AXH and ACH Technical Data
Autonomous Mobile Robots (AMR)

AXH 10

ACH 06

ACH 10

ACH 15

Li-Ion INSIDE

iGo systems

first in intralogistics

AXH and ACH Autonomous Mobile Robots (AMR)
Smart efficiency increase

Features	1.1	Manufacturer			STILL	STILL	STILL	STILL
	1.2	Manufacturer's type designation			**AXH 10**	**ACH 06**	**ACH 10**	**ACH 15**
	1.3	Drive			Battery	Battery	Battery	Battery
	1.4	Operation			Autonomous	Autonomous	Autonomous	Autonomous
	1.5	Load capacity/load	Q	kg	1000	600	1000	1500
Weight	2.1	Service weight		kg	170 [1]	145	205 [1]	215 [1]
Wheels/ chassis	3.1	Tyres			Vulkollan	Polyurethane	Polyurethane	Polyurethane
	3.4	Additional wheels (dimensions)			160 x 45	200 x 40	200 x 40	200 x 40
	3.5	Number of wheels (x = driven) front/rear			2x + 2	2x +2	2x +2	2x +2
	3.6	Track width	b_{10}	mm	584	668	758	758
Basic dimensions	4.4	Lift	h_3	mm	40	55	60	60
	4.15	Height, lowered	h_{13}	mm	222	240	260	260
	4.16	Loading platform, length	l_2	mm	1021	Ø 680	950 [2]	1000 [2]
	4.18	Loading platform, width	b_2	mm	619	Ø 680	750 [2]	780 [2]
	4.19	Overall length	l_1	mm	1440	956	1182	1182
	4.21	Overall width	b_1	mm	634	730	832	832
	4.33	Load dimensions	b_{12} x l_6	mm	1260 x 1060	900 x 900 [3] (780 x 780)	1200 x 1200 [3, 4] (1080 x 1080)	1200 x 1200 [3, 4] (1080 x 1080)
	4.34	Working aisle width with predetermined load dimensions	A_{st}	mm	2948 [6]	1473 [5]	1897 [5]	1897 [5]
	4.35	Turning radius	W_a	mm	1592 [7]	478	618.5 [7]	618.5 [7]
Performance data	5.1	Travel speed laden/unladen		m/s	2.2	1.5/2	1.2/1.5	1.2/1.5
	5.2	Lifting speed laden/unladen		m/s	0.02	0.29	0.29	0.29
	5.3	Lowering speed laden/unladen		m/s	0.02	0.21	0.21	0.21
	6.4	Battery voltage/nominal capacity (5 h)	V/Ah	kWh	48/120	48/36 [9]	48/38.5 [9]	48/38.5 [9]
Misc.	10.7	Sound pressure level L_{pAZ} (operator's position)		db(A)	<70	<75	<75	<75

[1] Weight of the adapter plate:
- AXH 10: h_{13} = 380 mm, +45 kg
- ACH 10: h_{13} = 450 mm, +70 kg; h_{13} = 500 mm, +75 kg; h_{13} = 700 mm, +94 kg
- ACH 15: h_{13} = 450 mm, +62 kg; h_{13} = 500 mm, +66 kg; h_{13} = 700 mm, +86 kg

[2] Loading platform rotation diameter: ACH 10: Ø 1060 mm; ACH 15: Ø 1114 mm

[3] With loading platform: loading platform required as carrier

[4] Pallet transport with adapter plate (l_3 x b_9 = 1200 x 887 mm)

[5] Including 200 mm (min.) operating aisle clearance

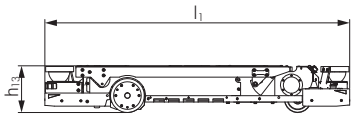
[6] Including 200 mm (min.) spacing in the aisles; 90° loading with +/– 300 mm tolerance: 3669 mm; with adapter plate (b_{12} x l_6 = 800, 1000 x 1200 mm): 2857 mm

[7] Rotation diameter with adapter plate: ACH 10 and ACH 15: 1411 mm
AXH 10: with adapter plate (b_{12} x l_6 = 800, 1000 x 1200 mm) lengthwise: 1327 mm

