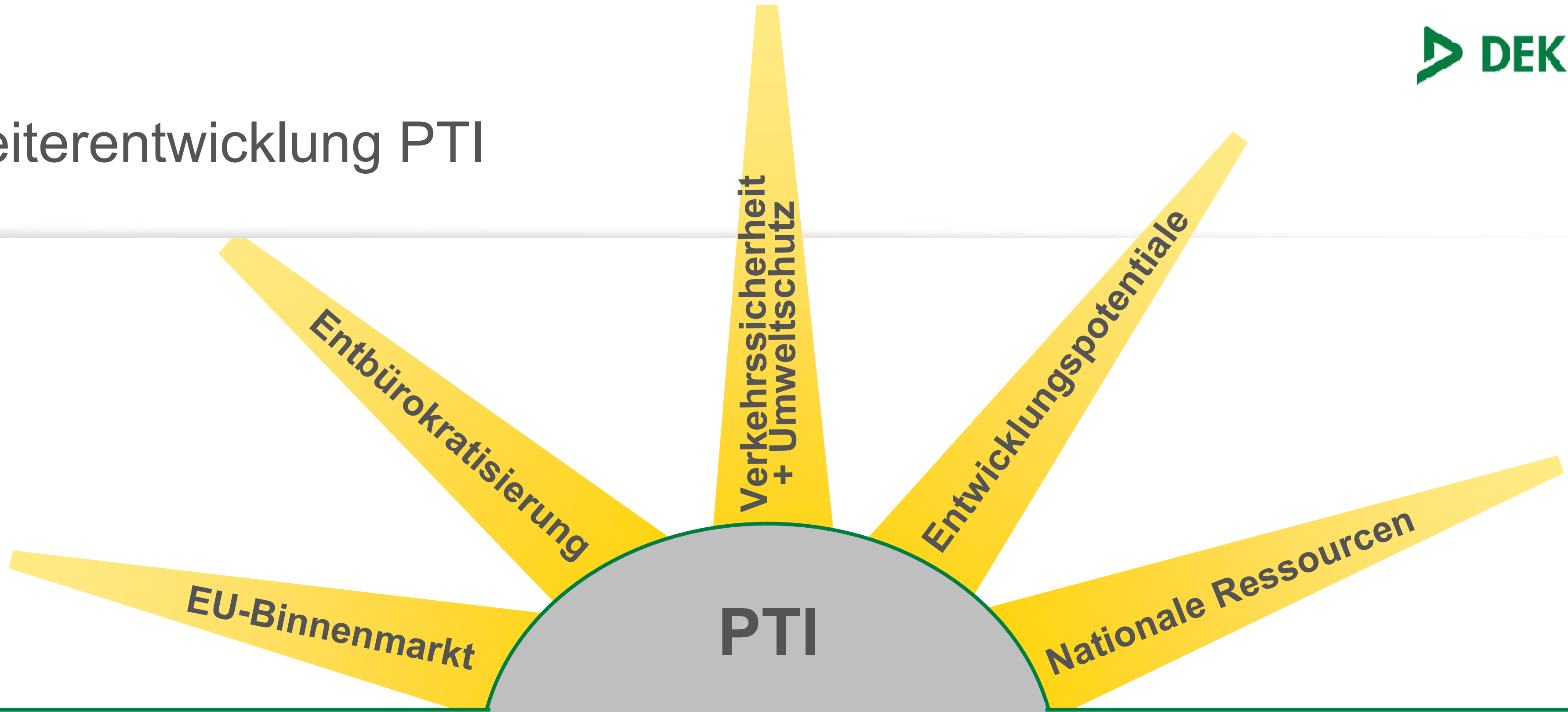
Umsetzung und Ergänzung durch nationale Programme bei deutlichem Anstieg an Fahrzeugen und Verkehrsleistung

Wesentliche Faktoren

- Weiterentwicklung in der Fahrzeugtechnik
- Ausbau des Rettungswesen
- Gesteigertes Niveau der periodischen Überwachung (HU)
- Verbesserung der Straßen und Infrastruktur
- …

Die Periodische Fahrzeugüberwachung (PTI: Periodical Technical Inspection) und deren Weiterentwicklung hat wesentlich zur Verkehrssicherheit beigetragen

Weiterentwicklung PTI



- Angepasste Prüftechnik
- Entwicklungen der Fahrerassistenzsysteme
- Verkürzung der Entwicklungszeiten
- Moderne IT
- Fortschritt in der Fahrzeugentwicklung
- Weiterentwicklung der Prüftechnik
- Harmonisierung
- Zunahme grenzüberschreitender Verkehr

Regelungen müssen Leitplanken auf dem Weg zu höherer Verkehrssicherheit sein

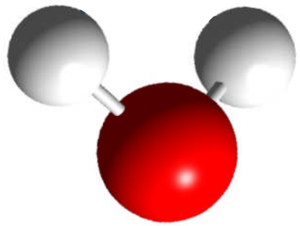
Quo Vadis PTI-Harmonisierung

Europa sucht neue Wege

- Offenes System mit Mindeststandards (Subsidiarität)

oder

- Politisch motivierte Entwicklung zu einheitlichem Standard (low … middle … high?)



- Geregelter Anpassungsprozess (z. B. Zyklen alle 2 Jahre, TAC*)
- Zentrale Entwicklungseinrichtungen („FSD-Modell", …)
- Impact-Analysen (EU-Studien, Projekte, …)

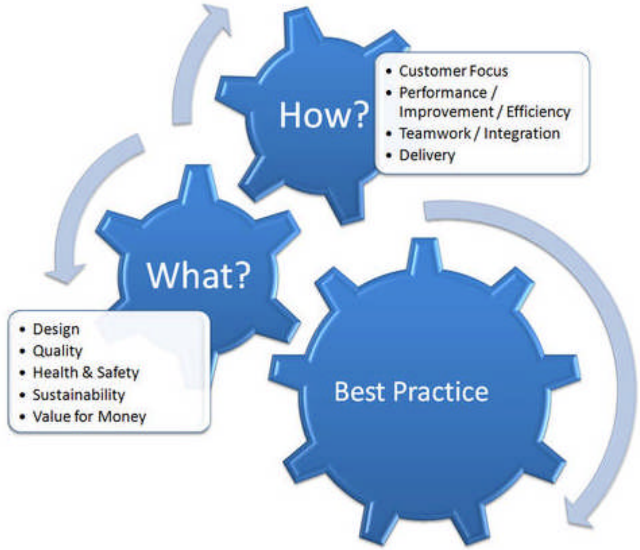
*TAC: Technical Adaption Comitee

Best Practice **Integration der Erfahrungen der Sachverständigen in Europa als Chance der erfolgreichen Weiterentwicklung PTI**

EU-Kommission - DG Move

Formulierung von 8 Themenschwerpunkten zur Weiterentwicklung von PTI

1. Prüfinhalte und Prüfmethoden
2. Mangeleinstufung
3. Untersuchungspflichtige Fahrzeugklassen
4. Prüffristen
5. Technische Ausstattung der Prüfstellen
6. Anforderungen an das Personal
7. Qualitätsmanagement und Behördenaufsicht
8. Datenbank für Fahrzeuginformationen/Prüfergebnisse



