



# Perspectives on Material Handling Practice

Papers in the Perspectives series have appeared in conference proceedings of the Material Handling Institute between 1992 and the present. As such they provide a point of reference as to how the industry is changing as well as insight into accepted practice during this period. In many cases the authors credited have either changed jobs or are no longer in the industry. Some companies as well have been the subject of mergers or reorganization with a new corporate identity.

## **THINK VERTICAL THE VERTICAL CAROUSEL SOLUTION TO SPACE, PRODUCTIVITY, AND ERGONOMICS OPTIMIZATION.**

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### **ABSTRACT**

“THINK VERTICAL” is a keyword in material handling today. As floor space becomes more scarce, and companies strive for improved performance from their order-picking operations, Vertical Carousels are playing a greater part in systems design. Improvements in Ergonomics, Inventory Control, Security, and Personnel Productivity are just a few of the many benefits derived from this equipment. Applications include small parts through heavy tooling storage in many heights, capacities and special characteristics. Under PC-control & software, ROI’s of 70% are common (12-14 month payback) to users including Electrical, Medical, Pharmaceutical, Automotive and a wide range of other manufacturers and distributors.

### **INTRODUCTION**

In this discussion, we will first look at the various benefits of the vertical carousel, and then will delve into the application guidelines for this equipment.

### **BENEFITS**



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While the list of potential operating improvements achieved through the implementation of vertical carousels can go on and on, we will concentrate today on the following:

Ergonomic Improvements  
Personnel Productivity  
Inventory Accuracy  
Space Recovery

In most areas of manufacturing and distribution, inventory levels are being reduced, and the concept of “Just In Time”, or JIT stock availability is well recognized. More products are being packaged and inventoried in smaller lot sizes to conform to this “streaming” concept of inventory supply. As a result, conventional pallet-handling is more often being replaced with manual-handling during the picking and stocking cycles.

Packages handled often weigh 20-35#, and fast picking times are being demanded for these loads. Conventional shelving does not lend itself well to effective picking of such loads because of the bending, stretching, and reaching necessary to pick and stock these items. Muscle strains and other medical injuries are common as a result. Simple fatigue can slow picking rates in these applications, and reduced visibility of the lowest and highest shelves contributes to pick errors.

Within manual-picking systems, the vertical carousel offers an excellent solution to all of these problems.

**All parts to be picked are delivered to the picker at an ergonomically-ideal waist-height.** The picker need not bend or stretch. Heavier loads can be slid off the carousel carrier of shelf levels, directly onto a workshelf without actual lifting. These loads can then be slid directly onto a matching-height cart or conveyor, again without lifting. As a result, injuries are reduced, fatigue is avoided, and picking rates remain on-target.

When configuring vertical carousels for an application, several types of carriers may be available. All carousel carriers must have a front lip to insure that parts do not slide off the edge during the operation of the machine. When storing heavier parts, consider carriers having ramped-lips, removable lips, or drop-down front edges. Such carriers further reduce the strain incurred in removing heavier items.

For very heavy loads (greater than 50#) special carriers are available which are equipped with roller-beds, further enhancing the removal of parts.

When equipped with multi-partition totes or drawers, **all parts may be easily accessed for the full depth of the carrier (up to 24”)**. All parts can be pulled out into the well-lit picking window where they may be easily and quickly identified and picked. Again, this is done without bending, stooping, or stretching.



Closely associated with the ergonomic issue is personnel productivity. The vertical carousel addresses this issue through three avenues: improved ergonomics, faster part location, and reduced travel time.

The improved ergonomics and part-location benefits are inherent in the basic concept of the vertical carousel, i.e. "Bring the parts to the picker". In addition, parts locating is further enhanced by limiting the number of parts presented at one time to only those present in the pick window. Horizontal markings along the pick window can further reduce the search cycle.

Because a large number of parts are stored vertically and within a very limited horizontal distance, the picker need not travel great distances to access these parts.

One lift-truck repair center stores 20,000 SKU's within a maximum travel distance of 8'.

With the application of pick-directing software and computer-control, the personnel productivity increases even further. By re-sorting the sequence of picks, items are presented to the picker with a minimum of machine-rotation delay time, and a minimum of horizontal travel along and/or between multiple machines. This means more picks within a discrete period.

Horizontal and depth position indicator lights are also available for most vertical carousels. These lights can point out the specific item to be picked, quickly directing the picker to the correct location. In multiple-partition totes, the appropriate front-to-back partition is also identified.

Some examples of productivity levels include:

Shelf-pick . . . . .	50-100 picks/man-hour
Vertical Carousel . . . . .	100-200 picks/man-hour
Vertical Carousel under computer & software control . . . . .	200-400 picks/man-hour
Vertical Carousel equipped with position indicator lights under computer & software control . . . . .	300-700+ picks/man-hour

Some users of vertical carousels have reported substantially higher rates than these, and one has reported that the net-productivity (considering picking, stocking, and maintenance) of his vertical carousels is higher than that of his A-Frame automatic pickers.

Improvements in pick-accuracy are generally achieved as well which helps further augment the net picking rates for final output.



Inventory and pick accuracy are promoted by the vertical carousel in several ways.

The machine is essentially a totally enclosed steel box. Unauthorized access to products from the rear and sides is eliminated, forcing maximum visibility of access attempts at the pick window.

Because most products are not visible at the same time, casual or “passing” pilferage is reduced. Deliberate access requires machine operation, which can be locked off through power-control switches. The units typically are equipped with lockable doors at the pick window, further enhancing the security of the contents.

