

From idea to implementation.
Guidelines for very narrow aisle warehouses.



STILL – always one step ahead. Since 1920.

For more than 100 years STILL has provided high-performance products of the finest quality in combination with fast and reliable service, making it a dependable and competent partner for your intralogistics needs.

Today we have over 9,000 employees worldwide, all of them hard at work developing and implementing innovative concepts and unique intra-company logistic solutions. As a result, our team is able to create system-orientated, custom-made, user-friendly and trendsetting innovations.

They form the basis of our product range – providing a solution for any need. However, our job is not completed with the delivery of one of our forklift trucks – STILL remains committed to providing any support you might need over the entire lifetime of your product. A personal team of regional STILL service managers and technicians is available to you on all communication channels around the clock, and thanks to the coverage of our service network always close to you. This guarantees high availability of your internal logistics.

STILL – always one step ahead.

Step by step towards a very narrow aisle warehouse:

The key to success for an efficient material flow in your very narrow aisle warehouse is careful planning! This STILL guideline for very narrow aisle warehouses provides you with an overview of the most important points you should follow when planning a new warehouse. We gladly take over the planning and implementation for you.

The recommendations and guidelines are to provide orientation. The goal: a professional and efficient solution to organise the flow of material in your very narrow aisle warehouse. In a very narrow aisle warehouse, the forklift trucks are moved along specified routes by guidance systems, as the space between truck and rack is limited to ≤ 500 mm with a minimum clearance of only 90 mm to the rack or the load.

Material Flow Analysis and Warehouse Planning.....	4
Floor Requirements	8
Racking Systems	16
Guidance Systems	26
Assistance Systems.....	36
Pedestrian Protection	40
Active Floor Compensation (AFC).....	46
Automation (AGV).....	47
Energy Systems.....	48
Cold Store Application.....	49
Normative References.....	50
Glossary.....	51

For beginners and professionals.
Tips for your very narrow aisle warehouse.



By your side right from the start.

Material flow analysis and warehouse planning with STILL.

Upon request, STILL may carry out a comprehensive material flow analysis prior to your project. This includes:

- Comprehensive analysis of your specific requirements
- Sources of the goods to be transported and their load carriers
- Analysis of warehouse conditions, processes as well as the structure of your goods and orders
- Development of a holistic and efficient concept for storage, turnover, order picking and transport not only as a snapshot, but also covering your growth opportunities
- Planning of your racking, industrial trucks, possible automation and software requirements
- Provision of efficient processes for material and information flow
- Coordination and realisation of the project



Data collection

We check your data for completeness and consistency and prepare the findings for the analytic process.



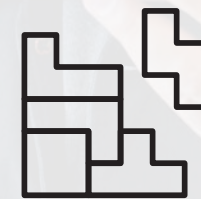
Analysis

We use various analysing techniques to provide you with a sound planning basis.



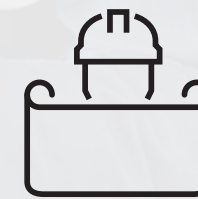
Optimisation

We develop approaches to prepare your logistics processes for improvements enabling you to handle current and future requirements.



Concept development

We offer you solutions and recommendations to increase the efficiency of the logistics system.



Implementation

On request, we install your tailor-made project – right up to the top of the rack.

Low investment, high flexibility:

Benefits of the wide aisle warehouse.

In combination with a pallet rack, the wide aisle warehouse is one of the most frequently used storage systems because it is very flexible. Furthermore, it is characterised by low investment costs. High lift trucks, counterbalance trucks, reach trucks and order pickers can operate in this type of warehouse. The required aisle width depends on the truck dimensions and the size of the load carriers.

Depending on the truck type, the turnover capacity and the utilisation of available space is medium or high. For example, the STILL FM-X reach truck lifts goods to a height of up to 13,000 mm needing an aisle width of approx. 2,900 mm. Depending on the truck deployed, the working aisles for counterbalance trucks need to be up to 4,000 mm wide and the trucks lift goods to a height of up to approx. 8,500 mm.

Little need for space, annual savings potential:

The benefits of the very narrow aisle warehouse.

We recommend the very narrow aisle (VNA) warehouse for small areas with a high turnover of goods. The aisles are very narrow, the racks even higher: up to 18 m are possible. Efficiency is a top priority in VNA warehouses: The system combines a high degree of space utilisation with a high turnover capacity. It offers direct access to all storage locations and enables highly flexible warehousing.

A number of truck guiding systems allow achieving high travel speeds and turnover capacities. In addition, they reduce the workload on the driver and minimise the risk of damage to goods or the rack. Thanks to the short payback period, the slightly higher initial investment costs are offset by high annual savings potentials.

The first decision:

Wide or very narrow aisle warehouse?



The base matters.

Requirements for floors and foundations.

Building a floor to use VNA trucks on is a task often underestimated. The floor requirements for VNA trucks are significantly higher due to the high lifting heights of up to 18 m, the short distances between the racks and the high travel speeds of up to 14 km/h. The floor must not only be able to carry the wheel load but also be flat and level. The following values and tolerances must also be observed.

To implement a project successfully, it is important to discuss the floor quality requirements in detail with the general contractor or floor installer early in the project. For the trucks to deliver the full performance and the maximum turnover rate, it is crucial they operate on optimum floors. To ensure clear communication, we recommend that you make our VNA guidelines* part of your contract with your floor and rack supplier.

Foundation: The floor slabs must fulfil the requirements of DIN 1045-2/-3 with a concrete quality of at least B 25 and in accordance with DIN 18202. Please always avoid interfering contours such as wells, channels and similar interruptions in the working aisles. If these are unavoidable, the flatness requirements also apply to these obstacles.

Screed: Industrial flooring, according to the requirements of stress group II (medium), Table 1 according to DIN 18560, Part 7 resistant to oils and greases. The surface must be non-slip and free of moisture, dirt and oil film and must not deform under load. The surface cover must provide good grip to meet the brake requirements given in DIN ISO 6292. According to DIN EN 1081, the earthing resistance must not exceed $10^6 \Omega$. Surface loads and wheel pressures need to be calculated specifically for the used trucks.

*VNA = Very Narrow Aisle



Transfer stations

are used to provide loading units for order picking stacker trucks. They can be located at ground level or at other levels.

In order to facilitate a quick and easy transfer, it is advisable to place the load units at the transfer points, especially at ground level.

Transfer aisle (A_u)

according to FEM 4.103-1/FEM 10.2.14-1

on the front face of the racking system. Used by the VNA truck to change aisles.

Working aisle width (A_{st})

according to FEM 4.103-1/FEM 10.2.14-1

corresponds to the minimum clearance between the racks or loads to be stored.

FEM 4.103-1/FEM 10.2.14-1:

define the flatness requirements of VNA warehouse aisles.

Floor quality requirements.

Allowed flatness requirements.

The flatness requirements according to FEM 4.103-1/FEM 10.2.14-1 should be observed in the working aisles and areas where the load is lifted. The remaining surface must correspond in its flatness to DIN 18202, Table 3, Line 3. Ask your floor installer or an independent tester to verify compliance. The measured result must be reproducible and it must be ensured that the measurement error allowance of the testing equipment (e. g. levelling instrument or laser beam) does not exceed 10 % of the permissible height differences.

Three different flatness tolerances are relevant for the working aisles in very narrow aisle warehouses:

- 1 height differences across the left and right lane
- 2 differences in height longitudinal to the lanes
- 3 short ripples of the lanes

Active Floor Compensation (AFC):

Not every warehouse is economically viable to build or refurbish the floor in accordance with the VNA requirements. The Active Floor Compensation (AFC) assistance system for the STILL MX-X VNA truck enables the truck to deliver its maximum performance in any case without the need to invest time and effort in installing a VNA floor or refurbish an existing floor.

Note:

- The safety distances to the shelf a_{21}/a_{23} (Figure 4) are determined individually. They depend on the travel speed, the guidance system as well as the height of the top shelf girder.
- The safety distance is determined on the assumption that the tolerances according to FEM 4.103-1/FEM 10.2.14-1 are met.
- If the allowances according to FEM 4.103-1/FEM 10.2.14-1 are not met, the truck's driving speed may have to be reduced for safety reasons. This restricts the truck performance and consequently reduces the turnover capacity.
- If the floor quality does not meet the requirements, it is possible to mill or grind the floor evenly and flat.
- Alternatively, the STILL iGo pilot safety assistance system can minimise the loss of performance. With STILL iGo pilot safety, it is possible to reduce the driving speed of the truck only in those areas where the poor floor quality makes this necessary.

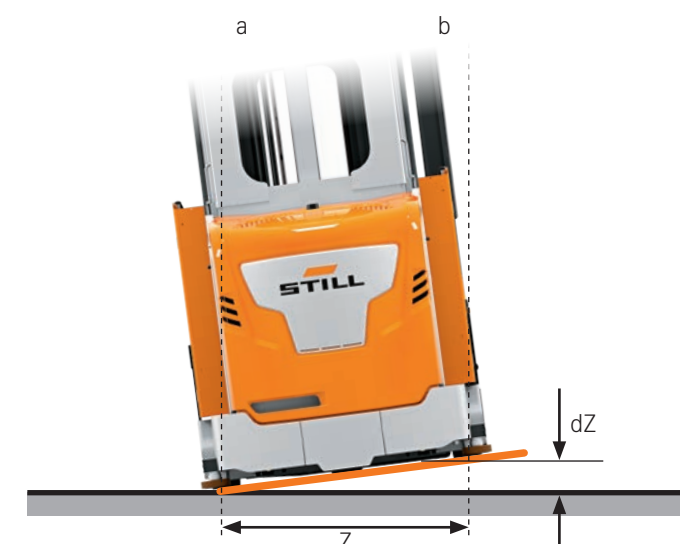


Differences in height across the lane:

The permissible height difference across the left and right lanes depends on the track width of the truck at the load end and the top shelf girder in your warehouse. The higher the top shelf girder, the smaller the tolerances for the flatness of the floor in the aisles. The maximum permissible height difference can be determined based on Table 1, Figure 2.3, and the track width (Z) of the respective vehicle.

Lift height	Z_{slope} (tolerance in mm/m)	Height difference (dZ) (corresponding to $Z \times Z_{\text{slope}}$)
up to 6 m	2.0	$Z \times 2.0 \text{ mm/m}$
10 m	1.5	$Z \times 1.5 \text{ mm/m}$
15 m	1.0	$Z \times 1.0 \text{ mm/m}$

Table 1: Allowed height differences



dZ = height difference; Z = track width; a, b = load wheels
Figure 1: Illustration of height difference



Note:

In the event that a floor is to be sanded subsequently in order to meet the applicable flatness requirements, full-surface milling or grinding of the aisles over the entire aisle width is recommended. If only the lanes are to be milled or sanded, the manufacturer's instructions must be observed. In addition, any noticeable and visible differences in height between the lanes and the other driving areas must be avoided.

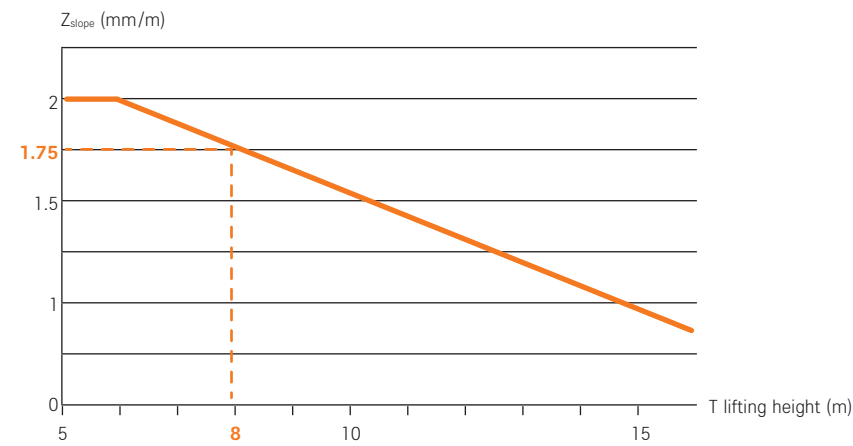


Figure 2: Example calculation of the maximum permissible Z_{slope}

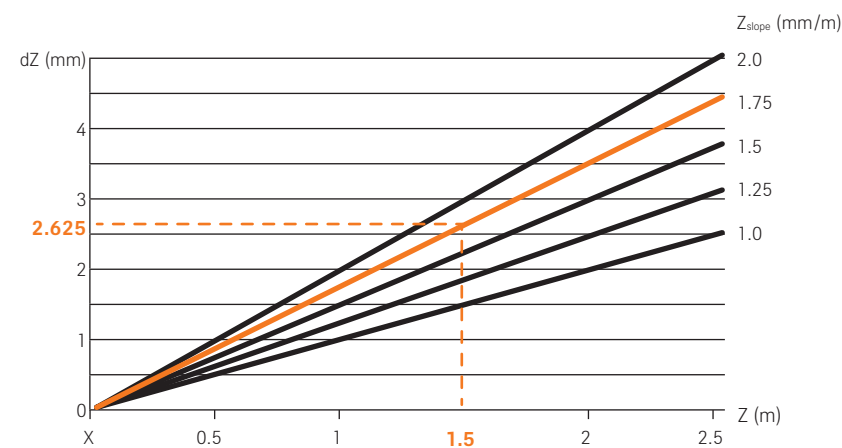


Figure 3: Example calculation of the maximum permissible height difference dZ

Example 1: Calculating the maximum height difference dZ between the left and right lane.