*©

Die Vielfalt in der EU stellt ein großes Potential für die Weiterentwicklung PTI dar

*http://www.wmcce.org/sites/default/files/images/Best%20Practice%20cogs.img_assist_custom-501x420.jpg

1. Prüfinhalte und Prüfmethoden - (Best Practice in Europa)

Prüfung sicherheitsrelevanter, elektronisch geregelter Systeme (EGS)

Inhalt

- Bündelung von Entwicklungskapazitäten
  (FSD GmbH als zentrale Stelle)
- Dynamische Anpassung von Prüfinformationen an die Fahrzeugtechnik
- Aufbereitung von Herstellerinformationen

Ziel

- Umfassende Bereitstellung von fahrzeugspezifischen Prüfinformationen
- Kosteneinsparung
- Hoher Qualitätsstandard bei der Prüfung von EGS

Weitere Beispiele

- Integration von OBD in die AU (Frankreich, Schweden, Niederlande, Deutschland)
- Brandschutzprüfung an KOM (Schweden)
- Geräuschmessung Fahrzeug (Maximalwert) und Hupe (Mindestwert) (Italien)

2. Mangeleinstufung – (Best Practice in Europa)

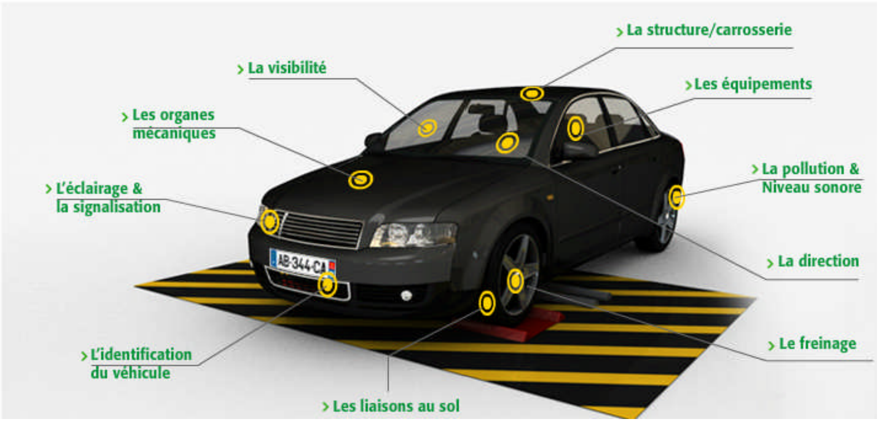
Einheitlicher Mangelbaum (Deutschland)

Inhalt

- Einheitliche Umsetzung von Vorgaben
- Zentrale Weiterentwicklung und Anpassung
- Zentrale Bereitstellung für alle ÜO

Ziel

- Qualitätsverbesserung
- Wettbewerbsneutralität
- Standardisierte Informationen für Kunden und Werkstätten



Weitere Beispiele

- IT-unterstützte Mangelerfassung (Frankreich)

3. Untersuchungspflichtige Fahrzeugklassen – (Best Practice in Europa)

Prüfung von L1 bis L7 (Zweiräder und Leichtfahrzeuge) (Spanien, Italien ...)

Inhalt

- Prüfung sicherheitsrelevanter Punkte an Zweirädern/Leichtfahrzeugen
- Prüfung umweltrelevanter Punkte (AU in Italien) an Zweirädern/Leichtfahrzeugen

Ziel

- Verkehrssicherheit erhöhen
- Niveau der technischen Sicherheit erhöhen
- Verbesserung der technischen Sicherheit dieser viel genutzten Fahrzeugklasse

Weitere Beispiele

- Motorräder > 50 ccm (Ungarn)
- LOF (Deutschland, Polen, Slowakische Republik, Tschechische Republik)

4. Prüffristen – (Best Practice in Europa)

Fahrzeugaltersabhängige Prüffrist (Schweden, Finnland, Polen …)

Inhalt

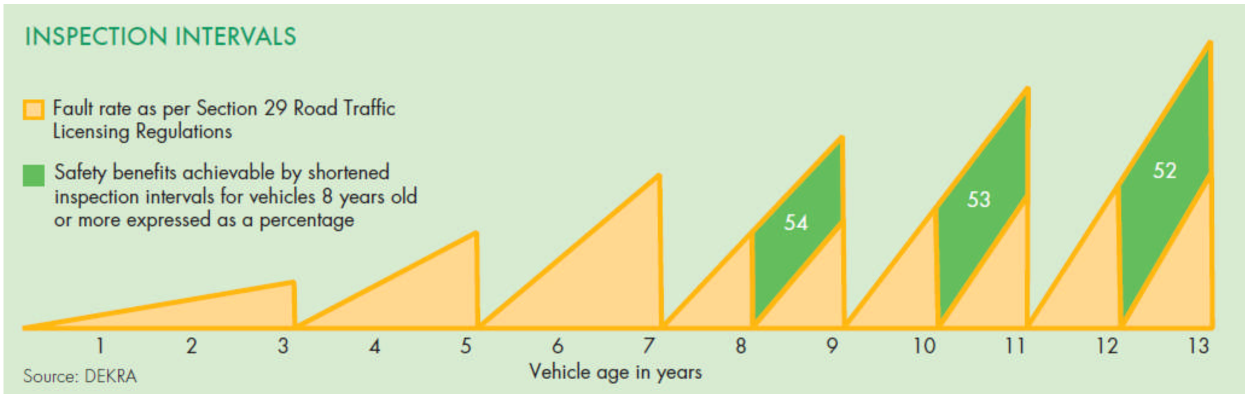
- Prüfung älterer Fahrzeuge in kürzeren Abständen
- Dynamischer Zyklus für PKW 3-2-1

Ziel

- Verbesserung der Verkehrssicherheit
- Anpassung der Prüffristen an Alterung und Verschleiss
- Anpassung der Prüffristen an das Fahrzeugalter

Weitere Beispiele

- 3-1-1 England, Luxemburg



5.Technische Ausstattung der Prüfstellen – (Best Practice in Europa)

Schwingungsdämpferprüfung (Frankreich, Belgien)

Inhalt

- Prüfung des Feder-Dämpfersystem auf einem Prüfstand
- Bewertung der Ergebnisse des Dämpfersystems
- Bewertung von Dämpfungsdifferenzen (rechts - links)

Ziel

- Verbesserung der Verkehrssicherheit
- Anpassung der Prüfung an die Fahrzeugtechnik
- Nutzung der Möglichkeit moderner Prüftechnik
- Steigerung der Qualität der HU

Weitere Beispiele

- OBD Scantool für Abgasuntersuchung (Frankreich, Schweden, Polen, Deutschland …)
- Reifendruckprüfgerät (Frankreich)
- Ladungssimulation für Bremsenprüfung (Schweden)

6. Anforderungen an das Personal – (Best Practice in Europa)

Betrauung, amtliche Anerkennung, Anforderungen an Aus- und Weiterbildung (Deutschland)

Inhalt

- Einsatz von hoch qualifiziertem Personal (Anlage VIIIb StVZO)
- Eintrittsvoraussetzungen + Regel zur Weiterbildung
- Dokumentationspflicht und behördliche Kontrolle

