

# ACH Technical Data

## Autonomous Mobile Robots (AMR)

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ACH 06

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ACH 10

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ACH 15

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# ACH Autonomous Mobile Robots (AMR)

## Smart efficiency increase

This specification sheet as per VDI Guideline 2198 only provides the technical values for the standard vehicle. Different tyres and the use of accessories etc. may result in other values.



Features			STILL	STILL	STILL		
			ACH 06	ACH 10	ACH 15		
1.1	Manufacturer						
1.2	Manufacturer's type designation						
1.3	Drive		Battery	Battery	Battery		
1.4	Operation		Autonomous	Autonomous	Autonomous		
1.5	Load capacity/load	Q	kg	600	1000	1500	
Weight	2.1 Service weight		kg	145	205 <sup>1</sup>	215 <sup>1</sup>	
Wheels/chassis	3.1 Tyres			Polyurethane	Polyurethane	Polyurethane	
	3.4 Additional wheels (dimensions)			200 x 40	200 x 40	200 x 40	
	3.5 Number of wheels (x = driven)		front/rear		2x +2	2x +2	2x +2
Basic dimensions	3.6 Track width		b <sub>10</sub>	mm	668	758	758
	4.4 Lift		h <sub>3</sub>	mm	55	60	60
	4.15 Height, lowered		h <sub>13</sub>	mm	240	260	260
	4.16 Loading platform, length			mm	∅ 680	950 <sup>2</sup>	1000 <sup>2</sup>
	4.18 Loading platform, width			mm	∅ 680	750 <sup>2</sup>	780 <sup>2</sup>
	4.19 Overall length		l <sub>1</sub>	mm	956	1182	1182
	4.21 Overall width		b <sub>1</sub>	mm	730	832	832
	4.33 Load dimensions		b <sub>12</sub> x l <sub>6</sub>	mm	900 x 900 <sup>3</sup> (780 x 780) <sup>4</sup>	1200 x 1200 <sup>3,5</sup> (1080 x 1080) <sup>4</sup>	1200 x 1200 <sup>3,5</sup> (1080 x 1080) <sup>4</sup>
	4.34 Working aisle width with predetermined load dimensions		A <sub>st</sub>	mm	1473 <sup>6</sup>	1897 <sup>6</sup>	1897 <sup>6</sup>
	4.35 Turning radius		W <sub>a</sub>	mm	478	618.5 <sup>7</sup>	618.5 <sup>7</sup>
Performance data	5.1 Travel speed		laden/unladen	m/s	1.5/2	1.2/1.5	1.2/1.5
	5.2 Lifting speed		laden/unladen	m/s	0.29	0.29	0.29
	5.3 Lowering speed		laden/unladen	m/s	0.21	0.21	0.21
	5.8 Max. gradeability		laden/unladen	%	<5 <sup>8</sup>	<5 <sup>8</sup>	<5 <sup>8</sup>
	6.4 Battery voltage/nominal capacity (5 h)		V/Ah	kWh	48/36 <sup>9</sup>	48/36 <sup>9</sup>	48/36 <sup>9</sup>
Misc.	10.7 Sound pressure level L <sub>pA,z</sub> (operator's position)			db(A)	<75	<75	<75

### <sup>1</sup> Weight of the adapter plate:

- ACH 10: h<sub>13</sub> = 450 mm, +70 kg; h<sub>13</sub> = 500 mm, +75 kg; h<sub>13</sub> = 700 mm, +94 kg
- ACH 15: h<sub>13</sub> = 450 mm, +62 kg; h<sub>13</sub> = 500 mm, +66 kg; h<sub>13</sub> = 700 mm, +86 kg

### <sup>2</sup> Loading platform rotation diameter: ACH 10: ∅ 1060 mm; ACH 15: ∅ 1114 mm

### <sup>3</sup> With loading platform: Loading platform required as carrier

### <sup>4</sup> Internal dimensions of the carrier (l<sub>6,1</sub> x b<sub>14</sub>)

### <sup>5</sup> Pallet transport with adapter plate (l<sub>3</sub> x b<sub>9</sub> = 1200 x 887 mm) with three fixation positions; l<sub>6</sub>: 1016 mm (position 1), 1000 mm (position 2), 800 mm (position 3); b<sub>12</sub>: <1219 mm

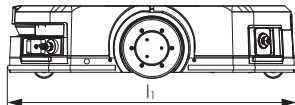
### <sup>6</sup> Including 200 mm (min.) operating aisle clearance; with load dimensions (l<sub>6</sub> x b<sub>12</sub>) of Euro pallet (800 x 1200 mm) = 1642 mm; UK pallet (1000 x 1200 mm) = 1762 mm; US pallet (1016 x 1219 mm) = 1898 mm