Assumption: lifting height = 8 m; lane $Z = 1.5$ m

Calculating the Z_{slope} using Figure 1: Lifting height = 8 m; $Z_{\text{slope}} = 1.75$ mm/m

Calculating dZ using Figure 2: $dZ = Z \times Z_{\text{slope}} = 2.625$ mm

In this case, the maximum allowed height difference dZ must not exceed 2.625 mm.



Figure 4: Determination of the permissible height difference

Example 2: Calculating the lateral movement of trucks.

The lateral movement is determined by the maximum height difference dZ , the track width on the load side and the height Hx .

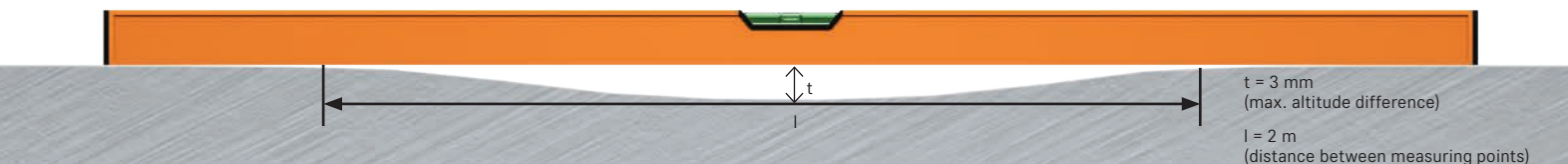
Lateral movement at maximum height:

$$\Delta X = dZ \text{ [mm]} / Z \text{ [m]} \times Hx \text{ [m]}$$

Assumption: lifting height 8 m; track width 1.5 m
According to Example 1, Figures 1 and 2 show a maximum permissible height difference of $dZ = 2.625$ mm.

Calculating the lateral movement ΔX :
 $\Delta X = 2.625 \text{ [mm]} / 1.5 \text{ [m]} \times 8 \text{ [m]} = 14 \text{ mm}$

In this case, the lateral deviation ΔX is 14 mm.



Measuring method for determining the flatness along the lane

Full speed ahead. Determining floor flatness.

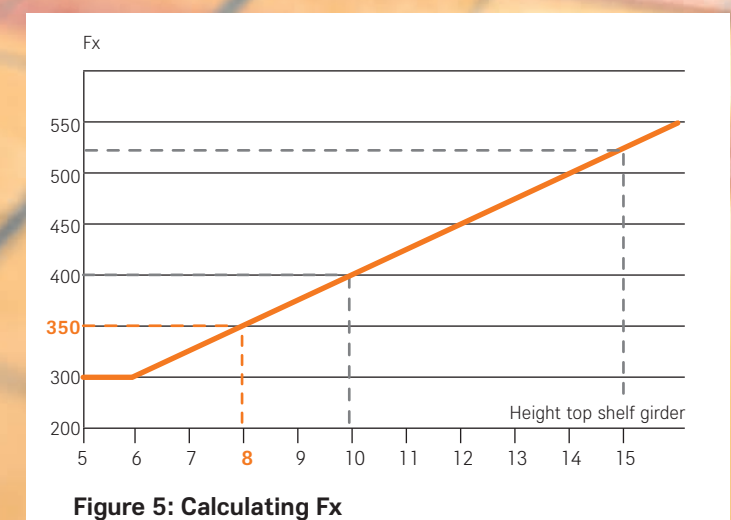
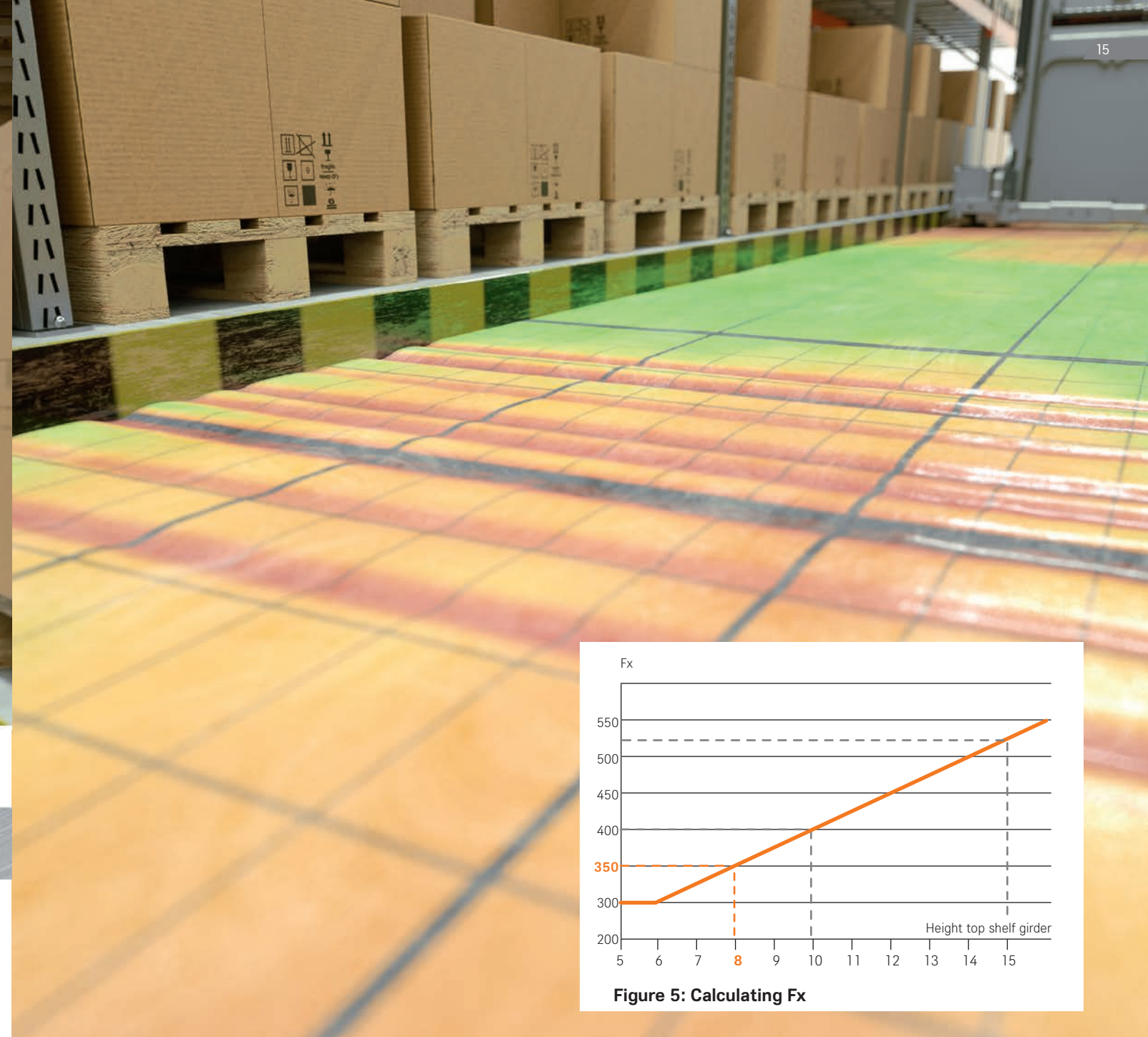
Allowances along the lanes.

The flatness along the lane must be calculated in accordance with FEM 4.103-1/FEM 10.2.14-1. When measuring, the respective dimension between two points is determined according to the figure above. The flatness tolerances and the distances between the measuring points can be found in Table 2.

Limit values for evenness along lanes in narrow aisles according to FEM 4.103-1/FEM 10.2.14-1

Distance between measuring points (l)	Maximum gap under ruler (t)
1 m	2 mm
2 m	3 mm
3 m	4 mm
4 m	5 mm

Table 2: Allowances along the lane



Short ripples (Fx) in the lanes.

Short ripples mean short successive bumps in the floor across the lane. Caution: When driving over these bumps, vibrations may occur and your VNA truck may begin to oscillate. The applicable ripple value Fx depends on the height of the top shelf girder. Lower Fx values mean larger short ripples at higher amplitudes, making the use of VNA trucks more difficult. When installing the hall floor, it is therefore important to ensure that the ripple values specified in Table 3 are observed.

Example for determining Fx:

Assumption: lifting height = 8 m

Calculating Fx with the help of Figure 5: $F_x \geq 350$

Examples for ripple values (Fx)

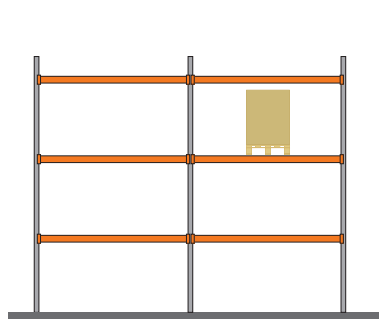
Height top shelf girder	Ripple value (Fx)
up to 6 m	≥ 300
up to 10 m	≥ 400
up to 15 m	≥ 525

Table 3: Examples for ripple values (Fx) are given in Figure 5

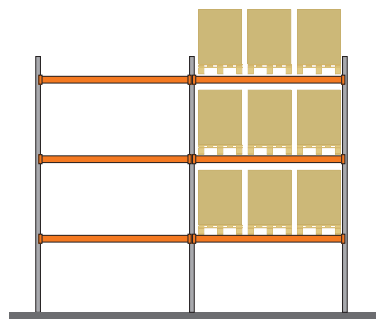
Tailored to your individual loads. Custom-made racking by STILL.

In your very narrow aisle warehouse, the racks must be precisely customised to the space available and the dimensions and weight of the loading units. On request, we will coordinate all aspects for you and deliver everything from a single source.

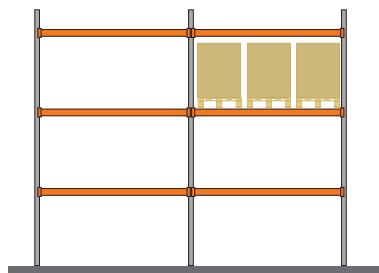
The four figures below show the different types of load.



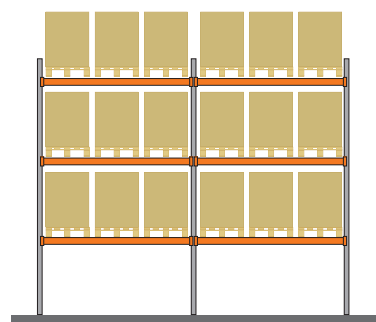
Unit load: Individual unit that is stored at a storage location. The weight of the load carrier determines the required shelf and bay load.



Bay load: Maximum load capacity of a rack bay in which load carriers are stored. Loads stored on the floor are not included.



Shelf load: Maximum load capacity of a self, consisting of a pair of girders holding several load carriers.



Frame load: Maximum load of a frame. Results from half of all load weights of the adjacent fields.





The unbeatable combination.

STILL racks and very narrow aisle warehouses.

STILL offers the right pallet racks and vehicles as a combination of systems for your very narrow aisle warehouse. When planning your racking, the dimensions of the load, the load weight, the loading equipment, the narrow aisle vehicles and the material flow requirements must be taken into account. We are happy to handle this task for you.

Racking.

Racks are usually free-standing and not fixed to the building. They can be set up flexibly according to requirements and

storage conditions, taking into account the load data and load specifications, and can be changed if the operating conditions change.

Other benefits of racks:

- Direct access to all load units
- Easy stock level monitoring
- Adaptability to the weight and size of the goods as well as to the storage space
- Flexible and cost-effective storage of various goods
- Direct picking from the shelf possible

As variable as your requirements.

Pallet racks by STILL.

Rack inspection by STILL.

A regular rack inspection helps to avoid accidents. We inspect your racking systems in accordance with the current legal requirements.



Design and components of pallet racks.

A pallet rack consists of a rack frame with suspended girders. The rack frame is securely fastened to the floor with floor anchors. Depending on the load weight, different profiles and material thicknesses are used. When designing a STILL pallet rack, we naturally take into account the requirements of the regionally applicable standards and safety regulations.

1. Support frame
2. Crossbars
3. Floor anchor (about 150 mm deep)
4. Load distributor
5. Transfer station (always recommended with centering device)
6. Corner protector

7. Collision guard
8. Shelf
9. Grid
10. Fire-resistant shelf
11. Support protection
12. Chipboard
13. Rear mesh wall
14. Placement frame
15. Push-through protection

Single and double shelves.

An efficient combination.