Ziel

- Notwendige Kompetenz sichern
- Sicherung von Q-Standards
- Festgeschriebene Lehrpläne
- Kontinuierliches Lernen fordern

Weitere Beispiele

- Weiterbildung + Audit alle 2 Jahre + min. 300 HU p.a. (Frankreich)
- Automechaniker mit 6 Jahren Praxis + 1 Woche Ausbildung (Niederlande)

7. Qualitätsmanagement und Behördenaufsicht - (Best Practice in Europa)

QM-Verein (Deutschland)

Inhalt

- Flächendeckende Durchführung von Audits (unangekündigte Nachkontrollen UN)
- Einheitliche Standards und Kennzahlen für die Systembewertung
- Unterstützung der ÜI-QM-Systeme

Ziel

- Wettbewerbsneutralität schaffen
- Schwerpunktaufgaben definieren
- Weiterentwicklung des QM-Systems

Weitere Beispiele

- Akkreditierung nach ISO 17020 (Schweden, Deutschland ...)
- Videoaufzeichnung (Tschechische Republik)
- Stichprobenprüfung in Werkstätten 3 % aller Prüfungen (Niederlande)

8. Datenbank für Fahrzeuginformationen/Prüfergebnisse - (Best Practice in Europa)

Aufbau einer EU-weiten Datenbank (DB) zur Speicherung von PTI-relevanten Informationen

Ziel

- Unterstützung der Harmonisierung in Europa
- Verbesserung der Effizienz des Systems der Fahrzeugüberwachung
- Vereinfachte Informationsbereitstellung auch für Dritte

Ansätze (Schweden)

Inhalt

- Bereitstellung von Daten an alle Prozessbeteiligten (zentrale DB)
- Zugang des Prüfpersonals zu aktuellen Daten

Ziel

- Vermeidung von dezentralen Datenbeständen
- Vereinfachung von administrativen Vorgängen (z. B. durch Zulassungsstellen, Polizei)

Best Practice - Vielfalt Chance für Europa

VIDEO-Vorführung

EU-Reformpaket für PTI
Chance und Risiko für die deutsche Fahrzeugüberwachung

DEKRA

On the safe side.

Anhang: Prüfinhalte und Prüfmethoden - (Best Practice in Europa)

Fedotov A., Domorozov A., Portnjagin E., Boiko A. (2011). Problems and modern tendencies of vehicle instrument control development. Irkutsk: National Research Irkutsk State Technical University.

PROBLEMS AND MODERN TENDENCIES OF VEHICLE INSTRUMENT CONTROL DEVELOPMENT

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Safety is a fundamental problem of the automobile transport industry. This problem has been especially relevant for the last few years because the vehicle fleet keeps increasing annually and there is no sign for the decrease of its growth.

Motorists' concern of the safety issues immediately followed the appearance of quite a large number of vehicles on the roads and when the first road traffic accidents took place. The causes of the accidents were different, but the majority of them had to do with one of the car systems malfunctioning. One of the main safety indicators was and still is, the braking effectiveness of a car.

At present, the widest spread diagnostic method of vehicle brake system effectiveness is the platform method, which includes the use of power brake platforms with rollers.

The current platforms with rollers, which were designed back in the 50's of the last century, didn't essentially change, with the exception of connecting them to computers, which allows information to be processed on the programming level. This upgrade significantly simplified the diagnostic processes of cars, but didn't eliminate the fundamental shortcomings, which are inherent in the power methods of platform control.

First of all, present brake platforms with rollers, which are used for diagnosing car systems, have a low measurement repetition performance of the same car on the same platform. Figure 1 shows the distribution histograms of the measured values of the braking force on the right and on the left wheels of a Toyota Corolla car, when it is tested on the platform with rollers.

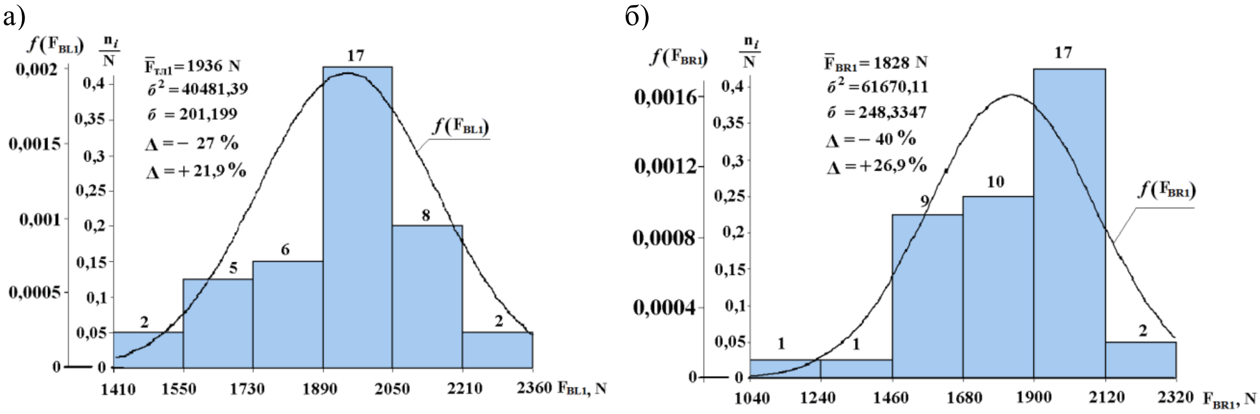

Fig.1 Distribution of braking forces on the front axle wheels of a Toyota Corolla when on the roller brake platform:
a – left wheel; b – right wheel; 1 – function of normal distribution;
2 – function of normal distribution with the rotary platform.

Second of all, the impact of tests on the systems of cars, which are performed on the roller platforms, doesn't fit the conditions in which road control tests of vehicles are done.

For instance, the tests of bus brakes on the road revealed that 50% of buses didn't stand the road test where they couldn't meet the standard value of deceleration and exceeded the linear side deflection [1] when braking, whereas when tested on the up-to-date platforms with rollers, the results were positive.

The analysis reveals that the rollers of the platforms which are used at present, have a radius from 90 to 1000 mm. The wide radiuses dispersion of rollers (in comparison with the road) causes a significant difference of the conditions in which wheels interact with the platform rollers. The research shows that when the radius of the platform rollers extends, the measurement errors of the forces decrease (fig. 2).

a) b)

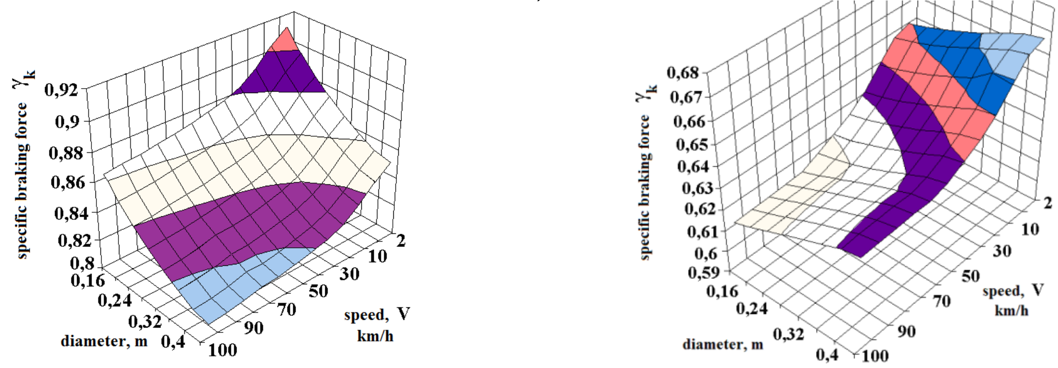

Fig. 2 The dependence of specific braking force on the speed and the diameter of the platform rollers (coefficient of adhesion is $\varphi_{max} = 0,8$):

a – when the braking wheel doesn't travel

b – when the braking wheel travels

The biggest values of radiuses are allowed in the platforms which are used for the conduction of research, in order to provide the best complience with the road conditions.

