



Determining The Right Lift Truck Navigation System

For Your Very Narrow Aisle (VNA) Warehouse


Machines. Ideas. Solutions.



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Today's pressures on warehouse managers are endless and unrelenting – to increase productivity, improve picking accuracy and drive down costs. Rather than fading away, these demands grow more intense each year, and many businesses continue to explore new ways to overcome these challenges in their operations.

While factors such as warehouse layout, aisle size and order picking methods impact overall productivity and order picking accuracy, the use of lift truck equipment and related navigation systems also plays a major factor. The purpose of this white paper is to review existing and new lift truck navigation technologies and the impact they have on very narrow aisle warehouse operations today. This paper will also identify key factors for warehouse managers to consider when evaluating these systems for their specific applications.

Lift Truck Navigation Options

The warehouse manager has three choices for reaching destinations in a warehouse:

- **Manual systems** (operator onboard lift trucks)
- **Fully-automated selections**, such as Automated Storage / Retrieval System (AS/RS), unit load or mini load, or Automated Guided Vehicles (AGV) solutions
- **Hybrid (or flexible) alternatives.** These are semi-automated systems that include both current and brand-new navigation and picking technologies, combined with operator onboard lift trucks.

Each of these choices has its own unique advantages and disadvantages:

- Manual systems have been the most flexible and productive, but generally have the highest labor costs and the lowest efficiency and accuracy.
- Companies may invest a lot of capital into fully-automated systems, seeing these as the silver bullet. For the right application, automation can be a great empowerment, but can also be capital-intensive, quickly outdated and highly inflexible in the face of rapid and uncertain change. Sometimes the most complex and most expensive solution is not the best choice.
- Hybrid Systems, also called "flexible systems" or "semi-automated systems," can offer the advantages of the other two with fewer drawbacks.

This white paper illustrates a warehouse manager's options for semi-automated material handling, especially in Very Narrow Aisle (VNA) applications. It also focuses on new warehouse navigation systems that use Radio Frequency Identification (RFID) transponders to locate and guide VNA lift trucks within the aisles of a warehouse.

Hybrid Systems: An Overview

Hybrid approaches are built on a Warehouse Navigation System. Warehouse Navigation uses RFID technology to support a semi-automatic approach to reaching racking locations within the warehouse.

Transponders, placed in the warehouse floor at specific intervals, carry information that an RFID reader in the lift truck reads to identify warehouse aisles, locations and distances with very precise accuracy – to within .4" or less. Equipped with this information and a height measuring system, the lift truck knows exactly the horizontal and vertical movement to most efficiently accomplish its task.

The lift truck can be programmed to reach specific pallet positions by selecting the most efficient combination of traveling and lifting/lowering. This technology, already proven in Europe, can deliver major efficiency gains, reduce product damage, improve picking accuracy and increase productivity up to 25%.

Maximum Flexibility, Minimum Maintenance

Flexibility for any changes in the warehouse and low installation costs are main considerations in developing transponder technology. In the past, commands to the forklift restricted the user through such methods as magnets or reflective markers. However, Warehouse Navigation offers complete freedom. Transponders are inexpensively installed, and if a rack row changes in the warehouse aisle, the transponders are simply and quickly reprogrammed to the new location.



What Navigation Choices Are Available To The Warehouse Manager?

The warehouse manager looking at a Hybrid or semi-automated system for warehouse navigation has three principal choices: indoor GPS, 2-D bar code tracking systems and RFID transponders (a floor-embedded control system).

1. Indoor GPS

- Can use network of ground-based transmitters that communicate to the lift trucks
- Currently tracks location only
- Has better tracking accuracy than satellite-based GPS systems
- Is capable of being used indoors or outdoors

CONCLUSION: This option has some applications for tracking lift truck location. For collection of lift truck performance data, further integration of systems is required.

2. 2-D Bar Code Tracking System

- Uses truck-mounted camera and ceiling mounted tiles to determine lift truck position within the warehouse
- Accurate to within inches
- Advanced integration between the lift truck and the system can provide travel path information to the lift truck operator
- Installation is expensive due to the quantity of tiles to be installed at the ceiling level.

