

# The Science of PALLETIZING

VOLUME 3



HIGH LEVEL • FLOOR LEVEL • ROBOTIC



How to choose  
the right system



## Foreword

The Science of Palletizing is an educational introduction to the basics of unit-load forming and is designed to familiarize you with the fundamentals of palletizing. Since all palletizing applications are unique, selecting a machine to meet your specific needs cannot be done by simply reading this book. However, the information covered should prove to be an essential tool in the selection process.

This book includes updated information from the three previous publications: The Science of Palletizing, How to Pick the Right System, and The Science of Palletizing, Volume Two – Systems. These versions were first released in 1987, 1988 and 1999 and were enthusiastically received by the material handling industry with over 52,500 copies being circulated. In this edition, updates on the latest trends in conventional and robotic palletizing, palletizer accessories, multiple line solutions and tips on how to select the right system are all included.

The Science of Palletizing is organized by chapters allowing the reader to identify the topics of most interest. Because of this, there is some information repeated throughout the book to ensure that a complete overview is presented. For example, conveyors are discussed in length in the Conveyors chapter and again in the Robotic Palletizing and Conventional Palletizing chapters as conveyors pertain to each of those solutions.

If you have additional questions not covered in this publication or a specific application for which you require assistance, visit [www.palletizing.com](http://www.palletizing.com), fill out the postage-free reply card at the back of the book or call toll free at 800-628-4065 or direct at 360-694-1501. We will be happy to assist you.

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# Table of Contents

<b>1</b>	Foreword
<b>3</b>	Table of Contents
<b>4</b>	<b>Chapter 1:</b> The History of Palletizing
<b>7</b>	<b>Chapter 2:</b> Common Elements of Palletizing
<b>25</b>	<b>Chapter 3:</b> Conveyors
<b>32</b>	<b>Chapter 4:</b> Robotic Palletizers
<b>41</b>	<b>Chapter 5:</b> Conventional Palletizers
<b>50</b>	<b>Chapter 6:</b> Multiple Line Solutions
<b>54</b>	<b>Chapter 7:</b> Accessories
<b>59</b>	<b>Chapter 8:</b> Now What?
<b>64</b>	<b>Chapter 9:</b> Identifying a Palletizer to Meet Your Needs
<b>67</b>	Acknowledgements & References
<b>68</b>	Palletizer Information Services
<b>70</b>	Glossary



# 1

## The History of Palletizing

## The History of Palletizing

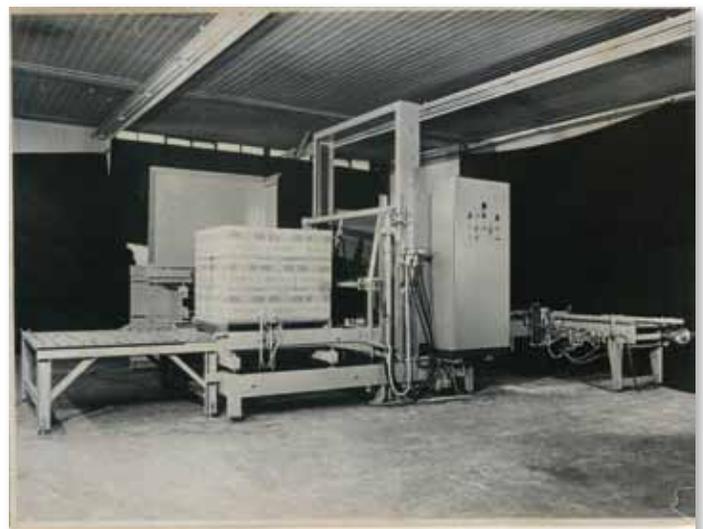
Hand stacking cases into pallet loads for storage or direct distribution has been around since the very first packaging lines were installed. However, as production rates increased to levels of 20 cases per minute and beyond, an automatic means for stacking cases became necessary. This created a need for an automatic solution, known today as the "palletizer."

Row-forming automatic palletizers were first introduced in the early 1950's. Pallet loads were created by product arranging on a row forming area and pushed onto a layer forming area. This process is repeated until a complete layer of product is formed and placed onto the pallet, until the pallet is complete and removed from the machine.

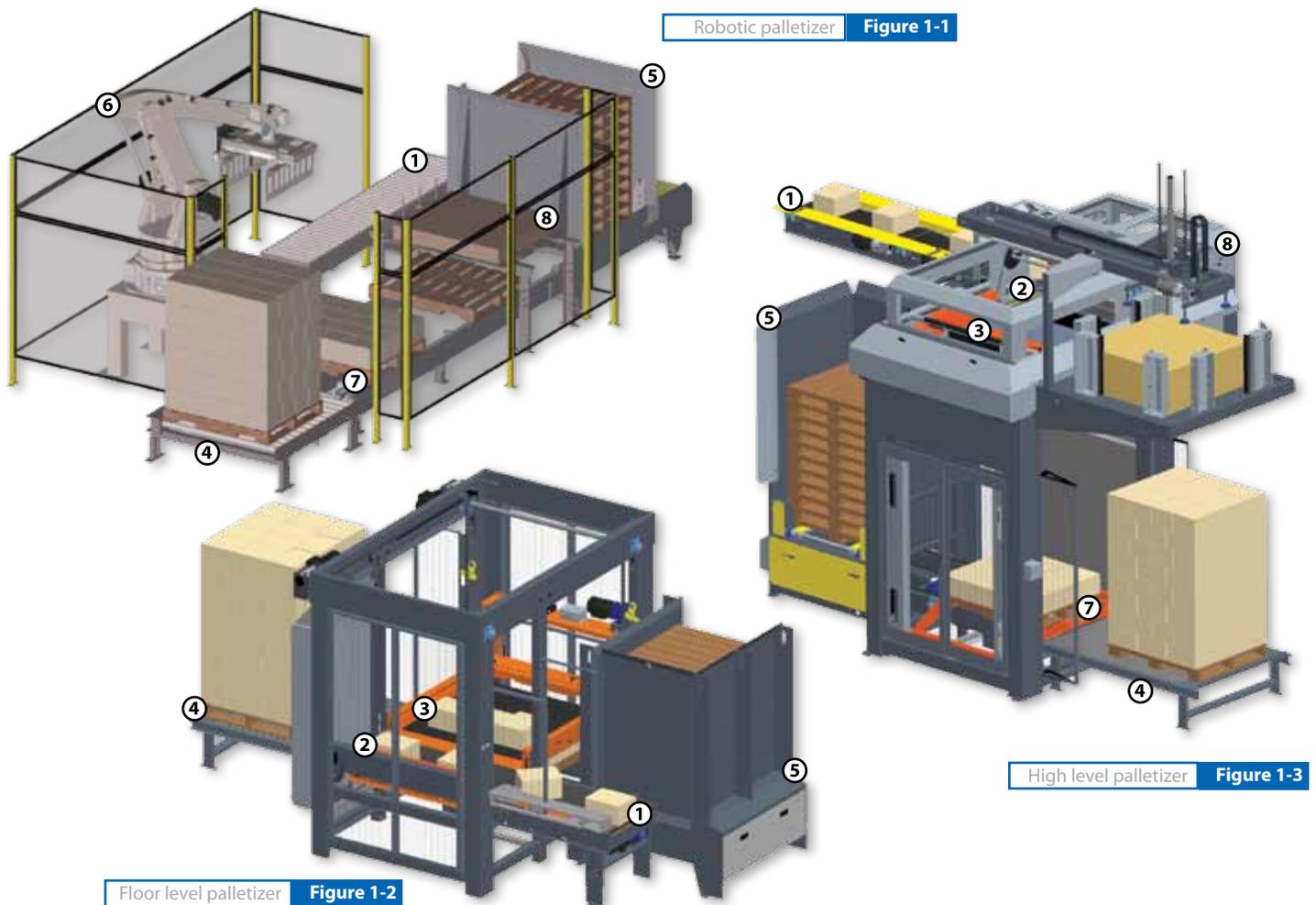
In the 1970's, the demand for higher speeds encouraged palletizer manufacturers to invent an in-line, continuous-motion palletizer. An in-line palletizer uses a continuous motion flow divider that guides the product into the appropriate location on the layer forming area until a layer is complete and placed onto the pallet.

Introduced in the early 1980's, robotic palletizers use an end of arm tool (end effector or product gripper) to pick the product from a conveyor or layer table and place it onto a pallet.

Both conventional and robotic palletizers can receive product at a high elevation (typically between 84" to 124") or low "floor level" elevation (typically at 30" to 36").



The following diagram shows the basic components of floor level, high level and robotic palletizers. There are relative advantages to each type of palletizing solutions that are discussed in detail later in this book.



Robotic palletizer Figure 1-1

Floor level palletizer Figure 1-2

High level palletizer Figure 1-3

- ① **Infeed:** Conveyor on a palletizer where product is oriented as required to make the patterns.
- ② **Row Former:** A conveyor on a palletizer used for accumulating oriented product in a row as part of the process of forming a layer.
- ③ **Layer Forming Area:** A section of the palletizer where rows are combined to form a layer.
- ④ **Discharge Conveyor:** A conveyor capable of receiving and transporting a palletized or unitized load of product from the palletizer or unitizer.
- ⑤ **Pallet Dispenser:** A mechanism that can accept a stack of pallets and discharge a single pallet upon demand.
- ⑥ **Robotic Arm:** An automatically controlled manipulator programmable in three or more axes.
- ⑦ **Pallet Station:** The area where the pallet is placed.
- ⑧ **Sheet Dispenser:** A mechanism that contains a stack of sheets and automatically moves a sheet from the stack for placement under the load or between layers.



# Common Elements of Palletizing

This chapter discusses common elements that are required with all types of palletizers. Both conventional and robotic palletizers must always consider the following requirements:

- Load Types
- Pallets
- Pallet Dispensing
- Pallet Conveying
- Sheet Types
- Sheet Dispensing
- Package Types
- Patterns
- Speed
- Working Conditions
- Safety

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## Load Types

There are two basic stacking methods, “palletizing” and “unitizing”. Palletizing is when product is stacked onto a pallet using a predetermined pattern configuration and a given number of layers. Unitizing carries out the same stacking procedure, but without a pallet. Unitized loads may be stacked onto a slip sheet or directly onto the conveyor (Figures 2-1, 2-2 and 2-3).

