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**Assistenzsystem für Schmalgangstapler
gleicht Bodenunebenheiten aus**

**Assistance System for Narrow-aisle Trucks
Compensates Floor Unevenness**

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Assistance systems, for example proximity controllers, parking aids, lane assistants or electronic stability controllers have long been standard equipment in many trucks. They are designed to warn the driver about critical driving situations or to intervene if a hazard exists. Assistance systems modelled on those in the automobile industry are now also coming into use in the industrial trucks area. In an industrial environment, they also contribute to reducing accident risks or not allowing them to arise in the first place. Here, however, they can contribute far more: Using assistance systems can also considerably increase efficiency. Still has now developed an assistance system for its narrow-aisle trucks that can compensate for uneven floors.

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SAFETY AND ASSISTANCE SYSTEMS

To counteract the causes of accidents with industrial trucks, the manufacturers of industrial trucks offer systems that reduce accident risks while contributing to increasing the efficiency of truck use at the same time. A basic distinction is drawn between safety systems and assistance systems in this respect. Depending on the respective area of use, safety systems are a mandatory requirement for the safe operation of Industrial Trucks (ITs). This means equipping a truck with

safety systems is either a direct or an indirect statutory necessity, or is specified as the state of the art in standards [1]. Assistance systems, on the other hand, are not absolutely necessary for safe operation, and are therefore not governed by laws or standards either.

According to Draft Standard EN 1175 of the European Industrial Trucks Safety Committee (CEN/TC150), assistance systems are defined as follows: "Assistance systems are systems that support users in their handling of trucks by supplying information, warnings and/or direct

intervention. They are aimed at improved ergonomics and greater efficiency when operating Industrial Trucks (ITs). Assistance systems are not necessary to handle ITs safely.” Thus, an assistance system is an additional equipment within the IT that is designed to support the driver to process complex tasks quickly and free from error when operating the truck, but without removing responsibility from him or her.

With regarding to these systems, a distinction is drawn between anti-collision systems and so-called driver assistants. Anti-collision systems protect persons or other trucks in a defined hazard zone. This is achieved by using sensors to detect persons, obstacles or other trucks. The sensors warn the truck driver and/or persons in the surroundings, and brake the truck [2]. Driving assistants, on the other hand, constantly measure a truck’s parameters, for example driving speed, steering angle, steering speed, lift height, load weight and load center of gravity, and actively intervene in the driving and load movements to avoid physically dangerous driving situations.

FOCUS ON SAFETY AND EFFICIENCY

To meet the steadily growing process demands of modern logistics, the market increasingly offers assistance systems that not only ensure a greater level of safety but are also designed to support the user to allow higher goods handling performance when driving ITs. Especially in an era of Industry 4.0 and the associated digitization, production and logistics processes are increasingly being networked using modern information

and communications technology with the aim of automating or partly automating processes in order thereby to optimize machines and plant. Assistance systems perform an important task in this respect, since they allow the design of procedures in a warehouse to be made safer and more efficient.

On the one hand, numerous companies now offer assistance systems that use appropriate hardware and software, wireless and sensor devices to give the operators or persons in the vicinity of the truck visual, audible or tactile warnings in hazardous situations, for example driving in reverse, or restrict the truck’s maximum speed depending on defined areas or conditions of use in order to prevent the risk of accidents. On the other hand, there are also systems that intervene either partly or fully autonomously in the truck’s drive, steering or signaling equipment to bring the truck’s performance and safety into harmony. That means these systems ensure the highest possible efficiency, taking all the safety aspects into account, so the operator can perform his or her tasks quickly but nonetheless safely. Investment in these assistance systems allows the operator not only to create safe conditions of use in his warehouse, but also to achieve a high level of goods handling performance.

DEVELOPMENT STEPS FOR ASSISTANCE SYSTEMS

Still is one of the pioneers in the use of assistance systems. One of the first assistance systems from the Hamburg based company is the Curve Speed Control on counterbalance trucks, which came

onto the market in 2003 with the RX 50 model series of electric trucks. The system automatically adapts the speed in curves to the steering angle to guarantee safe cornering.

Another assistance system on counterbalance trucks is speed reduction when the fork carriers are raised. This not only increases safety, but also ensures more precise, faster load handling. With Active Load Stabilization (ALS) as used on FM-X reach trucks and also on the MX-X narrow-aisle trucks presented in 2017, control is used to reduce mast wobble by up to 90 % when putting into or retrieving from storage, **FIGURE 1**. With the MX-X, this is achieved based on intelligently controlling push-out speed, taking the mast inclination, lift height and load weight into account. The result is an increase of up to 5 % in goods handling performance when putting into and retrieving from storage.