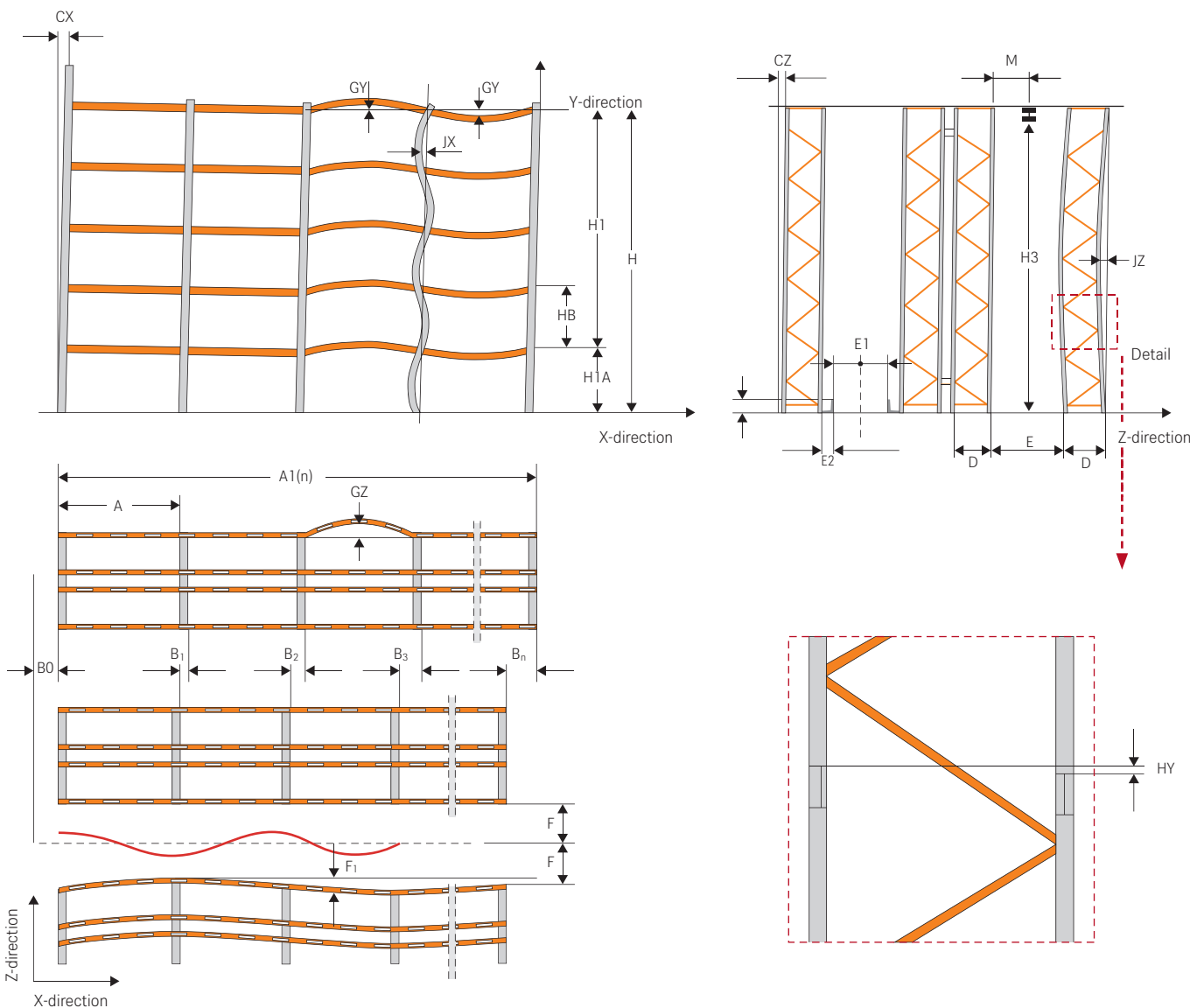
The basics for the static dimensioning of stationary steel racking are given in DIN EN 15512. DIN EN 15620, DIN EN 15629 and DIN EN 15635 also apply.

Very narrow aisle racks divide into single and double shelf racks. Our tip: Use both shelf types to make optimum use of your storage space. Single shelves are accessible from only one side, so they are best placed on the walls in the outer aisles. Double shelving allows access from both sides, so they unfold their full

Tolerances for rack assemblies and permissible deformations

According to DIN EN 15620 Class 300 A for man-up vehicles (operator and cab move up the shelf with load), e. g. MX-X, and 300 B man-down vehicles (operator and cab stay on floor while load moves up the shelf), e. g. NXV

potential in inner aisles of your racking. An exception is double-deep storage, in which two pallets are placed one behind the other.



Assembly allowances for class 300 racks.

According to DIN EN 15620.

Horizontal limit deviations for the XZ plane

Measuring procedure and description of the limit deviation		Assembly allowances for class 300 racks
delta A	Deviation from the rated dimension for the clear access width between two supports at any girder height	±3
delta A1	Deviation from the rated dimension for the total length of the rack, cumulative for the number "n" of fields, measured approximately at floor level	±3n
B	Cumulative misalignment of the crossbars in the direction of the aisle for the number "n" of fields, measured approximately at floor level For Class 300 B, this applies to the aisle supports and the rear supports	±10 or For class 300 A: ±1.0 n For class 300 B: ±0.5 n
delta B0	Deviation from the rated dimension of the rack front, related to the respective "reference line of the rack system Z", measured approximately at floor level	±10
CX	Frame deviation from perpendicular in X-direction	±H/500
CZ	Frame deviation from perpendicular in Z-direction	Without fixed lift: ±H/500 With fixed lift: ±H/750a
delta D	Deviation from rated dimension for the rack depth (single or double frames)	Single frame: ±3 Double frame: ±6
delta E	Deviation from the rated dimension for the aisle width approx. at floor level	±5
delta E1	Distance between guide rails	+5 0
delta E2	Distance between guide rail and front support	±5
delta F	Deviation from the rated aisle straightness, measured approximately at floor level with reference to the "aisle reference line X"	±10
F1	Deviation between adjacent supports, measured approximately at floor level in Z-direction	±5
GZ	Straightness of the girder in Z-direction	±A/400
JX	Straightness of the supports in X-direction between girders installed at a distance HB from each other	±3 or ±HB/750
JZ	Anfangskrümmung eines Ständerrahmens in Z-Richtung	±H/500
M	Abstand von der Frontseite der Regalstütze zur Oberkante der Führungsschiene	Determined by the author of the specification or by the manufacturer of the forklift truck
Tw	Trägerverdrehung in der Feldmitte	1° per m

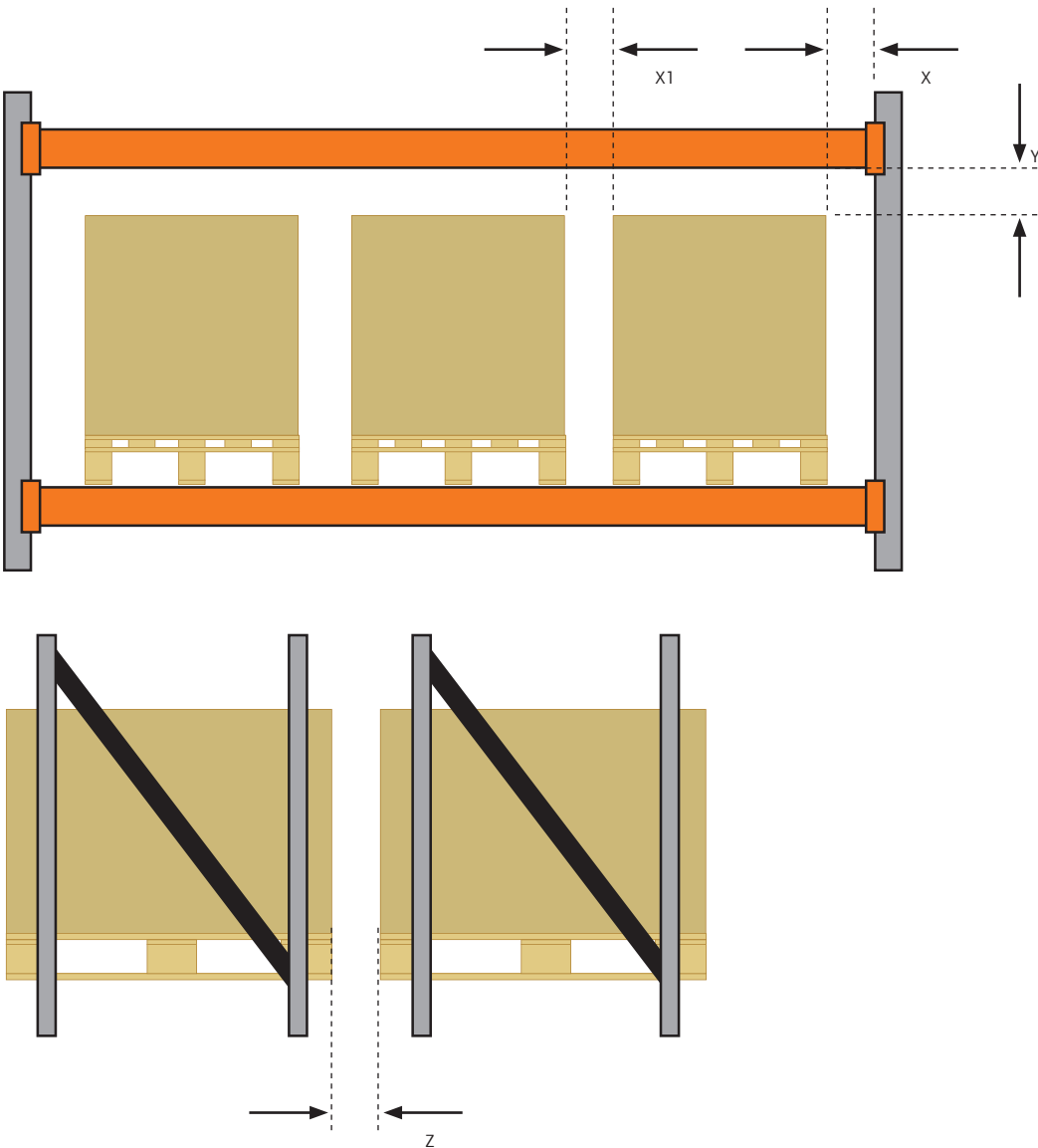
Vertical limiting deviations in Y-direction

Measuring procedure and description of the limit deviation		Assembly allowances for class 300 racks
GY	Straightness of the girder in Y-direction	±3 or ±A/500
delta H1	Deviation of the height from the top of the foot plate to any other level	300 A: ±5 or ±H1/500 300 B: ±3 or ±H1/1.000
delta H1A	Deviation of the height from the top of the lower girder to the top of the foot plate level	±7
delta HY	Deviation of the heights of the pallet carrying points between the front and rear beams in one compartment	±10
H	Height from top of foot plate level to top of rack support	
HB	Height from top of one level to next higher level	

Table 4: Assembly allowances according to DIN EN 15620

By far the best idea.
Standardised free spaces for maximum safety.

Free space is the nominal dimension between the load units and/or the rack components. In order to ensure safe storage and retrieval, the clearances shown in the table on the right must be observed. To maintain these tolerances, the use of a centering device at the transfer stations is recommended.



Free space for adjustable pallet racks.
According to DIN EN 15620.

Class	Designation	Operation	Yn (mm)	Y (mm)	X (mm)
100	Racking for SRMs	With storage and retrieval machines, without fine positioning at the storage location	The free space depends on the project. The planner must ensure that the values correspond to the requirements of the overall system.		
200	Racking with automated machines	With rack conveyors that are automatically controlled and with fine positioning at the storage location			
300 A	Very narrow aisle racking	Very narrow aisle truck (man-up)	3,000	75	75
			6,000	75	75
			9,000	75	75
			12,000	75	75
			15,000	75	75
300 B	Very narrow aisle racking	Stacker (man-down)	3,000	75	75
			6,000	100	75
			9,000	125	75
			12,000	150	100
			15,000	175	100
400	Wide aisle racking	Counterbalance trucks, reach trucks: trucks can drive and turn 90° inside the aisle for storage and retrieval	3,000	75	75
			6,000	100	75
			9,000	125	75
			13,000	150	100

Table 5: Clearances for adjustable pallet racks according to DIN EN 15620

- A distinction is made between different rack classes depending on the storage and retrieval machine:
- Class 100: Storage and retrieval machine (SRM)
 - Class 200: Automated VNA truck (man-up), e. g. STILL MX-X
 - Class 300 A: VNA truck (man-up), e. g. STILL MX-X
 - Class 300 B: Man-down stacker, e. g. STILL NXV
 - Class 400: Reach truck and counterbalance truck, e. g. STILL FM-X or RX 20, RXE 10-16C or RX 60

Safety first.
Checklist for you and your employees.



- Maximum load capacities:**
- Do you know the maximum load capacity of your VNA truck?
 - Have you followed the instructions on the type plates and load diagrams on the racking and on the truck?
 - Are your floors designed to support loads according to DIN 1045-2/-3, DIN 18202, DIN 18560-7 and DIN EN 15512?
 - If your racking is in an earthquake zone: Is the design earthquake-proof?
 - Have you observed the statutory building regulations for building permits or checked whether a building permit is required?



- Fire protection:**
- Is the next exit or the next fire section a maximum distance of 30 m (straight line or 50 m walking distance) away (DIN 4102 for Germany)?
 - Are the fire hazard classes LH, OH, HHP, HHS according to the guidelines for sprinkler systems VdS CEA 4001 included in the fire safety concept of the shelving design?