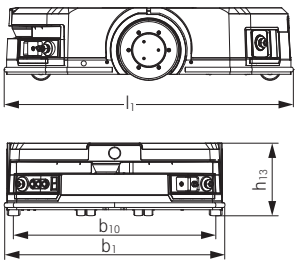
[8] Permissible step height <5 mm, traversable gap <15 mm

[9] Lithium-ion battery

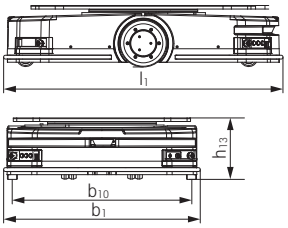
This specification sheet as per VDI Guideline 2198 only provides the technical values for the standard vehicle. Different tyres and the use of accessories etc. may result in other values.



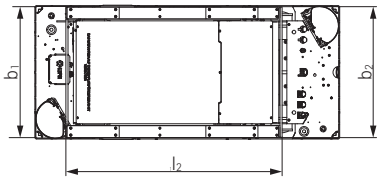
Side view AXH 10



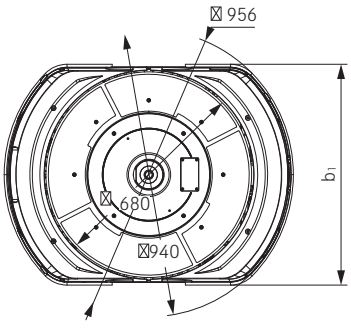
Side view ACH 06



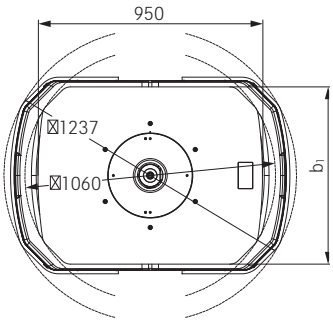
Side view ACH 10/15



Top view AXH 10

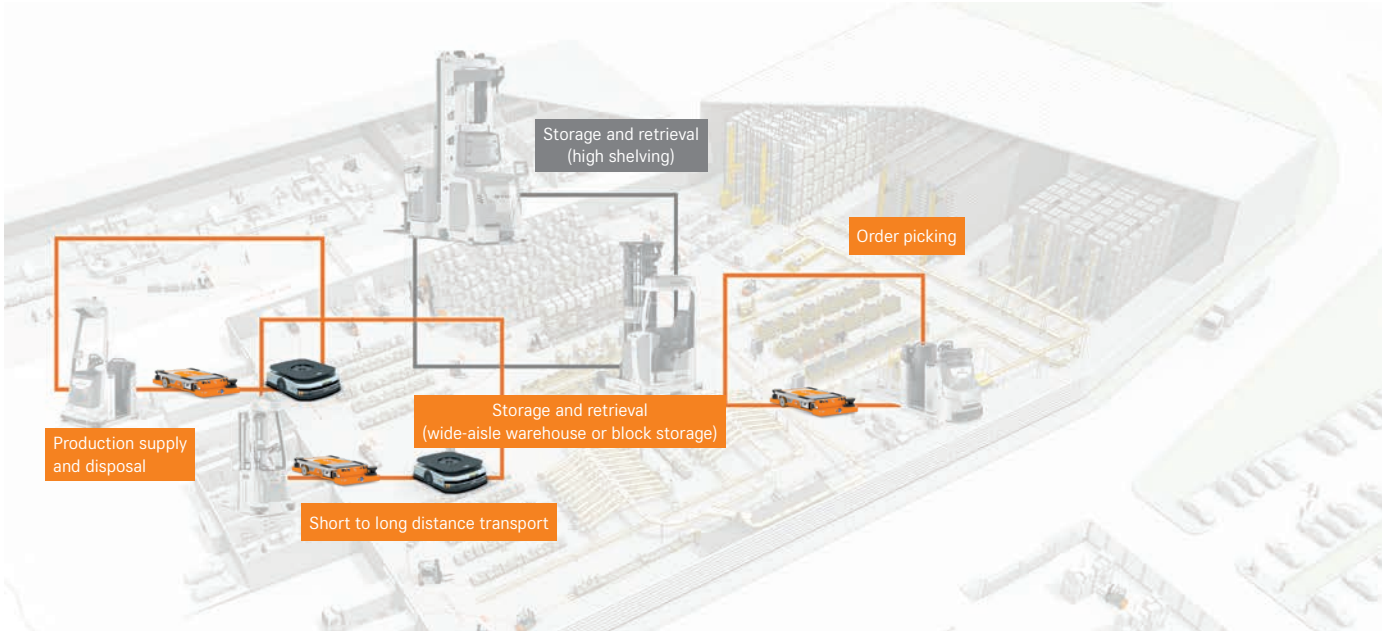


Top view ACH 06



Top view ACH 10/15

AXH and ACH Autonomous Mobile Robots (AMR)
Applications



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 tugger 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.
Both hybrid (series) trucks, which can be operated automatically and manually, and exclusively driverless trucks (automated guided vehicles – AGVs) are used in these areas as part of **an integrated solution**.
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.

Autonomous mobile robots such as STILL's AXH and ACH series are small, manoeuvrable and intelligent underride vehicles 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.

Comparison AXH versus ACH

Autonomous Mobile Robots (AMR)	**AXH** 	**ACH** 
Commissioning	Flexible + smart commissioning based on the specific environment	Commissioning using QR code technology
Navigation	SLAM navigation and circumnavigation of obstacles	Precise QR code navigation
Transport distance	Long distances	Short to medium distances
Application	Flexible load handling with trolleys + pallet transport	Flexible load handling with platforms/tables + pallet transport