The distance between axles of the platform rollers also influences the quality of measurements. The research reveals that when the distance between the axles of the platform rollers increases, the measurement errors of the forces also increase. (fig.3).

a) b)

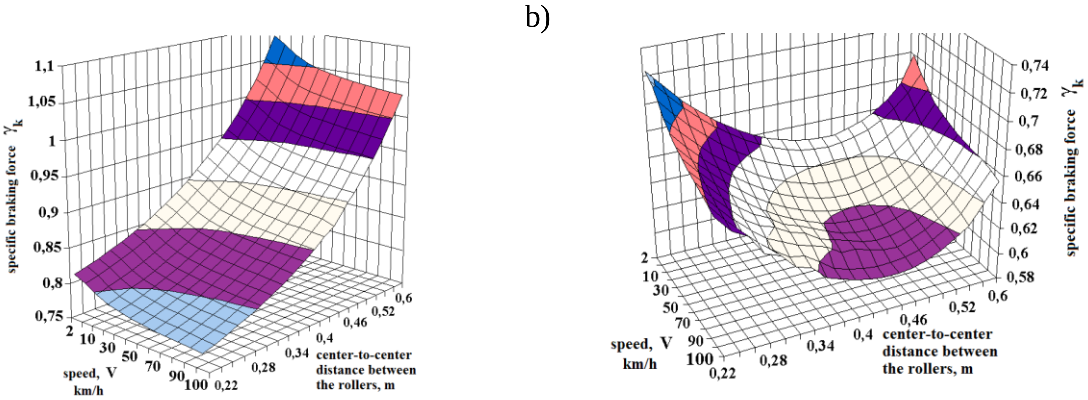

Fig. 3 The dependence of specific braking force on the speed and on the value of the

center-to-center distance between the rollers (coefficient of adhesion is φ_{max} = 0,8):
a – when the braking wheel doesn't travel
b – when the braking wheel travels

Traveling of the car while being diagnosed leads to the change of the normal forces dependance. According to the research, when there appears braking wheel traveling on the rollers, specific braking force changes.

The platforms with operational purposes are often given significantly smaller radiuses of rollers with the intention to limit the overall dimensions and in order to obtain the most possible transitive relations between the wheels and the rollers (in order to increase the speed of rollers rotation and the load devices connected to the platforms).

Since rollers in different platforms have very different values of radiuses, common indicators can not be used for the vehicle technical evaluation because the most important condition of objectivity isn't provided – invariability of the performance conditions. The test results, which were gained from different platforms, also can not be compared.

Despite the different statements of the question in discussion, the theoretical research, which has been conducted in this field, gives mostly an approximate understanding of what is going on with the tyre in the moment when the wheel interacts with the roller.

The known data in this field, published earlier, didn't provide the analysis which could reveal the possible influence of the curvature of the seating surface due to the fact that the biggest part of the research was conducted on the platforms either with a flat seating surface or with a big radius of the rollers or on the roads.

A double-seat scheme is used in the platforms with operational purposes. It means that one wheel sits on two rollers (fig. 4). One fact is very important here, it's that one of the rollers (pos. 1 on the fig. 4) on the braking platform is an active one – it's situated upfront and in the direction in which a car drives up the platform. The second roller (pos. 2 on the fig. 4) is passive. The reason why they are called so is simple, when the wheel interacts with the front and the back rollers on the platform, it loads the front one with normal force more than the back one. That's why the front roller is called *active* and the back one *passive*.

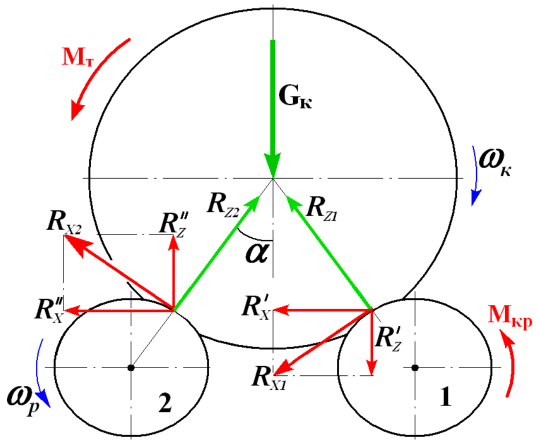

Fig.4 The scheme of the car wheel braking process on the platform rollers.

However, as the research reveals, when every wheel of the car sits on two rollers, the type of forces interaction in the 'car-platform' system changes significantly. So, when the wheel sits on two rollers, the area of contact (in comparison with the road) decreases significantly (up to 30%). And the installation of automatic wheels between the rollers with the following self-regulation isn't done in full measure when a certain inaccuracy (when the axle of the car isn't parallel to the axles of the rollers) of positioning exists.

When the car braking system is being diagnosed on the platform, the car sharply shifts along the rollers, even when the steering wheel is insignificantly steered. During the process of car diagnostics in such conditions it's practically always occurs that, at least, one wheel of the car can touch the ring-off roller (if it's available) or reach the edge. That can cause extra errors which should be considered when the relative difference of braking forces is being defined.

That's how the research helped to ascertain the dependence of the relative difference in braking forces of the axle wheels which is caused by mutual nonparallelism of the car axles and the platform when its seating rollers have different diameters (fig. 5). It's been ascertained that when the axles are nonparallel only for 3^0 and when the roller diameter is 0,2 m, the relative difference can reach up to 30%.

