

SENSORLINK LLC

**AUTOMATED STORAGE &
RETRIEVAL SYSTEMS**



**Automated Storage & Retrieval
System (AS/RS)**

COMPANY



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SENSORLINK company is a manufacturer of automated storage & retrieval systems (AS/RS), which are designed for ultra-dense targeted storage of goods in containers.

The system consists of racks, a track rail, a stacker robot and an in-and-out terminal.

A stacker robot with a container on board, moving along the racks along a track rail, ensures the movement of containers with parcels between storage cells and an acceptance-delivery terminal.

The system operates under the control of software developed by our company, which guarantees the uninterrupted and safe operation of a group of robots.

Our clients are THE RECON GROUP (USA), SUNLIGHT (USA), DELIVER-Ez (USA), INCOTEX Group of Companies, ETM and many others.

A demonstration warehouse complex has been installed in Moscow, where the key nodes of an automated storage and sorting system for small-piece goods have been implemented and tested.



The development and production of equipment began in 2007 and at the moment there is a development and expansion of the range of units of automated systems, which implies a comprehensive supply of racks, stacker robots, conveyor equipment, sorters, monorail transport, freight elevators, jobs small batch-picking and much more.

After a thorough study of his task, each customer is offered an individual logistic solution that guarantees efficient and reliable operation of the equipment with maximum economic effect.



PARTS OF SOFTWARE - HARDWARE COMPLEX

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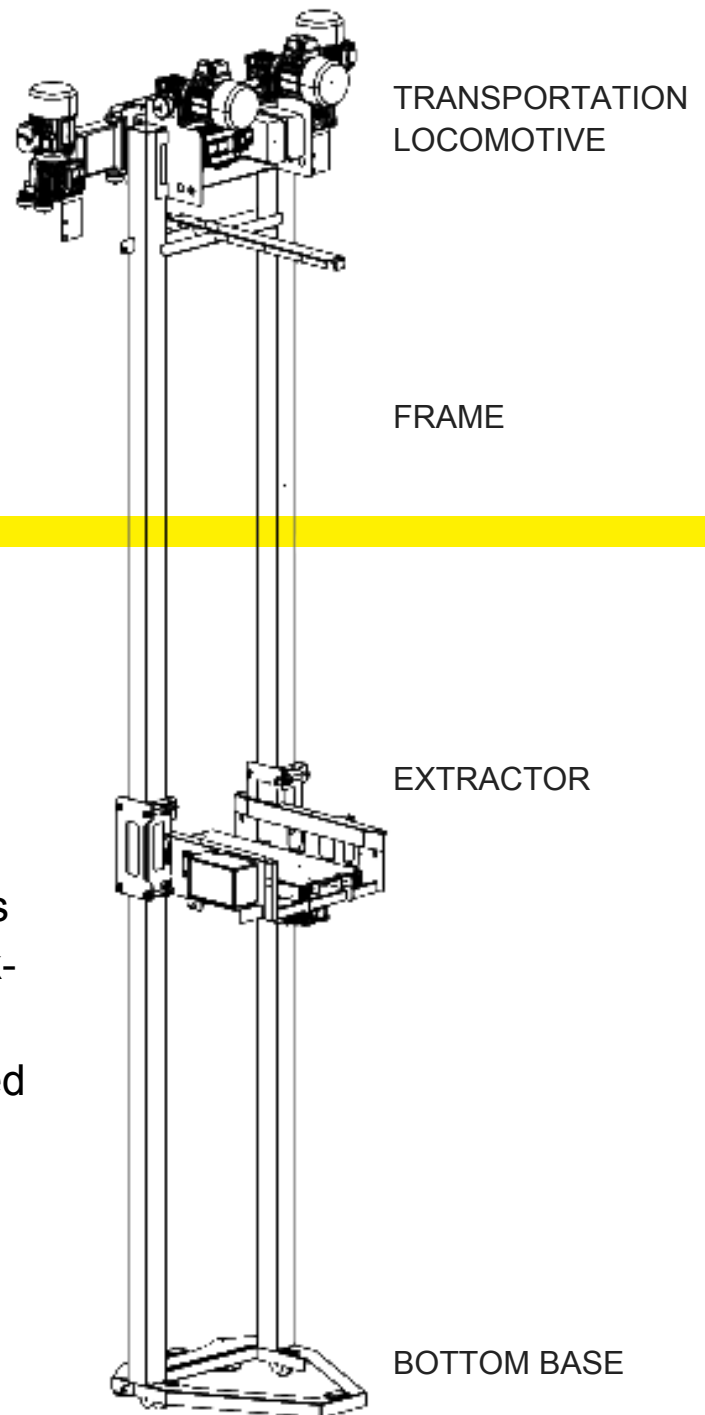
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STACKER ROBOT