Capacities	1 t	0.6 t/1 t/1.5 t
Max. speed	2.2 m/s	1.2 – 2.0 m/s
90° pick and drop times	Min. 45 secs	Min. 35 secs
Surrounding area when loading	Can be adjusted by the AXH, deviation of load placement by +/- 30 cm	Specifically defined during commissioning
90° loading (working aisle width A_{st})	Min. 2.8 m	Min. 1.4 m

Goods transport with trolleys: When transporting goods using trolleys, the AXH transports the entire unit from A to B. The innovative 3D camera ensures flexible lifting of the goods before they are loaded onto the AXH as well as precise unloading at the desired destination.

Goods transport with pallets: When transporting goods using pallets, the AXH picks up the pallet including the goods from a specified transfer station and transports it to its end station. Prior to unloading at the end station, the AXH checks whether the transfer station is free for the goods to be unloaded using the innovative 3D camera.

Goods transport with grid box and adjustable rack system: When transporting goods using a grid box and individually adjustable rack system, the goods are flexibly loaded and transported to their destination. Depending on customer requirements, flexible transport options can be provided that also incorporate the use of a trolley.

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.

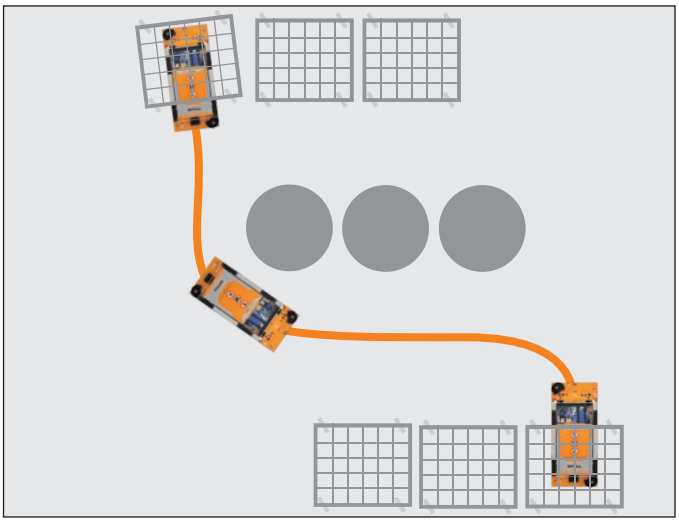
Goods transported directly on the vehicle: With direct goods transport, the goods carrier is transferred from the transfer station directly to the ACH. The ACH drives under the loaded station, lifts the pallet with its adapter plate and transports it to the destination. The station is refilled.

