Stacker Cranes for Boxes
Standard automatic warehousing system for boxes or trays which integrate shelves, machinery and warehouse management software into a single product.

Its extraordinary capacity for adaptation makes it possible to integrate any production or storage process.
Stacker cranes for boxes
- Single-mast stacker cranes
- Twin-mast stacker cranes

**Mechanical components**
- Bottom guide base
- Column
- Top guide base
- Hoisting cradle or mobile frame
- Electric box
- Hoisting operation
- Picking systems

**Electrical components**
- Onboard electrical cabinets
- Safety controls
- Data transmission

**Aisle equipment**
- Bottom rail
- Top rail
- Position measuring device
  - Laser telemeter
  - Absolute encoder
- Systems for aisle changing

**Modes of operation**
- Automated mode
- Semi-automated mode
- Manual mode

**Safety equipment**
- Safety at aisle ends
- Safety device
STACKER CRANES FOR BOXES

The miniload automated warehouse for boxes is made up of a central aisle, along which a stacker crane travels, and two racks built at either side used to store boxes or trays. The picking and handling area is formed by conveyors and is positioned at one end or at the side of the racking. Here, the stacker crane deposits the load extracted from the rack. The conveyors then take the box to the operator and once he/she has finished the job, it is returned to the stacker crane which then places it back in the racking.

The whole system is controlled by a management software package which registers the location of all the materials in the warehouse and keeps a real time inventory.

The extraordinary versatility of the system enables it to be integrated into any production or storage process.

Principal characteristics:

- Optimal use of space with its high storage density.
- High level of accessibility to loads.
- Permanent inventory with our state-of-the-art computer system.
- Increase in productivity with respect to conventional management.
- Total safety during the load handling processes, as the presence of operators within the storage area is not required.
- Protection of the load and absence of unknown losses.
- Reliability and simplicity of use.
- Reduced maintenance cost.
- Particularly effective for companies with demanding order preparation processes.
- Applicable to the majority of sectors: pharmaceuticals, laboratories and cosmetics, public administration, car industry, DIY, electrical appliances, telephones and communications...
- Reduction of the preparation and dispatch time of orders.
- Quick return on investment.
- Environmentally-friendly.
- Less need for specialization of operators.
**Single-mast ML stacker cranes for boxes**

Developed and manufactured by Mecalux, the ML 50/100 range of single-mast stacker cranes for boxes is designed to achieve a high level of productivity and manage two types of boxes:

- **600 mm x 400 mm Eurobox.**
  These stacker cranes are capable of managing plastic, cardboard or metal boxes, and rigid trays with a variable box and load height.

- **800 mm x 600 mm Eurobox.**
  Regarding boxes with greater capacity, Mecalux can organise the movement of any type of boxes or trays, and, as with lower volume boxes, heights adjusted to the needs of the warehouse are available.

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**Basic components**

1. Bottom guide base
2. Column
3. Top guide base
4. Hoisting cradle
5. Electric box
6. Hoisting mechanism
7. Drive mechanism
8. Cable-free electrical conduction

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**TECHNICAL DATA / Single-mast ML stacker cranes for boxes**

<table>
<thead>
<tr>
<th>Characteristics</th>
<th>ML-50</th>
<th>ML-100</th>
</tr>
</thead>
<tbody>
<tr>
<td>Load capacity</td>
<td>Up to 50 kg</td>
<td>Up to 100 kg</td>
</tr>
<tr>
<td>Maximum height</td>
<td>10 mm</td>
<td>12 mm</td>
</tr>
<tr>
<td>Load unit</td>
<td>Eurobox 1 units x 600 x 400 mm</td>
<td>Eurobox 2 units x 600 x 400 mm / 1 unit x 800 x 600 mm</td>
</tr>
<tr>
<td>Telescopic fork - double deep</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>Double LHD* fork</td>
<td>No</td>
<td>Yes</td>
</tr>
<tr>
<td>Max. drive speed ($V_x$)</td>
<td>180 m/min</td>
<td>200 m/min</td>
</tr>
<tr>
<td>Max. drive acceleration ($a_x$)</td>
<td>1 m/s²</td>
<td>0.8 m/s²</td>
</tr>
<tr>
<td>Max. hoisting speed ($V_y$)</td>
<td>100 m/min</td>
<td>90 m/min</td>
</tr>
<tr>
<td>Max. hoisting acceleration ($a_y$)</td>
<td>1.2 m/s²</td>
<td>0.75 m/s²</td>
</tr>
<tr>
<td>Type of LHD*</td>
<td>Telescopic fork</td>
<td>Adaptable to type of box</td>
</tr>
</tbody>
</table>

*LHD: Load Handling Device*
Twin-mast MLB stacker cranes for boxes

Designed to transport, handle, ship and store two load units in locations along a work aisle or at picking posts.