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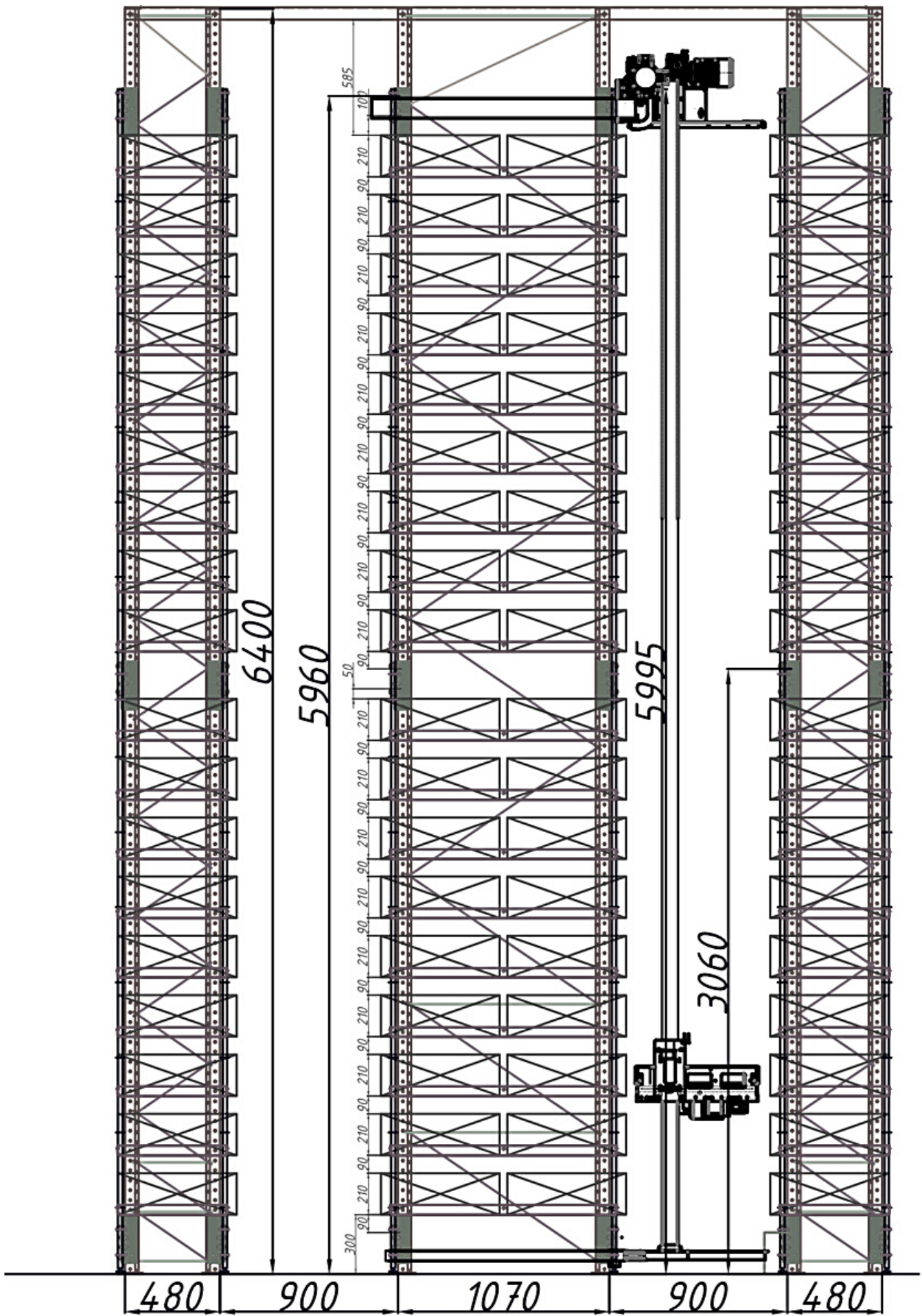
The stacker robot is designed for the automated delivery of a container to an acceptance terminal.

He moves between the racks, delivers the container from the rack to the pick-up terminal or places the container on the rack. The stacker robot is equipped with modern electric motors.



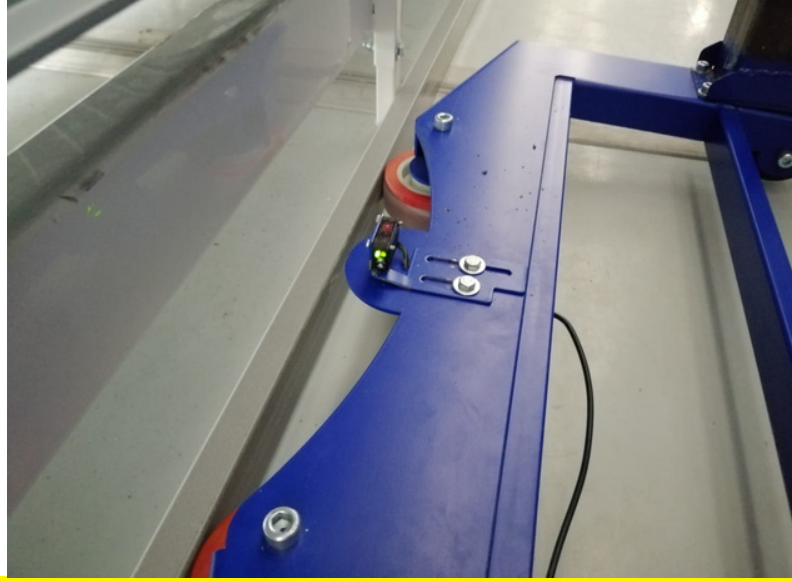
The products comply with all necessary EU standards (FEM 10.2.02, FEM 9.831, FEM 9.512/9.311).