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## Pallets

A pallet is a platform that supports goods for transportation and storage that can be moved by a forklift, pallet jack or other lifting device for transportation within an automated system.

## Brief History of Pallets

The modern form of the pallet was first introduced in 1925 and was modified throughout the 1920s to 1940s to create the modern 2-direction stringer pallet that is used today. The introduction of the pallet had a great impact on the rail car transportation system; taking a 3-day event of unloading up to 13,000 unpalletized cases down to a short 4-hour task once the cases were palletized.



Pallet load on pallet **Figure 2-1**



Pallet load on sheet **Figure 2-2**



Pallet load on conveyor **Figure 2-3**

## Pallet Sizes

There are trends to move towards domestic and global pallet size standardization. In the 1960s and 70s, the US grocery industry began conversion towards the 48" x 40" standard footprint, known today as the GMA or grocery pallet. Today, there are a total of six pallet footprints recognized by ISO 6780. Although there is a trend to standardize the pallet sizes used, there are hundreds of pallet styles used today.

### ISO PALLET DIMENSIONS [1]

Dimensions (mm)	Dimensions (Inches)	Wasted Floor, ISO Container*	Region
1219 x 1016	48.00 x 40.00	3.7%	North America
1200 x 1000	47.24 x 39.37	6.7%	Europe, Asia
1140 x 1140	44.88 x 44.88	8.1%	Australia
1067 x 1067	42.00 x 42.00	11.5%	North America, Europe, Asia
1100 x 1100	43.30 x 43.30	14%	Asia
1200 x 800	47.24 x 31.50	15.2%	Europe

\*Wasted floor space is the excess area in a shipping container where pallets cannot be placed

### PALLET DIMENSIONS BY INDUSTRY [2]

Dimensions (mm)	Dimensions (inches)	Production Rank	Industry
1219 x 1016	48 x 40	1	Grocery, many others
1067 x 1067	42 x 42	2	Telecommunications, paint
1219 x 1219	48 x 48	3	Drums
1016 x 1219	40 x 48	4	Military, cement
1219 x 1067	48 x 42	5	Chemical, beverage
1016 x 1016	40 x 40	6	Dairy
1219 x 1143	48 x 45	7	Automotive
1118 x 1118	44 x 44	8	Drums, chemical
914 x 914	36 x 36	9	Beverage
1219 x 914	48 x 36	10	Beverage, shingles, packaged paper
889 x 1156	35 x 45.5	Unknown	Military ½ ISO container, fits 36" standard doors
1219 x 508	48 x 20	Unknown	Retail

## Pallet Types

There are two classes of pallets: stringer pallet and block pallet and three main types of pallets: two way entry pallet, partial four way entry pallet and full four way entry pallet. Within each type there are many styles of pallets identified including: single deck, double deck, single wing, double wing, flush, single cantilever, and double-cantilever. [3]



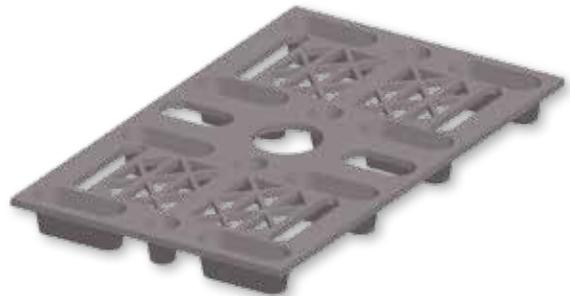
Winged pallet **Figure 2-4**



Stringer pallet **Figure 2-5**



Block pallet **Figure 2-6**



Nested pallet **Figure 2-7**



Four way pallet **Figure 2-8**



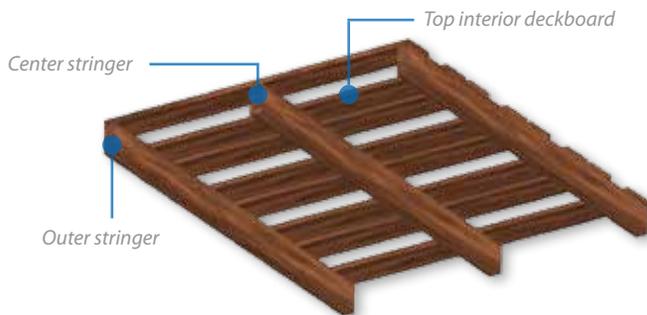
Two way pallet **Figure 2-9**

## Construction of Wood Pallets

Most pallets have a top, middle and bottom sections. The key difference in the pallet styles is how these three pieces are constructed. Some wood pallets only have top boards and stringers.

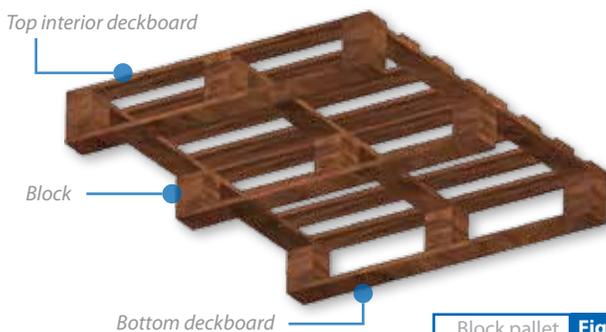
As discussed above, there are many styles of wood pallets and these all fall into two classes of pallets: stringer pallets and block pallets. The following are the key differences in the construction of these pallets.

**Stringer pallets** are constructed with top deck boards that are attached to two or more parallel pieces (called the stringers) to create the pallet structure.



Stringer pallet Figure 2-10

**Block pallets** are constructed using blocks to attach the top deck boards to the bottom deck boards. Most block pallets are constructed using 9-blocks, although a 4-block pallet and 12-block pallets are available styles.



Block pallet Figure 2-11

Top boards create the top deck of a pallet. These boards can all be the same or variable width or can be solid; they can be spaced evenly apart or joined.

Bottom boards create the bottom deck of a pallet. The bottom deck can consist of 3 longer skids, a picture frame or a solid deck.

The middle of the pallet is the key in determining which class the pallet will fall into. If the middle consists of long, parallel pieces then this creates a stringer pallet. If the middle consists of blocks, then this creates a block pallet.

### ISPM No. 15

(International Standards for Phytosanitary Measures) requires all wood packaging material with a thickness of over 6mm that are used to ship products between countries to be heat treated or fumigated with methyl bromide and marked with a seal of compliance in order to prevent spreading pests. This includes all wood packaging materials such as pallets, crates and dunnages. [4]

### Repaired Pallets

Quite often repaired pallets are used and it is important to understand the pallet grade system. Pallet grades refer to the condition of repaired wood pallets and the acceptable defects of the pallet.

Classes of repaired 48" x 40" notched three stringer pallets: [5]

- **Class 1:** Could contain metal plates, but no companion stringer repairs.
- **Class 2:** One or two stringers repaired using plugs and/or notched blocks or longer companion stringers.
- **Class 3:** Otherwise not meeting Class 1 and Class 2 criteria.

## Other Materials Used

Today, pallets are made of wood, plastic, composite wood (such as plywood), paper-based (also known as corrugate) and metal (aluminum, steel, etc). The intended use of the pallet, required life of the pallet and the environment in which the pallet will be placed, will determine the type of pallet needed.

**Slab Pallets** are a solid plywood board (sometimes plastic) usually between 7/8" and 1 1/8" thick. Sizes vary; common dimensions include 40" x 48" and 43" x 51".

Slab pallet **Figure 2-12**



**Plastic Pallets** come in many different styles, sizes and materials. Some plastic pallets mimic the construction of wood pallets while others, such as one piece molded pallets or nested pallets, are unique.



Plastic pallet **Figure 2-13**

## Pallet Condition

With the wide variation of pallet conditions for an automatic palletizer, it is extremely important to have a pallet inspection program in place to identify pallet defects. These defects may include protruding nails, broken boards, poor repairs, mold and missing bottom boards. These flaws may cause pallet jams or other problems that may create palletizer downtime or may even damage your product prior to shipping. In place of a pallet inspection program, some companies choose to participate in a Pallet Rental or Management System as follows.

## Pallet Rental Systems

Prior to 1990 there were two methods of acquiring pallets for shipping. The first is purchasing new and/or used pallets to ship goods on knowing that the pallet will not be returned. The second, mostly used by larger manufacturers, was individual "pool systems" that allowed the manufacturer to receive their pallets back to be used again.

In 1990, a National Pallet Rental Pool Program was introduced in the U.S. by CHEP after successfully implementing similar programs around the world. A pallet rental or management company supplies pallets to a user company in the supply chain. The advantage to participating in this program is that it is less expensive to "rent" a pallet than to purchase a pallet. However, the rented pallets must stay within the pallet pool and be returned to the rental company or the user company will receive an additional charge for the pallet. When considering using a rental pallet company, it is important to consider the type of pallets needed, the needs of your business partners and to familiarize everyone in your company and your network of retailers and logistics operators of your plan to use rental pallets in order to make it a successful program.[6] Today, there are many pallet rental companies; some of the largest include CHEP, iGPS, PECO, Kamps Pallets and CPC (Canada).

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## Pallet Dispensing

A pallet dispenser takes a stack of pallets and separates one pallet out to convey into the palletizer.

### Pallet Dispenser Types

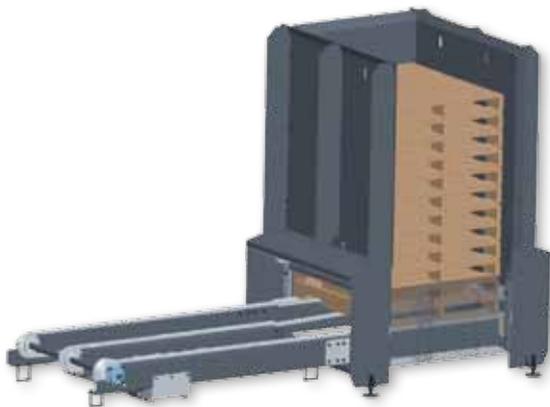
There are many different types of pallet dispensers in order to handle the various styles of pallets. The three main types of pallet dispensers are: Stripper Style with Pallet Hopper, Lift & Separate with Pallet Hopper and Staging Pallet Dispenser.