CONCLUSION: This type of system is suitable for wide aisle and VNA applications. However, the required truck-mounted hardware and ceiling-mounted tiles can make this a high-cost option for some applications.

3. RFID Transponder System

- The system's floor-embedded "transponders" communicate with RFID readers mounted onboard the lift truck to precisely determine the lift truck location and automatically adjust truck performance to match location requirements.
- Travel speed, travel direction, lift height, and auxiliary and ancillary lift truck functions can all be controlled – for maximum efficiency and productivity.
- These transponder-based systems result in the highest levels of picking accuracy.
- Highest accuracy allows the retrieval and put away of full pallets.
- Coupled with Warehouse Management System (WMS) communications, scanning or operator data entry can be completely eliminated.
- Warehouse Navigation can only be used within all rail-guided or wire-guided VNA lift trucks.
- The lift truck can enter an aisle in either direction. Entry into an incorrect aisle can also be prevented.
- The lift truck operator can always move the truck manually, retaining the ability to react to the unforeseen.
- All pick up and deposit information is delivered by the WMS via wireless RF terminals.

CONCLUSION: A Warehouse Navigation System is a proven alternative for warehouse managers in VNA environments, especially those interested in increasing productivity and efficiency in their operation.

How An RFID-Based Warehouse Navigation System Works

Here's how a Warehouse Navigation System, which uses transponder RFID technology, works to control guided VNA lift trucks within the aisle of a warehouse. For starters, to use Warehouse Navigation, a turret truck and/or order picker must be guided in the aisle by wire or rail. RFID transponders are also embedded into the floor.

