

**Requirements  
on hospital carts  
suitable for automated transports  
on the AGV system**

**MLR System GmbH**

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# Requirements on hospital carts suitable for automated transports on the AGV system

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## 1 List of abbreviations

The following abbreviations are used in this document:

Abbreviation	Description
AGV	Automated Guided Vehicle
AGVS	Automated Guided Vehicle System
ATS	Automated Guided Vehicle Control System
Cart	Hospital trolley for usage with an AGV
RFID	Microchip / transponder for radio-frequency identification

## 2 Introduction / General

This document describes the general requirements the carts used in hospitals will have to meet to be suitable for the automated transports by an AGV system.

For a project more specific information will be needed.

To make sure that the interface between cart and AGV vehicle will work in the system operation, it is highly recommended that the cart base design is checked by the AGV designer before the cart production begins.

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## 3 Design

### 3.1 Design of Carts

Efficient work results are needed in the daily clinic operations. Carts are closing the cycle of logistics functions as sorting, packing, transporting, storing and distributing.

Therefore an optimal design, the material and useful functions of transportation are important for process rationalization. Easy operations and more safety is achieved too. By focusing on a maximum friendliness cleaning the highest level of hygiene can be reached.

From the long experience of MLR with the implementation of automatic logistic concepts within hospitals and the delivery of needed surroundings (e.p. Carts, Cart Washers, Conveyors etc.) MLR recommends that carts that need regular disinfection should be out of stainless steel. For all others there is a choice between stainless steel and aluminum.

Carts should be of closed design transporting any dirty items. Carts with meshed sidewalls or with open covers can be used for clean goods as clothes.



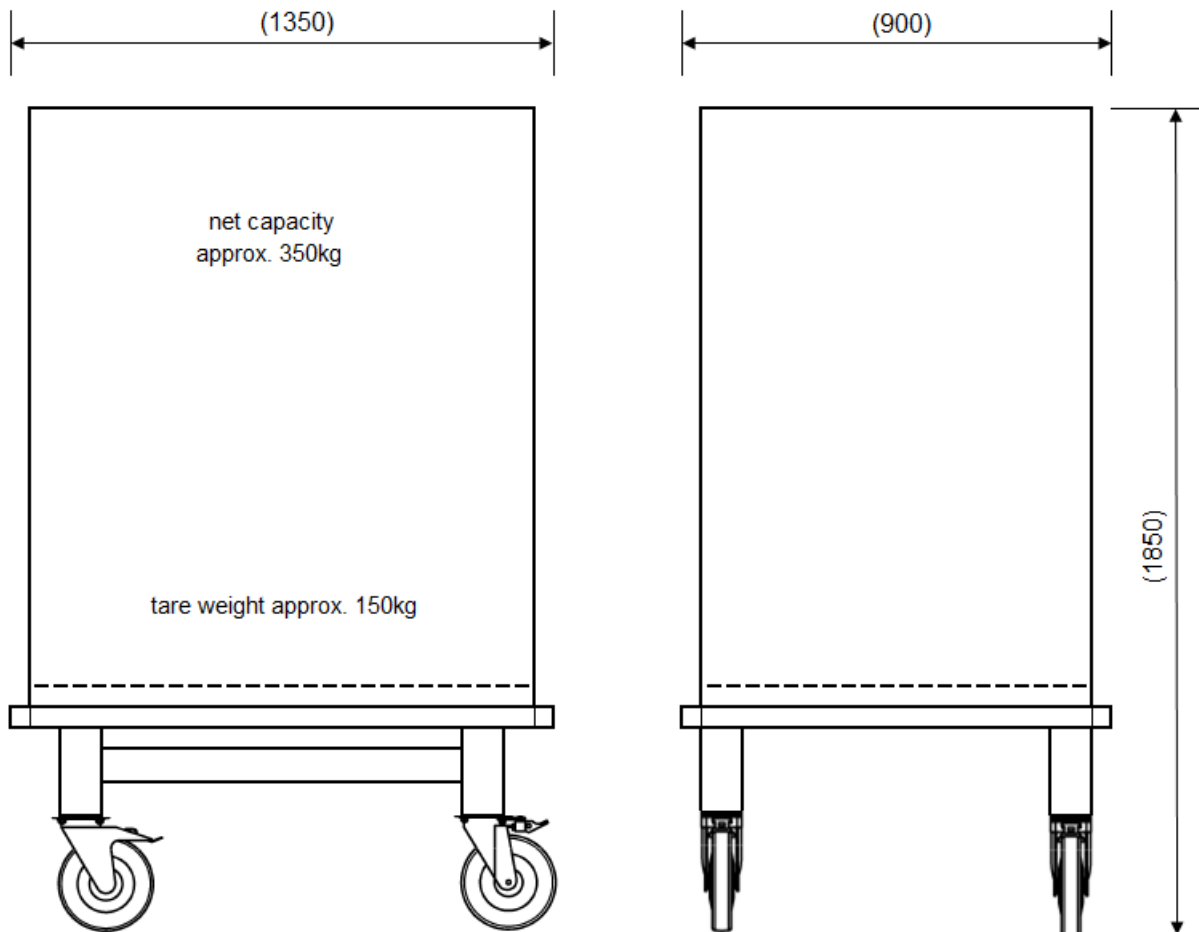
MLR AGVs in operation with different types of Carts