Depending on the warehouse room and requirements, stacking robots can have different configurations, heights, and lifting capacities.



BOTTOM RAIL BASE

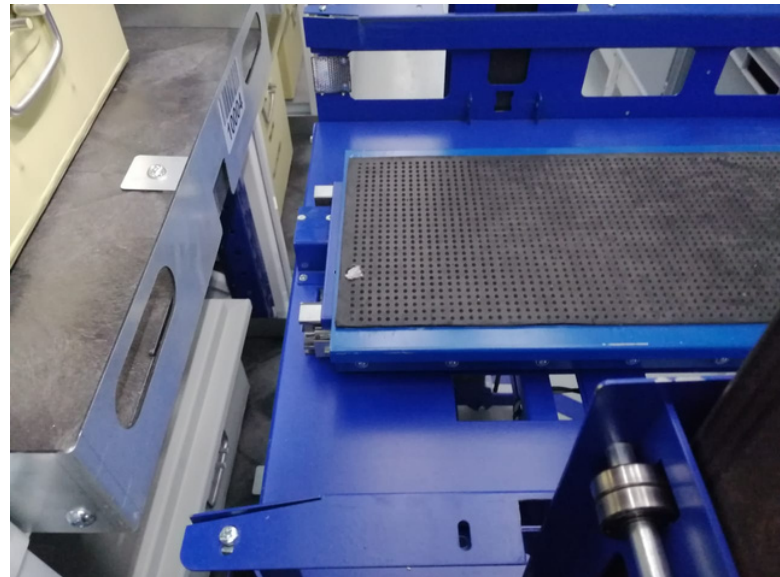
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Bottom base consists of a welded profile and has rail rollers that guide the stacker along the rail. It also takes the load from the stick and distributes it evenly.

EXTRACTOR

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Picks up the container from the rack and also places the container on the rack. The extractor serves containers that are located on both sides of him.

LOCOMOTIVE

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Locomotive provides movement of the robot-stacker along the upper guide rail in the horizontal and vertical direction along the racks. The drive wheels are shrink-fit on the axle, which makes this design one-piece. This method ensures the reliability and integrity of the assembly even under heavy loads and stretching of the metal with alternating motion.



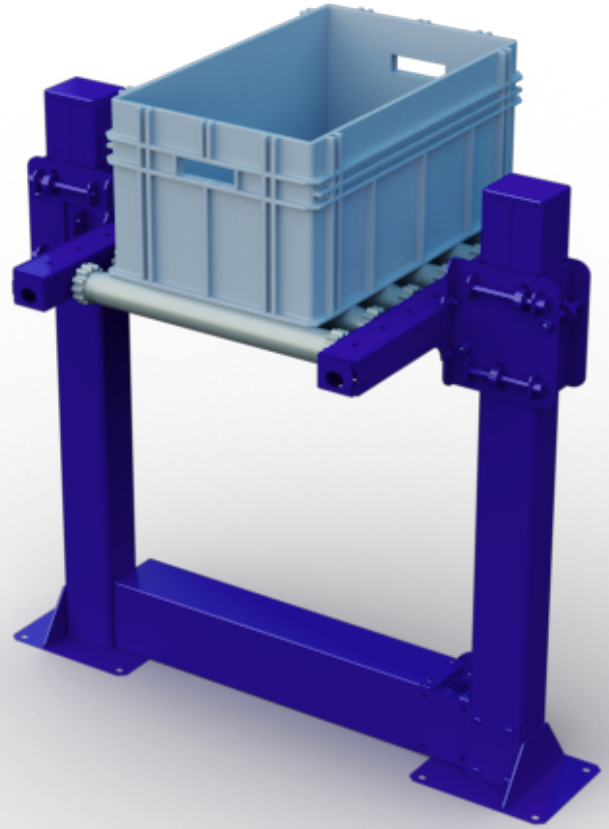
The stacker robot is powered via a bus bar that is attached to the top guide rail.

LIFT-CONVEYOR

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Moves containers up and down between two levels of the conveyor line.

The productivity of the lift-conveyor is 400 operations per hour.