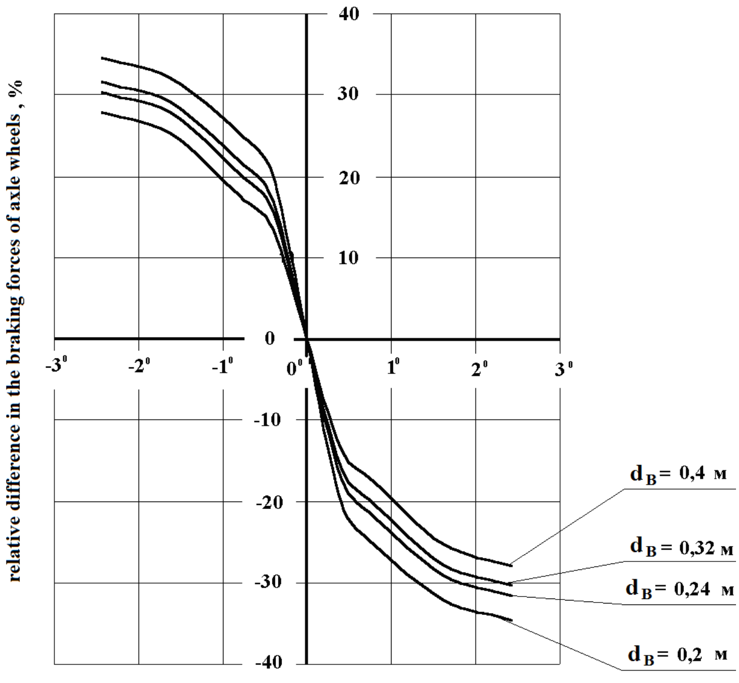

Fig. 5 Dependencies of the relative difference in the braking forces of axle wheels when mutual nonparallelism of the car axles and the brake tester when its rollers diameters are being varied. (coefficient of adhesion is $\varphi_{MAX\,0} = 0{,}8$)

As a rule, there's also a closed circuit in the platforms with rollers which generates a power flow that passes through the rollers. They are connected with each other by the platform circuit on one side and by the car wheel on the other one. Braking forces performance leads to longitudinal traveling of the car. Therefore, kinematic discordance will be in the power flow, which means that there will also be an extra power flow which is obtained as a consequence of the wheel radiuses (distances from the center of the wheel to the seating surface of the first and the second one) inequation among themselves.

The whole point is that, the similitude of the conditions, which imitate the rolling of wheels on the road and on the platform, can not be characterized on the basis of the similitude principle.

That's why, in order to compare test results, which were obtained on the different platforms, we need dimensionless characteristics, which would be able to charecterize vehicle behavior in road conditions depending on the change of the point of tyre contact. They could characterize it as functions derived from the deformation value (bend) for different types and sizes of tyres on different roller platforms.

The method of measuring braking force and the load on the axle along with the calculation method of deceleration or specific breaking force also greatly influence the cars diagnostics quality on the platforms with rollers.

According to the conducted overview of methods applied in different platforms, the platforms having been produced by different manufacturers, the indicators of deceleration or specific braking force are computed based on the braking forces, which were measured at the moment of automatic shut down of the platform electric motors or at the moment when maximum permissible effort on the controlling braking system element was reached, the effort is reached by the expression given:

$$\gamma_K = \frac{\sum F_{Xi}}{m_O \cdot g} = \frac{\sum F_{Xi}}{G_K}, \qquad (1)$$

where $\sum F_{Xi}$ – the sum of braking forces; m_O – car mass; g – the free fall acceleration; G_K – car weight.

In-turn, none of the normative documents regulate the measuring methods of the normal load on the wheels, the axle of which is being diagnosed on the platforms with rollers.

Manufacturers of platforms with rollers include the principle in the platform computer software. It's a principle of measuring the normal load G_{Ki} on the axle before diagnosing the braking system (static method) and further consider this load as a constant one (fig. 6). But as the research reveals, the normal load G_{Ki} changes during the diagnostics and it has a significant influence on the value of braking forces, because the coefficient is $F_X(t) = G_{K(t)} \cdot \varphi$, a fortiori and influences on the calculation of γ_K (fig. 6).

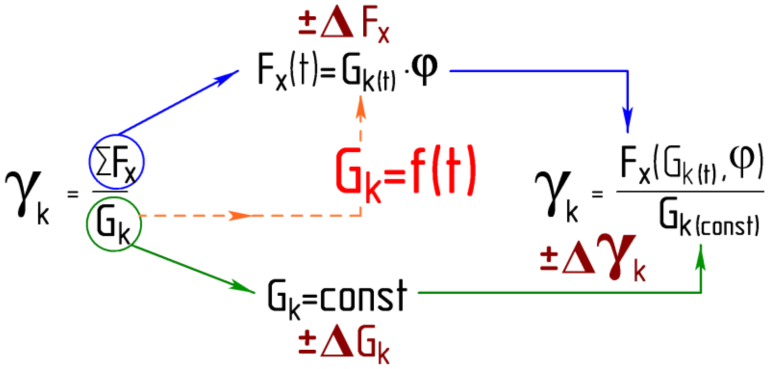

Fig. 6. The algorithm of defining γ_K, according to the manufacturer method.

Therefore, an error of calculation and dispersion of the measured values of specific breaking force γ_K may occur because of the ill-defined measurement of the normal load on the car axle being diagnosed and doesn't take into consideration its change at the moment of defining the maximum braking force F_{Xi}. The error may reach the level from 21,5% up to minus 7,16%.

The experimental research has been conducted in the following sequence. The car is mounted on the platform with rollers, according to the operations manual. It is mounted with its front axle wheels, it should be prepared according to the requirements of the normative documents. The mode - the measurement of breaking effectiveness was chosen in the software of the platform computer. After the command "brake smoothly", the robot pushed on the pedal that operates the braking effort. As a result of this, the braking of wheels happened and also the measurement of the braking forces $F_{X\,ij}$, normal load on the axle G_{ki} and the force $F_{\Pi T}$ were pushing on the brake pedal. All the measured parameters were registered by the platform computer and by the measuring complex in real time.

Multiple research was conducted. It was focused on the front car axle braking on the platform with rollers. The car hand-brake system was activated and with the wheel blocks installed under the back axle wheels. That multiple research revealed:

1) When there is an increase of braking forces, a temporal increase of normal load on the wheels of the axle, which is being diagnosed, is observed. It happens as a result of the longitudinal traveling of the wheels along the platform rollers and deformation of the elastic elements in the car suspension. And then its value sharply decreases, as a result of the counteraction of braking reactions to the normal load on the vehicle braking wheels (fig. 7). In consequence of the things mentioned above, the blocking of the axle wheels, which is being diagnosed, passes ahead and the platform electric motors shut down. Concordantly, potential car braking characteristics are not realized. The pattern of the way load changes toward the seating rollers from the diagnosed axle, influences the braking force value, thereafter, it also influences dispersion of its measured values;

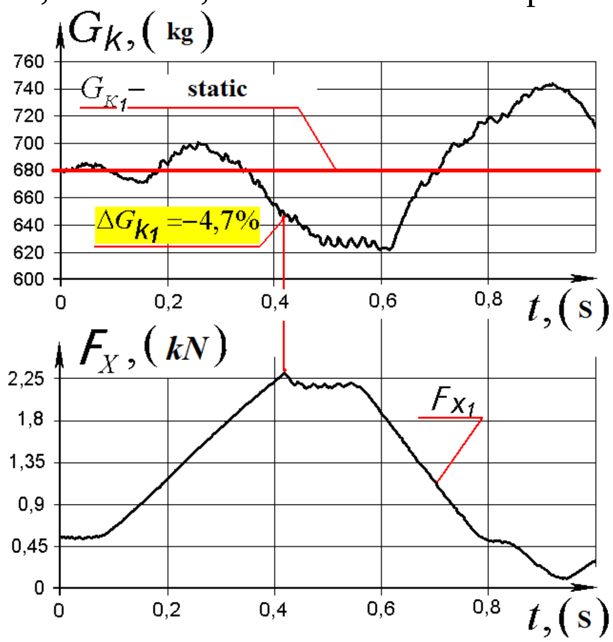

Fig. 7. Dependence of the normal load change on the car axle wheels and dependence of braking force of time while braking on the platform with rollers.