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## 3.2 Typical dimension of a full sized Cart

The typical outer dimension amounts to 1350 x 900 x 1850mm (L x W x H)



( ) accepted tolerances = +5mm

To prevent an overload of the AGV (max. payload = 500kg), but to reach an maximum of the net capacity, the tare weight of a Cart shouldn't be more than approx. 150kg.

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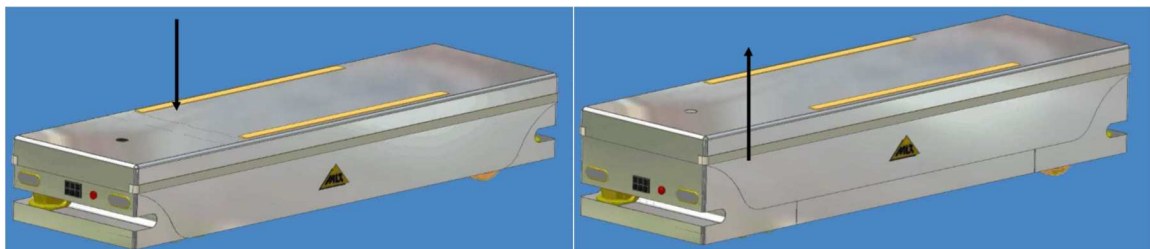
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## 3.3 AGV design

### 3.3.1 Principle of Pick-up and drop down of the cart by the AGV



The AGV is equipped with a lifting table. The whole upper cover is lifted for pick-up. On the cover are two bearings which are in contact to the carts.



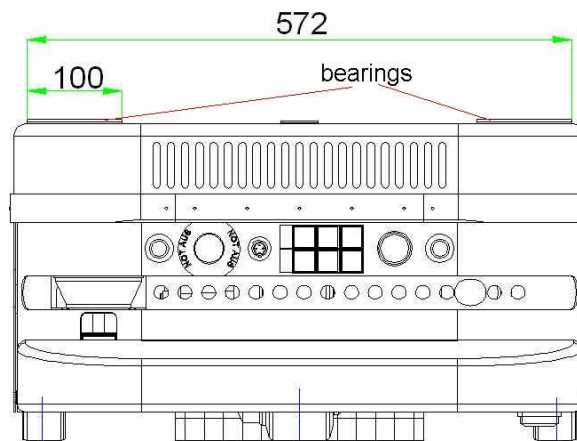
Cover down

Cover up

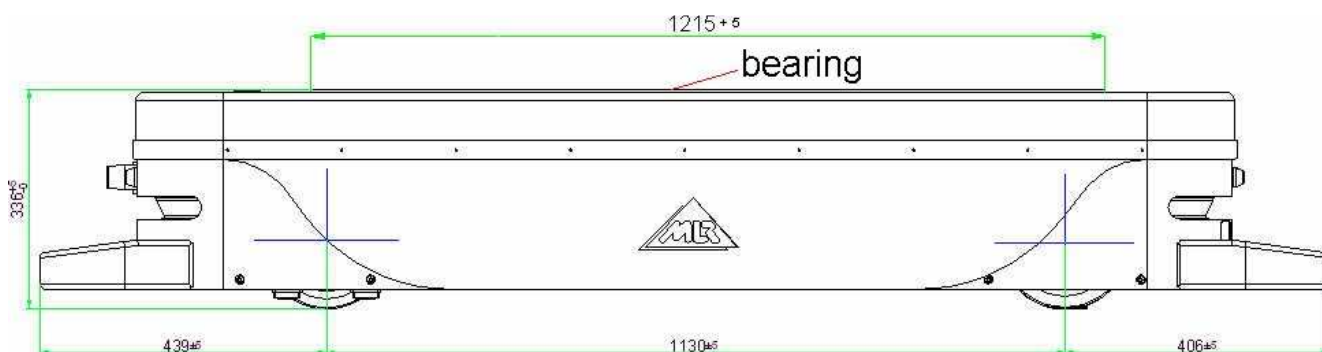
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## 3.3.2 Dimensions AGV