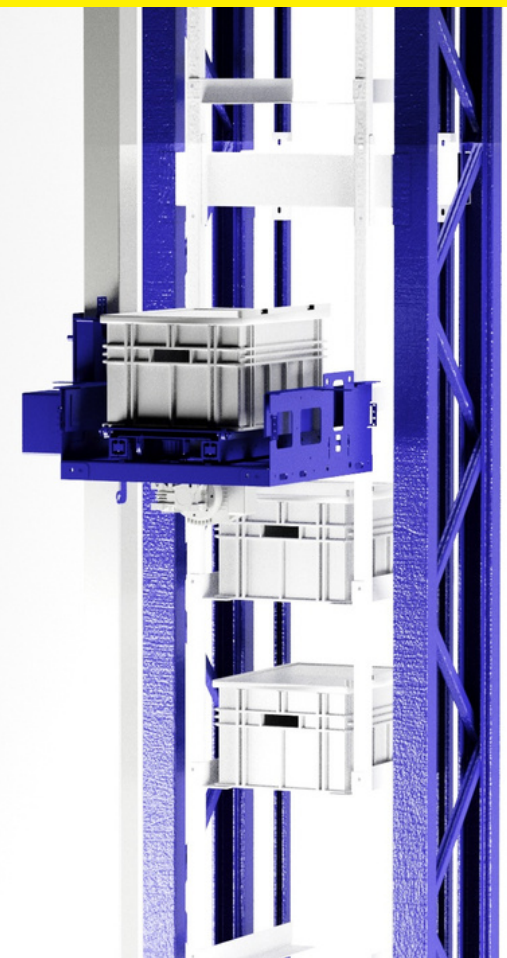


LIFT-STACKER

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The lift extractor moves vertically along the guide rails and serves both the viewing table conveyors and the pick-up terminals.

At the points of transfer of containers from the rack to the lift, a lift extractor is used, which has a similar design and functionality with a stacker robot.



CONVEYORS

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The conveyor system of the SENSORLINK company is a hardware and software complex that allows for targeted delivery of goods between different places using a conveyor.

The complex has the following advantages:

- unique patented cargo traffic management system
- reliable mechanics and mechatronics
- low power consumption
- availability of transfer modules for connecting the conveyor and robots
- ergonomic and inexpensive workplaces
- easy integration into third party control systems
- control program with user-friendly interface
- the absence of errors
- implementation experience on a large project (more than 400 delivery addresses)



TRANSFER MODULE

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moves the container from the rack to the conveyor/lift and back.

GATEWAY

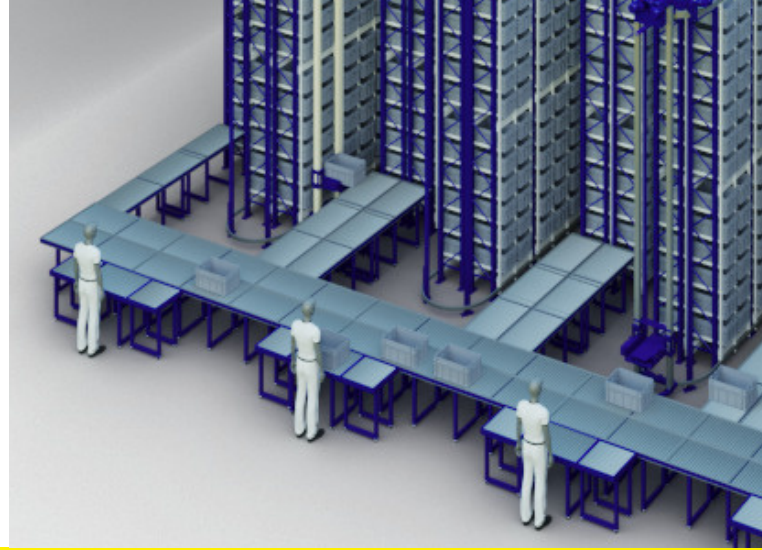
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The gateway is used to delimit access when performing receiving and transfer operations by unauthorized users. The gateway operates using an electronic terminal and a barcode system. A stacker robot brings a customer's parcel in a container from a rack and put it in a gateway. After opening the external door of the gateway, the client picks up the parcel from the container.