### <sup>7</sup> Rotation diameter with adapter plate: ACH 10 and ACH 15: ∅ 1411 mm

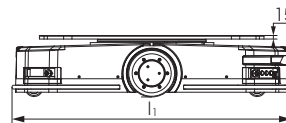
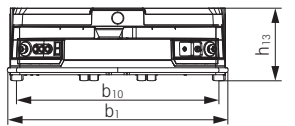
### <sup>8</sup> Permissible step height <5 mm, traversable gap <15 mm

### <sup>9</sup> Lithium-nickel-manganese-cobalt-oxide battery

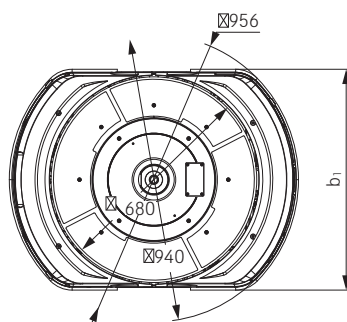
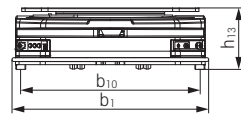
### <sup>10</sup> Battery running time (laden at nominal load): ACH 06/10/15: 9 h/7.5 h/6.5 h; battery charging time from charge status 0 to 100%: ~1.5 h