These cranes are able to transport load units with different sizes and materials (plastic, cardboard, metal, etc.).
TECHNICAL DATA / Twin-mast MLB stacker cranes for boxes

**Basic components**
- Bottom guide base
- Columns
- Top guide base
- Hoisting cradle
- Electric box
- Hoisting mechanism
- Drive mechanism
- Cable-free electrical conduction

**TECHNICAL DATA**

<table>
<thead>
<tr>
<th>Characteristics</th>
<th>MLB100Q-2EPSF</th>
<th>MLB100Q-2EPDF</th>
<th>MLB100Q-2ECDF</th>
<th>MLB100Q-2ECSF</th>
</tr>
</thead>
<tbody>
<tr>
<td>Maximum height (mm)</td>
<td>12,290</td>
<td>12,290</td>
<td>12,290</td>
<td>12,290</td>
</tr>
<tr>
<td>Minimum height (mm)</td>
<td>5,040</td>
<td>5,040</td>
<td>5,040</td>
<td>5,040</td>
</tr>
<tr>
<td>Picking systems</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Type of LHD*</td>
<td>Single-depth twin telescopic fork</td>
<td>Double-depth twin telescopic fork</td>
<td>SD**double telescopic fork with belts</td>
<td>SD**double telescopic fork with belts</td>
</tr>
<tr>
<td>Features</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Maximum load allowed (kg)</td>
<td>2 x 50/2 x 100</td>
<td>2 x 50</td>
<td>2 x 50</td>
<td>2x(50 + 50)</td>
</tr>
<tr>
<td>Box/container size (mm)</td>
<td>600 x 400/800 x 600</td>
<td>600 x 400</td>
<td>600 x 400</td>
<td>600 x 400</td>
</tr>
<tr>
<td>Max. drive speed (m/min)</td>
<td>250</td>
<td>250</td>
<td>250</td>
<td>250</td>
</tr>
<tr>
<td>Max. drive acceleration (m/s²)</td>
<td>1.45</td>
<td>1.45</td>
<td>2</td>
<td>1.8</td>
</tr>
<tr>
<td>Max. hoisting speed (m/min)</td>
<td>90</td>
<td>90</td>
<td>90</td>
<td>90</td>
</tr>
<tr>
<td>Max. hoisting acceleration (m/s²)</td>
<td>1.5</td>
<td>1.5</td>
<td>1.5</td>
<td>1.5</td>
</tr>
</tbody>
</table>

*LHD: Load Handling Device  **SD: single-depth.
MECHANICAL COMPONENTS

The design of the stacker cranes enables the forces transmitted to the structure which supports them to be minimised, thus preventing damage to the racking or the structure of the warehouse in the long run.

Bottom guide base or frame
The bottom guide base is made up of a set of steel profiles and sheets welded together, whose function is to support the weight which rests upon it (column, cradle and load), as well as to move the stacker crane along the aisle. This guide base is finished at the top by a plate to which the column is bolted.

The free and drive wheels are fitted at the ends of the guide base with polyurethane stripping in order improve the acceleration of the stacker crane. The rear drive wheel is operated by a gear motor with a hollow axle fitted with a shrink ring, which is directly assembled on the wheel axle. The torque arm bears the turning moment.

On the opposite side is the hoisting mechanism which consists of a geared motor out of which comes a solid axle in which the drum is fitted. The drum winds up the hoisting cable and this in turn pulls the cradle up.

Column
The column of the models for 50 kg loads is formed by an extruded aluminium profile which incorporates the guides and grooves to fasten all the required components.

In the case of models for 100 kg loads, the column is made from structural steel, shaped on the basis of a rectangular sheet-metal box which is reinforced inside. It has different precision-welded profiles to guide the hoisting of the cradle. The column is machined to facilitate assembly of the different stacker crane elements.

In both cases, the columns are provided with threaded holes for securing the top and bottom guide bases.
Top guide base
The top guide base joins the column to the top rail by its contrast wheels and enables drive movements to be performed without the risk of the miniload tipping over.

The top guide base is bolted to the top of the column.

Cradle or mobile hoisting frame
The miniload cradle is formed by two pieces – the guidance system and the extractor support – which are bolted together. Both pieces are built with welded sheets and profiles, to which the rest of the components of the unit are fitted.

The function of this part of the stacker crane is to handle the load units by means of the LHD, whose weight must be equal to or less than the load for which it was designed.