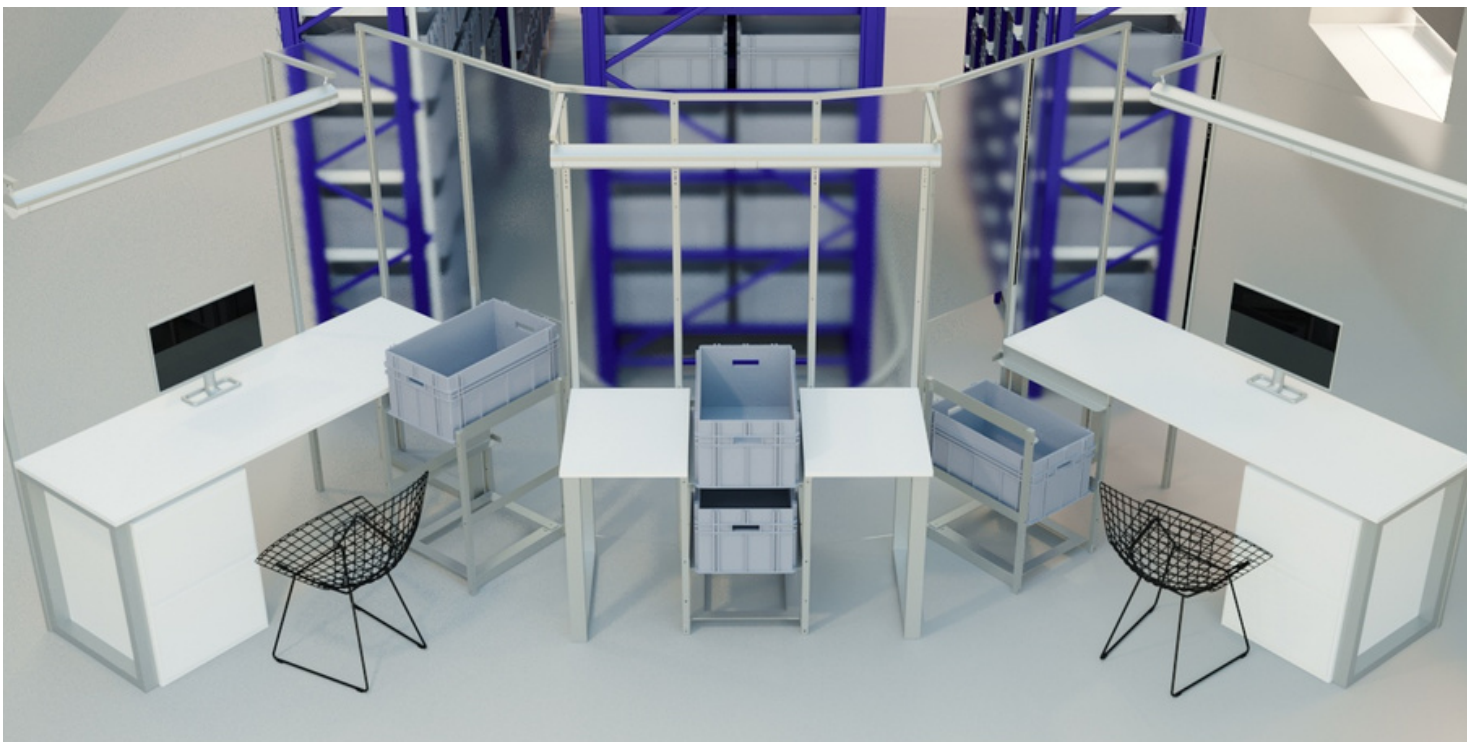
WORKPLACES

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Our company has extensive experience in creating various workplaces (WP) automated storage & retrieval systems (AS/RS):

- WP of replenishment (in particular with integrated weight control)
- selection points with delivery to tables with seated operator's workplaces
- places with permanent selection using loading carts
- semicircular delivery WP with an additional buffer of 14 boxes
- places of alignment with the conveyor with using a transfer module
- lift pick-up points





BASIC RACK ELEMENTS

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The frame legs are made of special cold-rolled steel profiles. The spacers and braces are made of metal profiles and are bolted to the frame uprights. The frame legs are supported by the thrust bearings. The footrests are fixed to the floor using anchor bolts.

In some cases, wall-mounted single rows according to FEM are connected to double rows in order to increase the safety of the rack structure. This is achieved by using the upper links. At the attachment points of the upper ties, frames with a cross-section are used according to the design loads and height.

Support heels are attached to the bottom of each frame post. If necessary, the frames are adjusted in height using leveling plates that are installed under each frame support between the heel and the floor. The thickness of the set of leveling plates and their number is determined based on the theodolite floor survey.

FENCE

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A metal mesh (Gitter, 3D) PPK 50*200mm (4P) d4 2*2.5m is used as a protective fencing of the shelving.

In the places where the robot is connected to the dispensing tables, a frame-type fence with an insert of polycarbonate or metal mesh is installed.

An access control system is installed in the areas of technological passages through the fence.



CONTAINERS

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The container must satisfy the following requirements to tolerances and design:

Material - polypropylene (PP)

Side walls - solid

Bottom - solid

The containers must have a rigid and solid construction with dimensional deviations along the sides of no more than 5 mm, bottom deflection no more than 1 cm. Measurements of deviations are carried out both on an empty and on a fully loaded container.

To exclude the abnormal load of the box at the WP, at the request of the Customer, weight control with a light indicator can be installed.



SYSTEM SECURITY

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All processes inside the warehouse are fully automatic. If it is necessary for technical personnel to come inside, the control server is set on to a "pause" state in which any automatic movement of mechanisms is excluded and only manual control is possible.



Along the racks, there are walkways along which robots move; these walkways are equipped with technical floors for personnel movement. Ladders lead to each tier. Robots and lifts are equipped with web cameras, which allow, together with manual control to solve the problem remotely in most cases. The robots have sensors for detecting side blockages.

There should be no obstacles in the walkways, if it appears there, the robot will not detect it, however, the robot itself and the rack construction are made in such a way that even in the event of a collision, its elements will not be destroyed.

AS/RS does not imply contact of structures with the ceiling. Therefore, there are no obstacles for the installation of lighting, ventilation and fire extinguishing means. Also, for local lighting, a lamp can be installed in the robot to illuminate the way area around it.