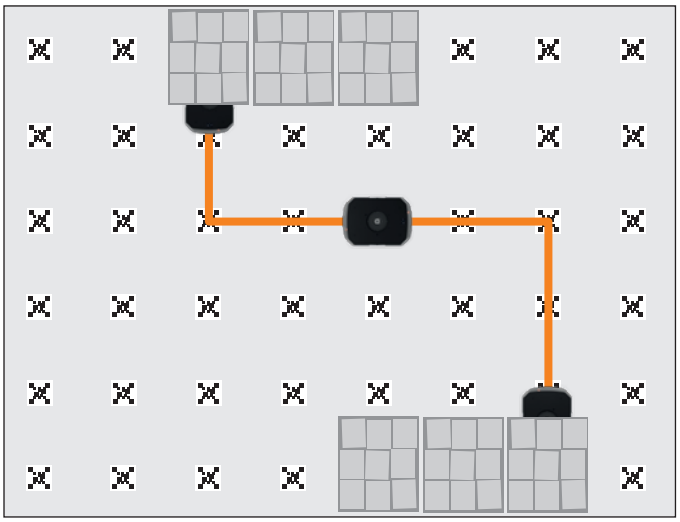
Transport of individual carriers: Depending on the customer's requirements, individual transport options (including a multi-level loading platform, conveyor trolleys or trolleys) are possible, e. g. for different carrier dimensions or transport orientation. If a conveyor trolley is used as the goods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

AXH and 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 to communication with doors or fire alarm systems. Communication, coordination and scheduling of transport orders are carried out via the intelligent AXH or ACH master controller software.
Transport orders can be placed in three different ways: from a host system (e. g. WMS or ERP), via a sensor located at the transfer stations or elsewhere, or by means of manual triggers such as push buttons, scanners or terminals. Alternatively, it is possible to transfer transport orders between the warehouse management system and the master controller software by means of interfaces. The smart, customised ACH master controller software distributes transport orders and defines the optimal route. In the case of the AXH, the vehicle itself determines the optimal route and receives transport orders from its master controller software. Traffic and scheduling management and energy management are also handled by the master controller 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 trucks in real time. This allows you to quickly and immediately adapt and optimise your processes.

Navigation



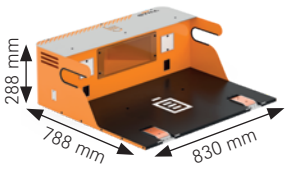


Symbolic representation

	AXH – SLAM navigation 	ACH – QR code navigation 
	Mapping: The first time the AXH is (manually) operated in a new warehouse environment, it produces an initial navigation map of its surroundings. The built-in laser scanners detect and record all relevant features of the warehouse.	**Mapping:** The navigation system of the ACH is based on a map of all the QR codes in the warehouse. This map is initially transferred to the vehicle by the master controller.
	Localisation: In order to determine its location in the warehouse, the AXH compares its navigation map with real-time data from its laser scanners. It also uses parameters such as wheel rotations and angles to orient itself and determine its position in the warehouse.	**Localisation:** The ACH uses the tight grid of QR codes distributed throughout the warehouse to determine its position and calculate its route. The vehicle then uses the codes to continuously update its location and direction of travel while on the move.
	Navigation: The AXH uses innovative SLAM (Simultaneous Localisation and Mapping) technology for navigation. This means that the vehicle constantly updates its stored maps in real time while on the move to ensure precise navigation and flexible route adaptation.	**Navigation:** In order to navigate, the ACH not only requires the QR codes but also an on-board camera and a defined inertial measurement unit (IMU). The vehicle uses the camera to read the codes on the floor, and uses the IMU to calculate the route between two QR codes.

ACH Autonomous Mobile Robots (AMR)
Charging and chargers

		AXH charger	ACH charger
General		48 V, 40 A, 1.6 kW	48 V, 30 A, 1.6 kW
	Availability	Europe	Europe
	Applicable AMR	AXH 10	ACH 06, ACH 10, ACH 15
	Plug	Type F (EU)/Type G (UK)	Type F (EU)/Type G (UK)
Vehicle	Dimensions	830 x 788 x 288 mm	560 x 527 x 686 mm
	Weight	40 kg	30 kg
	Touchscreen	-	Configured
	Length of power cable	2.5 m	2 m
Input energy	Nominal voltage	230 V	220 V (EU), 230 V (UK)



AXH charger

ACH charger

All STILL AMRs are equipped with lithium-ion batteries to ensure constantly high performance and availability thanks to simple interim charging. Multiple devices use the same fixed charging station to charge their batteries at different times. When it reaches a state of charge (SOC) of 30 % the vehicle autonomously initiates charging, then stops charging when it reaches an SOC of 90 %. This preserves the battery and ensures an optimum service life. The AXH charging device has charging contacts on which the vehicle positions itself and aligns itself precisely. The ACH charging device uses a connector. The vehicle reverses onto the charging station with the help of QR codes and docks with the connector.