Hoisting operation
The aim of the hoisting mechanism is to raise the mobile frame vertically by means of a reinforced steel cable.

The mechanism is formed by an AC drive designed to work with vector-controlled frequency variators.

The cradle is raised and lowered by means of a cable which passes through a system of two guide pulleys located in the top guide base and a winding drum in the bottom guide base.
LHD
It is possible to install several types of LHD according to the requirements of the loads stored in the miniload.

Mecalux classifies its LHD’s into two principal groups:
- LHD with a capacity for 1 box
- LHD with a capacity for 2 boxes at the same time

The table shows the most important data for each system.

1-box LHD
LHD with telescopic forks (EP)
The telescopic fork is formed by two bodies which slide together by means of heavy-duty guides and bearings. The fork is operated by gears and a drag chain for the top body. The high resistance against the torsion of the couplings guarantees the uniform movement of the body, avoiding excessive deflection with the load slipping to one end.

Two types of forks are available:
- Single-deep telescopic fork (EPSF)
  This fork is for horizontal handling, enabling the load units to be deposited in or extracted from single-depth racking.
- Double-deep telescopic fork (EPDF)
  This fork is for horizontal handling, enabling the load units to be deposited in or extracted from double-depth racking. It can be used in both single and double depth racking.

Motorized belt fork
LHD (ECSF)
This device is formed by a telescopic fork fitted to a body operated by two systems which push the body at the same time as dragging the load. It consists of two motorized mechanisms which power each system of belts (telescopic operation; dragging operation). The operation is quick and dynamic and can be used to work on both sides of single-depth racking.

LHD with sucker devices (EV)
This system is provided with sucker devices fitted on an electric telescopic arm, which allows a load to be taken to a single or double depth rack. The suckers clamp onto the side of the cardboard box, and hold onto it firmly so it can be either deposited or extracted.

Claws fitted at the side grasp the box without applying any pressure, in order to prevent it from moving sideways, and accompany it as it moves on the cradle.

<table>
<thead>
<tr>
<th>CHARACTERISTICS</th>
<th>EPSF</th>
<th>EPDF</th>
<th>ECSF</th>
<th>ECDF</th>
<th>EGSF</th>
<th>EGDF</th>
<th>EVDF</th>
</tr>
</thead>
<tbody>
<tr>
<td>Max. box size*</td>
<td>600 x 400</td>
<td>600 x 400</td>
<td>600 x 400</td>
<td>600 x 400</td>
<td>600 x 400</td>
<td>600 x 400</td>
<td>600 x 400</td>
</tr>
<tr>
<td>Max. box weight</td>
<td>100 kg</td>
<td>50 + 50 kg</td>
<td>50 kg</td>
<td>30 + 30 kg</td>
<td>50 kg</td>
<td>50 kg</td>
<td>22 + 22 kg</td>
</tr>
<tr>
<td>Max. fork speed with load</td>
<td>30 m/s</td>
<td>30 m/s</td>
<td>30 m/s</td>
<td>90 m/s</td>
<td>45 m/s</td>
<td>60 m/s</td>
<td>80 m/s</td>
</tr>
<tr>
<td>Max. fork speed without load</td>
<td>60 m/s</td>
<td>60 m/s</td>
<td>60 m/s</td>
<td>120 m/s</td>
<td>90 m/s</td>
<td>130 m/s</td>
<td>120 m/s</td>
</tr>
<tr>
<td>Max. acceleration with load</td>
<td>0.5 m/s²</td>
<td>0.5 m/s²</td>
<td>1 m/s²</td>
<td>1.5 m/s²</td>
<td>1 m/s²</td>
<td>1 m/s²</td>
<td>2 m/s²</td>
</tr>
<tr>
<td>Max. acceleration without load</td>
<td>1 m/s²</td>
<td>1 m/s²</td>
<td>3 m/s²</td>
<td>2 m/s²</td>
<td>4 m/s²</td>
<td>4 m/s²</td>
<td>4 m/s²</td>
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<tr>
<td>Aisle width</td>
<td>From 870 mm to 1,350 mm</td>
<td></td>
<td></td>
<td></td>
<td></td>
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</tr>
</tbody>
</table>

Sizes in mm
The telescopic device equipped with suckers is installed on a pneumatic swivel index plate, which allows the extraction to be done on both sides of the aisle, and even from the front, should the need arise.

The system permits boxes of different sizes to be stored in double depth and on shelves.