AGV front view



AGV side view



The length of the bearings (shown as 1215 mm on this drawing) may become customized according to the length of the trolleys.

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## 3.4 Special AGV requirements to the Cart chassis

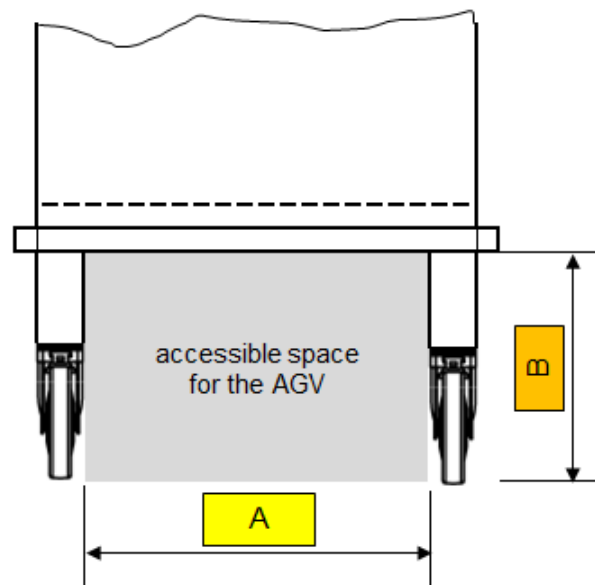
### 3.4.1 Tunnel

The so-called “tunnel” of the Cart is an accessible space which is needed for lifting by the AGV in the long direction (see sketch below / view from the front site):

- A = in horizontal way between the art wheels or rather the mounting brackets of the wheel
- B = in vertical way between the floor and the underside of the Cart chassis

The following criteria have to be fulfilled:

- The tunnel clearance (width and height) shall be suitable for the AGV to enter in to without colliding. The position tolerance of the AGV is considered.
- in any driving conditions the swivelling wheels must not touch the AGV casing during the Cart goes piggyback ride at the AGV.



**A** Functional measurement = 650mm +0 /-3

**B** Functional measurement = 370mm +0 /-5



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## 3.4.2 Border strip and substructure

For the manifold usage of the Carts a border strip is needed at the outer contour in length and width. This prevents damages during the external lorry transport as well as during the internal manual transport within the Hospital facility.

### Conditions for the material

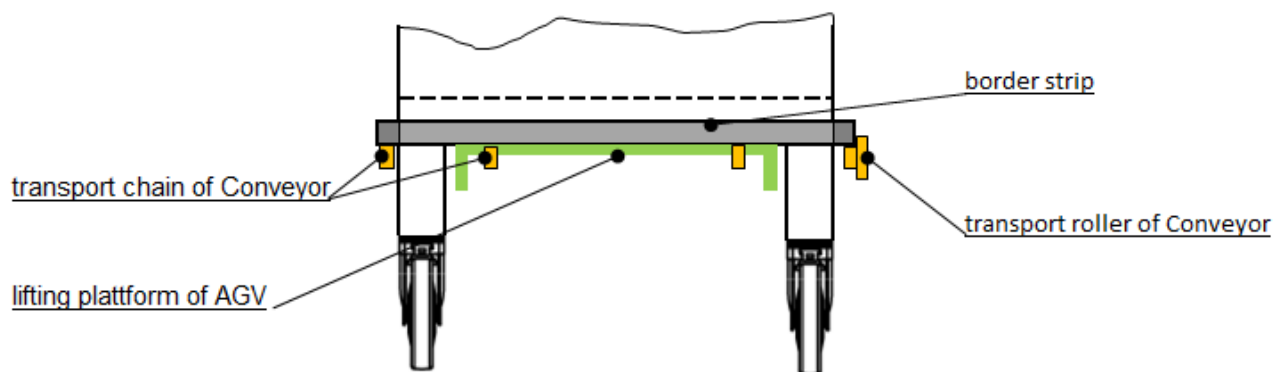
The border strip should be from plastic with a high friction performance but high impact strength. Furthermore, it has to be water- and heat-resistant (water temperatures up to 90°C within the Cart washer) and resistant to abrasion (e.g. don't use black rubber).