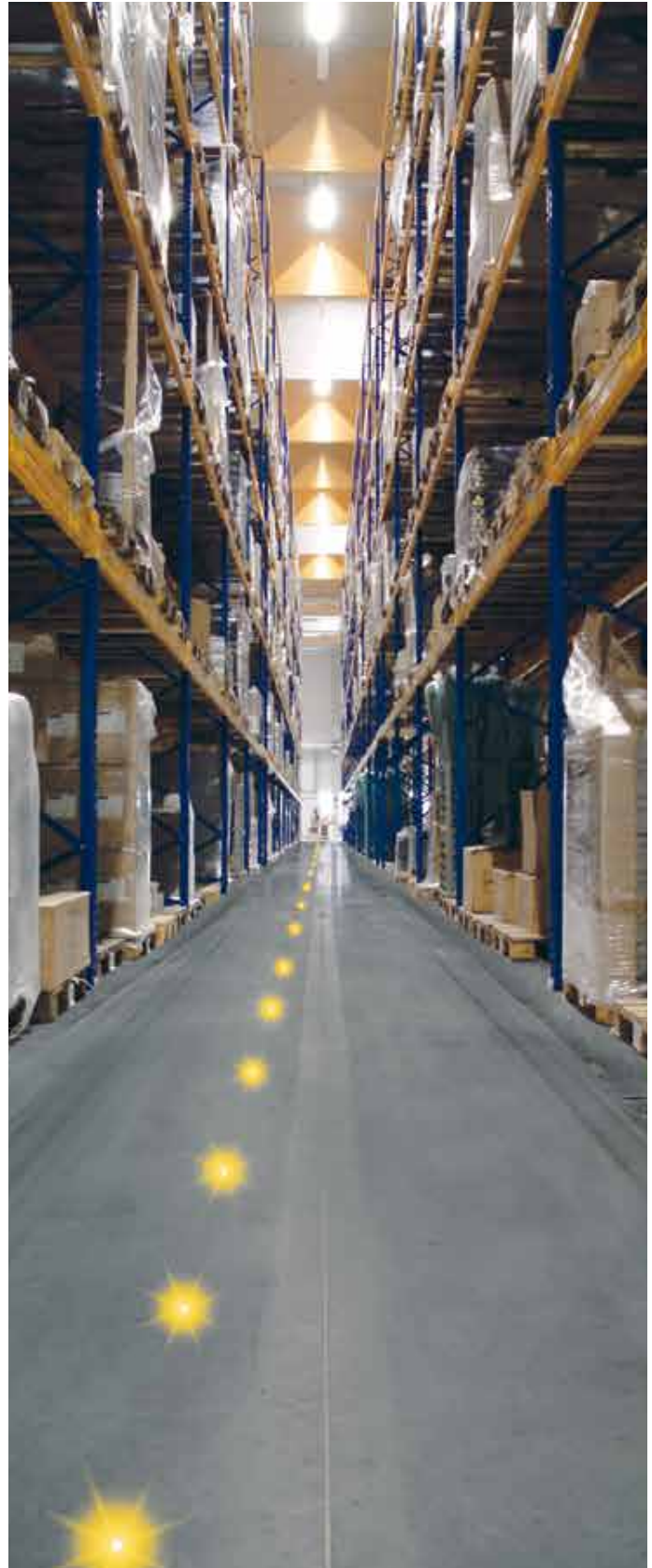


These transponders transmit instructions to the lift truck through RFID readers on the forklift's underside. RFID transponders do not require a direct line of sight. Armed with this flexible system, the warehouse can track the exact location of each lift truck outfitted with this technology.

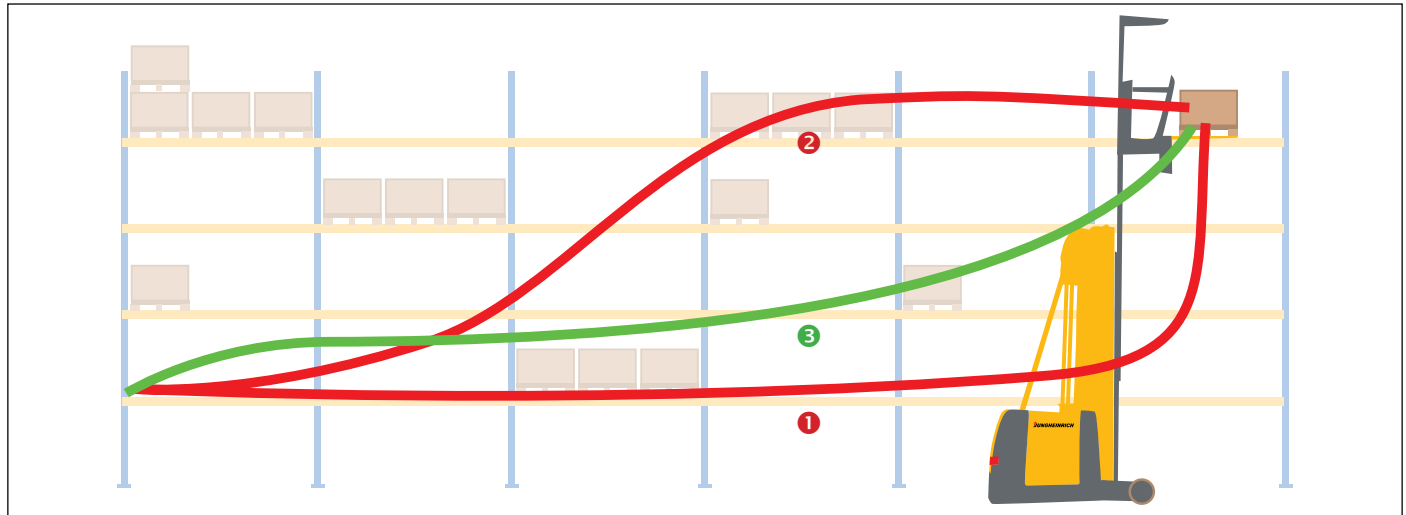
Let's focus on a specific example:

- The WMS sends an order to the RF terminal on the lift truck, telling it where the next pallet or case is to be picked up or put away. The locations are then communicated from the RF terminal to the lift truck's controller.
- Using the transponders and sensors on the truck, the lift truck identifies where it is in the aisle and where it has to go to pick. All the operator has to do is turn the throttle in the direction the lift truck has to travel, which is shown on the truck's display.
- The lift truck will then drive forward (or backward), automatically lifting/lowering to the right height and stopping at the correct pallet location. And, on a turret truck, the forks would reach out and pick the correct pallet.
- Once the pallet is picked, the lift truck sends a confirmation back to the WMS and is ready for the next order.

At this point, there is no need to scan either the location or the pallet, since both are already known by the system. Note that this elimination of scanning saves valuable seconds and reduces cycle time, which translates into increased productivity.