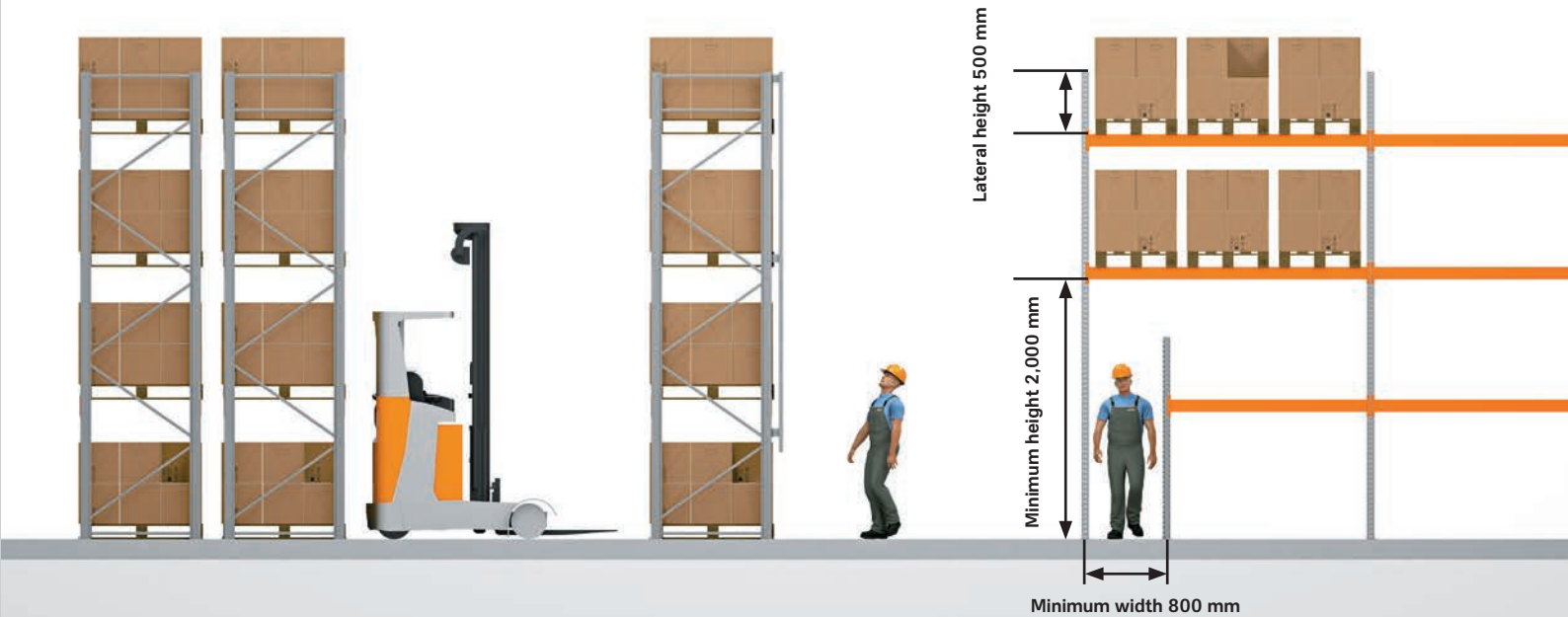


- Maintenance/damages:**
- What should your employees do in the event of a damage to the rack?
 - Have you scheduled regular rack inspections?



- Safety equipment:**
- Should your rack frames be protected not only at the front face but also inside the aisle? In addition to the corner or frame protectors at the entrance, we recommend a support protection or collision guard for your rack frames. This increases safety in the warehouse and reduces repair costs in the event of damage.
 - Are your loading units very heterogeneous? You can achieve more flexibility and a higher level of safety, for example, by using placement frames for cage pallets or mesh floors to store goods with varying base areas.

Keeping everything safe.
Protecting employees in the warehouse.



Requirements according to DGUV regulation 108-007 (formerly BGR 234) (Germany only).

In order to protect your employees from falling objects, a rack frame reaching up 500 mm above the top edge of the highest girder is required at the end face of the rack.

For free-standing individual rows, employees must be protected from falling objects. Our recommendation is a mesh rear wall.

For all racking passageways, a minimum height of 2,000 mm is required. In addition, the height of the passageways depends on the type of industrial truck in use: They should be at least 200 mm higher than the industrial truck.

The width of the escape route depends on the possible number of people. The minimum width of 900 mm of the escape route must be always clear of obstacles. The clear height of an escape route must be at least 2,000 mm.

Number of people	Clear width in mm*
<5	900
<20	1000
<200	1200
<300	1800

Table 6: Minimum width of escape routes acc. to ASR 2.3, Item 5, Paragraph 3&4

* Deviations from the specified widths are permitted under certain conditions, see ASR guideline.

To get your truck on track. Rail and wire guidance systems.

Guidance systems enable VNA trucks to travel safely within the aisle. You benefit from increased turnover performance. You can keep the safety distances to the shelves as small as possible and at the same time ensure that neither the rack nor the goods are damaged. In addition, the guidance system allows the driver to move the VNA truck diagonally so the driver can drive the truck and lift the cabin or the load at the same time. In consequence, the driver does not have to steer and can concentrate on finding the target.

VNA trucks are guided inductively via a guiding wire or mechanically via a guide rail. Depending on the guidance system, the height of the top shelf girder and the dimensions of the loading unit and the vehicle, the safety distances are individually planned by STILL VNA experts. DIN EN ISO 3691-3 prescribes a minimum safety distance of 90 mm to all liftable vehicle elements or the loading unit.

- A_{st} = aisle width, light dimension from load to load or rack to rack
- b_{26} = light dimension between the guide rails on the floor
- b_g = guide rollers on the vehicle
- Distance of guide roller to rail per side 2.5 mm



Guided to the destination.

Mechanical guidance system.



High guide rail (D 100)
Non-grouted, L-profile.



High guide rail (D 100)
Non-grouted, L-profile.



High guide rail (D 100)
Grouted, L-profile.

In a mechanical guidance system, the VNA truck is fitted with two guide rollers on each side. Steel profiles mounted on both sides of the aisle always hold the truck in the middle of the aisle. Depending on the vehicle configuration and the local conditions, a speed of up to 14 km/h can be achieved.

For your mechanical guidance system, you can choose between a high (D 100) or low (D 50) guide rail and between a grouted or non-grouted guide in the concrete base. With grouted rail guides, the racks stand on a concrete base - so you can pick up loading units easily on the first level without having to install a lower racking level with crossbars. In the case of non-grouted guide rails, a low rail in combination with special flat forks is used to store load carriers at floor level.

High guide rail, D 100 – standard:

Ground clearance of the lateral guide rollers: 18 to 50 mm

Rail height: 70 to 130 mm (with standard forks)

Low guide rail, D 50 – floor level mounting:

Ground clearance of lateral guide rollers: 10 to 26 mm

Rail height: 35 to 50 mm (with flat forks, thickness 35 mm)



Low guide rail (D 50)
To store load carriers directly on the floor.

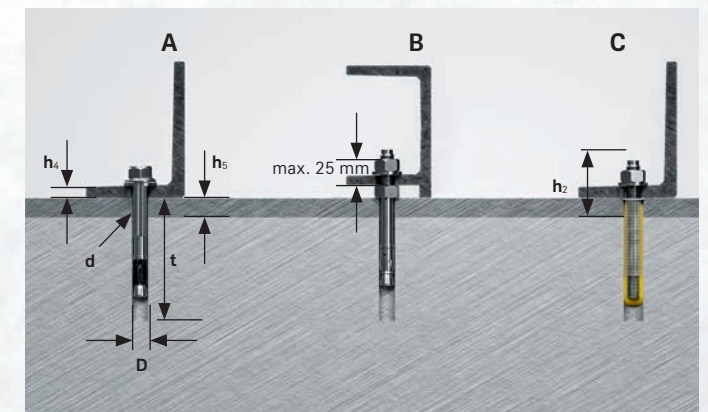
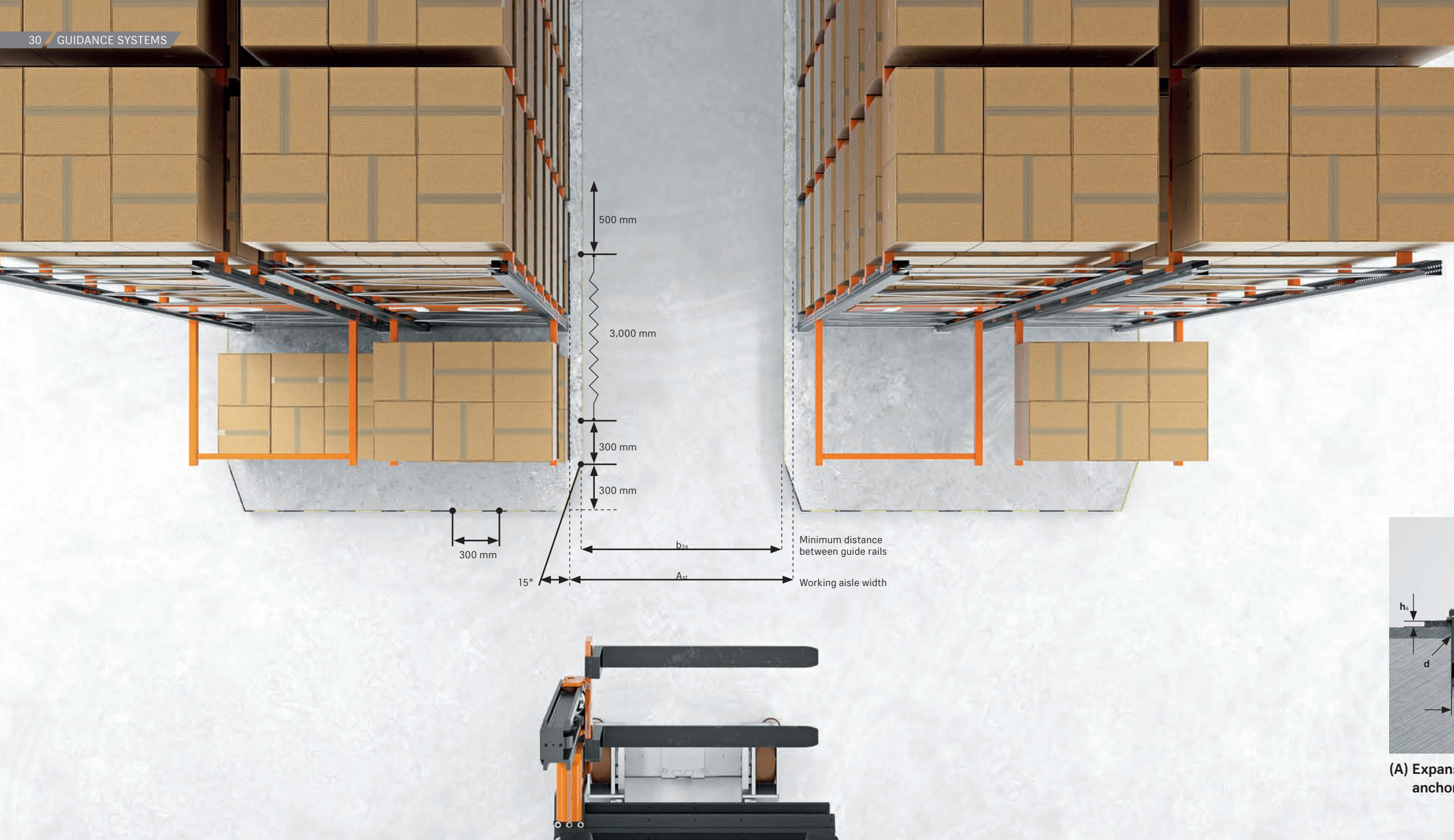
Note: The low guide rail requires an underclearance of at least 100 mm for the load carriers and the use of blade forks.



Low guide rail (D 50)
Requires the use of flat forks.

Advantages and important properties of the mechanical guidance system:

- Simple and robust system solution
- Simple mounting of the rails
- Wear- and maintenance-free solution
- Transfer aisle can be up to 1,000 mm narrower than the inductive guidance system
- Maximum travel speeds possible
- In general, for smaller to medium sized warehouses a cost-effective guide system solution
- Smaller working aisle widths possible



(A) Expansion anchor

(B) Expansion anchor

(C) Adhesive anchor with high guide rail (D 100), non-grouted, L-profile inside

Design and assembly of guide rails.

So that you can easily drive your truck into the racking aisle, the entrance of the aisle has an approx. 300 mm long entry funnel with an opening angle of 15°. In order to ensure easy and safe entry into the aisle, STILL uses a high rail profile (D 100) for the entry funnel even with low rail guidance. The strongest horizontal forces – up to 25 kN – acts on the entry funnel and the rail over an initial distance of approx. 3,000 mm in entrance stretch. Once all guide rollers are positioned between the guide rails, the forces reduce to less than 10 kN in the further course of the aisle.

The higher forces applied in the funnel and the drive range of the aisle require smaller distances between the anchorage points. In the drive range, the distance is 500 mm. For the funnel section and the first 3,000 mm of the drive range, we recommend a distance of approx. 300 mm between the anchors. This anchor spacing also applies to the front of the rail in the transfer aisle. The guide rails should be sufficiently strong to avoid deformation by lateral forces.

