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# Farmyard Loaders

## A Comparison of Articulated Steer Loaders and Skidders

*Worktime studies showed that farmyard loaders with articulated and skid steering which had the same engine power provided similar handling performance in the kinds of work important in agriculture. Due to the driving modes, which exhibit differences in some cases, their fuel consumption differs considerably. While the closed cab of the skidder protects the driver quite well, operating- and driving comfort is considerably lower than in farmyard loaders with articulated steering.*

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### Keywords

Farmyard loaders, pivot steer, skid steer, comfort, work capacity

### Literature

[1] - Kriterien zur Auswahl mobiler Umschlaggeräte. Tagungsband KTBL-Workshop „Landwirtschaftliche Transporte“, 21/22.2.2001, Berlin

In the past years, farmyard loaders have established themselves on farms which keep cattle and horses. Due to their slender design, they fit through narrow doors and allow cost-effective old buildings to be used for animal housing. The typical work cannot be done using the classic front loader tractor. The manual demanuring of single pens for horses requires approximately 30 working hours per year and horse, while the labour requirements decrease to about five hours if this work is done with a farmyard loader. The rationalization potential is similarly high if loading work or feed dispensing are no longer carried out manually, but if small farmyard loaders are used instead.

In order to obtain reliable data material as a basis for calculations and to be able to give recommendations for counselling, extensive comparative tests of farmyard loaders of different power classes are being carried out at the Technical College in Nürtingen. In each class, loaders with articulated and skid steering are compared.

### Power Classes

In the lowest power class, engine power ranges below 15 kW. These very compact machines can pass 1 m wide doors and carry payloads of ~ 250 kg. This payload is often insufficient. For this reason, the next higher class with an engine power of 15 to 25 kW is currently most widely used. Depending on the tyres, vehicle width ranges between 0.9 and 1.3 m. Empty weight varies from 1.5 to 2 t. They have sufficient lifting power for the demanuring of stalls, feed dispensing and the transport of round- and square bales. For the simultaneous lifting of several bales, which is necessary for high bale stacking, as well as the filling of larger feeder-mixer wagons or the removal of manure from deep litter stalls onto efficient manure spreaders, farmyard loaders having an engine power of more than 25 kW, which will probably become the most important loader class in the future, are considered. As an alternative to articulated steer loaders, compact loaders with skid steering are also used in the above-mentioned classes.



Fig. 1: Pivot-steer loader (company photo)

As of an empty weight of approximately 4 t, farmyard loaders compete with the wheel loaders known from the construction sector and the front-loader tractor.

### Articulated or Skid Steering?

Before the results of the exact studies are discussed, differences in everyday operation, which are difficult to quantify, will be explained in more detail. In loaders with articulated steering, the tool swivels with the steering movement. Therefore, loads can be picked up even under very narrow conditions and deposited on a trailer standing directly next to the loader. Only when the loader is close to a boundary is it difficult to get away from it because either the front- or the rear axle retains its direction and rolls against the boundary. Due to the kinematics, the wheels roll during steering even without the vehicle moving. In contrast to Ackerman steering, the wheels move at a very large steering roll radius even when the steered wheels are fully turned to one side, which protects both the ground and the tyres. This cannot be compared with the skid steering process, which causes extreme wear of the ground and the tyres. The wheels are not steered. Instead, they are forced into the curve by different circumferential speeds on the right and the left side of the vehicle. In the axle which bears less load, the lateral guiding force of the wheels is overcome. For this reason, the tyres should have no longitudinal tread. Ground surfaces not bound are destroyed after a few turning manoeuvres. During curve rides, lost loads (manure) are massaged into the surface, which leads to lasting soiling even on concrete surfaces. The articulated steer loader, however, only rolls over the dirt. The skidder with additional Ackerman steering is a mixed form, which allows smaller steering manoeuvres to be carried out in a sensitive and ground-protecting manner.

## Safety Aspects

If the vehicle is in a straight position, loaders with articulated steering can produce very large lifting forces on an even surface without the vehicle tipping over, which results from the long wheelbase and favourable mass distribution. This tipping resistance, however, is lost quickly when the steered wheels are turned to one side and the ground becomes uneven. On uneven ground, the permissible payload is only 60% of the tipping load reached when the steered wheels are turned to one side. The pendulum movement between the front- and the rear part of the vehicle exerts an additional negative effect on tipping resistance when the steered wheels are turned to one side. Independent of the steering angle, however, skidders or loaders with all-wheel steering are always supported by the same tyre contact points, which leads to higher payloads in similarly heavy vehicles. In practice, the large installed lifting force is often used in articulated steer loaders, and the payload is exceeded. This often causes accidents especially if the drivers are inexperienced. While rolling over generally does not have any consequences for the well protected driver of a skidder, the driver of an articulated steer loader runs a high risk of being injured or even killed. The largely closed cab of the skidder in connection with the retaining bar protect the driver efficiently.