Possible Travel Paths To Picking Destination (Diagram A)



- 36 seconds – common routes
- 28 seconds – fastest route using Warehouse Navigation

The Most Efficient Travel and Lift Path

One of the fundamentals of a VNA lift truck is that the higher the truck is, the slower the drive speed. At a height of 60 inches or less, maximum travel speed is considerably more than at a higher lift height. At high lift heights, travel speed is vastly reduced. This basic fact applies to both turret trucks and order pickers. To improve productivity and number of picks per hour, the operator needs to get to the location in the most efficient way possible – precisely what Warehouse Navigation achieves.

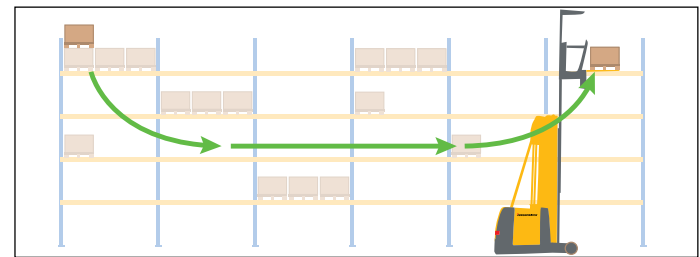
The graph above (Diagram A) illustrates three possible travel paths for a lift truck picking from the floor up to a high pick location. The first red line (Line 1) assumes the operator travels at full speed along the floor and then spends time lifting at the end. The total travel time is 36 seconds. The second red line (Line 2) assumes that the operator lifts and drives at the same time, which is a more efficient way of traveling. However, the total travel time is again 36 seconds.

The green line (Line 3) shows the path that Warehouse Navigation directs, completing the travel and lifting in 28 seconds – the optimum time to get to the location. This productivity gain represents a dramatic 29% improvement in one simple motion. That 29% improvement in this single example points to the kind of productivity gains that a Warehouse Navigation System is capable of delivering.

Simplified Decision-Making

The Warehouse Navigation system can also be used to eliminate the operator's decision-making regarding travel and lift routes, thereby delivering a faster and more efficient picking process. This increased efficiency is extremely important to the operator (who may be paid per pick), but even more so to the warehouse manager, who has the daily challenge of maximizing productivity and reducing costs.

The "Bathtub" Curve (Diagram B)



Another example:

- The operator begins his process by picking his order at the top of the rack location. The next pick location is down the aisle and also at the top of the rack.
- All the operator has to do now is to move the throttle. When he does, instead of moving directly across, the system directs the lift truck to drive and lower, because it can move faster at a lower lift height.
- As it gets closer to the pick location, the truck lifts to reach its destination with maximum efficiency.
- The Warehouse Navigation System takes the guesswork out of the process by deciding when to lift, depending on the height of the pick, and uses the most efficient route to achieve the designated pick.

This is also an added benefit for those applications that have seasonal or temporary lift truck operators, as there is no fall-off in productivity when a new operator starts in the warehouse. Warehouse Navigation ensures that new operators can operate the lift trucks as productively as experienced operators and also helps reduce the risk of product damage.



Conclusions

1. Today's technological advances allow full integration of the lift truck fleet into the WMS, creating the greatest efficiency in product movement.
2. Greater positioning accuracy produces reductions in travel, verification, error correction and throughput times.
3. These competitive advantages produce productivity gains of up to 25%.
4. These productivity gains are realized regardless of who is operating the lift truck. Thus, the warehouse will see these gains even when it has new staff, seasonal employees or night shift operators.
5. Because the controller stops the lift truck at exactly the correct position, product does not get damaged from either incorrect positioning or inexperienced operators.
6. Flexibility is key. Changing the layout of a warehouse does not mean re-laying of the transponders. They simply need reprogramming.
7. Net/net: Because the warehouse can move more product in less time, it can be possible to reduce lift truck fleet size and number of operators.
8. This technology is already proven in Europe, where it is currently in successful use in hundreds of applications, in addition to several North American operations. Warehouse Navigation is efficient, dependable and cost-effective.
9. Improved accuracy, reduced product damage and no loss of productivity with new, seasonal or temporary employees – these, in addition to other key benefits, all add up to increased productivity and a reduction in logistics costs.
10. These new advances in lift truck technology also provide warehouse managers with added flexibility, in addition to increased productivity and performance.