**Stripper Style with a Pallet Hopper**

A pallet stack (usually 12 – 19 high) is placed into a hopper with the stack resting on two elevated pads slightly above the two chains. When the dispenser is placed in motion the lugs on the chain push the bottom pallet through a nominal 7” opening in the front of the wall with the upper stack restrained by the front wall. (Figures 2-14a and 2-14b)



Stripper style with pallet hopper **Figure 2-14a**



Stripper style pallet dispenser isometric view **Figure 2-14b**



Lift & separate with pallet hopper **Figure 2-15a**



Lift & separate pallet dispenser isometric view **Figure 2-15b**

**Lift & Separate with Pallet Hopper**

Pallets are placed into a hopper (usually 12 – 19 high) where the pallet stack is resting on a lift mechanism. A lift mechanism raises the stack so that a holding mechanism holds the pallet stack from the second to bottom pallet. The lifting mechanism lowers the bottom pallet onto the chains or rollers and dispenses into the palletizer. (Figures 2-15a and 2-15b).

## Staging Pallet Dispenser

A pallet stack (12 – 19 high) is conveyed into the pallet dispenser and a lift mechanism raises the stack so that a holding mechanism holds the pallet stack from the second to bottom pallet leaving the bottom pallet on the conveyor. The lifting mechanism lowers the bottom pallet onto the chains or rollers and dispenses the pallet into the palletizer. When the last pallet in the stack has been dispensed, the system automatically conveys in the next stack of pallets.



Staging pallet dispenser with pallets Figure 2-16

In both the Lift & Separate and the Staging Pallet Dispensers lifting mechanisms are used. There are many kinds of lifting mechanisms. The lift mechanism can be a scissor lift, air bags, electric motor or air cylinder between the chains. The holding mechanism can be steel plates that swing down or swing in to hold the pallets by the outer boards or can be fork lift style. All of these are considered a lift and separate style. A variation of the lift and separate, with a holding mechanism for the side boards, is the Fork-Tine Style Pallet Dispenser. This is where two steel plates, similar to fork lift tines, run the full breadth of the pallet.

Fork style pallet dispenser Figure 2-17a



Fork style pallet dispenser isometric view Figure 2-17b

## Pallet Conveying

There are many types of pallet conveyors used in transporting a pallet load of product including: roller, chain, plastic belt and slat (Figures 2-18 - 2-22). For more sophisticated lines, Automatic Guided Vehicle (AGV), Laser Guided Vehicle (LGV) and transfer cars are used.



Chain driven live roller conveyor Figure 2-18

Gravity roller conveyor is the least expensive of discharge conveyors. However, it's not recommended for extra high loads or high column-stacked loads. Also, a length of 15 feet is considered maximum.

Belt-driven live roller and chain-driven live roller (CDLR) are the most common types of discharge conveyors. They are used when the pallet bottom boards are traveling perpendicular to the rollers. When used in five-foot sections, these conveyors can stage loads into a stretch wrapper or onto a shuttle car.

If the pallet bottom boards are parallel to the discharge rollers, they can lead to excessive vibration as the pallet travels over the rolls. The number of bottom boards also becomes critical in determining whether the pallet can travel along the discharge conveyor without shaking the load apart.

A full load discharge conveyor with close-centered rollers can eliminate some of the vibration. But the number and size of the bottom boards, diameter of the rollers and the roller's center to center dimension must be considered.

A two or three-strand chain conveyor is the preferred method of handling pallet loads when the bottom boards are running perpendicular to the direction of travel. The slat conveyor is also an option because its surface is flat and capable of conveying full pallet loads both with and without pallets.



Slat conveyor **Figure 2-20**

Unitized loads of product that could sag between rollers or when the product is light weight, small or has an irregular shaped bottom are best transported on a plastic belt conveyor.



Plastic belt conveyor **Figure 2-21**



Chain pallet conveyor **Figure 2-19**

### Challenges of Pallet Dispensing & Conveying

A key challenge to any automatic system is the quality of the pallets. Loose bottom boards, protruding nails that scrape and missing top boards on the outer edge may create a jam requiring manual intervention.

## Sheet Types

Slip sheets, deck sheets, tie sheets and cap sheets are frequently used for a variety of reasons. Some of the reasons include protection from moisture, adding load stability, or protecting the load from environmental elements. Sheets are made from many different materials including: corrugate (usually 1/8" thick), liner board, fiberboard or plastic. Depending on the purpose of the sheet, there is a material to meet your need.



Slip sheets on pallet or conveyor for unitized load **Figure 2-22**



Tie sheet or tier sheet between layers **Figure 2-23**



Cap sheet on top of pallet load **Figure 2-24**



Freezer sheets: used to separate layers to allow even cooling of product **Figure 2-25**



Trays, lid and corner boards **Figure 2-26**

Lift truck with push pull attachment **Figure 2-27**

### **Slip Sheets**

The primary purpose of slip sheets is for pallet-less load building (unitizing) and requires the use of a push pull attachment (Figure 2-27) on the lift truck. A slip sheet placed on a pallet (Figure 2-22) acts as an extra layer of protection for the product.

### **Deck Sheets**

In general, deck sheets measure equal to or slightly less than the top surface of a pallet. Deck and tie sheets can be used in similar situations.

### **Tie Sheets**

While rectangular cases may be interlocked to provide stability, square cases can only be column stacked. Tie sheets can be automatically inserted between pre-selected layers to improve stability (Figure 2-23). They are generally used with column-stacked loads, square cases, display packs or when many cases (20 or more) must be layered.

### **Cap Sheets**

A cap sheet is used to protect the top of a load and is placed while still in the palletizer or at a position downstream, such as in the stretch wrap machine (Figure 2-24).

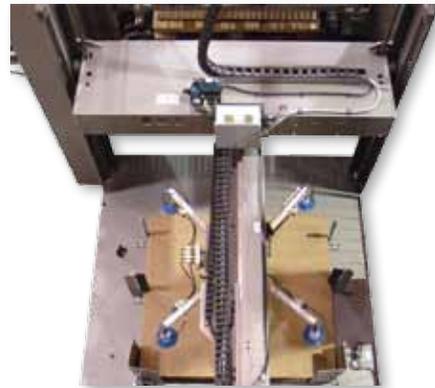
## **Sheet Dispensing**

Most sheet dispensers have the common element of working by suction cups via venturi system, using compressed air or by vacuum; creating a vacuum in the vacuum cup and picking up a sheet.

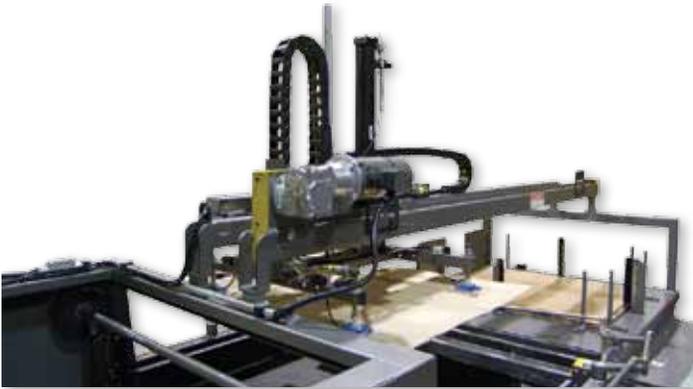
There are six types of sheet dispensers:

Floor level slip sheet dispenser **Figure 2-28**

**1. Floor Level Slip Sheet Dispensers** – This sheet dispenser is designed to take a sheet off of a stack and move to a single elevation, such as onto a pallet or roller conveyor for unitizing.

Floor level tie & cap sheet dispenser **Figure 2-29**

**2. Floor Level Tie and Cap Sheet Dispensers** - On a floor level palletizer the sheet dispenser is designed to raise a sheet to successively higher layers.



High level sheet dispenser **Figure 2-30**



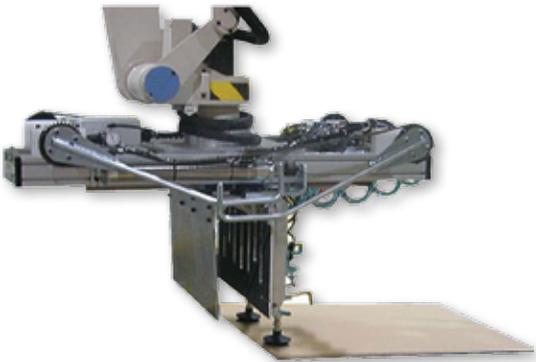
Dual hopper sheet dispenser **Figure 2-32**

**3. Sheet Dispensers on High Level Palletizers** – This sheet dispenser is located on the top of the machine to place a sheet on the pallet and between layers because the load is always raised to the top of the machine.

**5. Two Sheet Sizes** – Two sheet sizes can be handled in one sheet dispenser by using a dual hopper sheet dispenser.



Bulk loading sheet dispenser **Figure 2-31**



Robotic sheet placement **Figure 2-33**

**4. Bulk Load vs. Hand Stack** – Bulk load allows loading a pallet load of sheets into the sheet dispenser using a fork lift. Hand loading requires a smaller stack of sheets to be manually placed into the sheet dispenser.

**6. Robotic Applications** – A robotic end effector can be equipped with a sheet handling tool that when combined with a sheet table allows the robot to place the sheets onto the pallets or layers as needed. This adds tremendous versatility and can save the cost of buying a sheet feeder, but it does so at the cost of overall speed.

### Some Common Challenges of Sheets

1. Too much static electricity can cause multiple sheets to be picked.
2. Extremely porous sheets allow multiple sheets to be picked.
3. Used sheets can cause problems due to inconsistent sheet placement in the stack and lower quality sheets.
4. Freezer sheets with a waffle pattern can make it difficult to create a vacuum.
5. Ungraded sheets are not controlled (material composition and thickness).

### Package Types

The packing of goods into a container, such as a case, bag, wrap, etc.

### Packaging Trends

Evolution of package types has changed drastically over the last decade moving from the use of shipper cases to minimal packaging material and smaller cases. Palletizing traditionally was done on RSC and corrugate boxes, which was a heavy material to protect the individual retail packs for display on the shelves. Today, marketing requirements, retail outlets (such as club stores), green considerations and economical constraints are driving a revolution of packaging types.

