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Časopis Naučnog društva za pogonske mašine, traktore i održavanje
Journal of Scientific Society of Power Machines, Tractors and Maintenance

TRAKTORI I POGONSKE MAŠINE

TRACTORS AND POWER MACHINES

UDK 631.372
ISSN 0354-9496
2
Godina 19
Dec. 2014.

UVEĆAJ
UMANJI
PRETRAŽI

Novi Sad, Srbija

Trakt. i pog. maš., Trac. and pow. mach., Vol. 19, No. 2, p.1-108, Novi Sad, Dec. 2014.

UVODNIK

Poštovani čitaoci,

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Uredništvo.

Časopis | Jurnal

TRAKTORI I POGONSKE MAŠINE | TRACTORS AND POWER MACHINES

Izdavač – Publisher

Naučno društvo za pogonske mašine, traktore i održavanje
Scientific Society of Power Machines, Tractors and Maintenance

Suizdavač – Copublisher
Poljoprivredni fakultet, Departman za poljoprivrednu tehniku, Novi Sad
Faculty of Agriculture, Department of Agricultural Engineering, Novi Sad

Adresa – Adress
Poljoprivredni fakultet
Trg Dositeja Obradovića br. 8
Novi Sad, Srbija
Tel.: ++381(0)21 4853 391
Tel/Fax.: ++381(0)21 459 989
e-mail: milanto@polj.uns.ac.rs

Časopis izlazi svaka tri meseca
Godišnja pretplata za radne organizacije je 1500 din, za Inostranstvo 5000 din a za individualne predplatnike 1000 din
Žiro račun: 340-4148-96 kod Erste banke

Jurnal is published four times a year
Subscription price for organization is 40 EURO, for foreign organization 80 EURO and individual subscribes 15 EURO

Rešenjem Ministarstva za informacije Republike Srbije, Br.651-115/97-03 od 10.02.1997.god., časopis je upisan u registar pod brojem 2310
Prema Mišljenju Ministarstva za nauku, Republike Srbije ovaj časopis je "PUBLIKACIJA OD POSEBNOG INTERESA ZA NAUKU"

Štampa – Printed by
Štamparija "Feljton" Novi Sad, Stražilovska 17
Tiraž 300 primeraka

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Biblid: 0354-9496(2014) 19: 2, p. 7-17
UDK: 629.06

Naučni rad
Scientific paper

DEVELOPMENT OF BRAKE SYSTEMS OF THE TRACTORS AND TRAILERS IN COMPLIANCE WITH THE LATEST LEGAL REQUIREMENTS IN THE WORLD AND IN SERBIA

Glišović, J.[1], Mačužić, S.[2], Šušteršič, V.[3], Ćatić, D.[4]

SUMMARY

Transport tasks have radically changed in agriculture over the last decade. Speeds have increased along with tractor power so that 50 km/h even with a full load is quickly reached, which places more burdens on the brakes. Agricultural vehicles, especially those that can travel over 40km/h, must be fitted with safe and efficient braking systems to reduce road safety risks. Trailers being drawn must be the right size and weight for the vehicle drawing them and they should also be able to cope with the speed of the towing vehicle. They must be well maintained so that they don't cause braking problems for the towing vehicle. In order to address these issues, revised braking requirements will apply to all agricultural tractors and their trailers (both new and existing) from 1 January 2016. They will also apply to equipment such as slurry tankers, fertiliser or manure spreaders, grain chaser bins and so on.

Keywords: Tractors, trailers, braking system, legal requirements

INTRODUCTION

Modern agricultural machines help farmers to: efficiently use the agricultural area, maximize harvest results, use water in a targeted and responsible way, nourish plants with exactly the amount of fertiliser needed, protect their crops against damage via exact dosage and targeted application to maximize the yield while protecting nature, take the right decisions by providing all necessary information electronically, use of pesticides responsibly, manage their farms efficiently.

There is a tendency worldwide to improve tractor's transporting performance by increasing tractor speed. Nevertheless, the increase of the agricultural vehicles' speed requires efficient braking system that should enable agricultural vehicles to keep the pace with the other fast vehicles participant in road traffic, taking into account traffic safety.