2) At the moment when the platform computer measures braking forces (the moment when the platform electric motors shut down as a result of reaching the point where wheels spin-out S_X value ≈0,25), the error of the normal load (the normal load which was defined in the static mode) on the wheels of the diagnosed axle in comparison with its actual value (the actual value is based on the 50 measurements) it reaches interval from minus 11,8% to plus 0,8 (fig. 8). We'd like to remind you that according to the normative documents it should be not more than ±3%;

3) The error of the calculated specific braking force or deceleration gives from minus 21,5% to minus 7,2%.

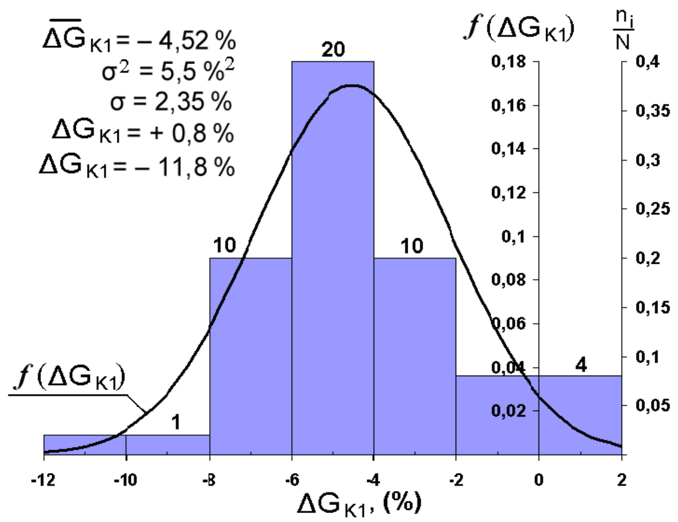

Fig 8. The error dispersion of the statically measured weight value of the front car axle on the platform, taking into account the actual one, where N – number of measurements;
nj – number of observations in the class.

Judging by the results of the research, it seems that it would be necessary to additionally limit car traveling against the platform rollers in the horizontal direction. Thus, we exclude unloading of the wheels of the diagnosed car axle during the braking on the platform with rollers. However, the fixing of the car, either in a horizontal or in a vertical direction, didn't give positive results. The error of the normal load (the normal load which was defined in the static mode) on the wheels of the diagnosed axle in comparison with its actual value (the actual value is based on the 50 measurements) reaches an interval from plus 0,1% to plus 3%. This complies with the requirements of the normative documents. But the error of the specific braking force calculation is in an interval from minus 10,8% to minus 5% which doesn't comply with the requirements of the normative documents.

Thus, the error of defining the specific braking force or deceleration is caused by the inaccurate measurement of the normal load on the axle and by the lack of accountability of its changes in the moment of defining maximum braking forces.

The results of the conducted research prove that application of the factory measurement method (fig.6) and calculation of the force parameters on the platforms with rollers, give big errors.

Grounding on the results received, we can make a conclusion that there is a necessity to measure the normal load on the diagnosed axle in the dynamic mode.

We developed the measurement method algorithm of force parameters in dynamics on the platforms with rollers. We have also conducted its experimental evaluation.

This method (fig.9) represents the process of braking as a dynamic one. That means that there is a constant registration of such parameters as load on the axle $G_{k(t)}$, braking force $F_{x(t)}(G_{k(t)},\varphi)$ and spinning-out $S_{x(t)}$. Concordantly, when maximum braking force is diagnosed, load on the diagnosed axle is measured along with it.

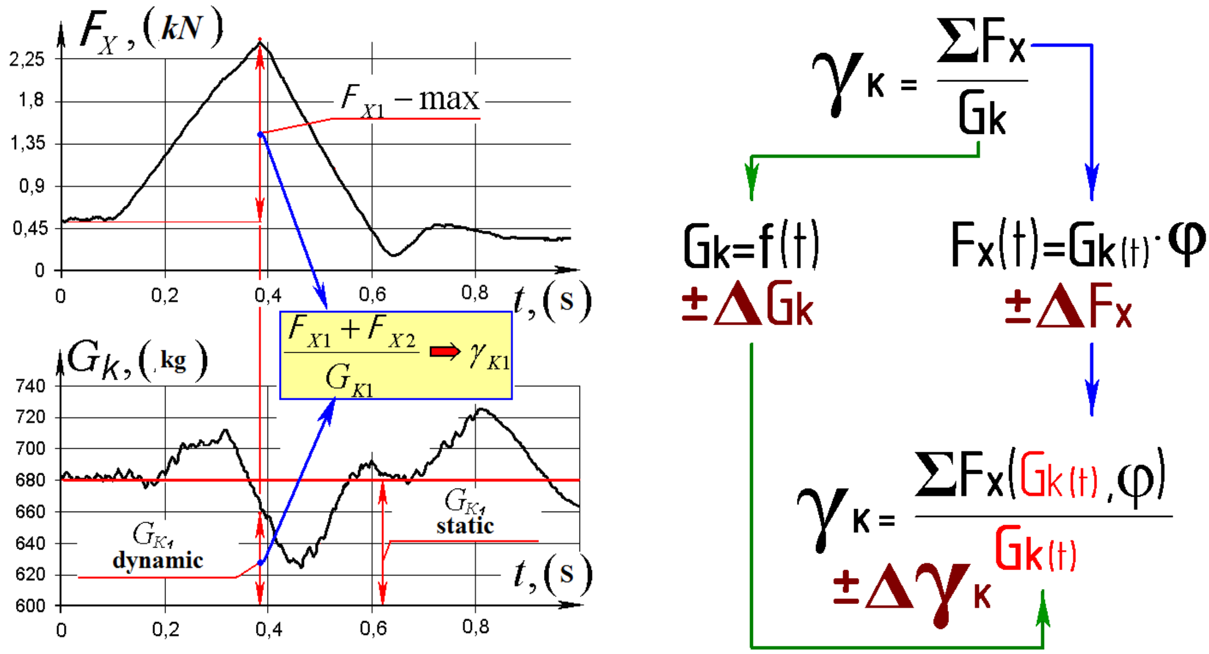

Fig. 9 The algorithm of the improved measurement method of the force parameters on the platforms with rollers.

Realization of this method in the operational conditions requires car fixing to prevent its traveling. Fixing can be done only with the wheel blocks when diagnosed on the platforms with rollers. Concordantly, there will not be extra time consumption significant to the conditions of mass production.

For instance, if unloading of the diagnosed axle happened while braking, consequently, the realized tangential reaction decreased. So, if we do a calculation of the specific braking force or deceleration, and we do it with the use of the values of diagnostic parameters, which were obtained in the dynamics according to the suggested method, we will obtain an objective result. The error of that result will comply with the normative documentation. But if the normal load was changed in the static mode then by using specific braking force γ_K (this value is bigger than its actual one) in calculation, we will obtain an underestimated result. Its error will not comply with the requirements which were revealed in the results of the research.