### Package Types

Today there are many different types of packages that require palletizing, including traditional RSC, shipper case, bundle wrapping, shrink wrapping, display packs, bags, trays, totes, over wrapping trays, plastic full depth tray (milk crate), small cases and plastic beverage trays.

### Definitions

**RSC** – Regular Slotted Case, typically corrugate case.



RSC Figure 2-34

**Bundle wrapping** – A flexible-film option for heavier and larger multipacks of two or more units that offers a surface for high-impact graphics, using primarily print-registered polyethylene film. Film thickness is 1 mm to 1.5mm and provides the strength needed for package carrying.



Bundle wrapping Figure 2-35

**Shrink wrapping** – A flexible-film option preferred for multipacks ranging from two bottles to even a 36 pack of bottled beverage. Film thickness is .45 mm to .75mm and requires trays, inserts or pads to enhance package strength.



Shrink wrapping **Figure 2-36**

**Display cases** – A corrugate case where the top is open, and the sides may be partially open.



Display cases **Figure 2-37**

**Trays** – Trays can be corrugated, plastic and at various heights.



Trays **Figure 2-38**

## Packaging Challenges for Palletization

1. **Smaller package footprint**, traditional case size was 16" x 12" now product is as small as 4" x 6" and can be stacked using automatic palletizers.



Small footprint packages **Figure 2-39**

2. **HCG (High Center of Gravity)** includes cases that are relatively tall with a small footprint. The general rule for determining a HCG is when the height is more than 1½ times the products width. Examples of HCG packages include some bag in a box products or (3) ½ gallon cartons of milk bundled together as shown below.



HCG cases **Figure 2-40**

3. **Extra large package footprint**, cases are now up to 36" x 24" or larger.

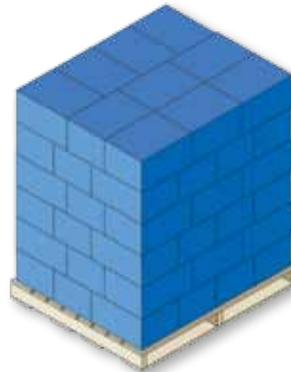


Extra large footprint packages **Figure 2-41**

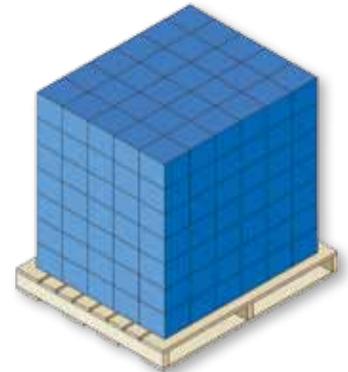
**4. Graphics on the package** are no longer protected by a “shipper case” requiring gentle handling of the primary package.



Packaging with graphics **Figure 2-42**



Interlock stack **Figure 2-43**



Column stack **Figure 2-44**

### Patterns

The number of case patterns that can be programmed into a fully automatic palletizer is virtually limitless, using today’s range of programmable controls and software. However, when a pattern is programmed into the palletizer, it is not simply a software change in the programmable controller itself. In some cases, mechanical adjustments to case stops, layer guides, etc. are required. Today’s technology makes it possible for these changes to be done automatically through the use of a HMI (Human Machine Interface).

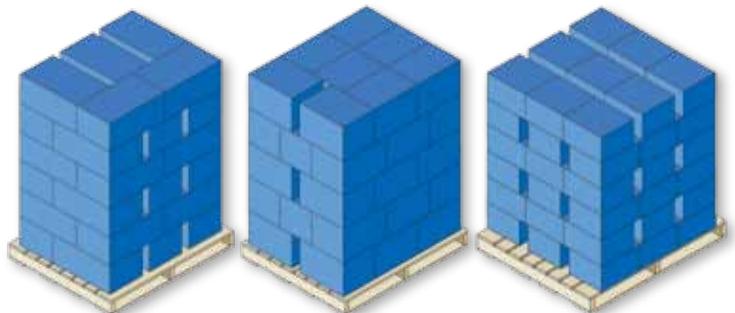
#### Traditional patterns: interlock and column

There are two basic types of patterns: interlocked and column stacked. Interlocked patterns are created with rectangular packages that enable the palletizer to create a load that has each layer rotated 180° for interlocking purposes. In this way a very stable load is built (Figure 2-43). Column stacked loads can be created with packages where interlocking cannot occur (Figure 2-44).



Interlock and column stack loads **Figure 2-45**

Some case sizes do not allow the patterns to be configured without gaps in the pattern either side to side (Figure 2-46) or front to back (Figure 2-47). Most palletizers have the ability to create patterns with these gaps in both directions (Figure 2-48).



Side to side gaps **Figure 2-46**

Front to back gaps **Figure 2-47**

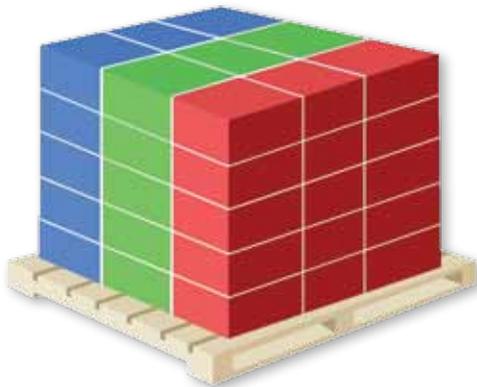
Gaps in both directions **Figure 2-48**

## Mixed Pallet Loads

Pallet loads have traditionally consisted of one SKU. Pallet loads with two or more SKUs, mixed pallet loads, are becoming more popular due to three common trends that occurred over the past 15 years. The first trend is retailers are placing smaller, more frequent orders to make better use of their floor space. The second trend is club stores demanding “shoppable” display ready pallets with minimal waste and a desire to reduce in-store labor costs.

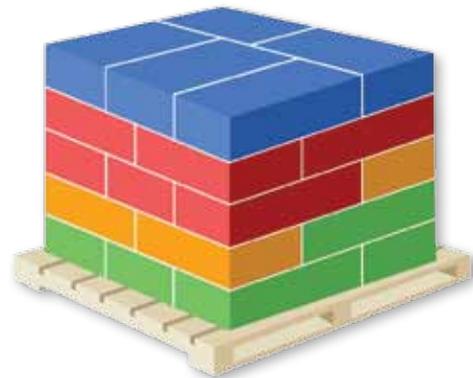
There are three common types of mixed pallet loads:

1. **Display pallets**, also known as **rainbow pallets**, are when every package size is the same but with different SKUs. This was first seen in the beverage industry where each layer or column is made up of a different flavor of beverage. For example, the first column (or layer) was cola, the second diet, the third grape and the fourth lemon-lime.



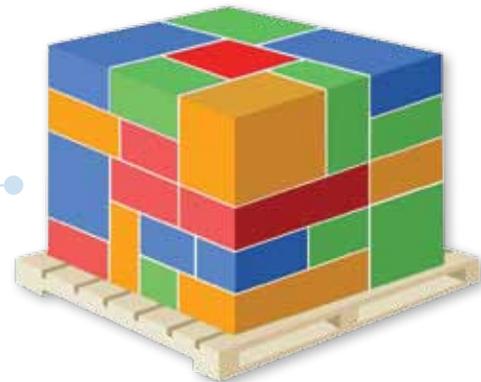
Display pallet Figure 2-49

2. **Mixed layer pallets** are created to meet store requirements of limiting the amount of inventory in the back rooms. This pallet load is similar to the display pallet where all of the package sizes are the same; however, this pallet load may have a layer and a half of cola, layer and a half of diet, partial layer of grape and a partial layer of lemon lime, all palletized to order.



Mixed layer pallet Figure 2-50

3. **True mixed pallet loads (order picking)** are also created to meet store requirements, as in the above example; however, this pallet load contains a variety of case sizes from a variety of manufacturers. For example, a true mixed pallet load may contain a half layer of cola, a half layer of diet cola, a half layer of toothpaste, a half layer of shampoo, a full layer of paper towels and a full layer of chips.



True mixed pallet Figure 2-51

Mixed load palletizing can be done at the manufacturers' plant, regional distribution centers or third-party logistics provider locations. Later chapters of this book will discuss how both robotic palletizers and conventional palletizers have adapted to create mixed pallet loads.

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## Speed

Generally, when speeds are discussed for a given palletizer; they are based on a 10 case per layer pattern configuration. A fully automatic, low speed palletizer will operate at a rate as low as 5 cases per minute (10 cases per layer, five layers). On the upper end of the speed range, some palletizers can handle 150 to 200 cases per minute (depending on number of cases per layer and number of layers).

In general, floor level machines can palletize up to 35 cpm, high level up to 200 cpm and robotic systems up to 25 cpm (single picking). This is dependent on case size and patterns required. However, there are exceptions to the rule. Both floor level and robotic palletizers have been able to palletize up to 80 cpm. All reliable palletizer manufacturers have a simulation program to show the achievable speeds for a given pattern.

When a customer considers speed requirements, they will often factor the maximum speed that the packaging line can run and add a "safety factor" of 10 – 25%. Palletizer manufacturers will pay special attention to carton size, package construction and case pattern configuration to come up with a speed that includes an additional safety factor. Sometimes this duplication of safety factors can sway a customer from a lower speed to a higher speed machine. A project may no longer be viable as a result of these additional costs. Therefore, it is important to communicate to the palletizer manufacturer if the desired line speed provided

already includes a safety factor so the appropriate machine can be quoted.

A well running palletizing system will have the capability of running 20 – 25% excess line speed. Example: Constraint of production line is 20 cpm, the palletizer should run at least 24 cpm. It is important to communicate the desired safety factor so that it can be factored into the appropriate palletizing solution.

The customer must be assured by the palletizer manufacturer that the quoted speeds for the pattern configurations they require are based upon continuous loads, and are sustainable and not surge rates.

In many cases, the purchase justification for a fully automatic palletizer becomes easier when the speed exceeds the ability of hand stacking the line, or when so many people are stacking that labor costs become prohibitive.