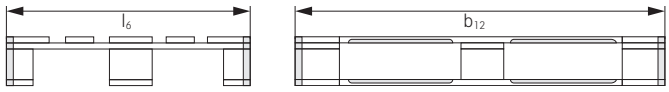
Technical requirements for carriers (loading platform, pallet and dolly) by model

			AXH 10	AXH 10
Carriers			Trolley	Pallet
Max. truck bed surface area	b_{12} x l_6	mm	1200 x 1000	1000 x 1200
Max. capacity	Q	kg	1000	1000
Height of transfer station or loading platform	h_{11}	mm	280	300

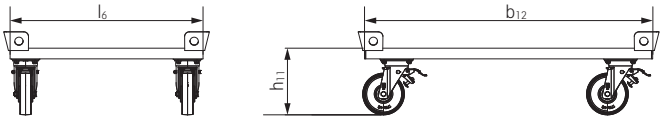
			ACH 06	ACH 10	ACH 10			
Carriers			Loading platform	Loading platform	Pallet	Pallet	Pallet	Pallet
Max. truck bed surface area	b_{12} x l_6	mm	900 x 900	1200 x 1200	1200 x 1000	1200 x 1000	1200 x 1000	1200 x 1000
Max. capacity	Q	kg	600	1000	1000	1000	900	900
Height of transfer station or loading platform	h_{11}	mm	330	330	320	480	530	730

			ACH 15	ACH 15			
Carriers			Loading platform	Pallet	Pallet	Pallet	Pallet
Max. truck bed surface area	b_{12} x l_6	mm	1200 x 1200	1200 x 1000	1200 x 1000	1200 x 1000	1200 x 1000
Max. capacity	Q	kg	1500	1500	1500	1300	1300
Height of transfer station or loading platform	h_{11}	mm	330	320	480	530	730

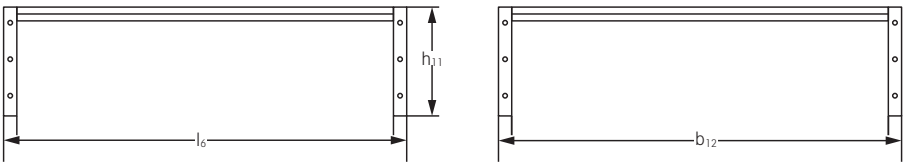
Technical drawings – Pallet



Technical drawings – Trolley



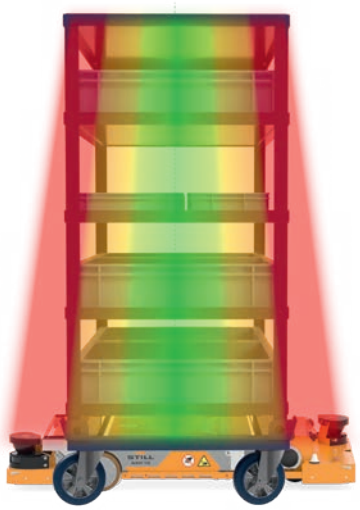
Technical drawings – Loading platform



For the greatest possible transport safety, the carrier should be placed centrally on the AMR. The further to the outside the load centre is, the more unstable the vehicle becomes. Loading on one side of the area marked in red or beyond is not permissible. Even when transporting on the adapter plate of the ACH, the load should be placed as centrally as possible to ensure even weight distribution. Placing it in the outer area may cause the vehicle to tip over. If the AMR 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:

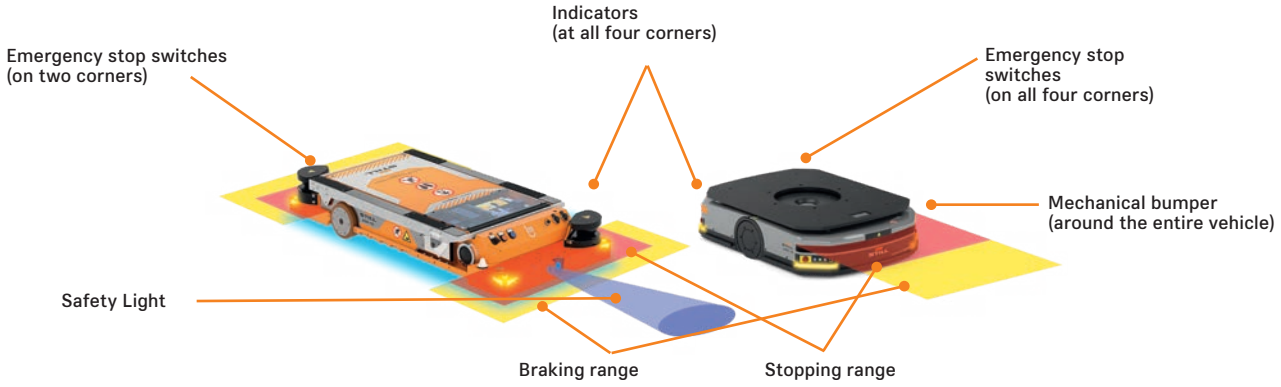
Green range: Recommended, stable operating range.
Yellow range: Not recommended range. The ACH can drive normally but visibly loses stability. The chassis may occasionally lift off the ground on one side.
Red range: Not permissible because the chassis hits the ground at the side. The AMR cannot drive with its intended function.
Outside the red range: Not permissible range. The chassis tips over.

Safety when transporting loads – AXH 10



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

Safety areas



Thanks to a multi-level, redundant safety system, with the AXH and ACH you are always on the safe side. Mechanical bumpers prevent damage to the vehicles, while defined safety areas in the direction of travel and around the vehicle and carrier enable automatic braking to avoid collisions. The size of the safety fields is individually adjusted for each customer environment and is dependent on the speed.
AXH = safety fields around the vehicle and carrier, which also cover the sides of the vehicle when driving around corners.
ACH = safety field in primary direction of travel thanks to a personal safety scanner. During rotational movements, e. g. a 90° turn, the mechanical bumpers help to prevent any major damage to the vehicle.

Robust solution for dynamic mixed transport

Safe load transport incl. flexible loading thanks to position detection via camera

Efficient transport solution with obstacle circumnavigation for long distances

Smart commissioning tools for individual hall layouts

AXH

The AXH is a powerful and versatile assistant for every field of application. Its innovative navigation and safety technology allows it to move freely, safely and autonomously around dynamic or mixed warehouse environments. Another highlight: the AXH can easily be integrated into existing working environments and systems. It can reliably and precisely detect and circumnavigate obstacles using its safety scanners, both in tight spaces and over long distances. This significantly reduces the risk of accidents in the warehouse and improves occupational safety for the benefit of humans, the machine and its load. The AXH is especially flexible when it comes to goods handling. Its sensitive sensors allow it to drive underneath trolleys and quickly and reliably transport them to their end station. As a result, this robust vehicle can transport a range of different goods around the warehouse – whether they are on pallets, in rack systems or in grid boxes – up to a load capacity of 1,000 kg, a maximum speed of 2.2 m/s and even over long distances. What's more, thanks to its powerful lithium-ion battery, the AXH can easily last a full eight-hour shift; smart charging solutions ensure that it is always ready for use when needed. This takes smart efficiency enhancement to a whole new level.

High throughput with low space requirements

Especially compact thanks to on-the-spot carrier rotation

Easy to integrate into new, optimised process landscapes and in areas designed for the ACH

Flexible transport of different carriers in tight spaces

ACH

The agile little trucks of the STILL ACH series are smart assistants for any warehouse. Using modern sensor technology, they move safely around the warehouse and are able to flexibly and independently adapt their routes. They can transport different carriers on their platform and can be flexibly linked to different storage and transfer stations. The key selling points of these mobile robots are their compactness, speed and high throughput with low space requirements. They require much less time and space for loading and unloading than a conventional AGV, and their small size and on-the-spot carrier rotation capability means they can safely manoeuvre through even the narrowest of aisles. Integrating ACH vehicles is easy and cost-effective, especially in new, optimised environments. Together with its excellent scalability and high safety standard, the ACH series from STILL offers an attractive entry into automation for many industries.

