

Land Rover fire truck modernization for improving transportation needs of the forestry farms and tree nurseries

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Abstract

In Poland farm tractors with trailers are used in forestry transportation work. Most of these trailers are equipped with dangerous one line pneumatic or inertia brake system.

The works done by PIMR-Industrial Institute of Agricultural Engineering and University of Life Sciences in Poznan [2] indicate needs for new set of trucks and gooseneck trailers, which should be designed for transportation use in forestry. Such modern forestry transportation unit should be equipped with new category of ball hitch and coupler, electronic braking system in gooseneck trailer and tyres - rated up to 90 kmph.

PIMR's idea was to transform Land Rover Defender [LRD] fire truck into mini forestry tractor for towing gooseneck trailer (gross trailer weight 3.5 tones). In 2007 LRD was equipped with 60 mm hitch ball for gooseneck trailers. Height of ball hitch over trucks floor allows easy mounting fire module. To transform fire truck into mini-tractor - fire module should be taken off then gooseneck trailer should be coupled on hitch ball, as well as light and electronic Sens A Brake System (SAB) plugs connected with proper sockets. Reversing procedure allow to transform forestry mini-tractor into fire truck.

Modernizing fire trucks should have immediately impact on better vehicles management and more efficient exploitations of trucks in forestry farms and tree nurseries.

Expected to obtain results 1) more efficient exploitation of fire trucks, 2) better work environment for driver, 3) general improvement of road traffic flow, 4) potential new job position market for rural and small town society.

Keywords: gooseneck trailer, hitch ball, electronic, hydraulic, brakes, safety.

Introduction

In Poland farm tractors with trailers are used in forestry transportation work. Most of these trailers are equipped with dangerous one line pneumatic or inertia brake system (Dubowski 2005). Very often forestry trailers (gross vehicle weight up to 13 tones) are not equipped in any brake system. Explanation that is usually heard from forestry drivers - it is because such trailers are not moving on public road system but on excluded forestry roads and of course it is not true.

The works done by PIMR-Industrial Institute of Agricultural Engineering and University of Life Sciences in Poznan indicate needs for new set of trucks and gooseneck trailers, which should be designed for transportation use in forestry (Dubowski 2002).

Such modern forestry transportation unit should be equipped with new category of ball hitch and coupler, electronic braking system in gooseneck trailer and tyres - rated up to 90 kmph (Dubowski 2007).

The adaptation of the Land Rover trucks, which are presently used mainly to quench fire in forests, should extent to the range of possible applications e.g. for the transport of trees from container nurseries to the area of new forestry fields, for wood transport on narrow forest ducts without using heavy forestry truck units, which devastate forest ways, and for the transport tanks with water (Dubowski 2003).

PIMR and Regional Biuro of the State Forests NFH co-operation

General idea of new transportation system for forestry trees nursery

Several meetings at Regional Biuro of the State Forest National Forest Holding (SF NFH) in Zielona Gora and its Forestry Department (Nadlesnictwo) in Babimost underline needs for research support from PIMR-Industrial Institute of Agricultural Engineering in Poznan. One of the most important issue that should be workout in near future is design of modern transportation system for new Forest Tree Nursery (fig. 1) located in small village Rogoziniec, Poland. Few years ago it was build as modern nursery unit with several tents for grow of trees in Styrofoam block containers. Containers (65x32x19cm) are made of expanded polystyrene foam and contain 53 or 74 cylindrical cavities or cells that are arranged in regular pattern (fig. 2).



Figure 1. Forest Trees Nursery - tent for growing trees in block containers



Figure 2. Styrofoam block containers with 53 cells for growing forest trees

By the methods which are used at the moment the time of loading block containers on truck and trailer is very long as well as time of unloading that is made by forestry workers.

Preliminary agreement ideas were 1) to use Land Rover Defender fire truck coupled with small gooseneck trailer, 2) to use wood pallets (2x2 m) each with 36 block containers (each container ~11kg and pallet ~450 kg of total weight) that at nursery site will be loaded by forklift truck and in the planting site will be unloaded by gooseneck trailer's hydraulic lift. During transportation forest trees should be protected against wind, heavy rain and sun so gooseneck trailer's load-carrying body should be protected by canvas cover.

In Poland fire trucks are used for fire service only seasonally from late spring till autumn so after ten years of service the average mileage is 50 thousands km. Out of fire season (early spring and late autumn) these trucks coupled with light gooseneck trailer could serve as mini liners for forest trees nursery transportation needs.

Design of special support frame for hitch ball and montage of Sens A Brake system in LRD
PIMR's idea was to transform Land Rover Defender [LRD] fire truck into mini forestry tractor for towing gooseneck trailer (gross trailer weight up to 3.5 tones). Two issues should be solved and well design – it is special support frame of hitch ball and montage of electronic Sens a Brake (SAB) system in the truck cabin (Dubowski 2007).

In 2007 LRD was equipped with special support frame of hitch ball for gooseneck trailer (fig. 3-4). Height of 60 mm ball hitch over trucks floor allows easy mounting fire module (fig. 5).