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## Working Conditions

It is important to consider the working conditions in which the palletizer will be placed. Most palletizers can be modified so that they can palletize in any environment. The following are a few of the conditions to be aware of:

- Extreme heat over 105°F ambient temperature
- Freezer applications under 32°F ambient temperature
- Wash down requirements
- Dusty or corrosive materials that may come into contact with the palletizer

## Safety

**Please Note: All palletizers, regardless of the manufacturer, can cause injury to personnel if the manufacturer's safety instructions are not strictly followed.**

Some key points to remember when working around any palletizer:

- The machine is automatic; any part may start at any time without warning. The machine may appear to be completely switched off when it is actually just waiting for product. As soon as the product arrives, the machine will begin operation without warning.
- Machinery guards have been designed to provide safe operation of the palletizer and reduce the possibility of personal injury and/or machine damage. It is essential to keep all shields, guards and safety devices in place before, during and after machine operation.
- If a shield, guard or safety device has been removed for any purpose, or is damaged or missing, it should be repaired or replaced before the machine resumes operation.
- Never clear product jams or attempt repair or maintenance on a machine while it has any form of power connected (air, hydraulic or electrical).
- Never attempt to work on or under the hoist without the machine being locked out and tagged out and the hoist safety pins securely in place.
- Never allow an operator to get on or into the machine without the electrical power and air supply being "locked out." This means locking out the electrical disconnect switch and the air supply using padlocks, with the key being kept by the person who needs to get on or into the machine.
- Never attempt to clear a pallet jam without first switching off the machine and locking it out.
- Never attempt to remove a full load from the palletizer until it has come to a complete stop on the discharge conveyor.
- Never attempt to weld anything on the palletizer while the power is switched on. Always disconnect the PLC before any welding is carried out.
- The palletizer will come with a number of warning decals which are positioned on the machine to indicate specific areas of danger. These warnings must be followed.
- Most palletizer manufacturers design their machines to very exacting standards, including accepted engineering standards, and applicable state and local codes. OSHA standards, however, apply to the location thereby becoming the responsibility of the equipment user and not the equipment manufacturer.
- Finally, require all personnel working with the palletizer to read the instruction manual and the safety related material.

# 3 Introduction to Conveyors

This chapter discusses the types of conveyors and conveyor systems that surround the palletizer including:

- Transportation Conveyors
- Accumulation Conveyors
- Merging Conveyors
- Sortation Conveyors
- Incline and Decline Conveyors
- Empty Pallet & Full Load Conveyors

A properly designed product and pallet load delivery system is essential to the successful performance of any palletizing project. This includes a detailed analysis of products and their handling characteristics and the proper selection of conveyors and operational modes for those products.

Conveyors used to deliver cartons, bags, trays, bundles, crates, etc. are generally of two types: transportation and accumulation.

### Transportation Conveyors

Depending on the layout, transportation may be used for the majority of the system. The mix of transportation to accumulation conveyor is dependent on many system design considerations. Transportation conveyor is most commonly used for transporting the product from the production area to the warehouse area for palletizing.

Transportation conveyors include belt conveyors, chain conveyors, flat top and table top chain conveyors and some types of live roller conveyors. Of these conveyor types, belt conveyors are the most widely used and economical type of transportation conveyor. However, flat top and table top chain conveyors are increasing in popularity for carton handling.

### Transportation conveyor photos:



Belt conveyors **Figure 3-1**



Table top conveyor **Figure 3-2**



Chain driven live roller **Figure 3-3**

## Accumulation Conveyors

Multiple line palletizing systems normally require accumulation conveyors to accumulate products until a full pallet load is received and the lane is able to discharge to the palletizer. Accumulation conveyor can also be used in single line palletizing system to allow production to continue for a short time during palletizer down time and to allow production machinery to clear out to avoid product or machinery damage.

Accumulation conveyors include live roller or flat top chain conveyors. The most commonly used accumulation conveyor is the live roller type because they are available as adjustable pressure or zero pressure type, which allows for gentle product handling.

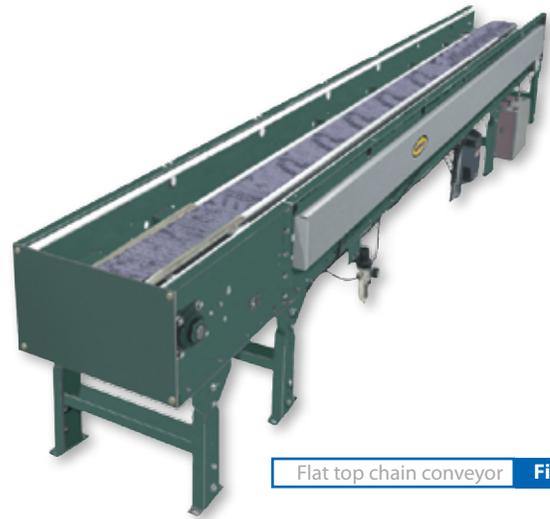
### Accumulation conveyor photos:



Live roller - adjustable pressure conveyor **Figure 3-4**



Live roller - zero pressure conveyor **Figure 3-5**



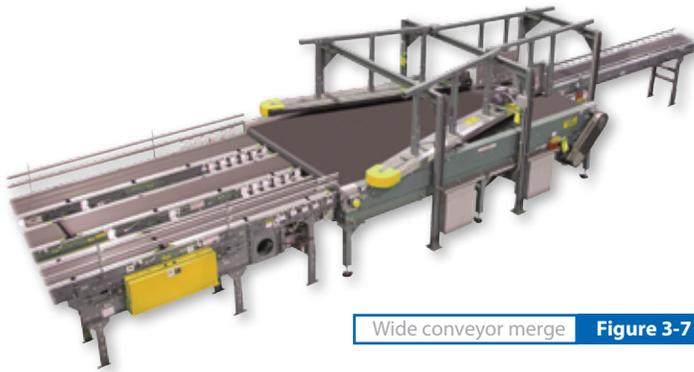
Flat top chain conveyor **Figure 3-6**

## Merging Conveyors

In multi-line palletizing systems the accumulation conveyors are merged to provide a single conveyor for delivery to the palletizer. The type of merge to be used varies depending on the product being handled, production rates, palletizing rates and layout constraints.

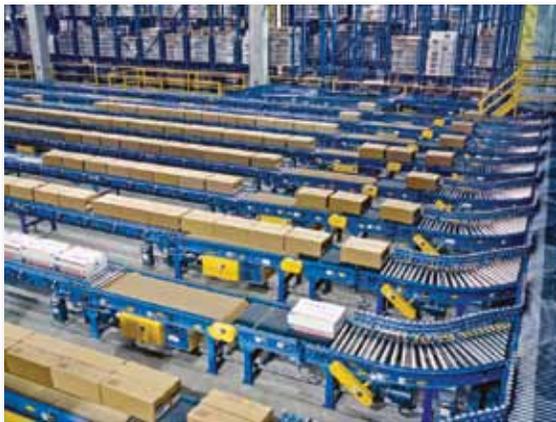
Sometimes, the palletizing area is remote to the production area. Merging several lines in the production area into a single conveyor for delivery to the palletizing area may be a cost effective solution.

The simplest merge conveyor is a wide conveyor section with carton guides that funnel the product from multiple infeed lines to a single discharge conveyor (Figure 3-7). This type of merge is usually limited to 3 accumulation lines, though some units are larger. Controls for this type of merge are usually simpler than other types.



Wide conveyor merge **Figure 3-7**

Another type of merge is a right angle version (Figure 3-8). Accumulation conveyors are arranged parallel to each other and perpendicular to the collector conveyor. As each line is released the product traverses a spur and enters the collector conveyor. An almost unlimited number of accumulation lines can be arranged in this manner.



Right angle merge **Figure 3-8**

Diagonal merges, also known as sawtooth merges, are similar to right angle merges except that the accumulation conveyors are aligned 30° or 45° to the collector conveyor. In right angle and diagonal merges, the controls schemes must incorporate methods to maximize the throughput of the merge by ensuring that the last unit from one line is closely followed by the first unit from the subsequent line. The larger the number of accumulation lines, the more complex these controls become.

## Sortation Conveyors

Sortation conveyors are used to selectively divide products on a single conveyor line to multiple conveyor lines. Another use for sortation conveyors is to deliver collected product to several lower speed single line palletizers. Sortation conveyors include pivoting arm diverters, pushers, pop-up roller diverters, right angle transfers, and sliding shoe sorters. Pivoting roller diverters and narrow belt sorters are variations of the pop-up roller diverter.



Pivoting arm diverters **Figure 3-9**



Pushers **Figure 3-10**



Pop-up roller diverters **Figure 3-11**

Right angle transfers **Figure 3-12**Sliding shoe sorters **Figure 3-13**

The proper sortation conveyor for an application is dependent on product type, size and rates.

### Incline & Decline Conveyors

Incline conveyors are used to raise product from an elevation near the floor to an elevation required for aisle clearance, overhead accumulation, overhead delivery conveyors or to match the infeed of a high level palletizer. Most often these conveyors are a style of belt conveyor utilizing high friction belting, a belt feeder to improve the transition between the lower level and the inclined portion and a nose-over section to improve the transition between the inclined portion and the upper level.

Inclined belts are typically belt on roller sections to minimize the horsepower requirements. Declined belts are frequently slider bed sections to take advantage of the natural braking due to friction between the belt and the slider pan.

Spiral belt conveyors **Figure 3-14**Slider bed belt conveyor **Figure 3-15**

Elevation changes can also be accomplished with vertical reciprocating conveyors, continuous vertical conveyors, spiral belt and chain conveyors and motor roller conveyors with belts installed.



Continuous case lift **Figure 3-16**



Reciprocating case lift **Figure 3-17**

### Empty Pallet & Full Load Conveyors

In palletizing systems, handling of the palletized load is as important as that of the product being palletized. In the simplest systems the palletizer delivers the completed load onto a single discharge conveyor, where a lift truck retrieves the load and delivers it to subsequent processing, storage or transportation areas.

Often a facility has multiple palletizers in close proximity to each other. It is sometimes desired to combine the completed loads onto a single conveyor system for delivery to a common retrieval location. In addition, it is sometimes necessary to double stack, stretch wrap or label the completed

loads and a combined conveyor system minimizes the investment in these devices.