Simply easy

- Space-saving and extremely agile (AXH and in particular ACH) and on-the-spot load carrier rotation (ACH)
- Supports automatic battery charging (perfect for lifetime-optimised automatic charging)
- Low maintenance owing to lithium-ion battery

Simply powerful

- High handling performance thanks to a lifting capacity of up to 1,000 kg (AXH)/1,500 kg (ACH)
- Uses lithium-ion batteries that allow the vehicle to operate for an entire shift (up to 8 hours) on a full charge
- Short handling times and high throughput, particularly in areas with narrow aisles and short transport distances (ACH)/over long distances in areas with standard-width aisles (AXH)
- Efficient obstacle circumnavigation at a maximum driving speed of 2.2 m/s (AXH)

Simply safe

- Meets the highest safety standards, including ISO-3691-4 compliance
- Maximum speed and cornering with the AXH thanks to two diagonally positioned safety scanners
- Maximum speed with the ACH thanks to safety scanners in the direction of travel and mechanical bumpers for rotational movements such as turning 90° corners
- 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

- 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
- Highly adaptable to hall layout thanks to smart commissioning tools and robust navigation technology (AXH)
- Flexible and simple troubleshooting thanks to QR code navigation for the ACH and easy commissioning for the AXH

Simply connected

- Simple integration into existing automation solutions and existing system landscapes via standardised IT interfaces
- Remote access to the vehicle possible via the control system
- Easy to integrate the AXH into existing process landscapes and overlapping routes
- Easy to integrate the ACH into new, optimised process landscapes and in separate areas

AXH and ACH Autonomous Mobile Robots (AMR)
Equipment Variants

		AXH 10	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	SLAM navigation algorithms	●	—	—	—
	Camera-based load detection	●	—	—	—
	QR code navigation	—	●	●	●
	QR code load detection	—	●	●	●
	User-friendly login on the vehicle	●	●	●	●
Safety	All-round safety with two diagonally positioned safety scanners	●	—	—	—
	Safety scanner for pedestrian detection, direction of travel to the front	—	●	●	●
	Safety field switch between raised and lowered platform	●	●	●	●
	Emergency stop switches on all sides (front left/right, rear left/right)	●	●	●	●
	Safety bumpers on the vehicle (front, rear)	—	●	●	●
	Direction indicators when turning	●	—	—	—
	Direction indicators in the form of LED strips	—	●	●	●
Navigation	SLAM navigation with dynamic object integration	●	—	—	—
	QR code navigation with standard interval of 1000 x 1000 mm	—	●	—	—
	QR code navigation with standard interval of 1350 x 1350 mm	—	—	●	●
HMI interface	Control buttons (on, off, reset)	●	●	●	●
	Status display	●	—	—	—
	Status light on rear of vehicle	○	—	—	—
	LED strips to indicate status of vehicle	—	●	●	●
	Audio communication	●	●	●	●
Load handling	QR code load detection during transport on loading platform	—	●	○	○
	On-the-spot rotation of load	—	●	●	●
	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	—	—	●	●
	Adapter plate for conveyor belt at height = 530 mm	—	—	●	●
Environment	WLAN communication	●	●	●	●
	Ambient temperature +5° – +45 °C	●	●	●	●
Energy	Lithium-ion battery management	●	●	●	●
	Automatic charging as needed via charging station	●	●	●	●
	Automatic charging via contacts underneath the front of the truck	●	—	—	—
	Automatic charging via connector at rear	—	●	●	●
	Information about the charging status thanks to flashing lights on each corner during charging	●	—	—	—
Service	Switch for automatic or service mode	●	●	●	●
	Connector for manual controller	●	—	—	—
	Wireless manual controller	●	—	—	—
	Wired manual controller	—	●	●	●
	Vehicle transport on forks	●	—	—	—
Driving	Differential drive with double wheels	●	●	●	●
	On-the-spot turning with and without locked platform	—	●	●	●
	Effective obstacle avoidance with front-wheel drive	●	—	—	—

● Standard ○ Option — Not available

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For further information please visit

www.still.eu

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