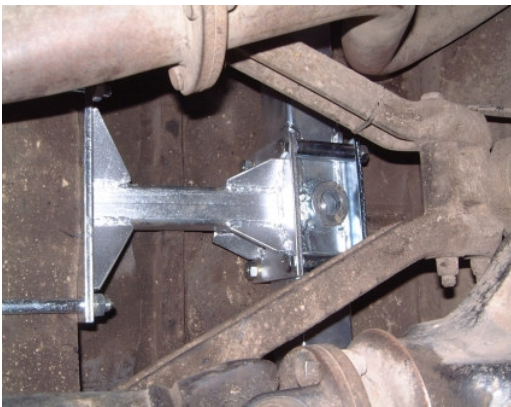


Figure 3. Support frame of hitch ball



Figure 4. Anchor plate with main beam



Figure 5. Land Rover Defender - 60mm hitch ball for coupling gooseneck trailer

To transform fire truck into mini-tractor - fire module should be taken off then gooseneck trailer should be coupled on hitch ball, as well as light and SAB System's plugs

connected with proper sockets. Reversing procedure allow to transform forestry mini-tractor into fire truck.

Montage of SAB system (EI Ltd. 2007) in the fire truck cabin was difficult and challenging because of lack of enough free space under dash board and overcrowding shelve with GPS receiver and several radio/mobile phone units with special services channels (forestry services, fire/medical channel). Mouse was located on the top of the dash board and electronic control unit (EVO) was placed on the small support plate mounted to the edge of wall just very next to acceleration pedal (fig. 6).



Figure 6. Brake Pad mounted on brake pedal and EVO controller on support plate.

Preliminary road and field test results

Laboratory research and preliminary road and field tests of Land Rover Defender 110 fire truck and PIMR's research gooseneck trailer GN2000 (GVW 3780 kg) proved that such road unit can easily transport goods on unpaved rural and forestry roads (fig. 7).

Research analyses that were run in the 2007 and 2008 year changed few issues of preliminary future gooseneck trailer's concept and pallet design. First homologation tests run on agricultural type of tires XP 27 275/65 R16 (recommended by Michelin Poland) were surprisingly to soft – so after two harsh braking they lost 6mm of groove's height and they were not able to achieve 0,5g deceleration. In addition all of four tires were dynamically unbalanced (190-200g). E-mail letters to main quarter of Michelin, France with PIMR kind request of support and cooperation were left without any reply. Polish branch of Michelin returned us money for four tires but managers strongly defend its product as one of the best in the field.

Despite Michelin Poland Product Manager's firm statements about tires European homologation - PIMR can not confirm good quality of XP27 tires and we would not recommended such low quality products for use in agricultural and forestry gooseneck trailers. PIMR is still searching for very good quality of agricultural/forestry type of tires (16-17,5 in size) with speed index 70-90kmph, air pressure about 3-4 bar and load per axle 3, 5 and 9 tones.



Figure 7. LRD 110 with research gooseneck trailer GN on forestry road.

Forest trees transportation system general outline

New trees transportation system general outline is based on smaller pallets which loading space will be 130x65cm and will be made of wood or steel. Each pallet will be equipped on both sides with additional frame structures for lifting and unloading such pallet container in the planting sites. Weight of container will be ~ 220kg. To protect forest trees roots against desiccation (dry out) each pallet container will be protected by individually mounted canvas cover - closely tighten to the side walls of the steel container frame. These allow to resign from idea of use small hydraulic lift and replace it by manually operated lift, located in the front of gooseneck trailer loading space and integrated with frame of its tongue.

Design of new pallet containers and innovation unloading system will be workout in 2008 year thanks R&D project NR10000604 supported by governmental funds of National Research and Development Centre in Poland (NCBIR 2008). Thanks that 36 months project will be design, developed and tested new transportation system based on box trucks and gooseneck trailers. New road units equipped with innovative types of coupling devices and brake by wire (BBW) electronically steered hydraulic brakes in towed vehicles - should have great impact on improving work safety, efficiency of transportation and reducing congestion on Polish roads network. Specialized gooseneck trailers should reduce human work, improve quality, safety and efficiency of agricultural and forestry transportation. New technology will be a chance for new job positions market and this is very important for rural and small town society.

Conclusions

1. Modernization of Land Rover Defender 110 fire truck was successful and forestry road tests has shown very good traction especially during towing gooseneck trailer – GVW 3780 kg on forestry and rural unpaved roads.
2. Elements of Sens a Brake system are functionally and ergonomically well located in truck cabin and electric wires are securely mounted under LRD fire truck body.
3. Design of 60mm hitch ball support frame is done well and could be only improved by expandable hitch ball version for regular LRD trucks that are used for forestry patrolling.

4. New gooseneck trailer should have wheels thread similar to LRD truck, GVW 3-3,5t and should be equipped with new forest trees transportation system based on medium size pallet containers, each with canvas cover for better forest tree protection against desiccation.
5. Tires should be much better quality than agricultural type tires XP 27 275/65 R16 and should be tested in tough research tests on unpaved forestry and agricultural roads as well as on public road network. It is important that wear of tires should be lowest as possible because trailers with GVW up to 3,5 t do not need to be equipped with ABS system.
6. New forestry transportation units based on light trucks and gooseneck trailers should improve exploitation of fire trucks that are used in Regional Departments of State Forest National Forest Holding as well as should improve work safety, forest trees transport quality and efficiency.

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