Fastening guide rails.

The rail mounting must be sufficiently dimensioned and permanently stable to withstand the considerable impact of the lateral forces exerted by the vehicle.

For rail fastening, STILL recommends adhesive anchors (C). Alternatively, expansion anchors (A+B) can also be used.

D = Drill hole diameter*

d = Marking anchorage depth

t = Borehole depth*

h₂ = Shaft height*

h₄ = Rail thickness

h₅ = Thickness of screed/insulation

*According to data provided by anchor manufacturer



On guiding wires to your goal. Inductive guidance system.

Barrier-free alternative.

This is how wire guidance works.

An inductive guidance system is a sensor-based, non-contact alternative to the mechanical guidance system and is increasingly in use today (for advantages see page 35). A wire loop laid in the floor forms the guideline. The wire is fed by a frequency generator with high-frequency alternating current (low voltage). This creates an alternating electromagnetic field. Your VNA truck is equipped with one antenna each at the front and rear in order to detect the generated magnetic field. This antenna permanently measures the lateral deviation from the wire. This ensures redundant safety monitoring and practical functions, such as automatic tracking on the guiding wire when

entering the aisle. The attached electronic system evaluates the signals and steers the truck centrally along the aisle above the guiding wire. For safe and fast tracking on the guiding wire, it is recommended to plan the transfer aisle 1,000 mm wider than the mechanical guide. Depending on the frequency generator, the guiding wire can be designed as a single-loop system or a multi-loop system.

Installation and allowances for the guiding wire.

The guiding wire should only be installed after the racks have been assembled. According to FEM 4.103-1/FEM 10.2.14-1, the deviation of the guiding wire from the centreline must not exceed 2 mm/m and must not exceed ± 5 mm over the entire aisle length.

A minimum distance of 50 mm should always be maintained between the armouring in the concrete and the guiding wire (c). However, a smaller distance can also be realised for you by means of field measuring. If you wish to use concrete with steel fibres, please ensure that the fibres are evenly distributed in the concrete. With wire guiding systems, the proportion of steel fibres in the concrete must not exceed 30 kg/m³.

The area of the guiding wire must be free of metal components such as cable ducts, expansion or movement joints etc. Maintain a minimum clearance distance of 200 mm around the guiding wire. If it is necessary to lay the guiding wire across an expansion joint, a double-insulated guiding wire must be used in this area to prevent cable breakage.

To prevent interference with other magnetic fields, no parallel guiding wires with the same frequency should be laid within a distance of 1,500 mm. Exception: return lines that are not used as lanes.

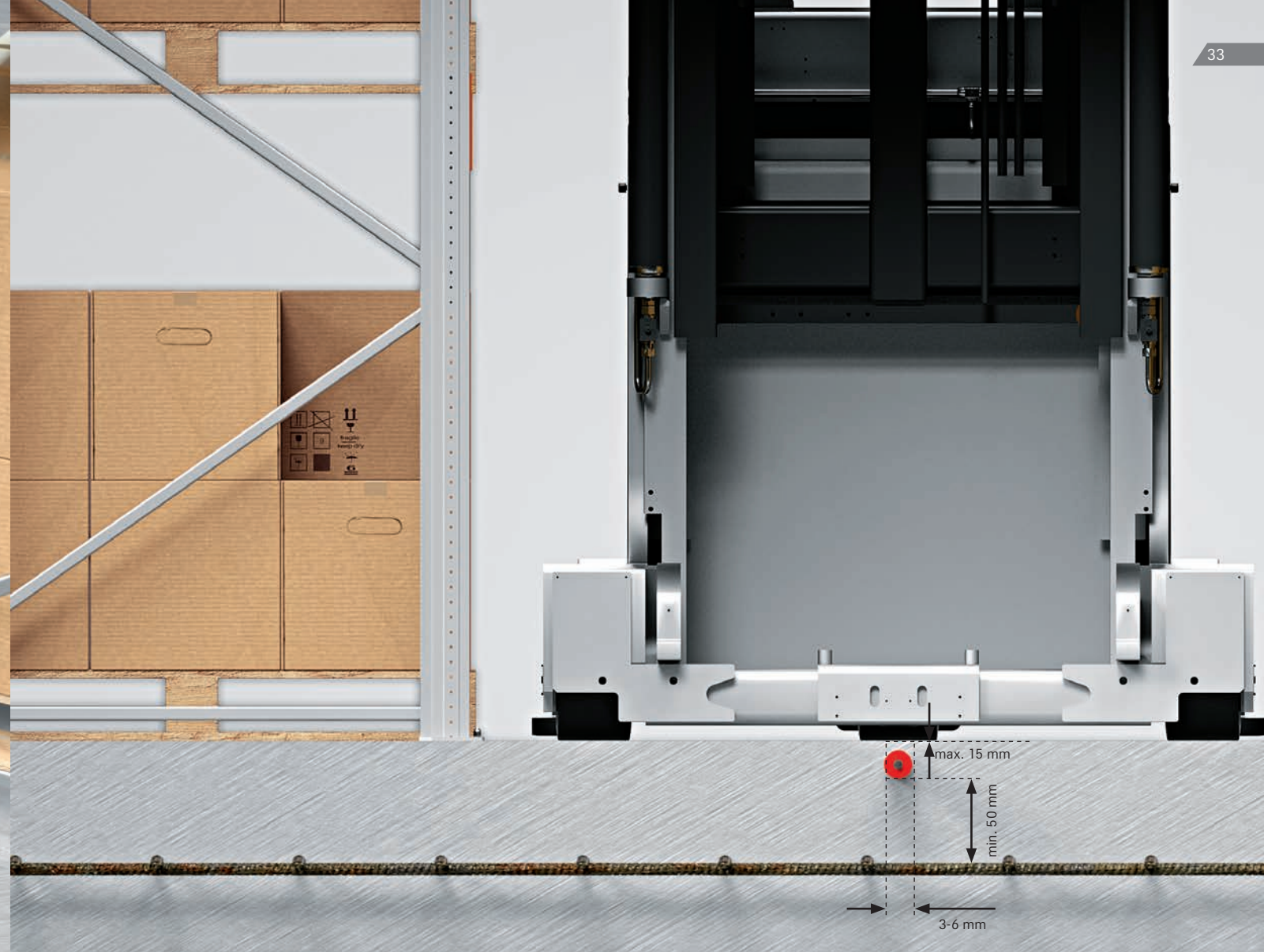


Illustration not true to scale

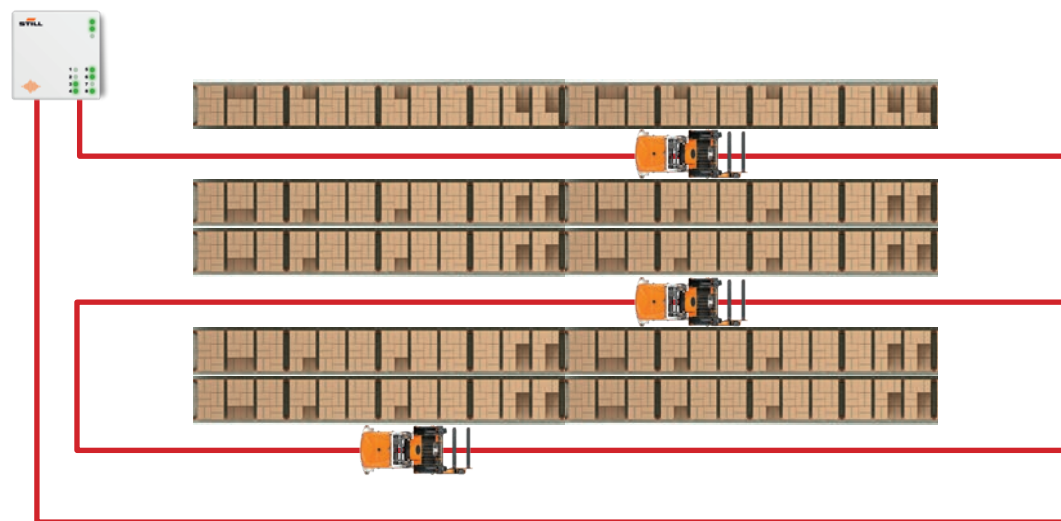
Dimensions for guiding wire:

Width: 3-6 mm, depth: maximum 15 mm,
distance from concrete reinforcement steel:
at least 50 mm.



Multi-loop system.

In case of damage, only parts of the warehouse are affected if a multi-loop system is installed. This makes the system less prone to failures. For fast tracking, the guiding wire of the individual loops should be routed as far as possible into the transfer aisle.



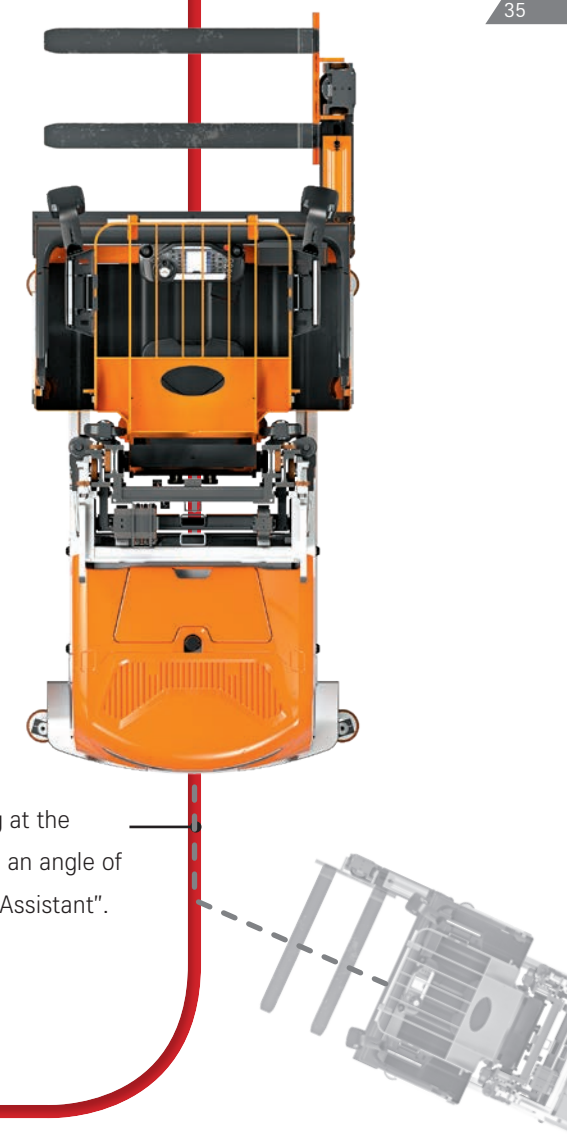
Single-loop system with separate return line.

In the case of an uneven number of working aisles, you need a separate return line to the frequency generator.

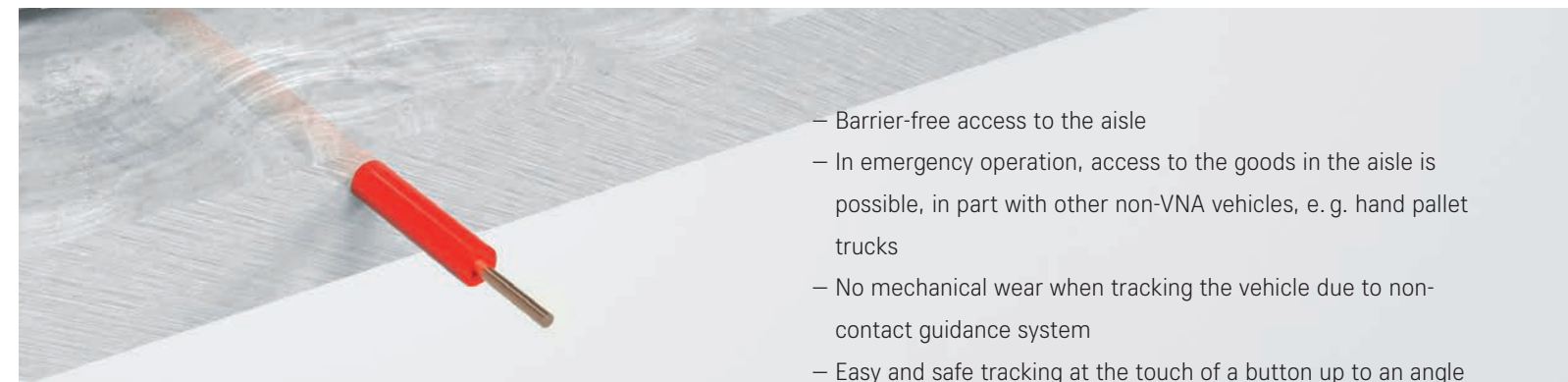
Master frequency generator (LFG)

The master frequency generator supplies the guiding wire in the floor with low voltage:

- Up to eight separate loops of 2,000 m each
- Optional battery buffering
- 300 Hz to 20 kHz
- Current: 30 to 110 mA
- Further frequencies and currents on request



Easy and safe **tracking** at the touch of a button up to an angle of 65° with the "Tracking Assistant".