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The European directive 76/432/EEC specifies the performance requirements for the braking systems of wheeled agricultural tractors with a maximum speed of up to 40 km/h (categories T1, T2 and T3). This directive was last modified in 1996. When the directive came under revision, tractors faster than 40 km/h (Category T5) and trailers & interchangeable towed machinery (category R&S), came into the scope. Until a compromise has been found between European Commission/Member states/industry categories, T5 and R&S vehicles fall under national type approval for braking. Braking on self-propelled agricultural machinery is also handled by national approvals. Regulation 167/2013 of the European parliament and of the Council of 5 February 2013 on the approval and market surveillance of agricultural and forestry vehicles add requirements and expand the scope to cover tractors, trailers, and towed equipment up to 60 km/h and above. Also in development is ISO 12933 Agricultural tractors-Safety and performance requirements for braking. The historical national differences within the EU, especially concerning trailer braking, require a lot of effort because the process of harmonization is complicated.

In North America, ANSI/ASAE S318 references ANSI/ASAE S365, Braking System Test Procedures and Braking Performance Criteria for Agricultural Field Equipment for braking requirements [1]. The scope of this standard includes both tractors and agricultural equipment. For a European designer of tractors marketed in North America, the minimum park brake performance requirement in this standard is particularly noteworthy. To paraphrase, the parking brake needs to hold the equivalent of 2.5 times the maximum weight rating for the tractor on an 18% slope [2]. This is more rigorous than the European equivalent of the maximum weight rating of a tractor on an 18% slope. Again, this difference can be traced back to the cultural practice and requirement for the use of chocks in Europe with no like requirement in North America. Per ANSI/ASAE S365, a trailer may weigh up to 1.5 times the weight of the tractor before trailer brakes are required, hence the parking brake requirement [3].

LEGISLATIVE REGULATIONS RELATED TO BRAKE SYSTEM OF TRACTORS AND TRAILERS IN EUROPE AND SERBIA

In view of the road safety, the braking systems of agricultural vehicles must meet a number of requirements for, among other things, braking efficiency, the follow-up action during slow braking, and a high speed of action during sudden braking (a response time less than or equal to 0.6 s). Particularly hazardous is the operation of assemblies of incompatible vehicles due to the different efficiency of action of their respective braking systems (braking asynchrony) [2, 8, 9]. The operation of a highspeed modern agricultural tractor with high-efficiency brakes coupled with a low braking-efficiency trailer will, on the one hand, lead to the accelerated wear and premature damage of the trailer's braking system and, on the other hand, cause overloading, rapid wear and possible damage of the tractor’s braking system [4, 5].

Agricultural vehicles, especially those capable of operating at speeds exceeding 40 km/h, must be fitted with safe and efficient braking systems to address the potentially serious road safety risks associated with using “under braked” trailed equipment on public roads, i.e. premature tractor brake wear or failure leading to the possibility of jack-knifing. Trailed agricultural equipment must also be correctly matched for the intended speed and load being drawn, and that such equipment is routinely maintained if tractor brake failure is to be avoided.

In order to address these issues, revised braking requirements will apply to agricultural tractors and their trailers (both new and existing) from 1st January 2016 (EC Regulation (EU) No.

167/2013).

Note that the term agricultural trailer refers to those trailers drawn behind agricultural tractors which are being used for agricultural, fisheries, forestry or horticultural purposes; and includes pieces of interchangeable towed equipment where the ratio of the Design Gross Vehicle Weight (DGVW) to the unladen weight is equal to or greater than 3.0. DGVW is the maximum laden weight as specified by the manufacturer [10].

Revised Requirements for Agricultural Tractors

Agricultural tractors which are already in service, provided their braking systems are correctly maintained, will already comply with the revised braking requirements outlined in Table 1 below.

A summary of the minimum tractor braking performance requirements expressed as percentage efficiencies (i.e. braking effort as a percentage of the tractor's Design Gross Vehicle Weight (DGVW)) are included in Table 1 below. These will apply to both new and existing agricultural tractors from 1st January 2016.

Tab. 1. Minimum Braking Performance Requirements for Agricultural Tractors from 1st January 2016

Minimum Braking Performance Requirements for Agricultural Tractors	
Speed rating less than or equal to 40km/h	Speed rating greater than 40km/h
Service Brake (25%) Parking Brake (16%)	Service Brake (45%) Emergency Brake (22.5%) Parking Brake (16%)

Revised Requirements for Agricultural Trailers

Agricultural trailers which are already in service, due to the wide variation in construction standards, may need remedial works carried out to achieve compliance; particularly if it is intended to draw them at speeds exceeding 40km/h.