There are two primary types of conveyor used to transport palletized loads. Chain conveyors are used to transport pallets with the bottom boards perpendicular to the direction of travel (Figure 3-18). Roller conveyors are used to transport pallets with the runners parallel to the direction of travel (Figure 3-19 - 3-20). Specialized combination transfer conveyors incorporate a live roller conveyor and a chain conveyor to combine the flow of multiple lines or divide a common flow into several perpendicular lines for subsequent processing, quality control, etc (Figure 3-21).



Chain pallet conveyor **Figure 3-18**



Gravity roller pallet conveyor **Figure 3-19**

In some palletizing systems the pallet consumption can be satisfied by a single pallet dispenser. In these systems it is sometimes desirable to provide a common pallet delivery system for multiple palletizers. A common slip sheet dispenser may also be incorporated. A variation of this allows the selective use of multiple pallet types to be delivered to multiple palletizers as required to meet varying production requirements.



Chain driven live roller conveyor **Figure 3-20**



Combination transfer conveyors **Figure 3-21**



# 4

## Robotic Palletizers

This chapter discusses robotic palletizing systems and goes into detail on the following topics:

- Types of Robotic Palletizers
- Layout of a Robotic Palletizing Cell
- Pallet Load Building
- Pattern Creation
- Pallet Load Quality
- Pallet Load Protection & Stabilization
- End Effectors (End of Arm Tools)
- Package Types
- Mixed Load Palletizing
- Speed
- Safety

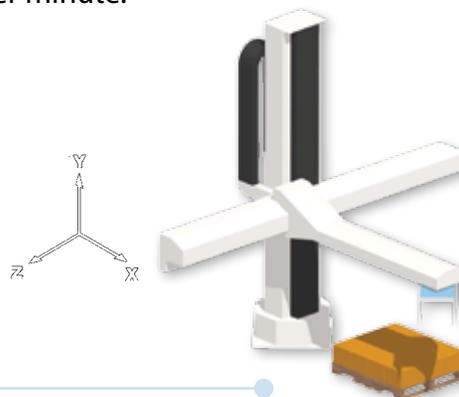
## Types of Robotic Palletizers

Robotic palletizers were first introduced to palletizing in the late 1970s and early 1980s and are currently used in industries where conventional palletizers have traditionally dominated; such as food, beverage, pharmaceutical, paper, automotive, chemical and consumer products. Robotic palletizers use an end effector or gripper to pick the product from a conveyor or layer table and place it onto a pallet. Today there are four major types of robotic palletizers: cartesian, scara, articulated and gantry.

The following drawings show the four major types of robotic palletizers and the axes through which they operate (Figures 4-1 - 4-4).

### Cartesian

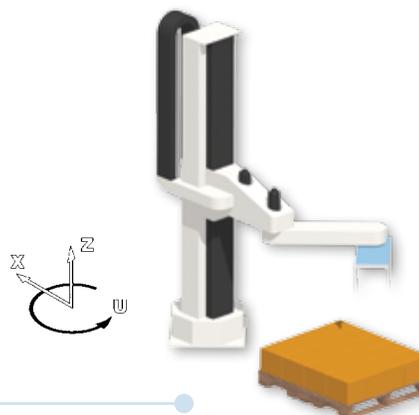
Cartesian robots are typically used in slow production facilities where there is product with consistent weight and sizes needing to be palletized. It is ideally suited as a lower cost solution for single line production at speeds up to 10 cases per minute.



Cartesian robot Figure 4-1

### SCARA

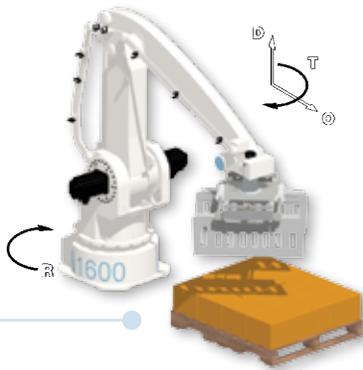
SCARA (Selective Compliant Articulated Robot Arm) robots are generally used in faster production facilities than the cartesian robot. The SCARA can typically handle up to 40 lbs. and is ideally suited for palletizing from one to three production lines at a total case rate of 20 cases per minute.



SCARA robot Figure 4-2

### Articulated

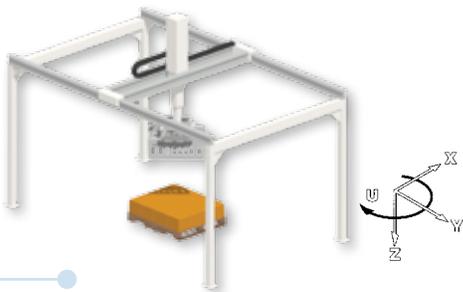
Articulated robots are the most versatile robots in the production environment. They are faster and have a variety of end effectors to pick up various product types. The articulated robot can handle a wide range of payloads up to 2,200 lbs. (including the end effector), though heavier weights are getting more common when picking complete layers. Articulated robots are capable of palletizing up to four lines at a time. On a single production line, the articulating robot can handle cases that are 50 to 60 lbs. at 25 cases per minute (single picked).



Articulated arm robot **Figure 4-3**

### Gantry

Gantry robots are generally the slowest, but have the advantage of being able to palletize a large number of SKUs simultaneously. They can also be used to handle extremely heavy product. The gantry robot has a larger footprint, and generally a much higher price tag.

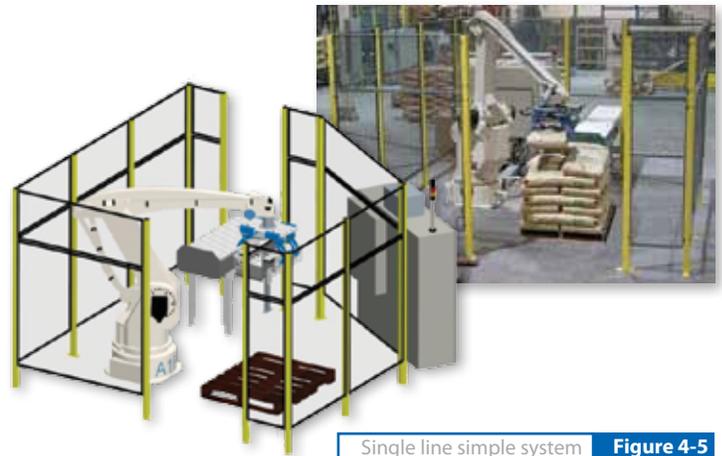


Gantry robot **Figure 4-4**

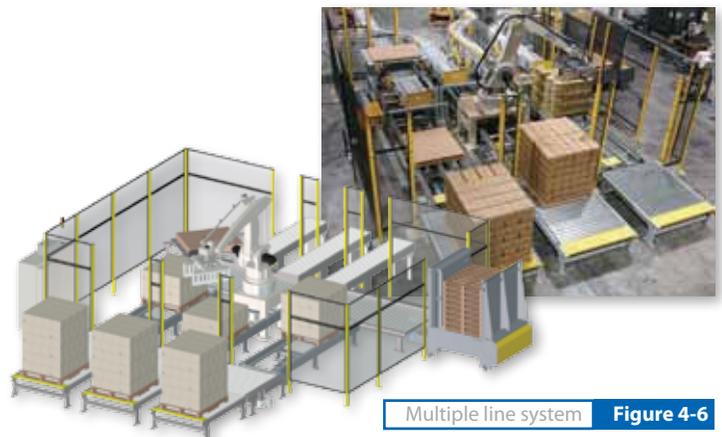
### Layout of a Robotic Palletizing Cell

A robotic work cell is the complete set of equipment that has been integrated for a specific task such as palletizing. The flexibility of a robotic palletizing system allows for endless layout possibilities and can include many pieces of peripheral equipment such as conveyors, pallet and sheet dispensers, reject stations, labelers, etc. It is important to consider the configuration of all these items and how each individual piece may effect the overall cycle time when developing a robotic palletizing system.

Robotic palletizing systems can vary greatly in complexity. Systems range from as simple as a single line with a manually placed pallet to very complex, such as a system that includes five packaging lines, feeding a single palletizer and stacking product onto five different pallet load building stations simultaneously.



Single line simple system **Figure 4-5**



Multiple line system **Figure 4-6**

## Pallet Load Building

As discussed in the first chapter, there are two main load building types, “palletizing” and “unitizing”. Both types can include placing sheets into the pallet load as needed. Both conventional and robotic palletizers can achieve the desired load types.



**Robotic palletizers incorporate the use of a pallet using one of the three following methods:**

**Pallet Dispenser** – Incorporating a pallet dispenser for dispensing single pallets into the robotic work cell without reducing the product stacking capacity of the robotic arm.



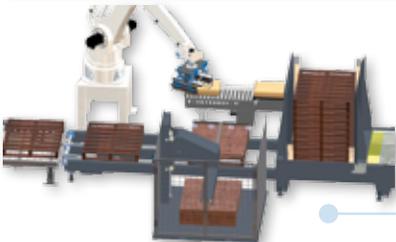
**Pallet Pickup Tool** – Adding a tool to the end effector for picking a pallet from a stack and placing it in the stacking location. This method affects the speed capacity of the robotic system.



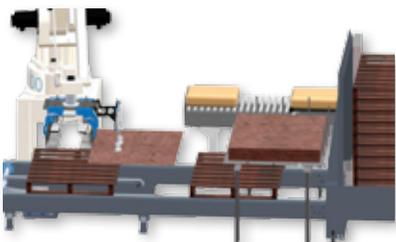
**Floor Stacking** – Stacking product on a single, manually placed pallet on the floor with no automated pallet handling. This method is suitable for very low capacity systems.

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**Robotic palletizers incorporate the use of slip and/or tie sheets using one of the following two methods:**



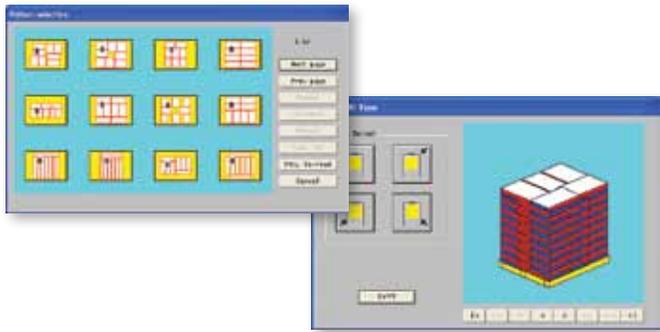
**Sheet Dispenser** – Incorporating an independent machine that picks up sheets and places them on the pallet (slip sheet) or within the load between layers (tie sheet). This method does not reduce the speed capacity of the robotic palletizing system.