No wear when tracking. Benefits of wired guiding systems.

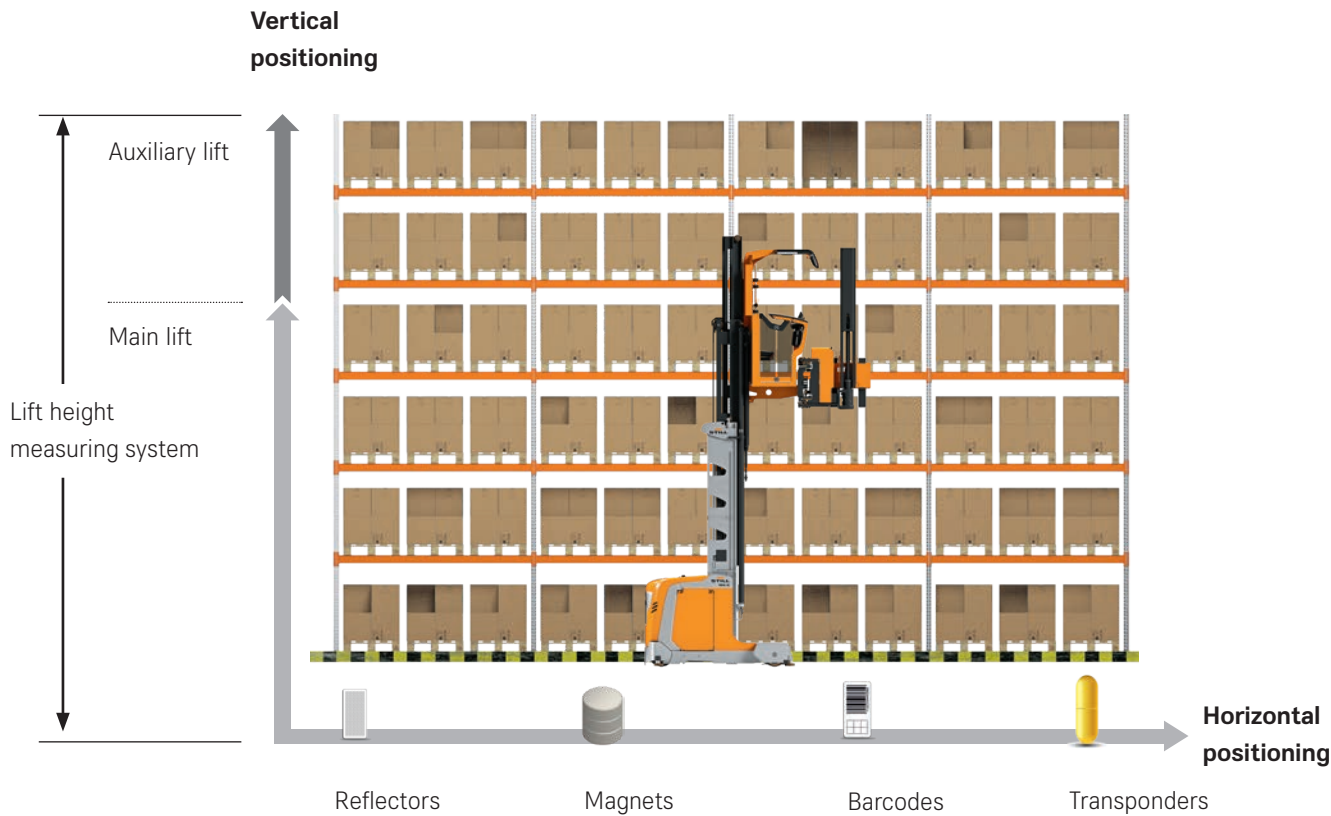
- Barrier-free access to the aisle
- In emergency operation, access to the goods in the aisle is possible, in part with other non-VNA vehicles, e.g. hand pallet trucks
- No mechanical wear when tracking the vehicle due to non-contact guidance system
- Easy and safe tracking at the touch of a button up to an angle of 65° with the "Tracking Assistant"
- Barrier-free load pick-up and delivery on the floor
- Cleaning of aisles and areas under the racks through better access and accessibility
- Transfer stations at the beginning of the aisle can be operated barrier-free on the floor
- Maximum utilisation of the clearance height in the warehouse
- Lower investment for medium to large warehouses compared to mechanical guidance system

Navigation, pedestrian protection etc.
The STILL assistance systems.

Vertical and horizontal positioning of your truck allows you to implement a wide range of functions:

- **Protective functions** (e. g. obstacle guards)
- **Efficiency functions** (e. g. automatic destination approach, navigation)
- **Status functions** (e. g. aisle detection)

The vertical position is determined with a lift height measuring system on the truck. To detect the horizontal position, you can choose from several systems. The table shows an overview of which system is required for which function. Functions such as aisle detection, aisle end stop as well as travel and lift cut-offs are usually carried out with magnets installed in the floor or reflectors mounted on the rack supports. Barcodes or RFID tags in turn enable navigation (STILL iGo pilot navigation) and extensive protective functions (STILL iGo pilot safety).



Functionality		Aisle detection	Emergency stops	Easy obstacle guard	STILL iGo pilot safety	STILL iGo pilot navigation	Additional information, e. g. "correct aisle"	System Benefits	Flexibility	Functional scope	In-floor installation	Optimisation of the marshalling zone
	RFID	Yes	Yes	Yes	Yes	Yes	Yes		High	High	Low	Yes
	Barcode	Yes	Yes	Yes	Yes	Yes	Yes		High	High	-	-
	Magnets	-	Yes	Yes	-	-	-		Low	Low	Medium	-
	Reflectors	Yes	Yes	Yes	-	-	-		Low	Low	-	-
	PPE	Yes	Yes	Limited	Limited	-	-		Medium	Medium	-	-

Table 7: Overview of positioning systems

Magnets are a simple and cost-effective way to implement functions such as aisle end protection, speed reduction or lift height limitation. They are installed in pairs (north pole and south pole magnet). Depending on the combination, the direction of travel is detected and the corresponding function is activated.

Reflectors are also simple and inexpensive. Functions such as aisle detection, speed reduction and lift height limitation are supported. We attach the reflectors directly to the respective

rack supports. The arrangement of the reflectors allows to detect the direction of travel and control whether the truck should slow down or speed up.

Barcodes make it possible to determine the exact position of the truck inside the working aisle. Comprehensive assistance functions can be implemented enhance safety in your warehouse the best possible way (with STILL iGo pilot safety) or to facilitate navigation and to approach individual pallet locations automatically (with STILL iGo pilot navigation).

This effectively prevents storage and retrieval to and from the wrong bays as well as damage to the goods and the rack. We install the barcodes on the rack supports at a height of 500 mm using adhesive labels. This simple installation does not involve high costs for you.

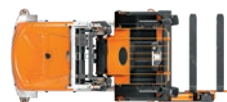
RFID technology also determines the truck position very precisely. This allows you to activate extensive assistance functions to maximise safety (STILL iGo pilot safety) or navigation (STILL iGo pilot navigation). The used RFID tags

are particularly small at around 22 mm in length and 8 mm in diameter – so they are easy to install in the floor. RFID technology stands out due to its high flexibility: If the storage situation changes, the RFID tags can be reconfigured by software.

Trust is good, control is better. Safety on board.

Outside the aisle:

The driver takes over the steering and the vehicle can move freely outside the rack aisles. The speed profile is adjusted/reduced according to DIN EN ISO 3691-3.



Inside the aisle:

The steering is blocked for the driver in the straight-ahead position and the maximum possible speed profile according to DIN EN ISO 3691-3 is available within the aisles.

According to DIN 15185-2, aisle detection and aisle end protection are mandatory for the use of VNA trucks. In addition, the operating status of the vehicle is enabled/controlled inside or outside the rack aisle. Standard safety requirements cannot be met without safe and reliable aisle detection. Aisle protection is thus a mandatory and reliably executed basic function for all cases.

With aisle detection, all functionalities required for operation in the aisle are activated as soon as the aisle is entered. For example, aisle detection activates the predefined maximum speed profile, deactivates steering for the driver and keeps it in the straight-ahead position.

- Aisle detection with a mechanical guidance system: by means of light sensors diagonally on the vehicle
- Aisle detection with inductive guidance system: by means of reflex light barriers on the vehicle and reflectors on the rack supports
- Aisle detection can also be carried out with RFID tags or barcodes. This is recommended when using the assistance functions STILL iGo pilot safety and STILL iGo pilot navigation

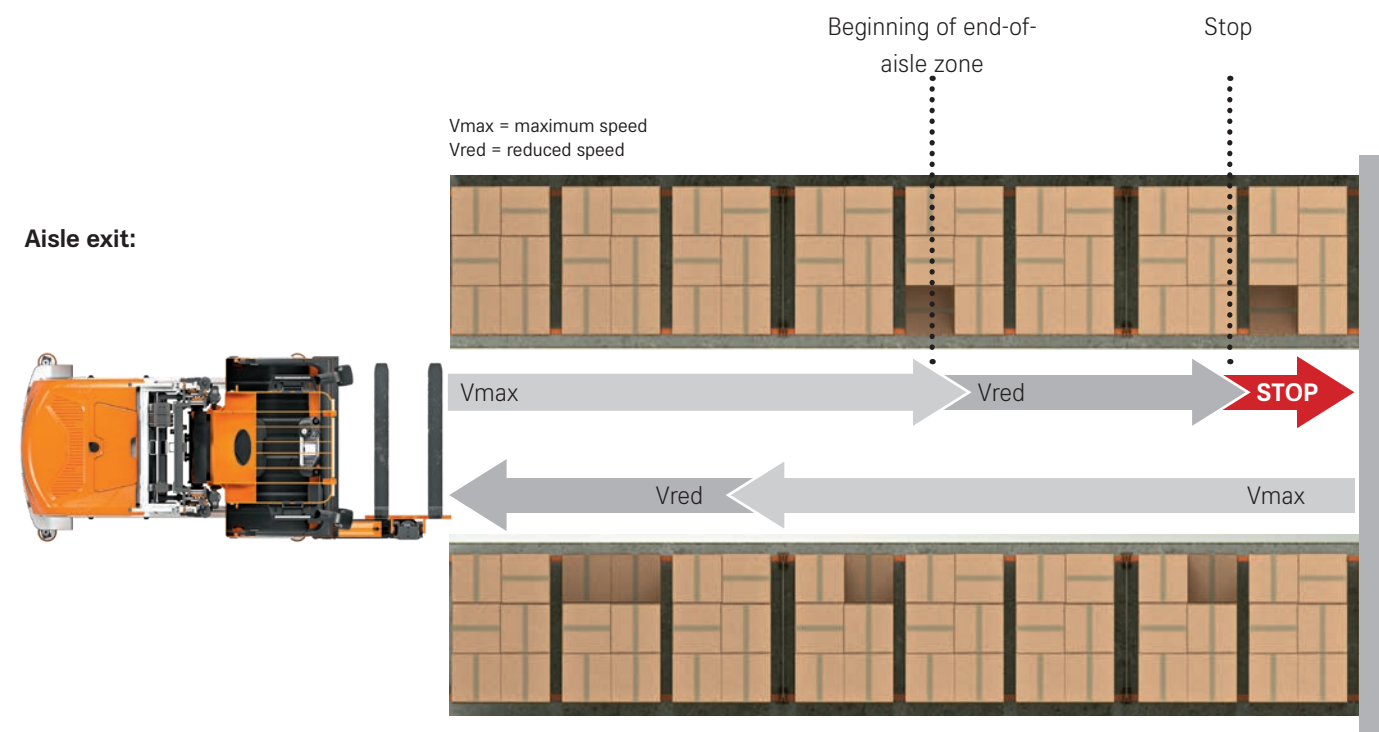
With aisle end protection, the vehicle is stopped or braked to 2.5 km/h (without operator intervention) at the end of the aisle before leaving it. Aisle end protection according to DIN 15185-2 is mandatory in the following situations:

- Before exiting the aisle
- Before crossing transfer aisles
- Before reaching the end of the aisle or a crossing inside the aisle
- When approaching closed aisle ends
- Before crossing escape routes, if these are accessible from outside of the aisle

Attention: Aisle end protection is an assistance function. It does not release the operator from his responsibility to drive the vehicle safely out of the aisle.

Aisle end protection can be realised by RFID transponders or magnets in the floor, barcode labels or reflectors on the rack supports or by a mobile pedestrian protection system (PPS). Additional functions can be defined for defined areas or zones in the aisle to increase safety in your VNA warehouse.

Aisle exit:



Temporary stop

When entering the aisle end zone, the vehicle decelerates completely. After two seconds, the vehicle can be driven further in the direction of the end of the aisle at a maximum speed of 2.5 km/h.

Absolute stop

If the truck approaches a closed aisle end, it brakes and stops completely. The driver can only position the vehicle at a reduced speed of 1 km/h towards the end of the aisle.

Welcome to the perfect workplace. Measures to protect your employees.

In order to operate a VNA warehouse, in many countries, as in Germany, measures must be taken to protect persons in the warehouse in accordance with the Industrial Safety Regulation (BetrSichV).

According to ASR A1.8 Technical rules for workplaces - Transport routes - a distance of at least 500 mm space to the left and right of the truck is required when moving through the aisles.