A summary of the minimum trailer braking performance requirements, once again expressed as percentage efficiencies, are included in Table 2 below. Note that the figure quoted for the service brake performance is based on the weight transmitted to the road surface by the trailer axle(s) fitted with brakes, whereas the breakaway and parking brake performances quoted are based on the Design Gross Vehicle Weight (DGVW) of the trailer. These will apply from 1st January 2016.

Tab. 2. Minimum Braking Performance Requirements for Agricultural Trailers from 1st January 2016

Minimum Braking Performance Requirements for Agricultural Trailers	
Trailers with a speed rating less than or equal to 40km/h and a Design Gross Vehicle Weight (DGVW) exceeding 5,000kg.	Trailers with a speed rating greater than 40km/h and a Design Gross Vehicle Weight (DGVW) exceeding 3,500kg.
Service Brake (25%) Breakaway Brake (13.5%) Parking Brake (16%)	Service Brake (45%) Breakaway Brake (13.5%) Parking Brake (16%)

Furthermore all agricultural trailers which are manufactured from 1st January 2016 and are capable by design of being drawn at a speed exceeding 40km/h must be equipped with:

- pneumatic braking systems (including load sensing functionality which matches the service brake effort to the weight of the load being carried); and those capable of being

drawn at a speed exceeding 60km/h must also be equipped with antilock braking systems (ABS).

- a breakaway brake capable of automatically stopping them should they become detached from the tractor while in motion.

However agricultural trailers manufactured prior to 1st January 2016 (provided they are incapable by design of being drawn at a speed exceeding 40km/h) may alternatively be fitted with a secondary coupling consisting of a chain or wire rope. Agricultural trailers and interchangeable towed equipment manufactured prior to 1st January 2016 which are capable by design of being drawn at a speed exceeding 40km/h and which are not fitted with a breakaway brake have until 1st January 2016 to achieve compliance.

Finally, overrun braking systems, where fitted to lower speed custom-made agricultural trailers or pieces of interchangeable towed equipment with a Design Gross Vehicle Weight (DGVW) not exceeding 5,000kg, must be capable of generating minimum service and parking brake efforts of 49% and 16% respectively [10].

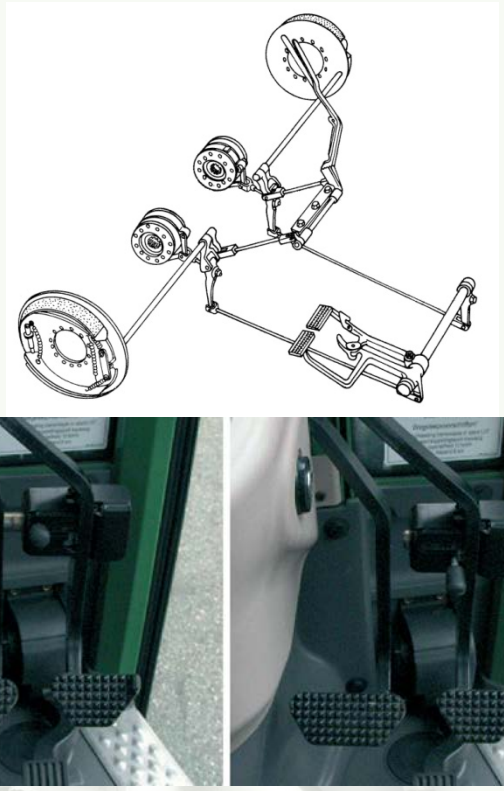
Revised Requirements in Serbia

Amendments to the Regulation of the division of motor vehicles, trailers and technical requirements for vehicles in traffic in Republic of Serbia of 22nd September 2014 brought: detailed definition of vehicles of type R-tractor trailer and type S-towed equipment, as well as the term-working equipment. It is also explained in more detail the term of braking coefficient, method and conditions used to measure it. The table that gives the prescribed minimum value of the braking coefficient is supplemented with the values for type S for working and auxiliary braking. Prescribed norms referring to the braking coefficient for vehicles of type T, i.e. R and S apply also to the measurement of deceleration vehicles' combination consisting of a tractor and tractor's trailer type R or S [12,13].