### Design of substructure

In general the frame of a cart is lightweight designed, because the tare weight must be small. Hence, tubular or box profiles as well as metal-bended profiles are used for construction. The substructure of the border strip must be able to meet the technical needs and functions, such as lateral impacts and supporting frame for AGV and Conveyor transport.

### Functions

- During the external lorry transport the Carts are placed close together. The border strip avoids damages and guaranteed an easy loading / unloading by a high friction performance.
- During the internal manual transport within the Hospital facility by operators sometimes one or several Carts will be placed close to the wall. The border strip avoids damages to the facility and at other Carts too.
- The border strip (as well its substructure) must be able to absorb lateral impacts without rubbing off.
- The border strip (as well its substructure) is the base for the AGV Transport as well the transport onto roller and chain conveyor systems.



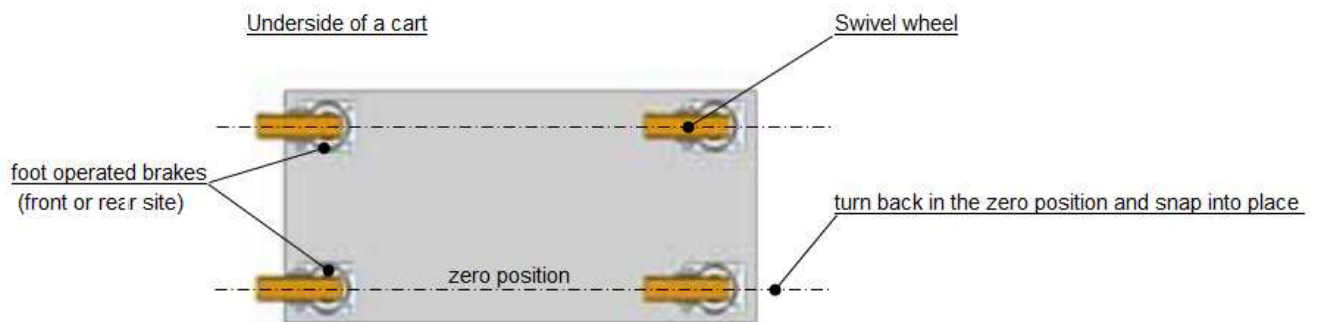
# Requirements on hospital carts suitable for automated transports on the AGV system

## 3.4.3 Wheels

A major focus must be laid to the wheels of a Cart in several directions! In below the important details are described.

### Arrangement of wheels

Depending on the maneuvering by manual operations and usage by AGVs the wheels of the Carts must be positioned as shown below.



### Outer distance between wheels

The outer distances between the wheels as well as the wheel width must be the same for all carts to allow the carts to be positioned in the pick-up stations.

### Type of wheels

Either four swiveling wheels or two swiveling and two standard wheels are used.

Locking devices within the wheel suspensions are giving a stable running performance at the straight line. These locking devices are important also for turn back in the zero position and snap into place during the manual positioning of the Cart. This arrangement of the wheels allows the intake and transport by an AGV.

To avoid rolling away two of the swivel wheels (front or rear side) should be equipped with foot operating brakes.

Swivel wheel



Swivel wheel with foot brake



# Requirements on hospital carts suitable for automated transports on the AGV system

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## Selection criteria of wheels

Dependent of the usage it's important to select the correct wheels to meet the requirements of the client. In following some of the main issues are listed:

➤ Diametre:

We recommend a diametre not less than 200 mm.

➤ Material:

Hardness, shape, tread material and diameter have a significant influence on driving comfort.

➤ Transport weight

Correct identification of the transport weight / load per wheel will affect the lifecycle of the wheel positively.

➤ Electrical conductivity:

The electrical conductivity of wheels and rollers helps protect against electrostatic discharge, which can be generated by transportation or freight.