According to DGUV Regulation 68 - Industrial trucks (formerly BGV D27), companies may only use industrial trucks, stacker trucks and order pickers in narrow aisles if they prevent the simultaneous presence of pedestrians in the aisles.

According to DIN 15185 Part 2, the following options are available for this purpose:

- Building design
- Technical measures at the entrances to the racking
- Technical measures on the industrial truck
- Organisational measures (in addition to structural and technical measures)

Please also note the different regulations for pedestrian protection applicable in different countries. We will be happy to support you in planning and implementing your very narrow aisle warehouse safety concept.



Construction measures – Walls, fences and doors:

- Walls, fences and doors: at least 2,000 mm high
- Doors which can only be opened from the public traffic area with a key or via an electronic access system
- Doors must be able to be opened at any time from the inside without a key
- Door opening monitoring interval (maximum five seconds)

Technical measures – Rack access (light barriers):

- At least one light barrier at 400 and 900 mm height above the floor
- Warning systems must be able to distinguish between pedestrians and trucks
- Audible and visual alarm when vehicle and pedestrian are in the same aisle
- Stationary warning systems must independently check their operability once per hour
- Activation and deactivation of the alarm system by key switch

Technical measures – Truck:

- Sensors must prevent pedestrians from being endangered in both directions of travel; the safe monitoring range, designed in accordance with protection against injury requirements, must be selected in such a way that the vehicle comes to a standstill in good time
- In case of a power loss, the truck must shut down; restarting must only be possible if there are no persons in the hazard area

Organisational measures:

- Operating instructions
- Training warehouse personnel
- Written instruction of the operators
- Traffic regulations with signs in the warehouse



Detects pedestrians and stops the truck:
The mobile STILL pedestrian protection system.

Technical equipment of the VNA truck. Mobile pedestrian protection.

When you decide on the STILL pedestrian protection system, we equip your VNA truck on the drive and load side with safety laser scanners. These monitor the route and detect if a pedestrian or obstacle appears within alert distance or the protection field. If a person is standing within alert distance, the speed is reduced automatically to creep speed (maximum 2.5 km/h). If there is a person in the protection field, the alarm signal will sound, and the vehicle automatically brakes to a standstill. For safety reasons, the driver cannot switch off the alarm until the truck has stopped moving. The safety scanner is mounted on the front behind the forks. So, when the fork is lowered, the safety scanner cannot scan the aisle in front of it and therefore

provides no safety function. In this case, the driving speed of the truck is restricted to creep speed (maximum 2.5 km/h). Outside the very narrow aisles, the mobile pedestrian protection system is not active.

Outside the aisle:

The pedestrian protection system (PPS) is deactivated. The alert distance function can optionally be used as an assistance function.

Entering the aisle:

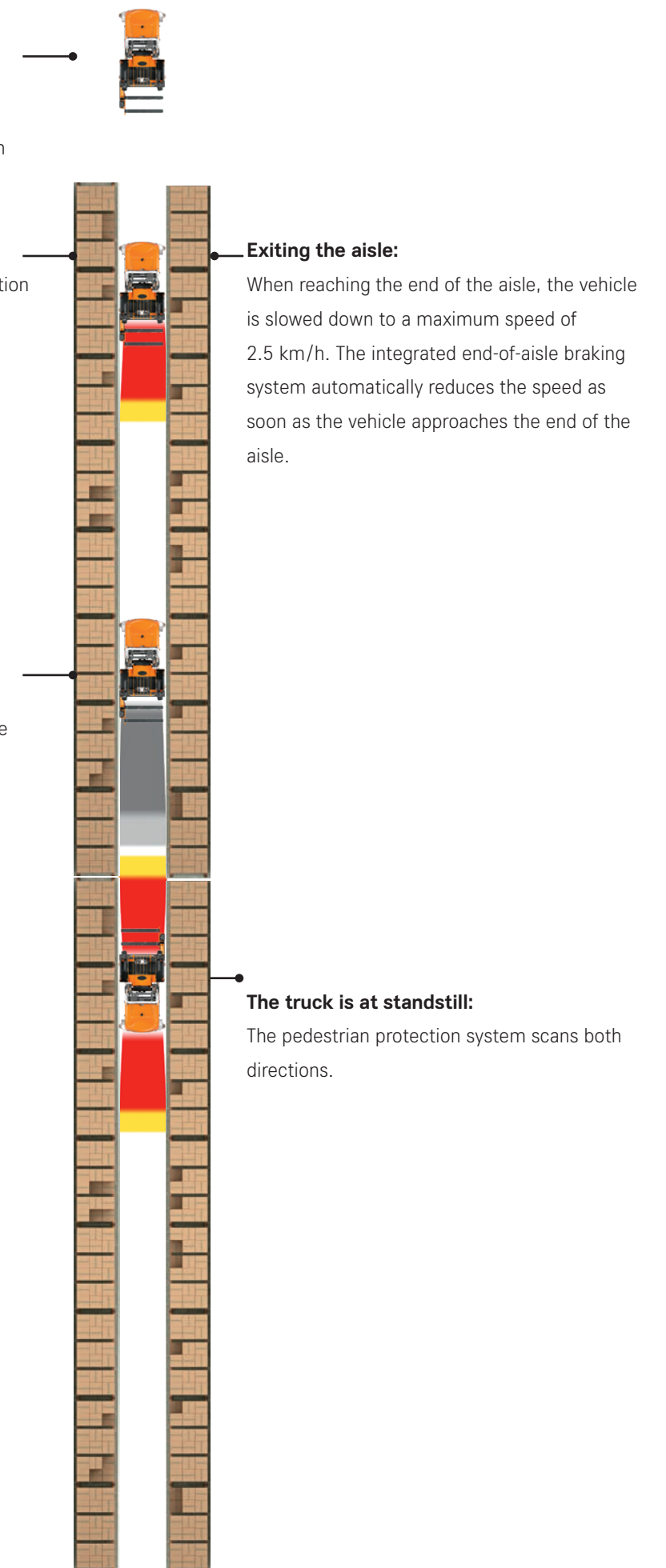
The PPS is automatically initialised and scans the direction of travel.

Alert distance (yellow) = Vred 2.5 km/h

Protection field (red) = truck stops

Blocked security scanner:

If the safety scanner is blocked by the cabin or load, the driving speed is reduced to V 2.5 km/h. Full travel is possible in drive direction.



STILL OptiSpeed – Fast and precise towards your destination.

The OptiSpeed control systems optimise vehicle movements for maximum goods turnover.

OptiSpeed 3.x ensures that the vehicle performance of VNA trucks is optimised according to weight and lift height and that vehicle movements can be carried out smoothly yet with maximum possible performance.

STILL iGo pilot navigation – Navigation assistance for the driver. The system recognises each storage location that is to be approached by the warehouse management system. With one-hand operation, the driver can navigate in the correct aisle,

with optimised performance, to the designated stop in front of the destination. With STILL iGo pilot navigation the vehicle stops automatically at the correct height and position, depending on load delivery or pick-up as well as for order picking. The target position is reliably met with a maximum deviation of ± 20 mm, which can be easily corrected by the driver. By selecting the assistance function “automatic load change” the entire load cycle is controlled by the driver with one hand. Efficiency and functional reliability with maximum relief for the driver.

STILL iGo pilot safety. Adaptable and configurable in a highly flexible way without hardware changes for any warehouse application individually, per warehouse, per aisle or only for individual areas.

A/ Optimised braking distances. Dynamic braking distance adjustment, always as short as possible before the end of the aisle. This increases the handling performance.

B/ Automatic speed adjustment. Automatic speed adjustments can be defined in defined zones or per aisle depending on the floor conditions.

C/ Lift stop. The adjustable lift stop enables optimum use of space up to the roof for different hall heights.

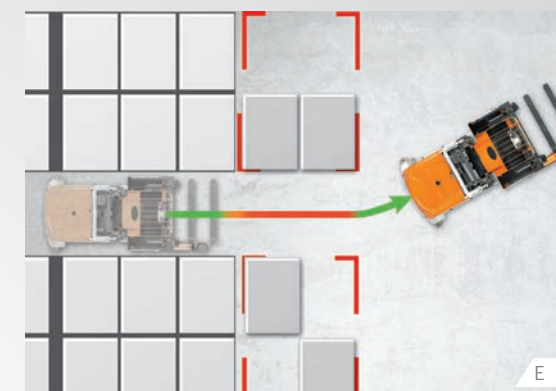
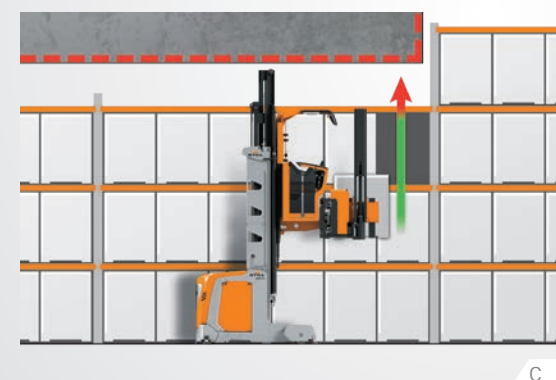
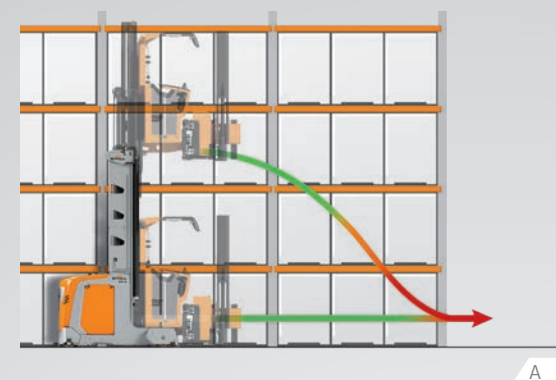
D/ Collision protection. Known obstacles can be defined. The driver does not have to pay attention to all obstacles inside the aisle and can concentrate on the work.

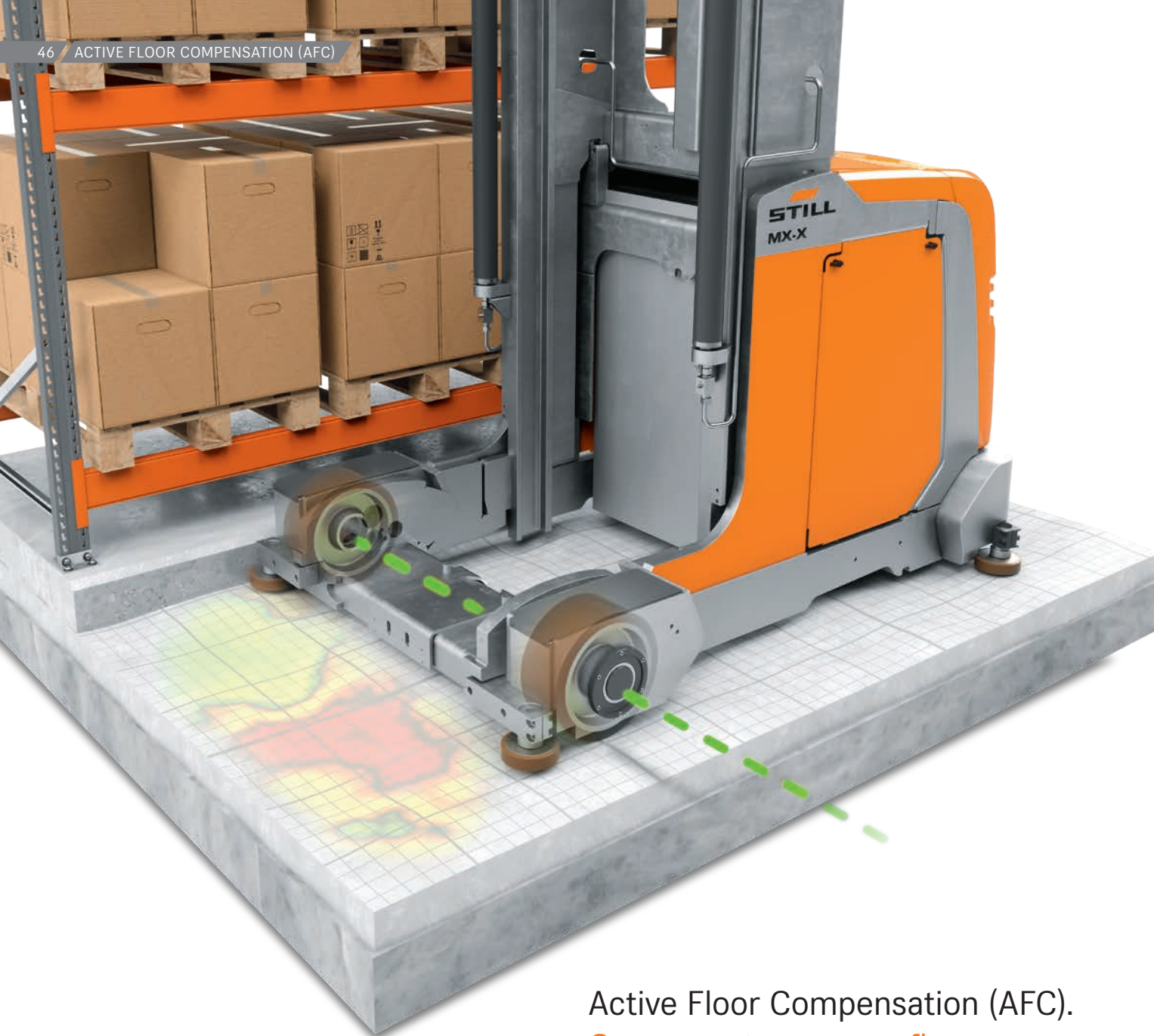
E/ Aisle exit assistant. The steering can be locked for a defined distance, e.g. when leaving the aisle, to avoid collisions at the transfer stations.