These new advances in lift truck technologies mean new solutions for warehouse managers today – in addition to new opportunities for greater gains in efficiency and productivity. Since each application varies, warehouse managers should consult with their local dealer or a trained warehouse product consultant to evaluate the best solution for their specific application's needs.

For more information

To learn more about the new Warehouse Navigation System technology available from Jungheinrich®, visit www.jungheinrich-lift.com.



Defining Best Practices For A Warehouse

Best practices for today's warehouse are built on five factors, called "The S.P.A.C.E. Principles". These principles enable the warehouse manager to compare the available navigation options.

- Space utilization
- Productivity
- Accuracy
- Cost reduction
- Efficiencies

1. Space Utilization – Manage the Cube

- Does the Warehouse Navigation System have the flexibility to allow for load variation? Can it adjust to load variation and/or dynamic storage within any storage medium?
- Variations can include product size, numbers of SKUs, inventory levels per SKU, seasonal peaks-valleys-adjustments and warehouse limitations.

2. Productivity – Move More in Less Time

- Can Warehouse Navigation allocate the use of the lift truck fleet most effectively? Can it handle inbound and outbound product throughout the system?

The warehouse manager can achieve maximum effectiveness by:

- Selecting the lift truck closest to the pick location.
- Allowing the lift truck to travel in the most effective manner to the pick slot at the same time as it is elevating.
- Automatically handling pallet loads in and out of the racking.
- Eliminating the need for bar code scanning.
- Communicating in real time.

3. Accuracy – Eliminate Common Mistakes

- Can the Warehouse Navigation System effectively integrate with the WMS to ensure accurate receipt, put away, picking and shipping of the product?

Here's how highest accuracy is achieved:

- The system produces accurate X, Y and Z positioning.
- Aisle verification is generated at time of entry.
- The system can drive either fixed or random put away and then communicate to the WMS.
- Automatic location data transfer from the Warehouse Navigation System to the WMS eliminates faulty bar code scanning (from, for example, a damaged bar code surface) or errors in manual data entry.

4. Cost Reduction – in Fleet, Labor and Pick Errors

- Can Warehouse Navigation effectively reduce material handling costs?

Important cost savings can be achieved by:

- Throughput or productivity gains that reduce fleet requirements by moving more product in less time.
- Potential reductions in lift truck fleet size and number of operators, which can mean lower equipment and labor costs.
- Reduced facility energy costs due to reduced lighting requirements; and with fewer trucks there is a reduction in battery charging requirements – therefore less energy consumption.
- Higher accuracy rates, thereby eliminating costs associated with returns, re-stocking, additional picks, shipping and product damage.

5. Efficiencies – Producing Greater Profits

- Does the Warehouse Navigation System effectively serve to convert logistics from cost of operation to a competitive advantage?

A complete transponder-based Warehouse Navigation System will:

- Incorporate the benefits of the best space utilization, productivity gains, increased accuracies and overall cost reductions.
- Provide for higher levels of achievement in all areas, producing a greater return on investment in less time and thereby establishing that competitive advantage.
- The more demanding the application, the greater the benefit.

FACT

Jungheinrich VNA Lift Trucks offer Superior **Performance**
Technology
Advantages



EKV 515 Turret Truck

COMPETITIVE ANALYSIS

JUNGHEINRICH

CROWN

RAYMOND

PERFORMANCE

Run Time on 1 charge (HOURS)	12.5	7	6
Lift Speed with load (FPM)	98	80	50
Travel Speed with load (MPH)	7.5	7	6.6

TECHNOLOGY

3 Phase AC Technology Standard	●	○	○
5th Generation Controls	●	○	○
Pioneer of AC Technology	●	○	○

ADVANTAGES

10,000 Hour 5 Year Warranty	●	○	○
RFID Transponder Integration	●	○	○
Adaptable to most Warehouse Management Systems	●	○	○



Built for your operations

We can offer you 5 million variations.