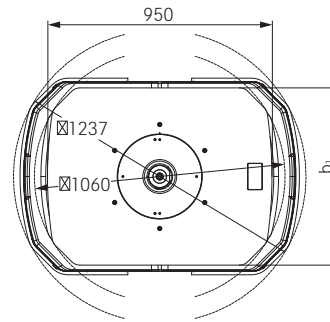
Side view ACH 06



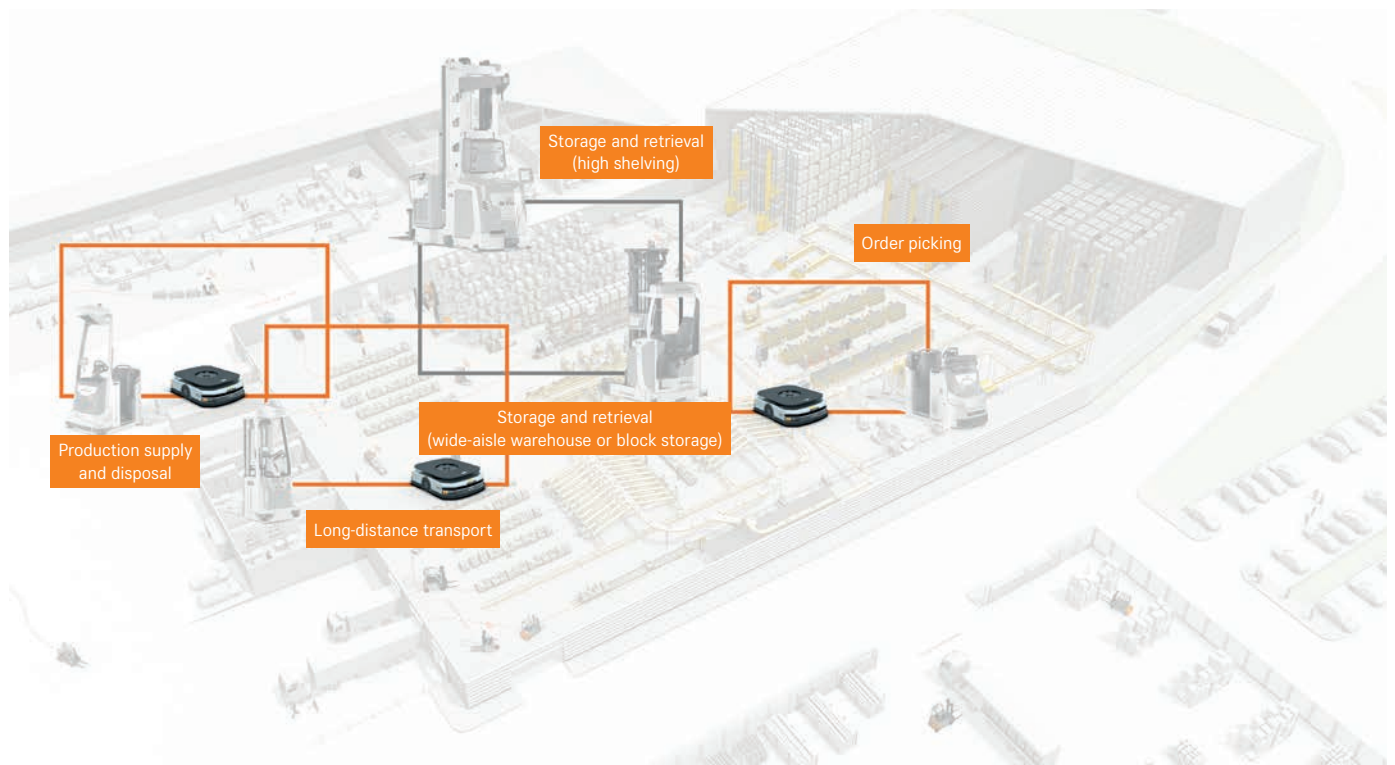
Side view ACH 10/15



Top view ACH 06



Top view ACH 10/15



Efficient warehouse organisation and optimisation of internal material flows are decisive criteria for the success of a company. For this reason, automation solutions have long been standard in many industries. The applications for automated logistics processes are diverse, such as production supply and disposal (e. g. via tigger trains), storage and retrieval of goods in racking (e. g. with reach trucks or narrow-aisle trucks), transporting pallets (high-lift pallet trucks) and order picking. Both hybrid (series) trucks, which can be operated automatically and manually, and exclusively driverless trucks (driverless transport systems – DTS) are used in these areas.

Innovative AMRs (autonomous mobile robots) are a pioneering addition to hybrid trucks and DTSs. These are increasingly finding their way into a wide range of industries such as e-commerce, medical, automotive, food and retail, and are being used in warehouses, distribution centres and production facilities.

AMRs such as STILL's ACH series are small, manoeuvrable and intelligent under rides that operate flexibly and proactively in complex warehouse structures. These can be used as a stand-alone solution or integrated into existing warehouse management and control systems to suit the customer's requirements. Compared to classic automated warehouse solutions, AMRs can be integrated cost-effectively into existing environments and systems. Operating and maintenance costs are also comparatively low. To decide on the vehicle concept that best suits your specific needs, it is important to evaluate various criteria. These include, for example, the infrastructure, environment and volume of traffic in the warehouse, the need for buffer storage and the type of load, not to mention the cost implications. STILL's experienced automation experts will support you in analysing your processes, evaluating the relevant criteria, selecting the right system as well as planning and implementing it. Our perfectly coordinated service concept, a comprehensive service network and the expert knowledge of specially trained service technicians ensure the availability of your system.

## ACH Autonomous Mobile Robots (AMR) Usage scenarios

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**Goods transport via a loading platform (table):** When transporting goods via a loading platform (table), the ACH transports the entire unit from A to B. The goods are placed on the loading platform. The ACH drives under the element, lifts it, transports it to its destination and deposits it there. If a conveyor trolley is used as the goods carrier, additional positioning measures may be required.



**Goods transported directly on the vehicle:** With direct goods transport, the goods carrier is transferred from the transfer station directly to the ACH. The ACH drives under the loaded station, lifts the pallet with its adapter plate and transports it to the destination. The station is refilled.