Under software control, a further level of security is available. All transactions and machine-movements can be limited to password-protected individuals. All such transactions can also be tracked and recorded as well.

Picking errors tend to be reduced because fewer products are displayed at one time allowing the picker to focus more intently on the item targeted. In addition, products tend to be better organized and containerized, so there is less intermingling of products. With software control and position indicator lights, the possibility of mis-picks is even further reduced.

The increase in pick accuracy reduces error corrections and re-picks, and can often eliminate final inspections, thus increasing the net-productivity as well.

The vertical carousel has long been known and loved for its space-recovery features. Using the wasted air-space in many operations has meant not only more efficient operation, but has allowed those operations to flourish in smaller building areas.

Vertical carousels can generally store products in 25% of the floor space required for comparable static shelving storage. When ceiling heights greater than 16’ are available, this number drops to 20% or less.

The ease of locating obsolete parts promotes more frequent and effective purging of these parts from the system. This of course frees up storage space and promotes optimum inventory policies.

One recent installation of a 25’ tall heavy-duty vertical carousel returned 90% of the stockroom floor space to the customer. The resulting 8000 sqft. of space is now being used for manufacturing and profit-generating activities previously unavailable.

## **APPLICATION GUIDELINES**



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With the benefits of the vertical carousel now evident, let's look at the range of products which can be effectively stored in them and other factors influencing their application.

### **Building Heights**

While the efficiency and storage density of the vertical carousel increases with increasing building height, the units have been successfully applied in buildings with clear heights of only 8'. The most efficient balance of storage density and access-time appears to be in the range of 12' to 25' tall units. Units over 50' tall have been installed with excellent results.

The vertical carousel can not only offer effective storage solutions, but can also serve as a transport medium for delivering products between multiple floors of a building or mezzanine system. Parts can be inserted on one level, and removed on another level.

Low ceiling heights are not necessarily a "show stopping" obstacle to the use of vertical carousels. Simple and inexpensive "dog houses" have been added to roofs, allowing the vertical carousel to poke through the roof and gain additional height. The other direction is also available and vertical carousels have been installed in pits as a means of gaining additional storage height. Both of these options have proven to be less expensive than the construction of new building areas.

A third alternative has also been employed: install the carousel outside the building and simply enclose it with an insulated and weatherproof shell. Access to the carousel is accomplished through the existing building wall.

### **Product Characteristics**

The height of products stored in vertical carousels should not exceed 15". The nature of this equipment requires the storage carriers and products to rise vertically, then travel a curved trajectory to the rear of the unit, followed by a descent and another curve. For units taller than 16" excess clearance must be provided for such loads to make this transition through the curves. This results in lower product density and reduced efficiency.

Carrier levels can be split into differing heights by the addition of intermediate shelf levels. The most effective carrier height is often an X2 or X3 multiple of the average product height to be stored. A broad range can thus be efficiently stored in a single carousel.

For example, a carrier spacing of 16" might give a usable clear height of 15". Adding one intermediate shelf level offers the ability to efficiently store items 15" high and items 7" high.

Adding a second intermediate shelf level provides efficient storage for 15", 7", and 4-1/3" high products.

It is important to monitor the total weight applied to such carriers, including the weight of the shelves. As storage density increases, the total live load increases as well.



Product lengths of 96” or more can be handled in vertical carousels because of their wide, unobstructed shelf levels.

Product depths up to 24” are standard for most carousel suppliers, and some supply greater depths. It must be remembered here that the depth of the carrier is part of the same formula that affects the limitation on height. While it is possible to supply deeper carriers, the vertical clearances must be increased which results in reduced storage density and efficiency.

Product weight or density must also be considered. Vertical carousels are available with carrier capacities ranging from 300# to 1100#, and carrier surface areas from 11 sqft. To 19 sqft. This results in a potential density range of 16#/sqft. To 100#/sqft. Of Uniformly Distributed Live Load. The carriers can support higher-density and weight loads (often up to their maximum load rating), but point-loading capabilities must be considered in such cases.

It is important to note that vertical carousels are typically offered with a standard carrier rating, and that this rating is based upon a standard unit height. When a unit’s height begins to exceed the standard height, the carriers are “down-rated” because the limiting factor now becomes the total capacity of the lifting chains.

Parts stored therefor can include items from virtually 0 weights to loads of 100# or more.

### **Volume & Movement Levels**

Some facilities are using vertical carousels as “forward picking areas”, and restock such units several times a day. The most common “rules of thumb” however are as follows:

Parts having movement rates of up to 4cuft. Per re-stock cycle can be effectively stored in a vertical carousel. Depending on the application, the re-stock cycle may vary from 2 hours to 2 months, but weekly is very common.

If a part is accessed for up to 10% of all orders, it is a good candidate for carousel storage.

Operations having thousands of small parts, of which they maintain a small inventory for each part (less than 0.5 cuft.).

Where FIFO, LOT NUMBER, or other sequencing factor must be closely regulated, software-driven vertical carousels can offer an ideal level of control.

There are of course exceptions to every rule. Some facilities for example, who specialize in very high movement products, choose to store their “low movers” in vertical carousels. With all factors being relative, for them the space-recovery was a maximum value, and the pick rates of the vertical’s was secondary. For the implementers of the “forward picking area” carousel installations however, the rapid access to thousands of parts was the key to success.



In conclusion, while the vertical carousel cannot be considered a panacea for all applications, like all the products discussed today, it has its ideal niche, and should be considered as a viable component in manual storage and retrieval systems. Pick-directing software should always be considered with vertical carousels since it provides the increased pick/stock speed and accuracy of Pick-To-Light systems at a fraction of the cost.



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