**Sheet Pickup Tool** – Using end effector mounted vacuum cups the robot can pick up and place sheets on the pallet or within the load.

## Pattern Creation

Robotic palletizers often utilize easy-to-use pattern programming software. This software allows product size to be entered and the stacking pattern to be selected from predetermined patterns. More sophisticated pattern programming packages give the ability to create multiple “unique” layer patterns within the load as well as the ability of alternating layer patterns (odd-even) to interlock the load for increased stability. Most programming packages provide the capability of saving and backing up pattern programs for security purposes.



## Pallet Load Quality

Robotic palletizers are uniquely capable of stacking products that cannot easily be handled with a conventional palletizer. Since a robot picks up and places a package there is a reduced opportunity for the product to tip over, a problem that occurs when relying on the traditional turning, row forming and stripping functions that conventional palletizers use when stacking unstable High Center of Gravity (HCG) products.

Robots can also handle very large package sizes. When compared to a conventional palletizer, robots are only constricted to the operating range and weight limitations, whereas a Conventional palletizer has a large frame that requires modification to allow a large product to enter and be stacked.

## Pallet Load Protection & Stabilization

By incorporating the use of sheets into a finished load, increased load stability can be achieved. There are three ways in which sheets can be used to protect and stabilize the load; a slip sheet, tie sheet and a cap sheet. The slip sheet is typically made of heavier fiber board and is placed directly onto the pallet for the load to be stacked on. A tie sheet is placed between layers to increase overall load stability. A cap sheet is placed on top of the finished load to protect the top layer of the product. Both tie and cap sheets are usually made of a thinner kraft paper or fiberboard.

There are two methods for integrating sheets into a robotic palletizing system; a sheet dispenser and a sheet pickup tool. The sheet dispenser incorporates an independent machine that picks and places the sheets without reducing the overall speed of the system. The sheet pickup tool uses vacuum cups mounted on the end effector to pick up and place the sheets on to the load. This method does reduce the speed of the system. Picking the right sheet tool depends on the layout and needs of each system.

## End Effectors (End of Arm Tools)

The infinite variety of end effectors is what makes the robot such a versatile solution for palletizing. End effectors can be designed to handle multiple product types with a common tool. Robotic system designed for case palletizing can be transformed into a bag, pail, plastic tote, bundle or other package palletizing system. This versatility gives the robotic palletizer a strong advantage over a conventional palletizer. A robotic system becomes a flexible investment capable of handling today's packages and is capable of meeting future needs as well.

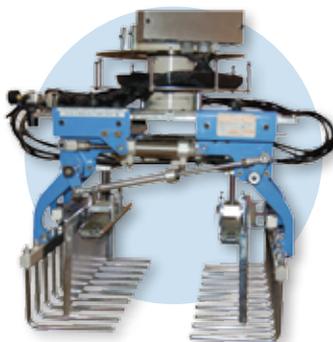
End effectors can employ different methods of product handling. These methods include clamp, fork, vacuum and custom design.



**Clamp Style** – General purpose mechanical tool capable of handling a wide variety of products by clamping the sides of the package. This tool is capable of picking up and placing multiple packages at once when they are in the same orientation.



**Fork Style** – General purpose mechanical tool suitable for rigid, semirigid and nonrigid products that require support from beneath. This tool is capable of picking up and placing multiple packages at once when they are in the same orientation.



**Finger Style** – A mechanical tool that opens and closes in two directions and is most commonly used in handling bags.

**Vacuum Style** – Uses a vacuum system to pick product from the top. There are two primary types of vacuum head. Full surface pad or individual vacuum cups arranged in a way to accommodate the needs of the palletizing system. The full surface pad is more universal and the vacuum cup type is more product specific.



**Custom Design** - Custom designed end effectors are the norm for robotic palletizing integrators, but there is a definite trend towards standardization and to only customize as needed.



## Package Types

The type of end effector is determined by the packaging type that needs to be palletized. Following are photos of some of the common package types that are palletized using a robotic palletizer.

Package types **Figure 4-7**



Valve bags



Poly bags



RSC cases



SOM paper bags



5 Gallon pails

### Mixed Load Palletizing

Mixed pallet loads are an emerging trend that requires developing technology to accomplish this task. As discussed in the first chapter, there are three common types of mixed pallet loads: display (rainbow) pallets, mixed layer pallets and pick-to-order pallet loads. Both robotic and conventional palletizers can easily create the display and mixed layer pallets. The pick-to-order pallet can be created by robotic palletizers with the addition of vision and specialized software to build the required pallet load.

Pick-to-order pallet loads are almost always created at a distribution center. These centers are generally warehouses that receive full pallet loads of specific products, none of which contain mixed products in the same load. Each pallet load is stored in a designated location until a pick list is received which calls for a specific mix of products from several loads. This combination of products may involve the re-palletizing of the different products onto a single pallet or several pallets and invariably involves different sizes of cases and/or package types. This can be accomplished by all four robotic types.

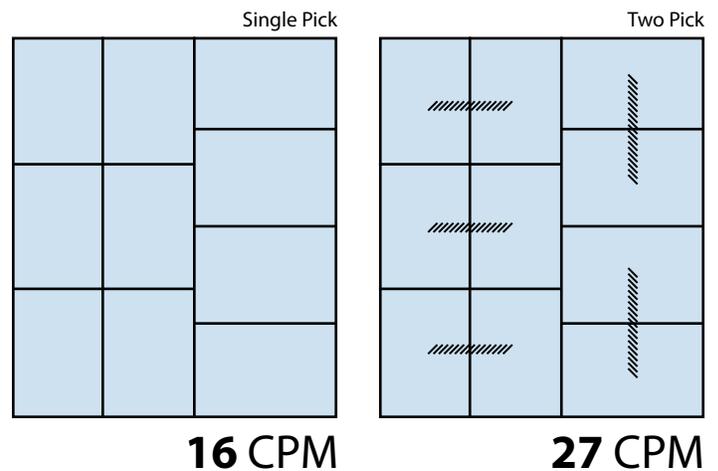


Pro E of mixed load **Figure 4-8**

### Speed

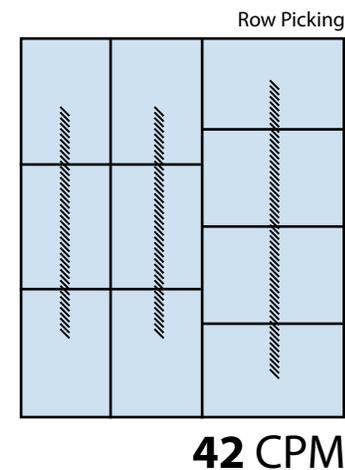
The speed range of robotic palletizers is dependent on the pattern configuration, package type, end effector, number of lines and the peripheral equipment, that makes up the robotic cell. All of the additional equipment may affect the overall speed of the robotic palletizing system.

The following is a sample of speed calculations for a standard 10-case pattern and how the speed can vary with the number of picks.



**16 CPM**

**27 CPM**



**42 CPM**

////// = End effector pick points

It is important to ask the palletizer manufacturer the following questions:

- Are the quoted speeds based on round-the-clock operation?
- Does the integrator quote “picks per minute” or “cases per minute?” Can they provide their capacity calculations to support their quoted rate?
- Are the speeds “sustainable” rates and not “surge” rates?
- Be sure to tell your prospective supplier if the rates you are asking for already have surge capacity included, so they know that they do not need to exceed this rate, which can save you money. Many times a prospective customer “pads” the rate and then the supplier “pads” the rate to make sure the speeds can be met. Many times this double padding causes a much more expensive solution to be offered than what is actually needed.

- **NFPA 79 2002**

(National Fire Protection Association – Electrical Standard for Industrial Machinery)

- **NEC 2002**

(NFPA 70 – National Electric Code)

- **UL508A**

Standard for Safety for Industrial Control Panels)

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## Safety

It is important that the robotic palletizer manufacturer you select is UL1740 Certified. This certification encompasses applicable requirements of the following standards:

- **ANSI RIA 15.06 – 1999**

(Industrial Robots & Robot Systems – Safety Requirement)

- **CSA Z434-03**

(Industrial Robots & Robot Systems – General Safety Requirements)

# 5 Conventional Palletizers

This chapter discusses conventional palletizers in detail and includes information on the following topics:

- Types of Conventional Palletizers
- Layout Configurations
- Pallet Load Building
- Pattern Creation
- Pallet Load Quality
- Pallet Load Protection & Stabilization
- Speed
- Package Types
- Mixed Load Palletizing

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## Types of Conventional Palletizers

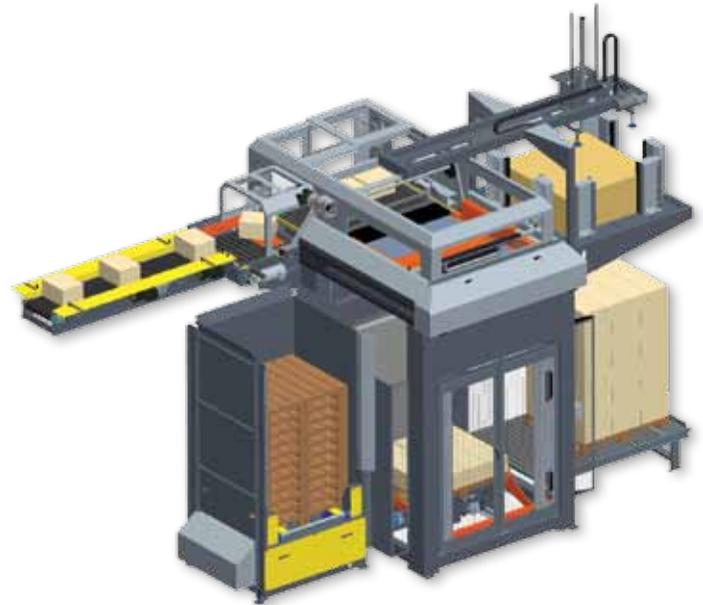
Palletizers were first introduced in the 1950s and are currently used in industries such as food, beverage, pharmaceutical, paper, automotive, chemical and personal care. There are two main categories of conventional palletizers: floor level and high level palletizers; the main difference is the elevation product is delivered to the palletizer. This is shown in the following diagrams.