DEVELOPMENT OF TRACTORS AND TRAILERS' BRAKE SYSTEM

Braking performance of the vehicle is prescribed by technical requirements and is determined by deceleration (m/s2) of the vehicle during braking. The tractor must be equipped with two independent braking systems (service and parking brake). For normal operation and control of the braking system, the maximum physical force required from a man during the maximum braking deceleration is in the range from 200N to 490N.

Steadily diminishing braking, reliable operation, low wear of the brake elements, and insensitivity to dirt and water are also required from the braking device. In the case of mechanical control, the muscle force is transferred from the brake pedal or control lever through a mechanism directly to the braking elements of the braking device (Figure 1a). Due to limitation of the compression force on the brake pedal, thus also the mechanical friction of the brake linings, the mechanical brake control is used only in handbrake and in service brake for smaller tractors. The braking command on the tractor is allowed to be laterally divided, whereby each brakes pedal corresponding to the brake to one side of the vehicle. On the Figure 1b, the control pedals are presented in a connected and disconnected position.



a) *b)*

Fig. 1. a) Mechanical brake system b) Connected and disconnected command of tractor's brake

In the case of hydrostatic transfer of the control force, the muscle force shall be transferred from the brake pedal to the master hydraulic cylinder, and then through the hydraulic installations to the individual braking elements, which are mounted on the driving wheels or some other elements with rotational motions. Usually, braking elements are mounted before the final transmission on the drive wheel for easier braking-stopping vehicles at lower rotational moment of inertia, and this is occurring at the moment of stopping of the tractor. The control braking force on the brake pedal can be increased by using a servo hydraulic device, which increases the

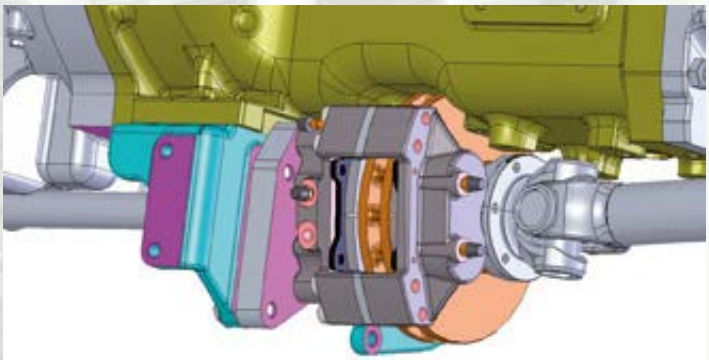


Fig. 2. Drive shaft brake

efficiency of braking and reduces the need of the physical force on the brake pedal.

Some manufacturers have developed a solution of drive shaft brake acting on Cardan shaft, which has been proven optimal particularly as safety brakes for safe parked on a slope. The advantage of this system: Due to the security lock the brake pedal of the service brake is mechanically locked.

Brakes are classified depending on the brake components: drum and disc, brake elements may be dry or immersed in oil. Dry braking elements have a large friction coefficient and a small contact surface and the accessibility, and ease to repair. Advantages of wet brake linings are in good heat dissipation and low wear of brake linings.

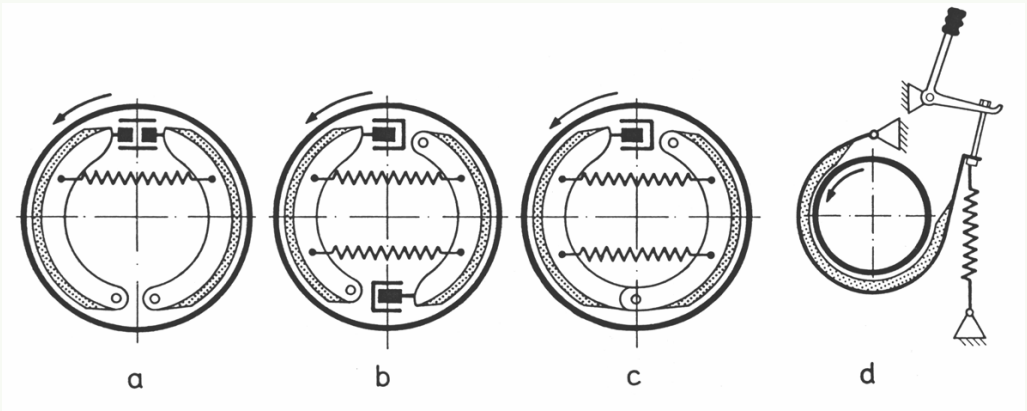


Fig. 3. Different constructions of drum brakes [11]