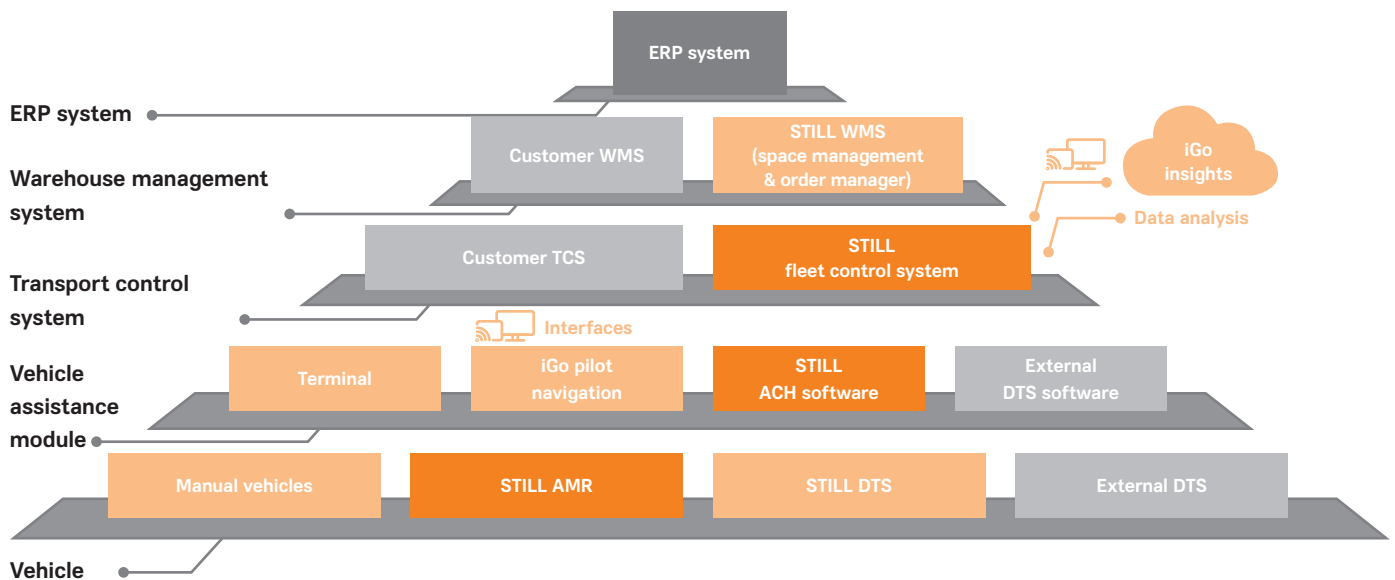


**Transports individual carriers:** Depending on the customer's requirements, individual transport options (including a multi-level loading platform, conveyor trolleys or trolleys) are possible, e.g. for different carrier dimensions or transport orientation. If a conveyor trolley is used as the goods carrier, additional positioning measures may be required. Our STILL experts will implement a bespoke transport solution to suit your needs based on your specifications.

## ACH Autonomous Mobile Robots (AMR) Software

In a (semi-) automated warehouse, everything is intelligently linked: STILL material flow management modules control all flows of goods and information, flexible interfaces (API) enable the simple and individual integration of different components. This means that DTSs (driverless transport systems) and AMRs (autonomous mobile robots) can be integrated as well as vehicle assistance modules and manual vehicles. Customer-specific requirements can also be implemented via the transport control system, for example in respect of communication with doors or fire alarm systems. Communication, coordination and scheduling of transport orders are carried out via the intelligent ACH software.

With the ACH series, a transport order can be triggered in three different ways: from a host system (e. g. WMS or ERP), via a sensor located at the transfer stations, or by means of manual triggers such as push buttons, scanners or terminals. The transport order is triggered within the transport control system and transferred to the vehicle assistance module via API. The intelligent ACH software dynamically distributes the transport orders to the vehicles in the fleet and, at the same time, defines the optimal route. Traffic and scheduling management and energy management are also handled by the ACH software. Thanks to the smart link, nothing will escape your attention anymore: you will always have an overview of all transport operations as well as the utilisation and status of your vehicles in real time. This allows you to make optimisations and adjustments to your processes promptly and directly.



## Navigation

In order for the ACH to perform its transport tasks reliably and without errors, three elements are necessary for position recording, assignment and navigation: QR codes, an HD camera and an inertial measurement unit (IMU).

### Position recording:

The vehicle calculates its route based on the IMU between two QR codes. After reading a QR code, the ACH updates its current position (location and direction of travel).

### Assignment:

The QR codes are the central orientation points for the ACH. For this purpose, as well as for route calculation, these are distributed in a tight grid across the entire facility. Each code has a unique identifier and direction/alignment to enable precise assignment of the position.

### Navigation:

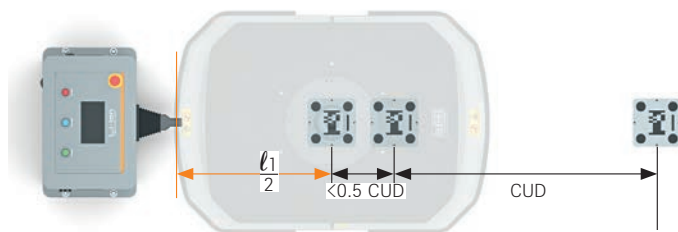
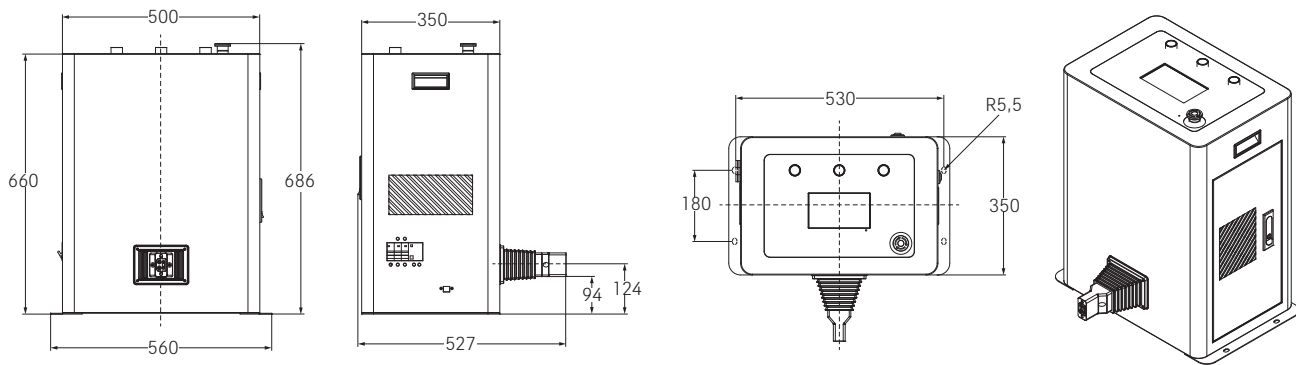
The ACH calculates its route from point A to point B as a series of journeys from one QR code to the next. A traffic control system regulates the priority assigned to the vehicles. For high adaptability of the system, the chassis is equipped with a large field of vision. This allows QR codes to be read even if the route deviates by up to 40 mm – for example, if the vehicle has slipped.