In addition to tipping, the vehicle's load poses a danger to the driver. Not only in practice are stacked bales transported without being sufficiently secured. This is even shown in advertising brochures. Without the cab or the protection bar, the driver of an articulated steer loader would be in extreme danger of being killed by the vehicle's own load.

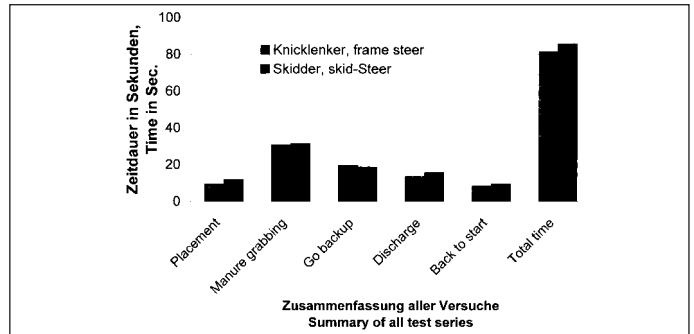
## Comfort

In the skidder, the short wheelbase leads to extreme pitching acceleration, which is increased further by the rough steering. Therefore, the maximum driving speed of the skidders tends to be lower than the maximum



Fig. 2: Manure loading skidder (company photo)

Fig. 3: Mean values of cycle times



speed of the articulated steer loaders. Hard tyres, which are necessary in loaders, as well as lacking axle suspension and imbalanced axle load distribution generally put a significant vibration load on the driver.

Water-cooled engines have superseded the air-cooled driving units, which used to be very loud in the past, so that the noise level in both kinds of vehicles has been slightly reduced. All in all, however, the sound pressure level is still very high in comparison with the tractor.

The most important difference in comfort manifests itself during getting on and off. The skidder requires that the driver climb into it from the front, while the driver's seat of the articulated steer loader can be reached easily from both sides. When tools are mounted or even loads are lifted, the driver of the skidder has difficulties getting to his workplace, which impairs the acceptance of these machines in particular among older people.

Skidders with a one-sided lift arm, which can be mounted on the side, are an exception. Due to the higher sitting position and the greater distance from the tool, the driver of the articulated steer loader has a better overview. During a typical loading cycle, the vehicle moves as much forwards as backwards. Here, the restricted view to the rear in the skidder is irritating.

When an untrained driver mounts a modern articulated steer loader, he can operate it immediately. The operating hydraulics are controlled using the joystick in the driver's right hand. In the automotive mode, the speed is set with the aid of the accelerator, and the steering system is operated with a normal steering wheel.

Skidders do not have a steering wheel. Instead, they feature several hand- and foot operating elements, whose functions differ from one brand to the next and which in some cases do not match the usual functions on tractors. Here, the inexperienced driver has massive problems adjusting.

## Worktime Studies

The exact studies were carried out with ma-

chines of the lower power class on a dairy farm and slightly larger loaders on a stud farm. The focus was on the typical work, such as demanuring, littering and feed dispensing. As described in reference [1], the work process was divided into work steps, and the percentage of the time required was recorded. A comparison of the work steps allowed the reason for the different loading performances to be analyzed. Fuel consumption was recorded for each loading cycle. For this purpose, the engines were equipped with sophisticated consumption measuring instruments.

The work process during demanuring can be divided into five work steps. These include: driving the machine to the loading location (preparation), filling of the loading fork (manure removal), driving to the manure spreader or the manure plate (manoeuvring), unloading, and returning to the starting point. If the 163 evaluated removal- and loading processes are summarized, the difference in the duration of the mean loading cycle is very small in the two loader types (fig. 3). Significant differences only occur when the spatial conditions are very narrow. The better overview provided by the articulated steer loader gives the driver more security and leads to slightly higher working speed.

Even though all machines compared had approximately the same engine power, fuel consumption exhibited considerable differences. Depending on the kind of work, consumption in the examined power class (11 to 24 kW) ranges between 1.2 and 3.9 l/h of diesel. In the extreme case, the skidder with the same power consumes twice as much fuel as the articulated steer loader. This must mainly be attributed to the fact that the engine speed of the skidder is fixed at a relatively high rpm level using the hand accelerator, while the engine speed of the articulated steer loader can be varied according to the requirements with the aid of the foot pedal. Only when the capacity of the loader is exploited to a large extent, which is the case in more spacious deep litter stalls, is consumption at a similar level.