**2-box LHD**

**Combined LHD fork (ECDF)**

Comprised of two LHD’s, this device makes the extraction process very flexible and allows two boxes to be deposited simultaneously. This type of LHD has a telescopic fork fitted in the centre of a belt conveyor. The speed of the belts is synchronized with the exit and entry movements of the fork to allow the continuous movement of the box when extracting from and depositing to the racking.

As the belts are situated two millimetres above the level of the telescopic fork, they enable the boxes to switch sides or depths when running, without the need to move the fork. These belts also make it possible to swiftly deliver and collect two boxes consecutively in the P&D station. This makes the system very flexible and speeds up processes.

**LHD with lateral claws and swinging fingers (EG)**

This is comprised of a combination of systems which enables up to two cardboard boxes to be handled simultaneously both in the racking and in the P&D station. It consists of a system of vertical telescopic forks in which a series of semi-detachable shafts are fitted. When the shafts are in a horizontal position, they grasp onto boxes (one or two units) in order to extract or push them. This movement takes place simultaneous to the turning of the rubber ribbons which form the base of the extraction system. The movements of these two independent ribbon conveyors are synchronized with the vertical forks. As they operate autonomously, they facilitate the movement of the boxes on board the machine in order to change their side or depth.

The great advantage of this LHD lies in its ability to manage cardboard boxes directly in the rack. As an alternative, the device can be fitted with a system to adapt to the different sizes of boxes in ranges of ± 200 mm. This option makes the device very versatile in installations where cardboard boxes of different sizes are handled.

### PICKING SYSTEM SELECTION CHART

<table>
<thead>
<tr>
<th>Type</th>
<th>Max. weight/load</th>
<th>No. of LHD</th>
<th>Picking systems</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>EPSF</td>
<td>EPDF</td>
<td>ECSF</td>
</tr>
<tr>
<td>ML50 50 kg</td>
<td>1</td>
<td>X</td>
<td>X</td>
</tr>
<tr>
<td>ML100 50 kg</td>
<td>1</td>
<td>X</td>
<td>X</td>
</tr>
<tr>
<td>2 x 50 kg</td>
<td>1</td>
<td>–</td>
<td>–</td>
</tr>
<tr>
<td>2 x 50 kg</td>
<td>2</td>
<td>X</td>
<td>X</td>
</tr>
<tr>
<td>100 kg 1</td>
<td>–</td>
<td>X</td>
<td>X*</td>
</tr>
<tr>
<td>MLB100Q 50 kg</td>
<td>1</td>
<td>–</td>
<td>–</td>
</tr>
<tr>
<td>2 x 50 kg</td>
<td>2</td>
<td>X</td>
<td>X</td>
</tr>
<tr>
<td>4 x 50 kg</td>
<td>2</td>
<td>–</td>
<td>–</td>
</tr>
<tr>
<td>100 kg 1</td>
<td>–</td>
<td>–</td>
<td>–</td>
</tr>
<tr>
<td>2 x 100 kg</td>
<td>2</td>
<td>X</td>
<td>X</td>
</tr>
</tbody>
</table>

* Consult technical desk.  ** Only for 600x400 mm boxes.

### PICKING SYSTEM SELECTION CHART

<table>
<thead>
<tr>
<th>Picking system</th>
<th>Plastic box/container</th>
<th>Rigid tray</th>
<th>Cardboard box</th>
<th>Boxes per LHD</th>
</tr>
</thead>
<tbody>
<tr>
<td>EPSF Single-depth telescopic fork</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>1</td>
</tr>
<tr>
<td>EPDF Double-depth telescopic fork</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>1</td>
</tr>
<tr>
<td>ECSF SD telescopic fork with combined belts</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>1</td>
</tr>
<tr>
<td>ECDF DD telescopic fork with combined belts</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>2</td>
</tr>
<tr>
<td>EGDF Telescopic arms with side claws</td>
<td>X</td>
<td>X</td>
<td>–</td>
<td>1</td>
</tr>
<tr>
<td>EGDF Telescopic arms with swinging fingers</td>
<td>–</td>
<td>–</td>
<td>X</td>
<td>2</td>
</tr>
<tr>
<td>EV Extendable arms with suction cups</td>
<td>–</td>
<td>–</td>
<td>X</td>
<td>1</td>
</tr>
</tbody>
</table>

SD: single-depth.  DD: double depth.
Electric box
The electric box on board of the stacker crane for boxes is fitted at the back of the column. The controls are laid out so that the stacker crane can be operated as an individual unit.

The electrical connection to the cradle is ensured through an electrified guide rail fitted flush to the column.

The electrical supply of the stacker crane can be turned off by a switch located inside the box.