Jungheinrich holds the answer: a modular building block system for the EKV 513–515 high-rack turret truck and order picker – for maximum flexibility regarding changing loads, warehouse design, floor conditions, energy costs and warehouse strategies. In short: maximum flexibility for nearly all factors and conditions that you have to face both today and in the future.



EKS 308

Order Picker



COMPETITIVE ANALYSIS

JUNGHEINRICH

CROWN

RAYMOND

PERFORMANCE

Run Time on 1 charge (HOURS)	12.5	7	6
Lift Speed with load (FPM)	68	43	33
Travel Speed with load (MPH)	7.1	7	6.5

TECHNOLOGY

3 Phase AC Technology Standard	<input checked="" type="radio"/>	<input type="radio"/>	<input type="radio"/>
5th Generation Controls	<input checked="" type="radio"/>	<input type="radio"/>	<input type="radio"/>
Pioneer of AC Technology	<input checked="" type="radio"/>	<input type="radio"/>	<input type="radio"/>

ADVANTAGES

10,000 Hour 5 Year Warranty	<input checked="" type="radio"/>	<input type="radio"/>	<input type="radio"/>
RFID Transponder Integration	<input checked="" type="radio"/>	<input type="radio"/>	<input type="radio"/>
48V Configurations	<input checked="" type="radio"/>	<input type="radio"/>	<input type="radio"/>

RFID Integration

Improve operational productivity by 25%.

A Warehouse Navigation System using RFID transponders guides VNA lift trucks through transmitting instructions to RFID readers on the forklift's underside. Armed with this flexible system, the warehouse can track the exact location of each lift truck outfitted with this technology. This ensures the most efficient travel and lift paths simultaneously. Also, there is no need for the operator to scan either the location or the pallet, since both are already known by the system. Note that this elimination of scanning saves valuable seconds and reduces cycle time, which translates into increased productivity.



Jungheinrich EKX Series

SUPERIOR PERFORMANCE

Understanding the Advantages



Up to 12.5 Hour Run Time on 1 Charge

- Doubled energy reclamation through regenerative braking and lowering
- Longer operating times with one battery charge (up to 2 shifts)
- Shorter charging times
- Active energy | battery management
- Longer battery life
- Battery rollers for quick battery swaps



Lift Speed of up to 100 fpm at Full Capacity

The fastest lift speed in the industry combined with the ability to perform over two shifts, the EKX 515 can drastically increase your operation's productivity. Bottom line, your facility can operate efficiently while knowing that you have the capability to handle larger influxes of product with ease.



The Industry's Fastest Travel Speed of 7.5 mph

The fastest travel speed means higher throughput. This feat is accomplished with high torque AC motors, excellent acceleration, and simultaneous lifting and lowering of main and supplementary lift.



Unmatched Support when you need it

- The Best Manufacturer Support in the Industry
- 50,000 Hour | Five Year Warranty
- Factory Trained and Certified Technicians
- 4 Hour response time

"You can see many years of engineering have gone into the Jungheinrich product."



PROVEN EXCELLENCE

"We discovered the maintenance cost on Jungheinrich's three-wheel EKX 515 was low, unbelievably low. And, it's battery life was twice that of the competitive models. So we acquired three of them.

We do maintenance, of course, but otherwise, Jungheinrich trucks just don't seem to break."

Chris Batt | Corporate Logistics Manager | American Hotel Register

"The Jungheinrich lift trucks are very well built. We were surprised when the products came in, especially in comparison to other lift trucks we considered. You can see many years of engineering have gone into the Jungheinrich product."

Randy Neeves | Vice President of Operations | Regal Logistics

"We did look at other electric trucks, but, in the end we decided Jungheinrich had more experience with AC technology and offered features that were more advanced. And they've proven to have a very reliable logistics organization — we've never really experienced a delay in getting spare parts from them."

Bruce Claridge | Plant Manager | REHAU's Cullman Construction Products Division

ADVANCED TECHNOLOGY

Understanding the Advantages

Jungheinrich EKS Series



The Pioneer in AC Technology

Over 400,000 AC trucks are in use all over the world. The depth of this knowledge is reflected in today's drive and control technology.