# ACH Autonomous Mobile Robots (AMR) Charging and charger

General	<b>ACH lithium-ion charger</b>	48 V, 30 A, 1.6 kW
	Availability	Europe
	Applicable AMR	ACH 06, ACH 10, ACH 15
Vehicle	Plug	Type F (EU) / Type G (UK)
	Dimensions	560 x 527 x 686 mm
	Weight	30 kg
	Touchscreen	Configured
Input energy	Length of power cable	2 m
	Nominal voltage	220 V (EU), 230 V (UK)
	Voltage range	198~242 V
	Performance	1600~2000 W
	Frequency	50~60 Hz
Output power	Performance	1600 W
	Voltage	42~58 V
	Current	0~30 A
	Overload power	110% of the rated power
Safety	Protection against reverse polarity	Configured
	Protection against short circuiting	Configured
	Protection against output overvoltage	Configured
	Protection against overheating	Configured
Other	Ambient temperature	0~45 °C
	Storage temperature	-40~75 °C



Four units each of the ACH 06 and 10 types or three units of the ACH 15 type can use the same charger with a time offset to ensure continuous operation. For this, the AMRs organise their charging processes just as autonomously as their routes. The charging process is initiated automatically when the battery level drops to 30%. QR codes on the floor navigate the vehicle to its station, it docks in less than five seconds, and the charging process starts after about 17 seconds. At a battery level of 90% at the latest, the vehicle undocks and resumes its work.

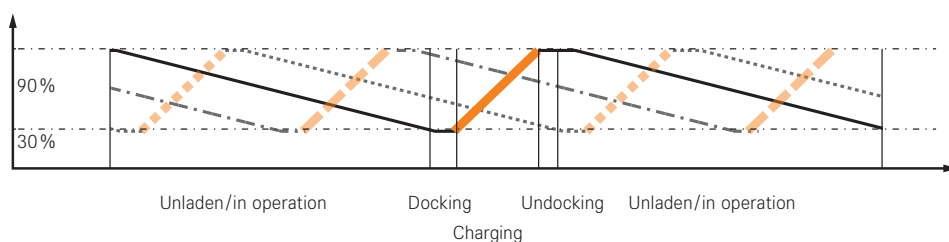


Maximum spacing limit for the QR codes in the layout (CUD<sup>1</sup>) by different types of AMR:

	ACH 06	ACH 10	ACH 15
Max. CUD <sup>1</sup> in mm	1000 x 1000	1350 x 1350	1350 x 1350
Average vehicle/charger ratio	4	4	3

The ACH reverses to the charging station; the illustrated format of the QR codes is needed for orientation.

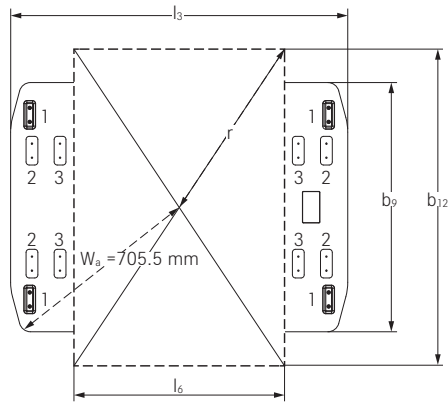
<sup>1</sup> Code Unit Distance = spacing of QR codes in the layout.



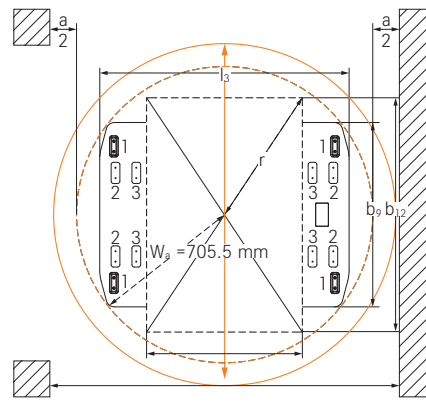
- ACH #1 in operation/discharged
- - - ACH #1 charged
- ACH #2 in operation/discharged
- - - ACH #2 charged
- ACH #3 in operation/discharged
- - - ACH #3 charged

Several ACH vehicles can be charged at one charging station, see graphic opposite.