Noise level from robot/lift/transfer module 45 dB

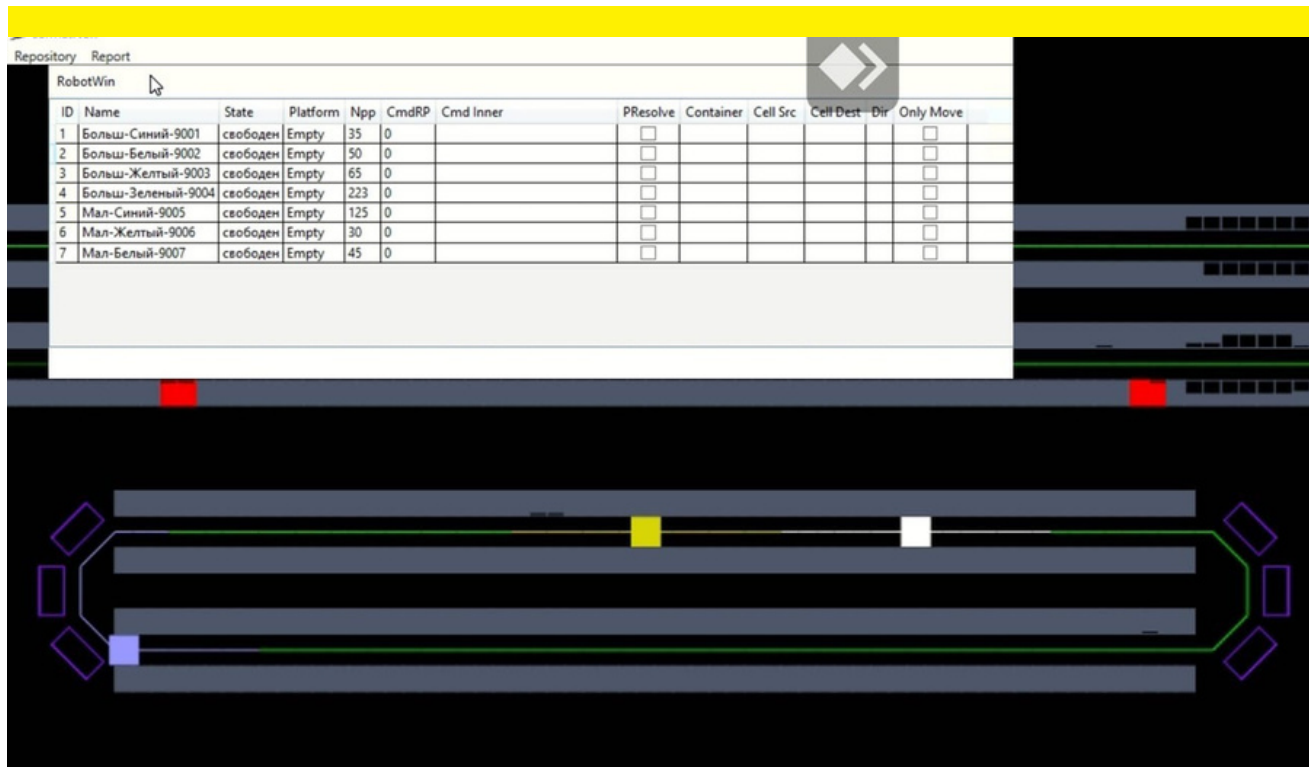
Noise level of roller conveyor 60 dB

The power consumption of the robot is 8 W*hour per operation. Because the use of protected collectors and low power consumption, the system is electric and fire safe.

AS/RS has no harmful effects on the environment.

TECHNOLOGICAL PROCESS CONTROL SYSTEM

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The control system PC is located anywhere in the warehouse at the request of the customer. It is a monitor with a diagonal of 23.6". With a touch screen, at the request of the Customer.

All AS/RS processes are displayed on the monitor. The position of all containers, robots, conveyors is displayed, stored and can be retrieved from the system at any time, including in the event of an emergency shutdown.

Remote problem solving is available: pause, equipment repair, reserve.

All processes are visualized on the server and each module (robots, conveyors, lifts) has its own control subroutine that works both in automatic and manual (operator) modes.

Installed on customer computers:

(Software installation)

- robot software agents
- stacker software servers
- server software for conveyors

The system has a built-in mechanism for monitoring the position of the box at any part of the warehouse (conveyor, rack, robot, lift, transfer module).

The RFID Radio Frequency Identification system can be applied at the request of the customer at any part, or as a whole as a redundant control system.

The "Sensorlink" company can provide consultations on RFID systems, if necessary, to install them, in particular, to determine in advance the location of the tags on the container. Also, together with the customer, to determine the control points for installing the readers and analyzing the information they received. However, RFID integration, procurement, tagging, readers, etc. is the subject of a separate agreement.

To service the AS/RS, a staff of 2 people is required (1 person per shift).

SOFTWARE

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Possible options for integrating SENSORLINK software into the customer's system can be divided according to the depth of integration and the mechanism of integration.

In any integration option, commands are issued to the system by adding records to the corresponding tables in the Oracle SQL server.

For example:

```
insert into sarmat.command_gas  
(command_type_id,container_barcode ,cell_name,  
rp_id)values(11,'00004','001N062',2);
```

Depth of integration options:

- cell level
- level of containers
- level of goods
- order level
- invoice level

Integration Mechanism Options:

- timer
- trigger

CELL LEVEL

The minimum level of integration. Requires the most additional work on the part of the Customer's software developers. The modified software from the Customer is installed on the operator's computers. The stacker server is delivered with only one command - "move container from cell N1 to cell N2".

All information about containers, goods, orders, invoices, etc. is stored exclusively in the Customer's database.