Depending on the construction drum brakes can be classified into internal and external brake. External drum brakes are used only for the parking brake, and are carried out as a wet solution - Figure 3 (d). The inner drum brakes are usually dry and can be classified depending on the installation of brake calliper and the brake hydraulic cylinders that push brake shoes to the brake drum such as Simplex (a), Duplex (b) and Servo brakes (c), Figure 3.

Disc brakes are used on tractors as a service brake, normally for braking of the front wheels of the tractor, and they are mounted on a shaft for the transmission of torque. They have wider use in the personal and commercial vehicles, Figure 4 (a). Multiple disc brakes consist of a plurality of braking plates, which are operating in the dry condition with a large pressure force between the plates during braking, Figure 4 (b). Pressure force is transferred due to changes in the position of balls, placed between the plates - the Giling system, Figure 4 (c). When the brake is not applied, there is a small energy losses due to friction and is protected from impurities. To reduce the wear of the brake lining, disc brake pads are immersed in oil, brake control is hydrostatic, and they are protected from dirt, and have steady braking effect and a long service period, Figure 4 (d). Their downside is significant energy loss due to hydraulic friction between the linings and oil, especially in higher speeds and cold oil in the state when the brakes are not used, but the brake disc rotating with a certain speed.

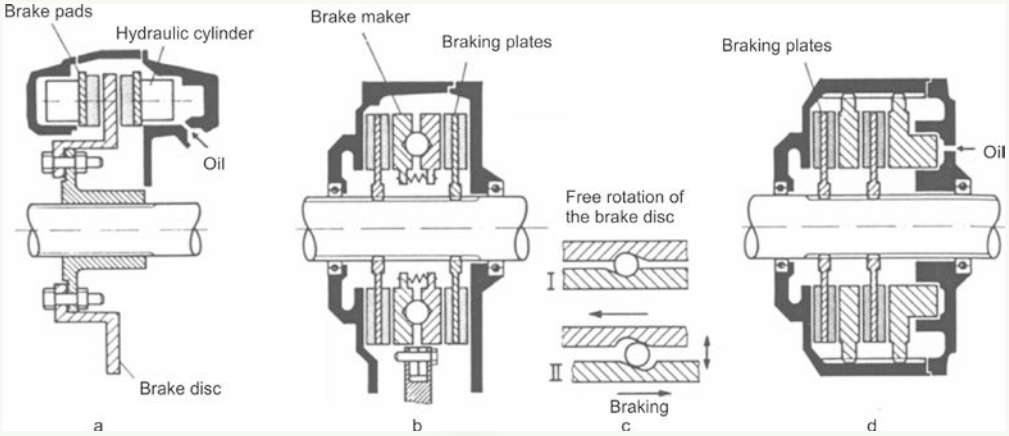


Fig. 4. Different constructions of disc brakes [11]

Ball on ramp brakes have a mechanism inside the axle however if they are hydraulically applied the actuation is usually accessible from outside which helps to reduce servicing costs. In order to make a ball ramp actuator non servo the actuator must be decoupled from the friction plates.

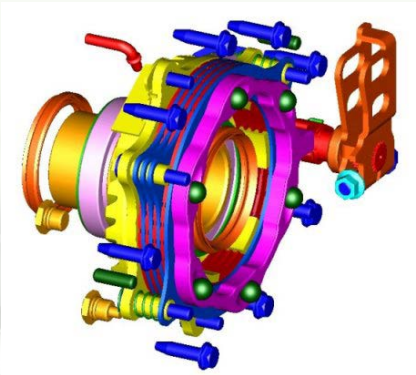
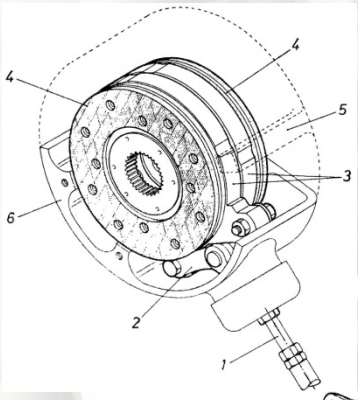