- Excellent productivity
- Low energy consumption
- Reduced maintenance and wear

The only 48 Volt Truck on the Market

- Excellent run times of up to two shifts
- Increased performance
- Higher throughput for demanding applications

The Highest Picking Height in the Industry

The EKS is the only order picker that has the ability to pick at lift heights of over 400"

ADDED BENEFITS



Adaptability to most Warehouse Systems

The EKS 515 is adaptable to most warehouse software management programs, helping to increase product performance and your bottom line.



Low Cost Compliment to your WMS

RFID Transponders or "pills" can be installed within your warehouse. Each "pill" can be installed in about 5 minutes, and typically costs only \$20 each. Yet, the results can be enormous.

- Allow for maximum performance of each truck
- Add additional safety by automating some functions
- Creates a semi-autonomous environment at minimal cost



State-of-the-Art Ergonomics

A highly productive operator is one that avoids fatigue and guess-work

- Spaciously dimensioned cab
- Outstanding field of vision through the mast
- Height-adjustable operating console with generous storage space
- Truck performance can be set for each individual operator



"In normal operation with our other truck brands, we have to change batteries every 8 hours, but Jungheinrich trucks give 12-hour shifts before recharging - and sometimes even more. That kind of performance is just one factor leading to a big improvement in our productivity."

Alfonso Castro | Engineering Manager | Procter & Gamble

WHO IS JUNGHEINRICH ANYWAY?

Jungheinrich Facts:

- The 3rd largest forklift manufacturer in the world with a growing presence in the U.S.
- Jungheinrich designs a full range of electric warehouse products – including those manufactured in Houston, TX.
- Jungheinrich builds a premium product. Their design team focuses on ergonomics, efficiency and solutions for the customer.

Extensive Dealer Network

With hundreds of locations throughout North and South America, Jungheinrich dealers offer more than quality lift trucks. By providing direct lift truck sales, forklift rentals, and parts and service support, Jungheinrich forklift dealers strive to provide the service you need — when you need it most.

Parts – Over 150,000 parts stocked in the United States

We understand that you need your parts as soon as possible. And it's our goal to get them to you. As part of our commitment to provide an efficient parts program, our Jungheinrich dealer network has access to genuine OEM parts that can be delivered overnight, anywhere in the United States.

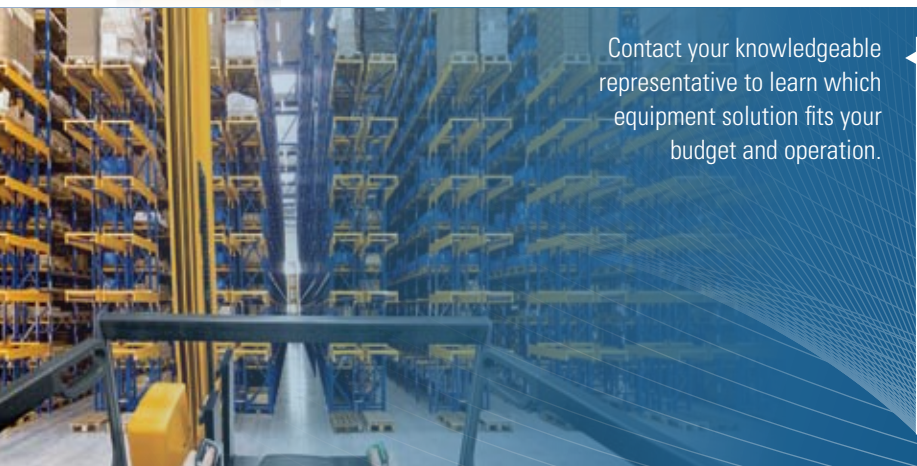


LEARN MORE

Discover how these trucks can improve your application...

Go to tri-liftnj.com/narrow_aisle

- *View videos of these trucks in action*
- *Download product brochures and spec sheets*
- *View testimonials on how these trucks have helped others*
- *Get in touch with your Tri-Lift NJ Representative*



Contact your knowledgeable representative to learn which equipment solution fits your budget and operation.



“Great Reputation, Great Service, Knowledgeable Technicians.”

Tim C. | Logistics Manager | Valued Tri-Lift NJ Customer

Phone: 732.220.0444 | Fax: 732.220.0440

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