To prevent electrical discharge and resulting accidents the selected material of wheels and its whole construction must be able to derive generated electrical charge. One or more wheels shall have conductivity for safe discharging of electrostatic charge

➤ Colour:

In hospitals are mostly bright floors. Thus, bright and / or non marking materials should be preferred.

➤ Corrosion, chemical, temperature resistance

Surfaces of wheels and its components should be made of galvanized steel or provided with a lacquer protective layer. Bearings should be sealed by protective caps and maintenance free.

The operation of a wheel also depends on the effect of temperature. The temperature for the tread results from the interaction of ambient temperature and rolling friction in respect of material of the wheel and the transported weight of load.

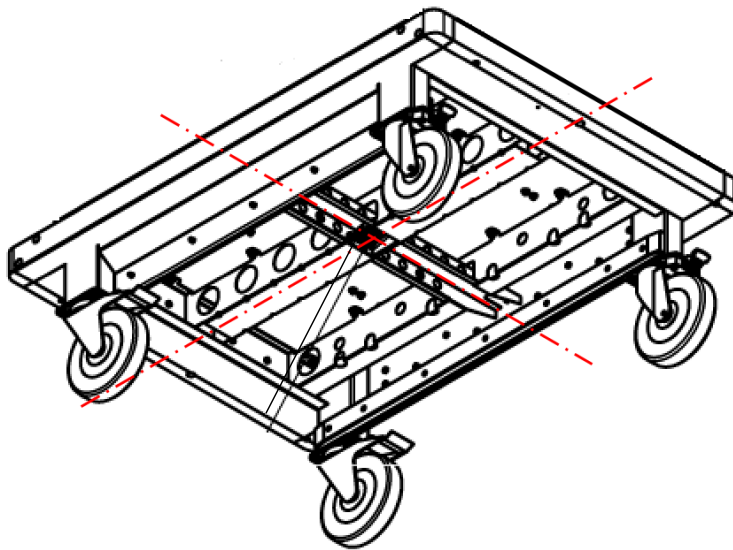
The chemical resistance of a wheel must be considered if direct contact is present with aggressive media (eg. washing and rinsing by Cart Washer).

# Requirements on hospital carts suitable for automated transports on the AGV system

## 3.4.4 RFID assembly

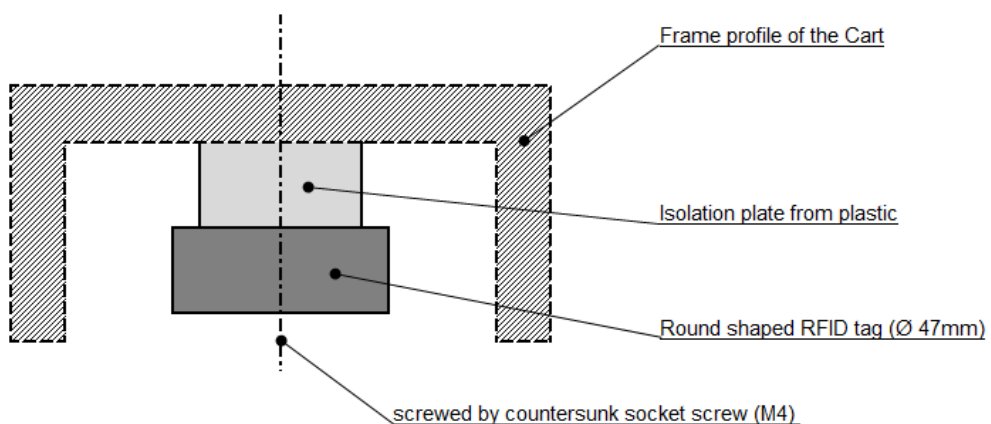
Each Cart will be equipped with a transponder. Since the RFID reader and its antenna is installed in the center of the AGV, the transponder must be in the center of the Cart also.

Position of the RFID / transponder underneath the Cart



RFID tags are read by a RFID reader inside the AGV while the positioning of the AGV underneath a Cart. Since the reading distance of the RFID reader's antenna is limited to some centimeters, the position of the RFID tag must be close to the RFID reader.

Position of transponder within metal-bended profile



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## 4 Cart identification

### 4.1 Cart ID

Each Cart should be equipped with an individual ID of up to 4 digits by a machine washable label on each front and backside.

The size of the digits should be big enough for an easy identification the Cart ID at a distance of approx. 10m.