Fig. 5. Ball on Ramp Brakes



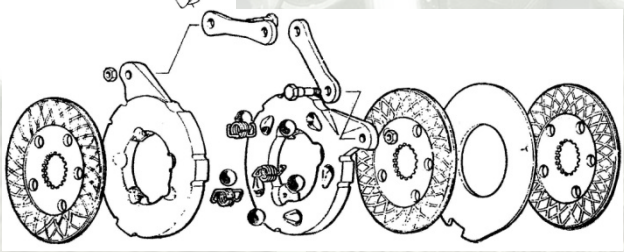


Fig. 6. Multi-plate disc brake [6]

Most modern multi-plate disc brakes (Figure 5) run in oil to transfer the heat away from the

friction plates but that hasn't always been the case. The enclosed nature of the brake does require consideration of heat dissipation though. There are two fundamental types of multi-plate brakes, servo and non servo. The purpose of a multi plate disc brake is the same as the more conventional calliper. It has to retard, stop and hold the vehicle. The fundamental difference is that it is self contained and cooled by oil. The braking faces are between a number of interleaved friction discs and counter plates alternately keyed to the housing or splined to a driveshaft. The plates are clamped together to produce a braking torque either by an annular piston which is coaxial with the driveshaft or by a ball and ramp mechanism. Many vehicles using this type of brake have hub reduction gearing so it is common for oil immersed brakes to be inboard of this gearing and as such they run at five or six time wheel speed.

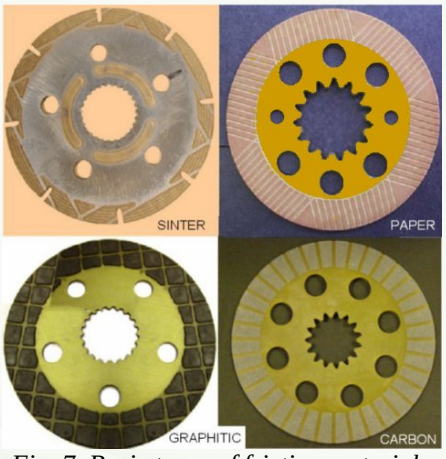


Fig. 7. Basic types of friction materials

There are four basic types of friction materials available each with their own pros and cons, sintered, paper, graphitic, carbon (Figure 7).

Sintered bronze is made by sintering a blend of powders into a porous matrix on a steel carrier plate. It is a tough durable material well able to live with overheating. On the downside it has a low dynamic friction and a high static/dynamic friction ratio which can cause chatter noise. Paper frictions materials are so called because of the manufacturing process as much as the material itself. They contain a range of fibres and friction modifiers which are then saturated in resins. The resulting material is soft and easily damaged. Paper materials have a high dynamic friction level and a low static/dynamic friction ratio which gives them well torque capacity and low noise however their energy capacity tends to be low. Graphitic materials are moulded compositions of graphite and resin binders. The have good thermal capacities which make them durable however they have a moderate static/dynamic friction ratio which may make them noisy. Carbon linings give stable friction, high load and low wear but are very expensive as such they are rarely used.

Grooves are either machined or moulded into the friction material to aid oil flow and thus cooling. Numerous patterns exist and each friction plate manufacturer has his favourite however the following points should be born in mind. The oil must be part of the cooling process. If large amounts of oil are present then the oil can flow quickly through the plates however if supply is limited then the flow through the plates should be restricted. Oil trapped between plates increases the parasitic drag losses and causes oil heating during brakes off running.

Putting the servo mechanism directly at the brake allows the rest of the system to run at reduced stress, for example the hydraulic pressure could be reduced to about 25% of that used in an actuator boosted system.

Magnetorheological brakes are type of braking systems which utilize magnetorheological fluid as a medium in brake torque transfer. These systems have possibility of precisely handling the braking force electrically, do not require special adjustments, neither periodical maintenance [7].