LEVEL OF CONTAINERS

Low level of integration. Requires a lot of additional work on the part of the Customer's programmers. The modified software from the Customer is installed on the operators' computers. The stacker server is delivered with three commands:

- take container K1 from cell N1 for storage
- move container K1 to cell N1 for selection
- return container K1 from storage cell N1

All information about goods, orders, invoices, etc. is stored exclusively in the Customer's database. Information about containers is partially stored on the AS/RS server.

ORDER LEVEL

Deep level of integration. Requires work on the part of the Customer's software developers. The modified software from the Customer is installed on the operator's computers. An order server with a large set of commands is supplied. In addition to the commodity server, there are commands: order goods T1 in the quantity of Q1 into selection cells C1 (the order cooperation mechanism works)

All information about invoices is stored exclusively in the Customer's database. Information about containers, goods and orders is partially stored on the AS/RS server.

LEVEL OF GOODS

Medium level of integration. Requires additional work on the part of the Customer's software developers. The modified software from the Customer is installed on the operator's computers. A commodity server with a large set of commands is supplied. Including:

- accept container K1 with goods T1 from cell N1 for storage
- deliver goods T1 to cell N1 for selection in the amount of Q1
- take goods T1 from container K1 in quantity Q1
- deliver the goods T1 to the container K1 in the amount of Q1
- inventory goods T1 K1 container in a quantity Q1
- return K1 container from N1 cells for storage

All information about orders, invoices, etc. is stored exclusively in the Customer's database. Information about containers and goods is partially stored on the server AS/RS.

INVOICE LEVEL

The deepest level of integration. Requires virtually no work on the part of the Customer's software developers. Sensorlink software is installed on operator's computers. It comes not only server software, but all the users of the program "turnkey". Exchange with the Customer's software takes place according to the following scheme:

From the Customer's software are product cards, receipts / consignment notes

The AS/RS software confirms the receipt of receipts and selection of invoices. Or messages about the problem of arrival / collection

Information about containers, goods, orders, invoices is partially stored on the server AS/RS.

MECHANISM OF INTEGRATION "TIMER"

It is an individually developed module for the Customer, in a programming language convenient for the Customer (e.g. C #, Delphi, php, ...).

This program module runs on a timer every 2 seconds. At the time of the timer, it exchanges information with the Oracle SQL server AS/RS, and with the Customer's IS. Carrying out the necessary operations according to the algorithm agreed with the Customer.

MECHANISM OF INTEGRATION "TRIGGER"

If the Customer's IS is developed on an Oracle SQL server, then a convenient "trigger" variant of data exchange is possible. The AS/RS base connects as remote for the Customer Base. When the corresponding data in the Customer's IS is changed, some commands are triggered into the AS/RS database. Also, the Customer's base is made remote for the AS/RS base. And, upon completion of operations in AS/RS, the Customer's base is triggered.

GEOGRAPHY OF IMPLEMENTATION OF AUTOMATED SENSORLINK SYSTEMS

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ARKANZAS (USA)

THE RECON GROUP (TRG)

WASHINGTON (USA)

COMPANY SUNLIGHT

CALIFORNIA (USA)

DELIVER-Ez COMPANY

MOSCOW (RUSSIA)

ELECTRICAL TECHNOLOGY DISTRIBUTOR ETM

INCOTEX GROUP OF COMPANIES

NEWEST TECHNOLOGIES LS

ST. PETERSBURG (RUSSIA)

NPO AURORA

JSC SKB VT "ISKRA"

SARATOV (RUSSIA)

NPO MOSSAR

KALININGRAD (RUSSIA)

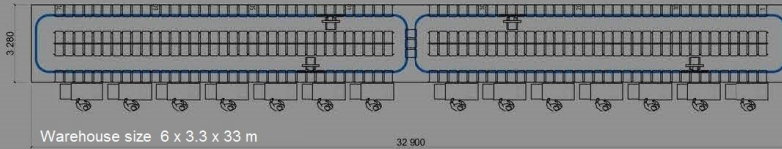
GOLD FRONT

RYAZAN (RUSSIA)

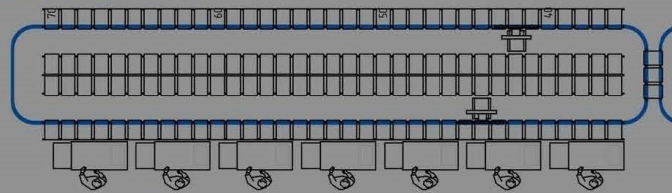
RADIO PLANT

EXAMPLES OF IMPLEMENTED PROJECTS

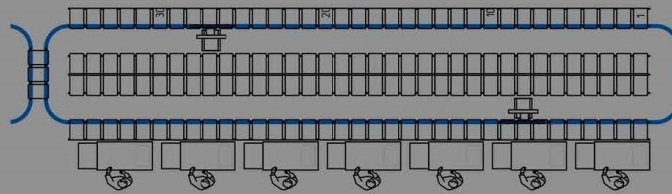
AUTOMATED WAREHOUSE COMPLEX



SECTOR A



SECTOR B



COMPLEX STRUCTURE

14 **4800** **180**

Workplaces for sorting the contents of containers.

