

## High speed transfer system "Hakobot LM-50i"



Hakobot appearance

JTEKT has developed "Hakobot", a high-speed transfer system which utilizes a link mechanism on the vertical axis. This system allows transfer between multiple processes within shaft component machining production lines such as grinding, lathing and inspection. It also enables the quick grasping and releasing of workpieces onto equipment.

"Hakobot" utilizes a link mechanism that differs from conventional loaders on the vertical axis, allowing the vertical axis to move more quickly and smoothly.

### 1. Features

#### (1) Quick grasp and release of workpieces

The smooth, high-speed, low vibration motions of the vertical axis reduce grasping and releasing time from 6 seconds to 4 seconds compared with conventional machines.

#### (2) Installation in plants with low ceilings

Through the utilization of the link mechanism on the vertical axis, a maximum loader height of 4 meters from the floor was achieved, 20% lower than conventional machines.

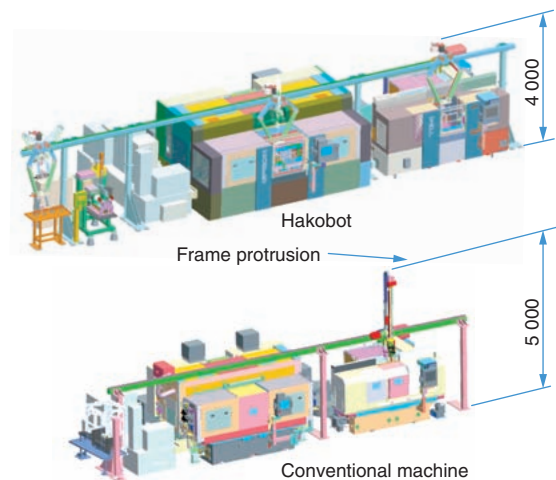
### 2. Structure

The system grasps and releases workpieces onto and from machines and transfers workpieces between machines and to the workpiece stocker. The exchange of machined workpieces with workpieces to be machined has a direct influence on cycle time, and therefore an increase in speed is necessary.

This product also reduces workpiece grasping and releasing time through the utilization of a link mechanism on the vertical axis.

#### 2. 1 Vertical axis mechanism

Two arms from the drive shaft, arm 1 and arm 2, are located on the left and right of the vertical axis and utilize a mechanism to support the hand part. Due to this, the frame at fully raised position does not protrude largely from the top of the equipment like conventional machines, enabling installation in plants with low ceilings as well.



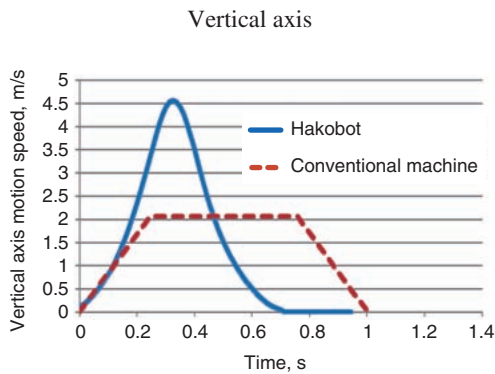
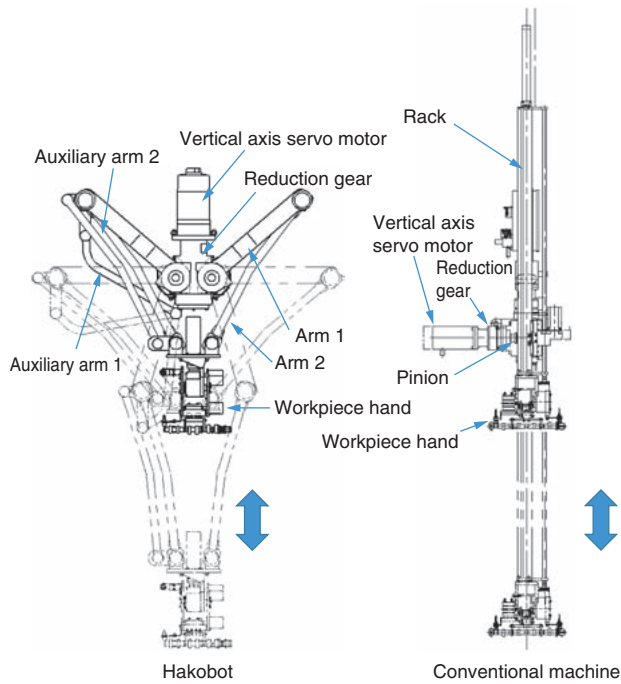
Height comparison

Auxiliary arms 1 and 2 are attached to arms 1 and 2 on the other side, with a parallel link constructed to limit the lateral direction freedom of the hand part. Drive power is transmitted to both arm 1 parts from the servo motor attached to the top part via a reduction gear, allowing up and down motions. Due to the use of a worm reduction gear, the mass of the arm, hand and workpiece are not transmitted to the servo motor.

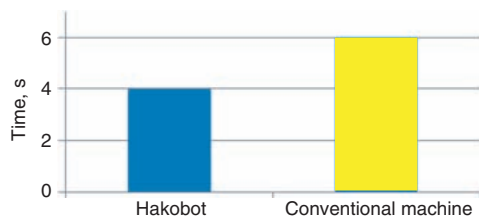
#### 2. 2 Characteristics of vertical axis movement

When raising the speed of up and down motions in the conventional direct moving axis, the mass of the hand and other parts and the force exerted at stop are stimulated by acceleration and deceleration, causing vibration. Therefore the maximum speed is determined by the acceleration limit, inhibiting faster speeds.

The link mechanism utilized by the vertical axis of this product is designed to decrease speed at the fully raised position and increase speed at the intermediate position, enabling smoother acceleration and deceleration than with control from only the servo motor. This allows for significantly faster vertical axis motion, which shortens motion time and thereby reduces grasping and releasing time.



Vertical axis speed diagram

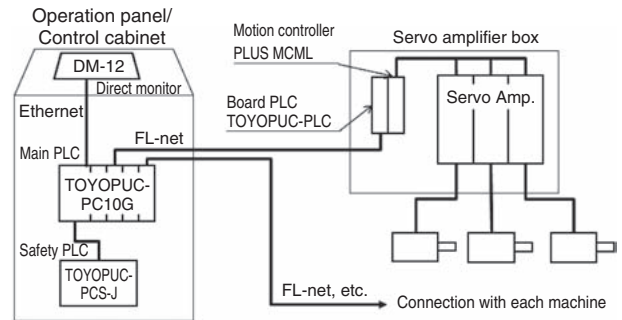


Grasping and releasing time

**2. 3 Control unit**

This machine utilizes the high-function, large capacity TOYOPUC-PC10G in consideration to the connections with upper-level networks and to each machine. A board-type PLC, TOYOPUC-PLUS, is employed within the servo amplifier box. Furthermore, miniaturization has been achieved for the servo amplifier through the addition of motion controller PLUS MCML.

For operability, an SFC (Sequential Function Chart) is utilized to visualize the transfer cycle.



System configuration chart

**3. Specifications**

Specifications

Specifications		Hakobot	Conventional machine
Travel axis	Speed	2.67 m/s	2.67 m/s
	Stroke	1.2 m	1.2 m
Vertical axis	Speed	4.5 m/s	2 m/s
	Stroke	1.2 m	1.2 m
Cradle axis	Speed	360° /s	360° /s
	Stroke	120°	120°
Grasping and releasing time		4 s	6 s
Loader time		4 m	5 m

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(Machine Tools Development Dept., Machine Tools & Mechatronics Operations Headquarters)

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