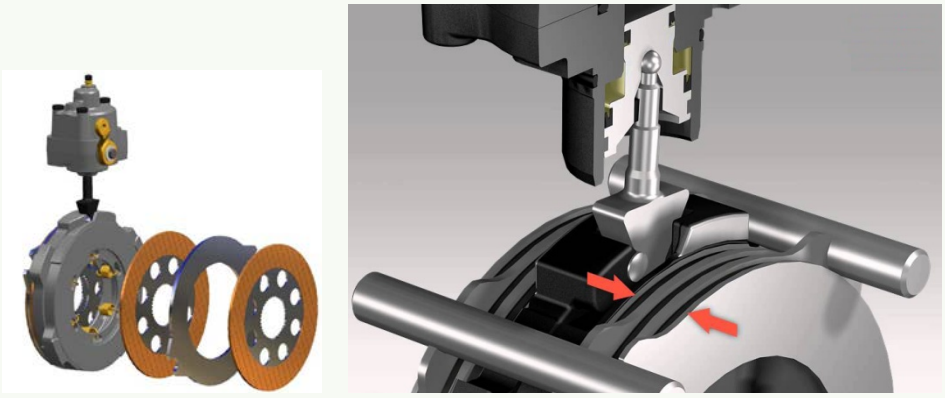


Fig. 8. Multi-plate disc brakes with servo mechanism

Uneven terrain and a huge amount of variation in traction conditions, even from wheel to wheel, means that an effective antilock braking system for tractors requires more advanced development. New and smart application of ABS technology to tractors, which not only offers confident stopping power with increased safety, but also increases tractor manoeuvrability and improves safety when operating on steep hills is developed in CNH Industrial New Holland. ABS SuperSteer™ uses ABS technology to manage each wheel's brake individually.

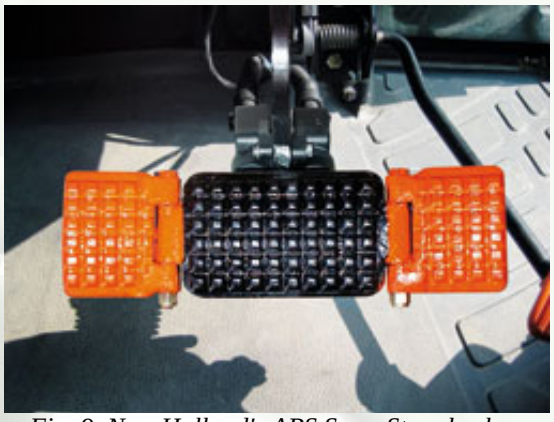


Fig. 9. New Holland's ABS SuperSteer brake-assisted steering will be operated by extensions to the single brake pedal [14]

Using a single foot pedal, the ABS SuperSteer™ allows the tractor to be steered by the brakes. Two orange pedal extensions either side of a single pedal replace the conventional, independent two-pedal arrangement. At low speed, this provides the driver with the same single-wheel steering as a conventional tractor, but automatically disables at

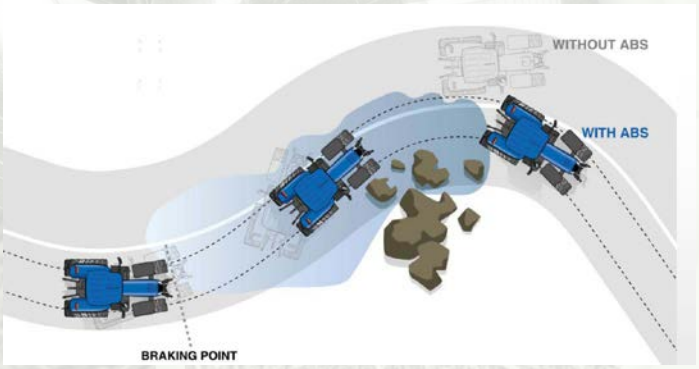


Fig. 10. Improve manoeuvrability with ABS [14]

higher speeds to prevent accidental application.

The ABS SuperSteer™ function includes tyre slip control and automatic coupling with the steering angle. This allows the tractor to perform tight turning manoeuvres without driver intervention on brakes by pivoting on a braked rear wheel, reducing the turning circle to that of a tractor fitted with a SuperSteer™ front axle. A driver-selectable amount of slip on the pivoting wheel is allowed to prevent soil damage.