### 4.2 Cart RFID

The core of an RFID system is a memory called transponders or tag. For automatic reading of an RFID tag by an AGV each Cart will be equipped with a transponder (see chapter 4.5.4).

The RFID tag has a round shape with a screw hole in the center. For better insulation to the material of the Cart, the tag is screwed with an additional plastic plate as shown in the following.

#### Technical data's of used HF-Transponder

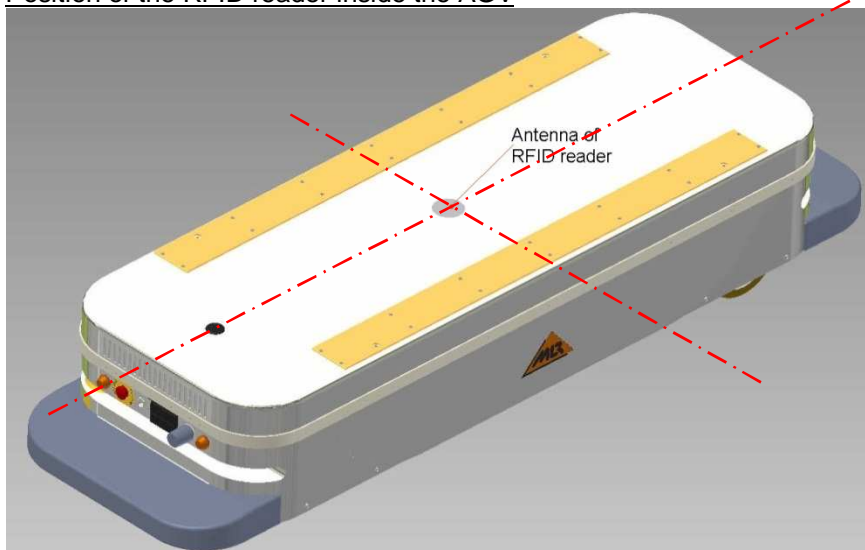
RFID type	Philips SLI
Frequency	13,56 MHz
Diameter	approx.. 47mm
Height	approx. 10mm
Color	Black
Memory capacity	1024 Bit
Storage temperature	- 40°C to 125°C
Operation temperature	- 20°C to 85°C



### 4.3 Cart reader

The RFID reader and its antenna is installed in the center of the AGV, the transponder must be in the center of the Cart also.

#### Position of the RFID reader inside the AGV



The RFID reader and its antenna shall meet the requirements of RFID tag. Since the use and the type of construction vary, it isn't described in this specification specifically.

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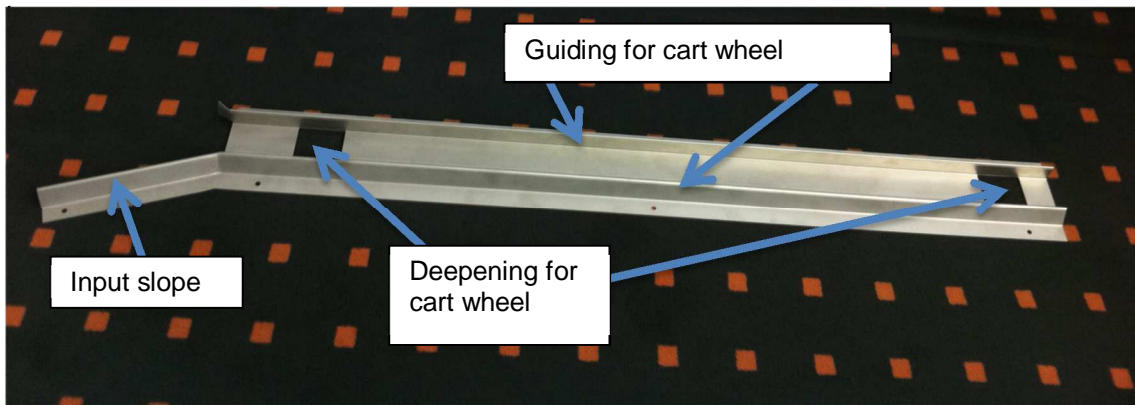
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## 5 Guiding rails

For the pick-up stations guiding rails are used. The delivery stations doesn't need any rails, because we've presumed that the floor is flat and has enough grip that the carts don't move after they have been dropped by an AGV.

The design of the guiding rails depends on the design of the cart.