Certain conclusions about the anti-blocking system (ABS) are necessary to be mentioned. On the one hand, ABS is an extra car option and it doesn't always function. On the other hand, ABS functions in critical situations, so people's lives and safety of goods depend on its functioning. That's why the present approach of the separate control of the braking system technical condition and ABS is flawed (fallacious). Because with existing control methods, which are conducted at the speed of 2-4 km/h, a qualitative evaluation of braking system technical condition and ABS is impossible.

It's necessary to develop new effective methods of braking system control with the functioning ABS on the platforms.

The suggested control method is grounded on defining the integral parameters of the braking process control of the car with functioning ABS on the platform with rollers:

1. To evaluate car braking effectiveness – average value of specific braking force: $\bar{\gamma} = \frac{1}{K}\sum_{j=1}^{K}\frac{\bar{R}_{xj}}{\bar{G}_{\kappa j}}$,

where $\bar{R}_{xj}$ – the average value of the braking process of the realized tangential reaction on each of the car wheels; $\bar{G}_{\kappa j}$ - the average value of the braking process relative to the weight of the car parts which put pressure on every braking wheel;
K – the number of car wheels.

2. It is expedient to evaluate car stability, when braking with functioning ABS, with the help of relative difference of axle wheels braking forces $\bar{K}_{н}$. The relative difference was calculated based on the average values of realized tangential reactions obtained during the braking process $\bar{R}_x$. The reactions were measured on every wheel of the diagnosed car axle: $\bar{K}_n = \frac{\left|\bar{R}_{x\,\mathrm{left}} - \bar{R}_{x\,\mathrm{right}}\right|}{\bar{R}_{x\max}} \cdot 100\%$,

where $\bar{R}_{x\max}$ - the crest of average values of realized tangential reactions obtained during the braking process on the left $\bar{R}_{x\,\mathrm{left}}$ and on the right $\bar{R}_{x\,\mathrm{right}}$ wheels of the diagnosed car axle.

3. It is rational to evaluate the ABS regulation quality, while going through the car braking process, based on the average values of the relative spinning – out $\bar{S}$: $\bar{S} = \frac{1}{K}\sum_{j=0}^{K}\bar{S}_j$,

where $\bar{S}_j$ - the average value of spinning out for one car wheel.

The less $\bar{S}$, the more accurate and timely ABS reacts to the braking mode change of the car wheels. It also regulates the process of braking more accurately. And otherwise, the more $\bar{S}$ the more rough ABS reaction toward the braking process and as a sequence, the reaction is less accurate and adequate.

It's reasonable to use the parameter $\bar{S}$ only along with the parameter $\bar{\gamma}$ which considers car braking effectiveness with the functioning ABS.

The range of change significant in the slipping of ΔS and the realized tangential reaction ΔR_x are grounded for more accurate ABS regulation quality evaluation, while going through the car braking process.

4. It's rational to base the velocity control of car braking systems with ABS on the time measurement t_{cp} – from the moment when the working braking system controller is pressed on to the moment of reaching the specific braking force of its normative value. It's regulated by the All-Union State Standard (GOST)
P 51709-2001.

The conducted analysis helped formulate the basic requirements. They are the qualifying standards for the control method of the braking process of the cars with functioning ABS when they are tested on the platforms with rollers. The method should provide:

- synchronous spinning of all the seating rollers on the platform during all the braking process;

- continuous measurement of braking forces, normal loads, specific braking forces, angular velocity, angular velocity and slipping. All of the mentioned above should be done individually for every breaking wheel during the whole diagnostic process;
- the speed of rollers spinning, without intensifying power of the platform actuating source, needed for ABS functioning;
- the exclusion of temporal measurement errors and kinematic parameters of the braking process which are connected with the wheels torsional vibrations;
- the possibility of simultaneous diagnostics of all the braking car wheels;
- the possibility of the car weight redistribution between its axles;
- the uniform scaling of the seating rollers spinning on the platform when braking;
- a minimally possible number of friction assemblies in the power circuit in the the area – from the point of braking force application to the measuring sensor;
- the measurement systems errors which do not exceed the standards requirements;
- the use of integral indicators for the evaluation of the breaking process quality of the cars with functioning ABS.

The fully supporting braking inertial roller platform (fig. 10) was designed and made according to the requirements. The platform rotating mass acceleration is provided by the propulsion of the diagnosed car. Noncontact magnetostrictive sensors provide braking forces measurement on every braking wheel.

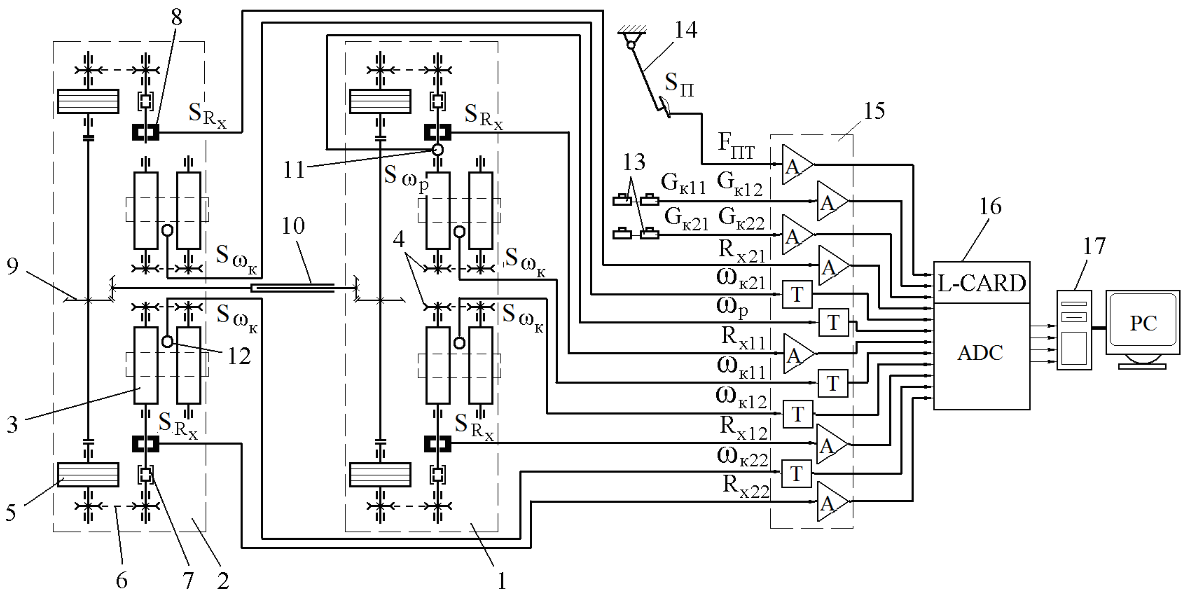

Fig. 10 The scheme of the fully supporting braking inertial roller platform:
1 – non-rotatable platform, 2 – rotatable platform, 3 – supporting roller, 4, 6 – chain belts, 5 – rotating mass, 7 – chain coupling, 8 – magnetostrictive sensor of decelerating torque, 9 – angle countershaft, 10 – multiple-splined propshaft, 11 – inductive sensor of the supporting roller angular velocity, 12 – inductive sensor of the car wheel angular velocity (ABS standard sensor), 13 – weight sensor, 14 – force sensor on the brake pedal, 15 – amplifiers and conversion devices module, 16 – ADC (analog-digital-converter), 17 – computer

Time dependences of the realized tangential reactions R_x on the car wheels, angular velocity of support rollers ω_p, and wheels $\omega_к$. When a TOYOTA COROLLA braking system with functioning ABS was tested on the developed braking platform.