Fixation position (position 1, 2 and 3)



Safety distance a = 200 mm



Adapter plate on ACH 10 and ACH 15

	ACH 10 & ACH 15
Dimensions of the adapter plate $l_3 \times b_9$ in mm	1200 x 887
Load dimensions $b_{12} \times l_6$ in mm	Fixation points 1, 2 or 3
800 x 1200 mm	Position 3
1000 x 1200 mm	Position 2
1016 x 1219 mm	Position 1

Technical requirements for carriers (tables and pallets)

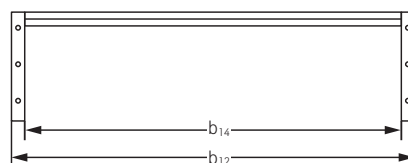
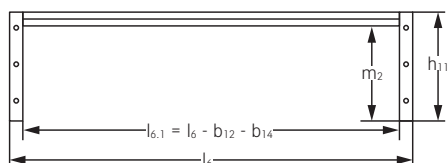
			ACH 06		ACH 10			
Carriers ( $l_6 \times b_{12}$ )			Loading platform	Loading platform	Pallets	Pallets	Pallets	Pallets
Lift height	$h_3$	mm	55	60	60	60	60	60
Max. height platform extended	$h_4$	mm	295	320	350	510	560	760
Height, lowered	$h_{13}$	mm	240	260	290	450	500	700
Loading and delivery height	$h_{13} + \text{free lift}$	mm	270	290	320	480	530	730
Max. centre of gravity height	$h_{c1}$	mm	314	890	1450	1450	1450	1450
Max. capacity	Q	kg	600	1000	1000	1000	900	900

			ACH 15				
Carriers			Loading platform	Pallets	Pallets	Pallets	Pallets
Lift height	$h_3$	mm	60	60	60	60	60
Max. height platform extended	$h_4$	mm	320	350	510	560	760
Height, lowered	$h_{13}$	mm	260	290	450	500	700
Loading and delivery height	$h_{13} + \text{free lift}$	mm	290	320	480	530	730
Max. centre of gravity height	$h_{c1}$	mm	890	1450	1450	1450	1450
Max. capacity	Q	kg	1500	1500	1500	1300	1300

Table - Technical information

		ACH 06	ACH 10	ACH 15
Dimensions $l_6 \times b_{12} \times m_2$	mm	900 x 900 x 270	1200 x 1200 x 290	1200 x 1200 x 290
Height loading platform	$h_{11}$	mm	330	330
Number of levels		1	1	1
Weight, unladen	kg	24	40	60
Capacity	kg	600	1000	1500

Technical drawings of loading platforms



# ACH Autonomous Mobile Robots (AMR) Safety

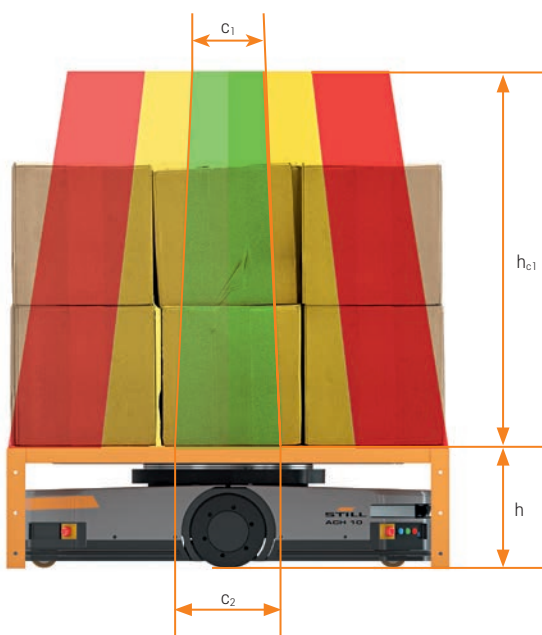
For the greatest possible transport safety, the carrier should be placed centrally on the ACH. The further to the outside the load centre is, the more unstable the vehicle becomes. Loading on one side in the area marked in red or beyond is not permissible. Even when transporting on the adapter plate, the load should be placed as centrally as possible to ensure an even weight distribution. Placing it in the outer area may cause the vehicle to tip over. If the ACH transports loads with an off-centre centre of gravity, the following requirements must be met, according to the illustrations opposite, in order to ensure transport safety:

**Green range:** Recommended, stable operating range.

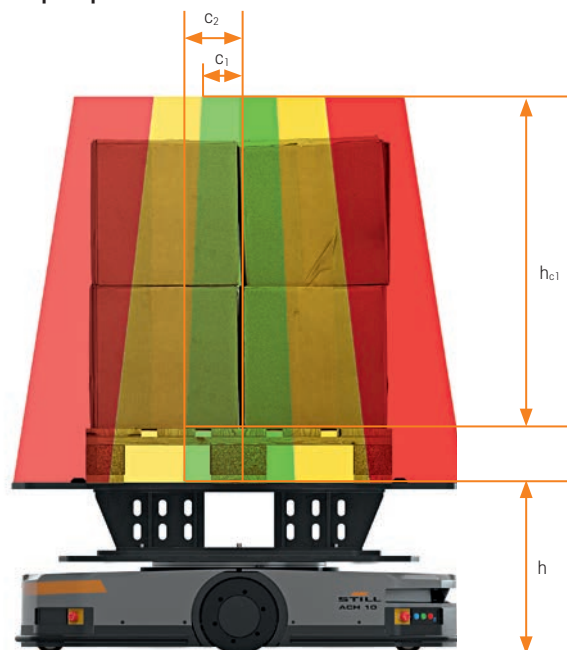
**Yellow range:** Not recommended range. The ACH can drive normally but visibly loses stability. The chassis may occasionally lift off the ground on one side.

**Red range:** Not permissible because the chassis hits the ground at the side. The AMR cannot drive with its intended function. Outside the red range: Not permissible range. The chassis tips over.

Safety when transporting loads - ACH 06, ACH 10 & ACH 15



Safety when transporting loads - ACH 10 & ACH 15 with adapter plate



## Requirements for load centre for ACH with table transport

			ACH 06	ACH 10/ACH 15
Height of load pick-up (table)	h	mm	330	330
Max. centre of gravity height	$h_{c1}$	mm	743.0	893.5
Max. lateral centre of gravity offset at maximum height	$c_1$	mm	216.2	258.9
Max. lateral centre of gravity offset at minimum height	$c_2$	mm	275.7	330.7

## Requirements for load centre for ACH with direct pallet transport

			700	500	450	290
Height of load pick-up (adapter plate)	h	mm	700	500	450	290
Max. centre of gravity height	$h_{c1}$	mm	650	650	650	650
Max. lateral centre of gravity offset at maximum height	$c_1$	mm	117	125.8	127.8	140.2
Max. lateral centre of gravity offset at minimum height	$c_2$	mm	143.8	151.8	153.8	166.2

Emergency stop switches (on all four corners)

Mechanical bumper (around the entire vehicle)



Stopping range

Braking range

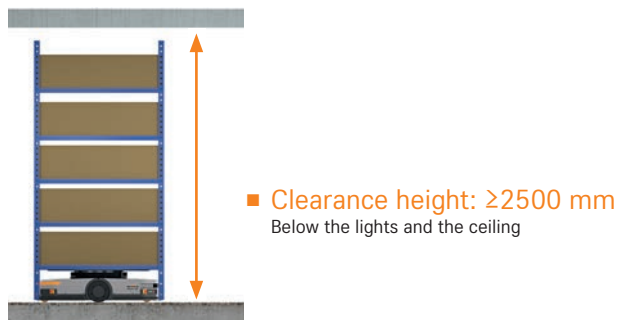
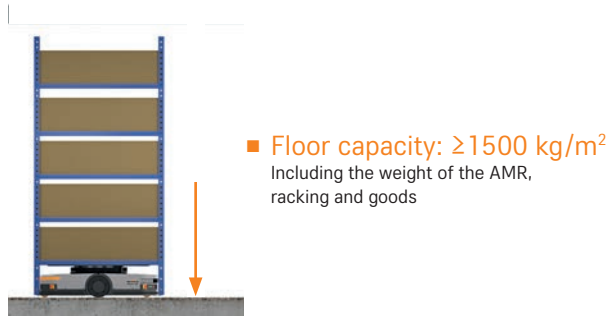
Always on the safe side owing to the multilevel, redundant safety system. The size of the safety fields is individually adjusted for each customer environment and is dependent on the speed.



## ACH Autonomous Mobile Robots (AMR) Gradients/floor requirements

In order for smart industrial robots such as the ACH to move autonomously on their flexible routes through the warehouse, the warehouse must meet a number of requirements. This primarily concerns the floor, which must be completely level and must not

exceed a degree of fluctuation of max. 3 millimetres per square metre. This is an important prerequisite for the flat vehicles to be able to navigate smoothly and unerringly even through complex warehouse structures.