Safety controls
A power distribution cabinet in the aisles incorporates standardized power protection devices and electronic safety mechanisms.

The access to each aisle is secure and controlled by a safety mechanism, as well as by a button pad with warning lights and a restricted access key.

Data transmission
In order to establish communication between the decentralised periphery terminals and the fixed PC or PLC, along with the adjustable-speed drives, infrared optical communication systems (photocells) are used, with reaches of up to 240 m and a transmission speed of at least 1.5 Mbps, for working temperatures of -30°C or above if necessary.

The fixed photocells are fitted at the end of the aisle, and the photocells on board are fixed to the bottom guide base.

The data communication between the mounted box and the cradle takes place by means of an infrared photocell equipped with a data transmission system.
The aisle equipment is formed by a bottom rail, a top guide rail, position measurement systems and systems for changing aisles.

### AISLE EQUIPMENT

#### The bottom rail
The rail used is a HEA-100 which is fitted to the concrete slab by means of support plates and anchor bolts, at maximum intervals of 925 mm. At the ends, they are interspaced at intervals of approximately 600 mm.

In order to install the rail, holes are first drilled in the concrete slab, the threaded bolts are then inserted and the free space is filled with a special fixing resin.

Then, the support plates are fitted and the area is adjusted by levelling them along the whole length of the aisle. The rails are also fitted by cutting the splice points in a straight line, perpendicular to the axis of the aisle.

Finally, the joint of both sections of the rail in its side and centre are welded using special electrodes. The welding is polished down to a bead of no more than 4 mm.

#### The top rail
The top guide rail can be formed by an LPN 80 profile. It is fixed to the top profiles used to join the rack structures by means of welded adjustment plates.
Position measuring device
The most reliable and sophisticated devices are used for measuring the exact position of moving units:

- Laser telemeters
- Absolute encoders

Precise positioning
A laser range finder reports the exact position along each axis (movement and hoisting). This information is sent directly to the microprocessor in the servomotor to correctly control the stopping position at any location.

Absolute encoders
Rotary devices with a codified value which is neither repetitive nor incremental. They produce an absolute and unique value for each angle of the shaft. They keep the measured value even when the machine has been disconnected. They are commonly installed in telescopic forks.

In general, they are fitted with coupling devices without excessive sliding or wear and, in most cases, cover short routes.
Systems for changing aisles

When goods turnover is not very high but the storage volume is considerable, it is not necessary to place a stacker crane in each aisle.

In this case a system called a transfer bridge is used. This enables the miniload to be changed from one aisle to another. The bridge is located on the shuttle where it is anchored and moves sideways to the destination aisle where the transfer is to take place.

This system allows the best possible performance of the miniload inside the aisle, although it is less flexible when changing aisles. This problem is overcome by means of good management and the optimisation of movements with sufficient forecasting and planning. The installation of a system for changing aisles entails an exhaustive study of the factors involved in the operations which are performed in the installation.

The Mecalux management system enables movements and location of the goods to be well planned in order to have a properly-balanced facility.
Mecalux’s stacker cranes for boxes can operate in automated, semi-automated or manual modes in function of needs. The first mode corresponds to the normal operation of the installation, while the third mode is used for maintenance work.

MODES OF OPERATION

Automated mode
Here the orders are executed after being sent through a communication photocell from the conveyor management computer. In this mode, the following operations are executed:

- Location.
- Extraction.
- Change of location.
- Correction of errors in the warehouse.
- Self-learning of storage locations in the warehouse.

Semi-automated mode
This is used for carrying out support functions, such as:

- **Automated access to a location.**
  The miniload is automatically positioned in the location ordered by the operator.

- **Automated cycle of forks.**
  A load unit is automatically deposited or extracted in the location indicated by the operator.

Manual mode
This enables all the components of the stacker crane for boxes to be accessed with restrictions in order to carry out maintenance and repair work.
SAFETY EQUIPMENT

Mecalux has equipped its machines with the basic ergonomic and safety equipment needed to perform work and maintenance operations as simply as possible.

Safety at aisle ends
Hydraulic buffers are securely fitted to the floor at the ends of the aisle. The buffers are calculated to absorb the full impact produced by the miniload when travelling at a nominal speed.

Safety devices
- Emergency circuit.
- Magnetothermic protection and thermal probe in motors.
- Current limiters for the motors.
- End stops in hoisting, driving and monitoring of speeds.
- Emergency stop areas at aisle ends.
- Driving and hoisting movements only with fork centred and load correctly centred.
- Touch-sensitive photocell to confirm empty storage spaces.
- Different devices to allow access to the aisles.