The guiding rail is designed to guide the two right or lefts wheels of a cart. It has an input slope for an easy cart insertion. In addition a deepening for each wheel is integrated for a proper positioning of the cart.



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## 6 Examples of conveyors

### 6.1 Chain conveyor

Each conveyor unit consists of an entry module, middle modules as well as a handover module to the AGVs. Each module represents an independent chain conveyor with its own drive system.



handover module to the AGVs



entry module



middle modules

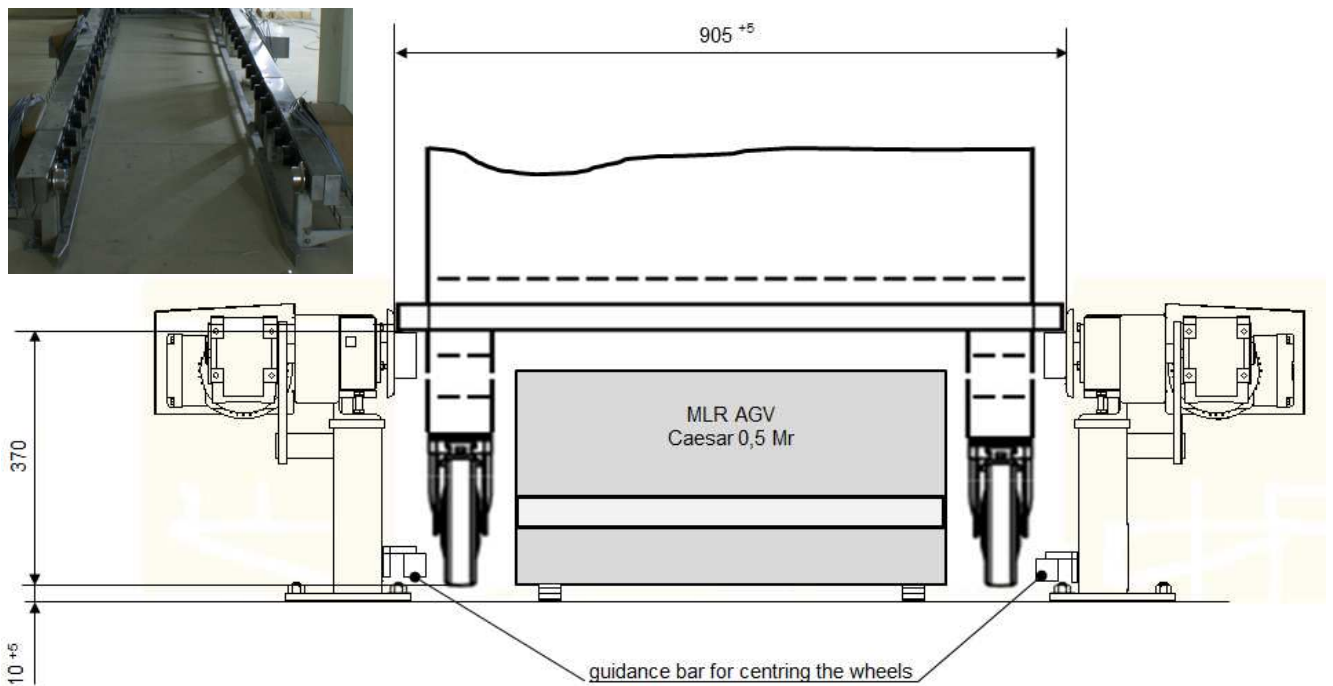
middle modules

The chains of the conveyors have a middle distance of 560 mm the entry and middle modules as well as 860 mm for the hand-over module to the AGV (dimensions depending on trolley design).

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## 6.2 Roller systems

Roller conveyors are another type of conveyors. In general they need a little more space than chain conveyors.



principle function of handover to a conveyor system

## 6.3 General requirements to all conveyors

There are several functions which must be considered during the time of planning.

Such as:

- Dropping height of the carts
- Drive-in distance for the carts
- Required open range between the edges of conveyor system for the AGV
- Guidance bar for centring the Cart wheels



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## 7 Disinfection of Cart

We strongly recommend to disinfecting carts with waste and food.

Therefore the carts should be able to be washed manually and / or automatic by a cart washer.

No water should be left in the cart. Using aluminium carts special washing fluid is to be used.



In general carts are tilted by 5° in the washing machine to allow water to flow out after washing.