Navigation systems or aisle safety systems, such as the Optispeed 4.0 or the Optisafe, are reliable assistants that maximize goods handling performance, specifically in the narrow aisle area. They are used to calculate the quickest driving route and to obtain the relation between driving and pushing in/pulling out to optimize the actual work of putting into and retrieving from storage. The latest development for narrow-aisle trucks – also known as Very Narrow Aisle Trucks (VNA) – is the assistance system Active Floor Compensation (AFC), which can be used to level uneven floors.

FLOOR QUALITY DECISIVELY AFFECTS PRODUCTIVITY

The use not only of highly technically developed narrow-aisle trucks but also of high-quality floors are indispensable in narrow-aisle warehouses. At the same time, the specifications applying to driving lanes in narrow-aisle warehouses are considerably stricter than for other storage areas. As well as an appropriate load-bearing capacity and the exclusion of plastic deformation of the floor, another precondition is that the floor must have been laid absolutely level and flat, and shows no waviness whatsoever. In narrow-aisle warehouses and everywhere where trucks are driven with a raised load, the floors must conform to the tolerances of the VDMA Guideline for floors designed for use with narrow-aisle

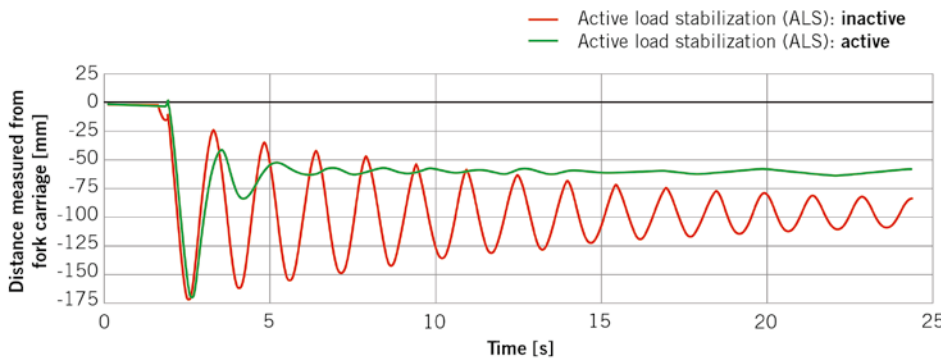


FIGURE 1 Mode of action for ALS (© Still)

industrial trucks [3]. This is because compliance with these requirements is the only way to guarantee the machines' full performance level and associated high productivity.

Thus, substrate quality is a decisive factor to ensure the narrow-aisle truck's maximum driving speed combined with safe operation, while maintaining a safe separation distance relative to the shelving and lift-height-dependent driving speed. If floors do not conform to the requirements, or worse still if they show signs of wear, vibrations caused by the tiniest floor unevenness will be transmitted directly to the truck. The driver will be shaken violently in his or her cab, and there is a danger that the load or in the worst case the shelving and/or the entire warehouse will be damaged.

To create optimum floor conditions in a narrow-aisle warehouse, the warehouse operator must invest a large amount in laying and/or finishing the floor. To ensure the trucks achieve the desired quiet running, the floor must be laid by companies qualified to lay VNA floors or, in the case of an existing warehouse, the floors must be ground down and/or machined. That entails high costs. Even if effort and costs are taken into account, unevenness in the floor can never be excluded completely. This is why trucks in a narrow-aisle warehouse often operate at reduced speed and/or without fully using their possible driving and goods handling performance.

COMPENSATION OF UNEVENNESS OF THE FLOOR

Still has brought onto the market AFC, an assistance system for the MX-X narrow-aisle truck that ensures safety, higher efficiency and ergonomics in a narrow-aisle warehouse, and offers a real alternative to the costly production of a floor quality suitable for VNA trucks. In contrast to ALS, which is used only when putting loads into and retrieving them from storage – when the truck is stationary – AFC takes effect when the truck is driving in a narrow aisle. This takes place as follows: Generally speaking, AFC records height differences on the respective load wheel driving lanes when driving in a narrow aisle. Depending on the difference between these two heights the load wheels are adjusted to the floor's unevenness in real time, so

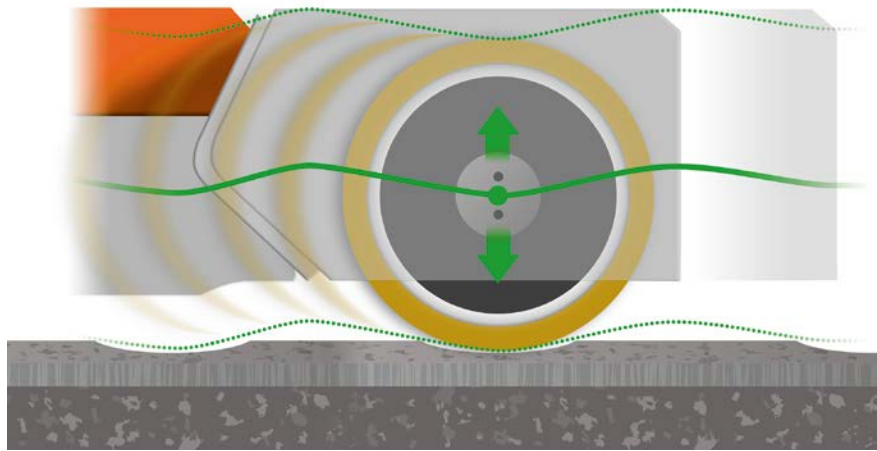


FIGURE 2 Relative wheel axle adjustment by AFC on a wavy, unground floor (© Still)