■ Permissible step height:  $\leq 5 \text{ mm}$



■ Permissible gap width:  $\leq 15 \text{ mm}$

■ Permissible angle of inclination:  $\leq 5\%$  ( $2.8^\circ$ )

The floor must not only be level, but also as free as possible from obstacles such as high steps, wide dips and steep ramps. It must also support a minimum weight of 1500 kg per square metre (equivalent

to the total weight of the AMR, carrier and load). In order to be able to reliably transport higher loads, such as racking, the ceiling height should also be at least 2.50 metres.

## ACH Autonomous Mobile Robots (AMR) Smart efficiency increase

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High throughput with low space requirements

Simple integration into existing automation solutions

Flexible transport of different carriers

High availability owing to Li-Ion technology



Thanks to the latest sensor technology, the intelligent vehicles of the STILL ACH series move independently, proactively and safely in the warehouse, even in mixed operation with people and other industrial trucks. They can transport different carriers on their platform and can be flexibly linked to different storage and transfer stations. The smart ACH 06/10/15 score points above all for their compactness and speed. When picking up and delivering loads, the small, manoeuvrable under rides only need less than half the space required by a manual forklift truck – an unbeatable advantage when space is at a premium. Compared to DTSS, the routes can also be narrower. In fact, these

can be exactly as wide as your load dictates. In addition, the ACH can pick up and deliver its load much faster, requiring up to 30% less time per pick-up and delivery. Compared to classic DTSS, the ACH series vehicles thus have a higher throughput with a reduced space requirement and can be integrated cost-effectively into existing environments and systems. Operating and maintenance costs are also comparatively low. Together with its excellent scalability and high safety standard, the ACH series by STILL offers an attractive entry into automation for many industries. Smart efficiency increase.

### The 'Simply Efficient' factors: Performance attributes as a measure of economic efficiency

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#### Simply easy

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- Simple integration into existing mobile automation solutions
- Space-saving use and high manoeuvrability even at lower aisle widths
- Supports automatic battery charging (perfect for lifetime-optimised automatic charging)
- Low maintenance owing to lithium-ion battery



#### Simply powerful

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- High handling performance thanks to a lifting capacity of up to 1500 kg
- Uses lithium-ion batteries that allow the vehicle to operate for up to 9 hours on a full charge
- Fast throughput with a high driving speed and short turnover times



#### Simply safe

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- Meets the highest safety standards, including ISO-3691-4 compliance
- Obstacle detection ensures that the vehicle is safe for personnel, even at close range, owing to the integrated safety rail
- Always on the safe side owing to the multilevel, redundant safety system
- Suitable for use in mixed environments with operators or other vehicles



#### Simply flexible

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- Scalable expansion possible as customer requirements increase
- Flexible use owing to the transport of various carriers and goods
- Excellent availability owing to lithium-ion battery



#### Simply connected

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- Simple integration into existing automation solutions and existing system landscapes via standardised IT interfaces
- Remote access to the vehicle via the control system

## ACH Autonomous Mobile Robots (AMR) Equipment Variants



		ACH 06	ACH 10	ACH 15
External software	Intelligent routing algorithms	○	○	○
	Intelligent loading logic	○	○	○
	Interfaces to existing WMS, ERP etc.	○	○	○
	Interfaces for infrastructure: doors, conveyor belts etc.	○	○	○
Integrated software	QR code navigation	●	●	●
	QR code load detection	●	●	●
	User-friendly login on the vehicle	●	●	●
Safety	Safety scanner for person detection, direction of travel to the front	●	●	●
	Emergency stop switches on all sides (front left/right, rear left/right)	●	●	●
	Safety bumpers on the vehicle (front, rear)	●	●	●
Navigation	Position accuracy +/- 10 mm	●	●	●
	Stopping accuracy +/- 5 mm	●	●	●
	Angle accuracy +/- 1°	●	●	●
	QR code navigation with max. interval 1000 x 1000 mm	●	—	—
	QR code navigation with max. interval 1350 x 1350 mm	—	●	●
HMI interface	Control buttons	●	●	●
	LED displays	●	●	●
	Audio communication	●	●	●
Load handling	QR code load detection	●	○	○
	Rotation of the vehicle bed	●	●	●
	Dimensions of the loading platform 900 x 900 mm	●	—	—
	Dimensions of the loading platform 1200 x 1200 mm	—	●	●
	Adapter plate for pick-up and drop-off station at height = 320 mm	—	●	●
	Adapter plate for workplaces at height = 480 mm	—	●	●
Environment	Adapter plate for conveyor belt at height = 530 mm	—	●	●
	WLAN communication	●	●	●
Energy	Ambient temperature 0-45 °C	●	●	●
	Automated interim charging	●	●	●
Driving	Differential drive with double wheels	●	●	●
	Turning on the spot	●	●	●

● Standard ○ Option — Not available



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