4800 CELLS
Warehouse capacity

Double operations per hour

80 calls per workplace per day

Container size
250x350x500

Stacker robots

4

FUNCTIONAL PROPERTIES



Voltage

220 V



Power consumption

4 kWh



Lifting capacity

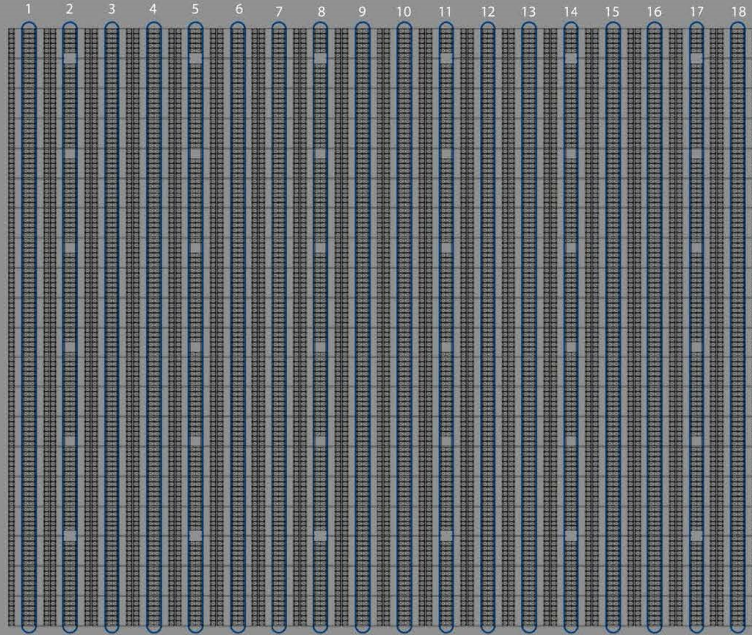
50 kg

03/18

AS/RS started to work

EXAMPLES OF IMPLEMENTED PROJECTS

AUTOMATED WAREHOUSE COMPLEX



Warehouse size 56 300 x 71 900 mm

COMPLEX STRUCTURE

105.000

105.000 cells
Warehouse capacity
Container size
149x400x600
250x400x600

36

Workplaces for
sorting the contents
of containers.

36

Stacker robots

1800

Double operations per hour
1200 calls per
workplace per day

FUNCTIONAL PROPERTIES



Voltage

220 v



Power
consumption

36 kWh



Lifting capacity

40 kg

2020

AS/RS started to
work

GAMMA

EXAMPLES OF IMPLEMENTED PROJECTS

AUTOMATED WAREHOUSE COMPLEX



COMPLEX STRUCTURE

12 **100**

Workplaces for sorting the contents of containers.

Double operations per hour

80 calls per workplace per day

2160 ДСЕ 6 480 CELLS
Warehouse capacity

4320 ПКИ Container size
280x400x600
147x400x600

7 Stacker robots

FUNCTIONAL PROPERTIES

 **Voltage**
220 V

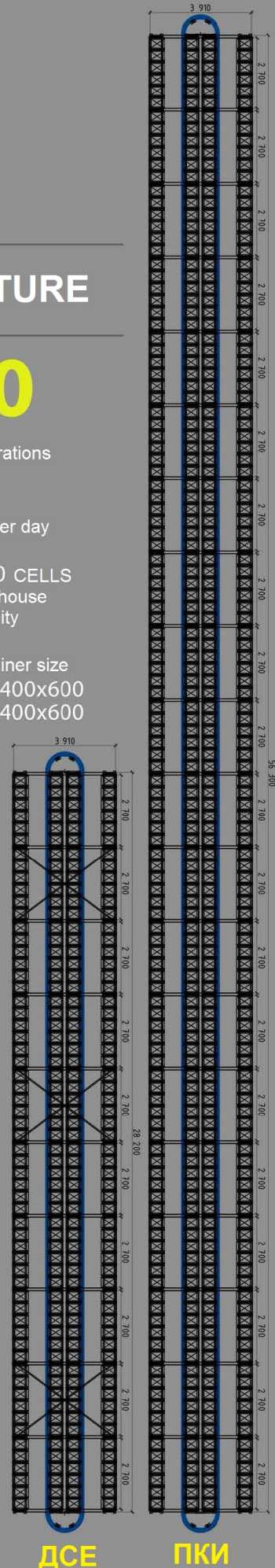
 **Power consumption**
3 kWh ДСЕ
4 kWh ПКИ

 **Lifting capacity**
50 kg

03/20

AS/RS started to work

PP3



EXAMPLES OF IMPLEMENTED PROJECTS

AUTOMATED WAREHOUSE COMPLEX



COMPLEX STRUCTURE

100

Double operations per hour
80 calls per workplace per day

1516

1516 CELLS
Warehouse capacity

Container size
250x400x600

2

Stacker robots

3

Workplaces for sorting the contents of containers.

FUNCTIONAL PROPERTIES



Voltage

220 V



Power consumption

2 kWh



Lifting capacity

50 kg

08/19

AS/RS started to work