the truck chassis is always kept horizontal and the lift mast is always vertical, **FIGURE 2.** In this respect, due to very fast processors, the response of the AFC system is delay-free even at maximum possible driving speed. Up to now, AFC is unique in the market in the way

it operates. Whereas other systems only dampen lateral swaying movements of the lift mast and cabin when driving over uneven floors, AFC prevents the occurrence of swaying, and keeps the chassis horizontal at all times. It does not allow a swaying moment that could

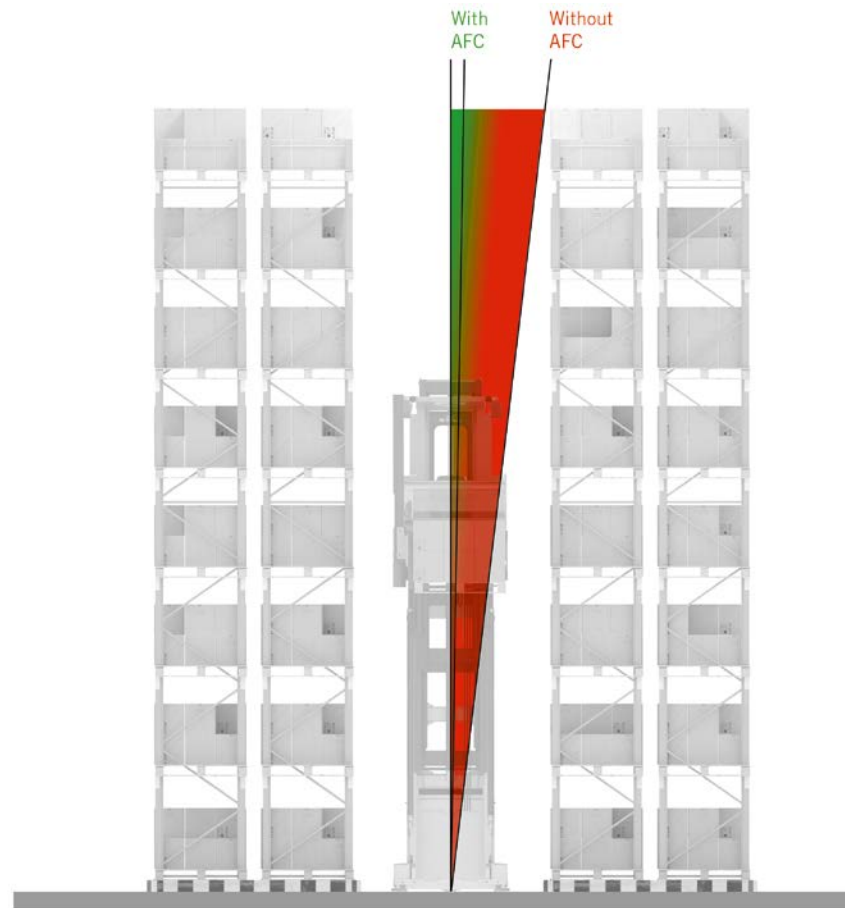


FIGURE 3 Lateral outward sway of the truck with and without AFC in a shelving aisle without a VNA-quality floor (© Still)

be transmitted to the truck to occur at all, **FIGURE 3**. That protects the load, the warehouse and also the driver. He/she no longer needs to drive more slowly, and instead can drive quickly from one storage location to the next. The use of AFC in a narrow-aisle warehouse allows a considerably larger throughput to be achieved regardless of work cycles.

SUMMARY

Safety and assistance systems are increasingly being used in industrial trucks and will become standard equipment in the future, as in other vehicles. They contribute more and more to

avoiding mistakes, making people's work easier and minimizing risks. This leads to an efficiency gain that makes a significant contribution to every company result. For economic and ergonomic reasons, operators and drivers will pay more attention to assistance systems in the future. Without assistance systems that create high added value for users due to their complexity, manufacturers of industrial trucks will no longer be able to serve the premium segment with the high efficiency requirements in logistics. With AFC, another system is now available that increases both the safety and cost-effectiveness of warehouses.

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