F/ Position selection. Pre-selecting a destination allows to automatically approach defined, frequently used positions such as transfer stations.

STILL iGo pilot navigation:

The individual navigation assistant for your warehouse.





Active Floor Compensation (AFC). Compensates uneven floors.

Maximum driving performance even on uneven ground.

High quality floors are crucial in very narrow aisle warehouses. Bumps in the floor are directly transferred to the truck and the driver. To allow top driving speeds, maximum efficiency and high driving comfort, the floor must be absolutely flat. Refurbishing the floor is not only costly but also time-consuming.

Active Floor Compensation (AFC):

With this option for the VNA truck MX-X, STILL offers a real alternative to the reconditioning of the warehouse floor to make the aisle floor more even. The system detects bumps in the lanes of the load wheels and compensates the bumps in real time. The truck frame always remains horizontal, the mast always vertical. The system reacts without delay even at maximum driving speed. In contrast to passive systems, which

only dampen vibrations, AFC actively compensates bumps before they are transferred to the truck. Less vibration, higher goods turnover and more comfort are the consequence.

Unique worldwide: STILL Active Load Stabilisation (ALS):

Active Load Stabilisation (ALS) is unique in very narrow aisle applications. The hydraulic control system optimises the reach movement during storage and retrieval, thus preventing the mast from swinging up. The system not only increases comfort, but also enhances turnover performance by up to 5%. In addition, the system compensates for the lateral inclination of the mast at higher lifting heights and ensures an even storage depth.



iGo systems Automation –
Precision in very narrow aisles.

Automation in intralogistics is becoming more and more important and pays off in many ways: automation offers higher safety by improving transport quality, preventing damage and avoiding accidents involving people.

Automation paves the way for more process excellence: there are no mispicks, avoidable empty journeys and mistakes in goods in automated processes. In addition, you benefit from maximum availability and reliability: efficient transport control in combination with a professional service concept to enable optimum fleet utilisation around the clock.

And because you can operate our trucks that are automated with iGo systems manually at any time and because our automation solutions are scalable, you always remain flexible. Our VNA iGo systems trucks play off all their strengths especially in very narrow aisles. For storage and retrieval processes at floor level as well as at the highest level of the rack. With our expertise, we support you in analysing your processes and identify automation potentials in order to strengthen your company for the future.

Always energised. Energy systems for every application profile.

No matter whether light applications or industrial use with continuous operation:
Together we will find the best system for your requirements.

For operation in Germany, certain requirements for charging stations and charging points for batteries must be taken into account:

- VdS 2259: Guidelines for damage prevention - Battery charging systems for electric vehicles
- Trade Association of Wholesalers and Warehousing Companies: Battery Chargers for Industrial Trucks

Lead-acid battery, without battery change

Proven, inexpensive and easy to maintain. For charging (at the end of a shift), the battery is manually connected to a charger. Suitable for single shift or double shift applications with a few hours of service. Lead-acid batteries (PzS) must be inspected weekly and cleaned monthly. The charging station must be fitted with an acid-proof floor and ventilation.

Lead-acid battery, with battery change

The system can be extended with spare batteries for single or double shift applications and high shares of traveling and lifting. This requires additional space for the battery, change frame and possibly for a truck (e. g. forklift truck) to change the battery.

Lithium-ion battery, with opportunity charging

For similar light or medium duty applications. With appropriate chargers, lithium-ion batteries can be fully charged in one hour. The batteries are absolutely maintenance-free and do not expel gas. The use with opportunity charging is especially economical (system efficiency >90%) and charging points are less restrictive.

Continuous charging system

For very intensive or 24/7 operation with lead-acid batteries. Without opportunity charging or battery change. The battery is charged while driving. A power rail along the rack supplies the onboard charger. The maintenance and charging requirements for lead-acid batteries continue to apply.

Light applications
~500 to 1,000 hours per year

Average application intensity
~1,000 to 1,700 hours per year

Heavy applications
over 1,700 hours per year

Single shift

Two shifts

Three shifts

STILL MX-X for cold storage warehouse operations.

Notes for cold stores:

- Lifting and lowering speeds always reduced
- Cold store trucks can only be used to a limited extent in the “normal range”
- Maintenance intervals every 500 operating hours
- Reduced battery capacity (additional fan heaters, seat heaters, etc.)
- Partially extended repair times due to the operating conditions (e. g. due to corroded screws or complete drying before returning to the cold zone)

Our technical experts will support you in questions concerning cold storage applications, particularly with regard to service requirements, battery life and truck handling, taking into account the logistical task at hand.

Customer example Schmidt Zeevis: STILL MX-X application in a fish trading company. Handling 133 types of fish and 800 pallet spaces.

VNA trucks in cold stores are subject to the toughest conditions. We recommend that you carry out a detailed analysis prior to your project. Appropriate operation considerably reduces service costs and ensures a long service life for the truck. Our STILL cold storage cabin guarantees a pleasantly tempered workplace at outside temperatures down to -30 °C. We equip the cabin individually for you with thermostat heating, wireless communication, emergency exit and ventilation system.

Typical requirements for a cold store application.

- Permanent use at maximum -30 °C
- The truck only leaves the cold store for major repairs
- The vehicle must be dry before entering the cold store; alternating operation (warm/cold/warm/cold) is not permitted
- Battery change takes place in the cold store, the battery is charged in the “warm zone”
- Permanent power source for heating the electrical and hydraulic components of the vehicle (constant charger), so the vehicle does not cool down even during charging times

To be sure that matters take their proper course.

Normative references.

DIN EN 1045-2: Concrete, reinforced and prestressed concrete structures - Part 2: Concrete - Specification, properties, manufacture and conformity – Rules of application for DIN EN 206

DIN EN 1045-3: Concrete, reinforced concrete and prestressed concrete structures - Part 3: Construction work – Rules of application for DIN EN 13670

DIN 18202: Allowances in building construction - Structures

DIN EN 18560-7: Screeds in building construction - Part 7: Highly stressed screeds (industrial screeds)

DIN EN 1081: Elastic, laminate and modular multi-layered floor coverings - Specification of electrical resistance

FEM 4.103-1/FEM 10.2.14-1 Warehouse floors – Storage system areas operated by Industrial Trucks - Part 1: Tolerances, deformations, methods of measurement and additional requirements for VNA truck operation

DIN EN 15512: Stationary steel rack systems - Adjustable pallet racking - Basics of static design; German version EN 15512:2009

DIN EN 15620: Stationary steel rack systems - Adjustable pallet racking - Deviations, deformations and allowances; German version EN 15620:2008

DIN EN 15629: Stationary steel rack systems - Specification of storage facilities; German version EN 15629:2008

DIN EN 15635: Stationary steel rack systems - Application and maintenance of storage facilities; German version EN 15635:2008

DIN 4102 (series): Fire behaviour of building materials and components

VdS CEA 4001: Guidelines for sprinkler systems - Planning and installation

DIN EN ISO 3691-3: Industrial trucks - Safety requirements and verification - Part 3: Additional requirements for industrial trucks with a liftable operator station and industrial trucks designed to travel with a lifted load (ISO 3691-3:2016); German version EN ISO 3691-3:2016

DIN ISO 6292: Powered industrial trucks and tractors - Braking performance and component strength

DIN 15185-2: Industrial trucks - Safety requirements - Part 2: Use in narrow aisles

VdS 2259: Guidelines for damage prevention - Battery charging systems for electric vehicles

Trade Association of Wholesalers and Warehousing Companies: Battery charging systems for industrial trucks

ASR A1.8: Technical rules for workplaces - Traffic routes

ASR A2.3: Technical rules for workplaces - Escape routes and emergency exits, escape and rescue plan

DGUV Regulation 68 - Industrial trucks (formerly BGV D27)

DGUV Regulation 108-007: Storage facilities and equipment (formerly BGR 234)

Industrial Safety Regulation (BetrSichV)
Is the German implementation of the Work Equipment Usage Directive 2009/104/EC and regulates the provision of work equipment by the employer, the use of work equipment by employees at work and the operation of systems requiring monitoring in the sense of occupational health and safety.

What does this term mean?

Glossary from A to Z.

Term	Definition
Aisle	Minimum distance from load to load or shelf to shelf within aisle.
Aisle detection	Detection of an industrial truck entering an aisle.
Aisle end protection	Device which automatically brakes the industrial truck to a maximum speed of 2.5 km/h or to a standstill when it exits the aisle.
Automation	Self-propelled industrial trucks that are automatically controlled and do not require operator intervention to operate.
Battery change rack	The battery change rack is a device for lateral battery change.
Cold storage operation	Use of industrial trucks in settings with low temperatures down to -30 °C; no interchangeable use; VNA trucks only possible for continuous use in deep-freeze/cooling areas.
FEM-4.004 test	At least once a year – as required by law – a FEM-4.004 test must be carried out on forklift trucks in accordance with the BGV D 27 Regulation for Industrial Trucks. After this accident prevention regulation the operators are personally responsible for the safety of their forklift trucks.
Forks - blade forks	Blade forks are used for handling goods without load carriers or load carriers with low entry openings. They are characterised by a fork blade with a very flat cross-section and a long bevel ending in a very thin tip. Due to this shape, the load capacity of blade forks is lower than that of standard forks.
Guidance system	Technical equipment through which an industrial truck is guided without interference from the driver.
Guide rail	Mechanical guidance of the industrial truck through steel profiles.
Load carrier	Load carriers are defined in DIN 30781. Accordingly, they are load-bearing means on which goods can be grouped together to form a unit load. The most common form of load carriers are rigid pallets in a wide variety of forms. Flexible pallet-sized sheets – so-called slip sheets – are also used.
Loading aids	Loading aids or load carriers are receptacles that combine individual goods or smaller units of goods for transport and storage purposes to form larger units. The best known examples are Euro pallets, ISO containers and pallet cages.
Loading unit	Loading units consist of the load and the load carrier.
Man-down truck	Man-down trucks are designed for storage and retrieval, with the operator's platform remaining in the lower position while the load is lifted.
Man-up truck	Man-up trucks are order picking trucks in which the operator's platform, including the load, moves up to the required rack level.
Operating condition	Operating conditions result from the working environment and are influencing factors on industrial trucks.
Operating time	The operating time describes the period of time during which industrial trucks are used. A distinction is made between one-, two- and three-shift operation.
PPS	Pedestrian Protection System.
Rack	Steel construction with height-adjustable girders designed to support load units.
Rack beam	Steel beam for holding load carriers or load units.
Rack depth	In a rack bay, the distance between the outer edges of the shelf girder is referred to as the rack depth.
Rack frame	Steel construction between the shelves to accommodate the beams.
RFID	RFID stands for Radio Frequency Identification and is a method of reading and storing data contactlessly and without visual contact.
Screed	It is immediately usable after hardening or can be covered with a coating. Layer which is applied as a floor on a load-bearing substrate or on intermediate separating or insulating layers.
Shelf girder	Shelf girders serve as load-bearing structures for the loading unit.
Space utilisation rate	The space utilisation rate describes the ratio between the total available storage space and the total used or usable space.
Subfloor	Load-bearing subfloor below the screed.
Surface load	The surface load describes a load that is evenly distributed over a surface. The surface load is defined as force (Newton) per square meter: [N/m2].
Track	Distance between load wheels, measured from centre to centre.
Transfer aisle	Driveable cross aisle for changing between the narrow aisles.
Transfer station	Storage points at the end of a rack aisle that serve as an interface between different types of handling equipment, e. g. wide aisle to narrow aisle.
Very narrow aisle (VNA)	Transport route in racking systems with a safety distance on both sides of less than 500 mm between the most protruding parts of the industrial truck, including its load, and fixed parts of the surrounding area or rack.
VNA truck	VNA trucks can work in aisle widths of up to 1.250 mm. They are therefore particularly suitable for use in narrow aisles.
Warehouse management system	With a warehouse management system, all goods movements can be individually controlled and intelligently handled, from goods receipt, warehouse control and picking through to route provision and loading in the outgoing goods area.
Wide aisle	Transport route in racking systems with a safety distance of more than 500 mm on both sides between the most protruding parts of the industrial truck including its load and fixed parts of the surrounding area or rack.



STILL GmbH
Berzeliusstr. 10
22113 Hamburg
Germany

Tel.: +49 40 73 39 20 00

Fax: +49 40 73 39 20 01

info@still.de

For further information please visit

www.still.eu

STILL is certified in the following areas: Quality management, occupational safety, environmental protection and energy management.



first in intralogistics