CONCLUSIONS

Adoption of the upcoming European legislation in the field of agricultural tractor and trailer will place new demands on manufacturers of agricultural tractors, trailers and machinery in terms of braking systems. An increase number of tractors with speeds over 60 km/h participate in traffic on highways. Therefore, they must comply with the braking performance of other traffic participants. This led to the development of new generation of efficient wet multi plate brakes, combined tractor's hydro-pneumatic braking systems that are compatible with trailer's pneumatic braking system, braking combined with steering system that increase tractor manoeuvrability, ABS braking system, etc. The incompatibility of the braking systems of vehicles in tractor units, resulting in jack-knifing or skidding during braking, was for example the cause of about 9.7% fatal road accidents involving agricultural vehicles in the UK in the years 1999-2004. Future EU tractor-trailer braking legislation is likely to require significantly greater performance. This can be achieved without undue difficulty or excessive cost, but there is a vital need to raise user awareness and understanding of trailer and trailed appliance braking system specification and selection, to minimise future performance shortfalls.

ACKNOWLEDGEMENTS

This paper was realized within the researching project "The research of vehicle safety as part of a cybernetic system: Driver-Vehicle-Environment" ref. no. 35041, funded by Ministry of Education, Science and Technological Development of the Republic of Serbia.

REFERENCES

[1.] ANSI/ASAE S365.8 MAY2007. Braking System Test Procedures and Braking Performance Criteria for Agricultural Field Equipment, 9.2.2, ASABE, St Joseph, Michigan
[2.] Radlinski, R.W., Flick, M.A.: Tractor and trailer brake system compatibility, SAE Transactions, paper no. 861942, 1986
[3.] Murray, D. L.: International standards and product globalization: "we're not in Kansas anymore", 24th Annual Meeting of Club of Bologna, Hannover, November 10-11, 2013
[4.] Scarlett A.: In-service assessment of agricultural trailer and trailed appliance braking system condition and performance, The Agricultural Trailer Braking Study. RR697 Research Report, 2009 (http://www.hse.gov.uk/research/rrpdf/rr697.pdf)
[5.] Wong, J. Y.: Theory of Ground Vehicles, New York, John Wiley & Sons, 1993.
[6.] Todorović, J.: Braking of motor vehicles: design, maintenance, testing, Institute for Textbooks and Teaching Aids, Belgrade, ISBN 86-17-00337-5, 1988
[7.] Poznić, A., Časnji, F.& Stojić, B.: Magnetorheological brake utilization potential in agricultural tractors, Tractors and power machines, vol. 16, no. 2, 2011, pp. 75-82.
[8.] Radonjić, D., Janković, A.& Radonjić, R.: Motion safety of a tractor with a drawbar trailer in the terrains with the inclination of the reduced coefficient of adhesion, Tractors and power machines, vol. 16, no. 2, 2011, pp. 111-118.
[9.] Kamiński, Z., Czaban, J.: Diagnosing of the agricultural tractor braking system within approval tests. Eksploatacja i Niezawodnosc-Maintenance and Reliability 2012; 14 (4): 319–326
[10.] REGULATION (EU) No 167/2013 OF THE EUROPEAN PARLIAMENT AND OF THE COUNCIL of 5 February 2013 on the approval and market surveillance of agricultural and forestry vehicles
[11.] Bernik, R.: Technique of agricultural tractors, University of Ljubljana, Biotechnical Faculty, Department of

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SADRŽAJ
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SAČUVAJ
PRVA STRANA
ZADNJA STRANA
IZLAZ

Agronomy, Script, Ljubljana, 2004
[12.] Regulation of the division of motor vehicles and trailers, and technical requirements for vehicles in traffic, "Official Gazette of the Republic of Serbia", N°40/2012, 26.4.2012.
[13.] Regulation Amending and Supplementing Regulation of the division of motor vehicles and trailers, and technical requirements for vehicles in traffic, "Official Gazette of the Republic of Serbia", N°102/2014, 22.9.2014.
[14.] ABS and ABS SuperSteerTM, Leading safety in agriculture, http://app.claas.com/2013/ university-symposia/download/aetc/03-2_Chris_Carrier_ABS_SuperSteer_NH_T7.pdf

The paper received: 01.11.2014. The paper accepted: 15.11.2014.

UVEĆAJ
UMANJI
PRETRAŽI