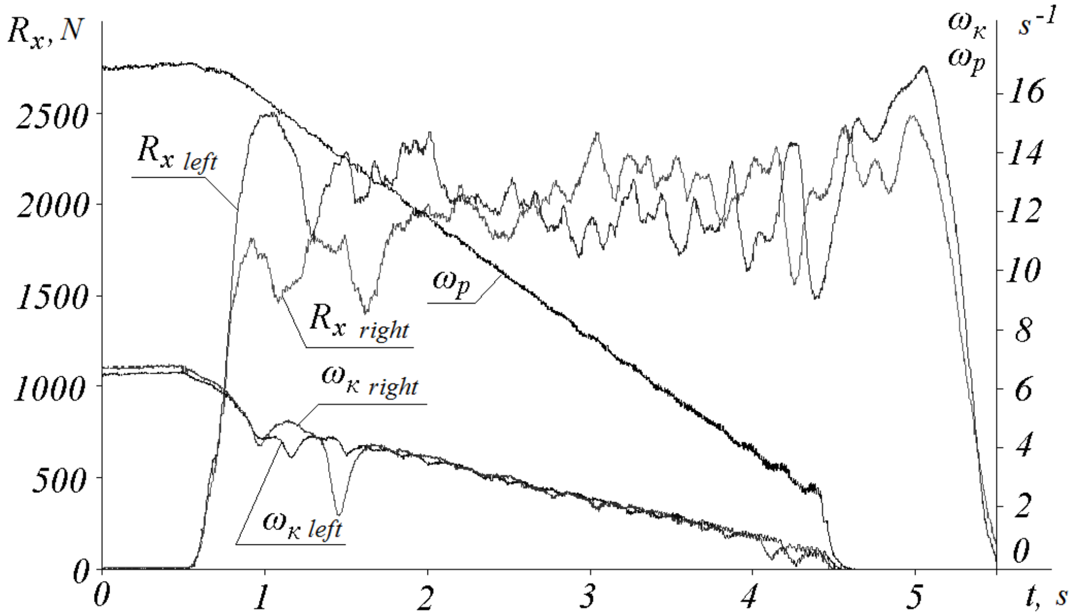

Fig. 11 Oscilloscopic picture of a TOYOTA COROLLA braking process with functioning ABS on the fully-supported roller brake platform (front axle).

It was also revealed that ABS doesn't work if separate diagnostics of axles is done, i.e. if during the diagnostics process one or more wheels of the axle, which are not diagnosed, are non-rotatable. It happens because there is an absence of signal in the ABS electronic control package from the angular velocity sensors of the non-rotatable wheels of the vehicle axles which are not diagnosed. That is why there's no possibility to control brake processes of the multiaxle vehicles with functioning ABS in the conditions provided by the platform.

To provide the effective control of a multiaxle vehicle with ABS, the basis of a construction was conducted and a single-platform inertial tester with rollers was produced. It allows conduct consecutive diagnosing of every axle anti blocking system of the multiaxle vehicle. The kinematic platform scheme is provided on the Figure 12.

An electric motor with the phase-wound rotor 16 having a capacity of 40kW is used as an actuating device. It provides the testing mode of vehicle brake system diagnostics when the car initial braking speed is from 5 to 70 km/h, which is quite enough for effective ABS testing. (It provides it with the help of liquid rheostat 15 and mechanic gear reducer.) From figure 1 we can see that the electric motor 16 drives rollers 2 by cardan drives 13, chain belts 5 and rotating masses 14. The rollers have a ribbed surface. Rotating masses 14 provide kinetic energy storage in the mode of platform rollers acceleration. And its expense they maintain the wheels rotation of the diagnosed axles during the process.

The emulator 10 construction of non-rotatable wheels braking process of the vehicle axles, which aren't diagnosed, with ABS function was developed. It was done for adequate ABS operation during the braking system diagnostic process of multiaxle vehicles on the single-platform tester.

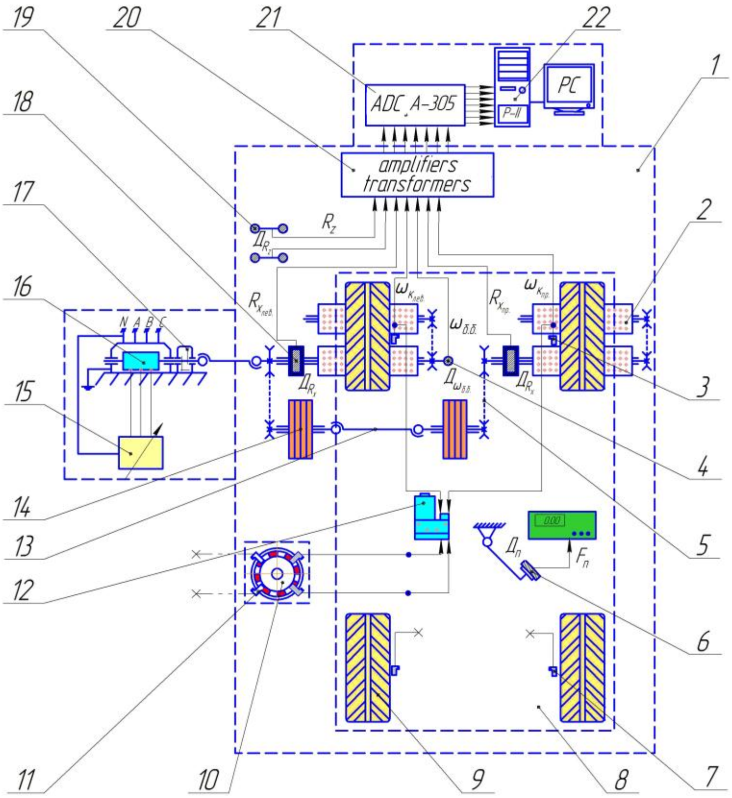

Figure 12 – Structural scheme of the developed platform and vehicle
1 – single-platform brake tester; 2 – rollers; 3 – wheels angular velocity sensors of the diagnosed vehicle axle; 4 – rolles angular velocity sensor; 5 – chain belts; 6 – brake pedal force sensor; 7 – switched off wheels angular velocity sensors of the axle which isn't diagnosed (or more than one axle) 8 – VEHICLE; 9 – wheels of the axle which isn't diagnosed (or more than one axle) 10 – emulator; 11 – emulator angular velocity sensors; 12 –ECM (electronic control module) with ABS pressure modulator; 13 – cardan drives; 14 – fly wheels; 15 – liquid rheostat; 16 – electric motor; 17 – mechanic gear; 18 – brake forces magnetostrictive sensors; 19 – wheels load sensors of the vehicle diagnosed axle; 20 – amplifiers and conversion devices module; 21 – analogous-digital conversion; 22 – personal computer.

Application of all the methods, sequences and equipment mentioned above will allow for movement to a new level of the modern vehicle technical check up.

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