Floor level palletizer **Figure 5-1**

## Floor Level Palletizer

Floor level palletizers have an infeed entry level of approximately 30" to 36". As product flows through on the infeed conveyor, a turning device rotates the product into the appropriate orientation before it moves to the row forming area. Once a completed row is formed, the row is pushed onto the layer forming area. This layer forming area can be a table (solid steel plate or plates) or apron (made of tubes) depending on the style used by the palletizer manufacturer. Once a completed layer is formed, it is moved forward to the stripper apron or plate and is lowered or raised to the pallet or previous layer, which remains static during the load building process. This process is repeated until a pallet load is complete and moved onto the pallet discharge conveyor, which is typically at an elevation of 18".



High level palletizer **Figure 5-2**

Floor level palletizer **Figure 5-3**

Advantages to a **floor level** palletizer include:

1. Floor level palletizers generally are lower in cost than high level palletizers.
2. Maintenance on a floor level palletizer is easier than a high level palletizer because parts are easier to access.
3. A fork truck operator can monitor the case infeed of the floor level palletizer while filling the pallet magazine or removing a full load from the discharge conveyor.
4. The infeed elevation makes them ideal for close coupling to the case packers and case sealers, which have similar discharge elevations.

### **High Level Palletizer**

High level palletizers have an infeed elevation from 84" to 124" or higher. As with the floor level palletizer, product comes in via the infeed conveyor to a turning device that rotates the product into the appropriate orientation before it moves to the row forming area. Once a completed row is formed, the row is pushed onto the layer forming area. This layer forming area can be a plate or apron depending on the style used by the palletizer manufacturer. High level palletizers raise and lower the pallet for each layer that is placed on the pallet or previous layer. Once a completed load is built on a high level palletizer, the entire load is lowered to the discharge elevation and then conveyed out of the machine. A discharge elevation for high level machines is typically between 18" and 30". The operator station for a high level machine is located on an elevated operator platform.

High level palletizer **Figure 5-4**

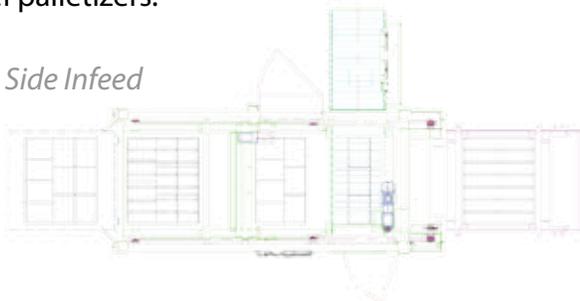
Advantages to a **high level** palletizer include:

1. High level palletizers are more suited to situations where the palletizer is located some distance from the case packer or sealer.
2. A high level palletizer has a higher throughput relative to the size of the footprint, using production facility floor space more efficiently.
3. For high speed applications above 40 or 50 cases per minute, a high level palletizer becomes the obvious choice regardless of the case packer or case sealer discharge elevation.

## Layout Configurations

Cases entering the palletizer can be fed 90° to the discharge or rear fed moving parallel to the discharge. This applies to both floor level and high level palletizers.

*Side Infeed*



*Rear Infeed*



*Front Infeed*



## Pallet Load Building

There are two methods used to create a palletized load: row forming and inline.

A row forming palletizer begins to form a pallet load when packages convey through a turning device in the appropriate "run" or "turn" position. The package is then conveyed to the row forming area where the packages form a row; once a row is complete it is pushed onto a layer forming area. This process is repeated until a complete layer of product is formed and placed onto the pallet, until the load is complete and removed from the machine.



Row forming palletizer **Figure 5-5**

An in-line palletizer uses a continuous motion flow divider that guides the product into the appropriate location on the layer forming area until a layer is complete and placed onto the pallet.



In-line palletizer **Figure 5-6**

## Pattern Creation

The number of case patterns that can be programmed into a fully automatic palletizer is virtually limitless using today's range of programmable controllers and software. As discussed in the first chapter, pallet loads can be interlocked or column stacked with or without gaps. Gaps in a pattern are created in order to make a uniform outside cube, making the pallet load stronger and more stable for shipping.

In order to form the appropriate patterns, the palletizer may need additional features such as a turning device, case stops, pusher gate or a bi-parting stripper apron mechanism.

## Turning Devices

Prior to the product moving into the row forming area, the product must be oriented into the appropriate orientation (run or turn). There are four common turning devices that accomplish this: turn shoe, cushioned turn, turn table and soft turn (differential roll speeds).

The turn shoe simply allows the case to rotate 90° around a corner based on the traction of the intersection of the infeed and row former rollers.



Turn shoe **Figure 5-7**

The cushioned turn rotates the product by using a turn shoe with cylinders that allows the shoe to gently give as the product turns 90°.



Cushioned turn **Figure 5-8**

The turn table is a grate in the infeed that pops up underneath the product and rotates it +90°, -90° or 180°.



Turn table **Figure 5-9**

The soft turn uses VFDs (variable frequency drives) that adjust the speed of the rollers on one half of the infeed allowing the product to rotate +90°, -90° or 180°. The soft turn is used most commonly in inline palletizers and applications that require high speed, labels out and gentle product handling.



Soft turn Figure 5-10

### Case Stops

Mechanical case stops are used during pattern formation in the row forming area to create side to side gaps. These stops use cylinders and pneumatic valves to operate, together with software to determine which case stops are required for which pattern. Should a very large number of case pattern sequences be required (20 to 40 patterns for example), it is advisable to place a case stop in all of the available locations. Then pattern changes become simple software commands with no additional hardware needed.



Case stops Figure 5-11

### Pusher Gates

Pusher gates are used in order to create a front to back gap in the pattern. When a layer is formed, it is placed on a stripper plate or apron; this plate is then carried forward over the pallet to place the layer onto the pallet. When the plate is fully forward, a gate comes down to allow the layer to stay in position over the pallet while the stripper plate pulls back, placing the layer onto the pallet below. When a gap is required in the pattern, a pusher gate will be used to hold a particular case in position prior to being released.



Pusher gate Figure 5-15

### Bi-parting Stripper Apron

The use of a bi-parting stripper apron allows front to back gaps to be created in the pattern without the use of a pusher gate. The stripper apron opens in the middle of the layer allowing the front to back gaps in the pattern to be created while the layer is being placed onto the layer or pallet below.



Bi-parting stripper apron **Figure 5-13**

### Pallet Load Quality

An automatic palletizer should have the ability to build loads with consistent accuracy and repeatability. With perfect conditions, an automatic palletizer could stack accurate loads with a repeatability of less than 1/4" variation from the top layer to the bottom layer (over a standard 64" load height).

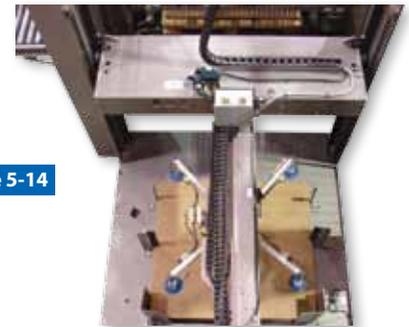
However, there are two key factors that cause difficulties, such as, uneven pallets and imperfect cases. These two factors combine to reduce the repeatability and accuracy in load stacking. Yet, a palletizer equipped with front and side retainers will maintain an accuracy of plus or minus 3/8" from the bottom layer to the top layer (over a standard 64" load height).

### Pallet Load Protection & Stabilization

Every manufacturer that is shipping product to a store, warehouse or distribution center has the goal that the product will arrive to the end destination without any damage. In order to achieve a protected and stable pallet load, additional equipment may be required.

### Sheets

As discussed previously, sheets are a way to protect and stabilize a pallet load. Slip sheets refer to the sheet on which the load is stacked and is typically made of a heavy fiber board. Tie or tier sheets are placed between the layers for stabilization. Cap sheets are used to protect the top layer of product. Both tie and cap sheets are typically made of a thin kraft paper or fiberboard. Various types of sheet dispensers are available for both floor level and high level machines. If slip sheets and tie sheets are required on the same palletizer, two feeders or a dual hopper may be required, since the sheet materials or sizes may be different.



Single sheet feeder **Figure 5-14**



Dual hopper sheet feeder **Figure 5-15**

Typical sheet feeder capacity is between 12" and 24", which may last for one shift. However, there are bulk-loading sheet feeders available, with single and double hoppers, to allow 36" to 40" of sheet capacity. These are used when higher production or less frequent sheet dispenser filling is required.

Bulk-loading slip sheet dispensers are also available for high level machines for placing the sheets on pallets. When tie sheets are required for high level machines, they have to be placed in the hopper located on the upper elevation. In the past this was typically done by an operator standing on the operator platform. Today, there are bulk load tie sheet dispensers that allow a fork truck to load a pallet load of sheets at floor level and elevate the sheets to the palletizing area.



Bulk loading sheet dispenser **Figure 5-16**

## Speed

Generally, when speeds are discussed for a given palletizer; they are based on a 10-case per layer pattern configuration. A fully automatic, slow speed palletizer will operate at an approximate speed of 10 cases per minute. On the upper end of the speed range, some palletizers can handle 150 to 200 cases per minute.

In general, floor level machines can palletize up to 35 cpm, high level up to 200 this is dependent on case size and patterns required. All reliable palletizer manufacturers have a simulation program to show the achievable speeds within a given pattern.

When a customer considers speed requirements, they will often factor the maximum speed that the packaging line can run and add a "safety factor" of 10 - 20%. Palletizer manufacturers will pay special attention to carton size, package construction and case pattern configuration to come up with a speed that includes an additional safety factor. Sometimes this duplication of safety factors can sway a customer from a lower speed to a higher speed machine. A project may no longer be viable as a result of these additional costs. Therefore, it is important to communicate to the palletizer manufacturer, if the desired line speed provided already includes a safety factor so the appropriate machine can be sized for the application.

### Package Types

Today, with the advances in controls, addition of pattern programming software, use of servo motors and variable frequency drives, conventional palletizers are flexible enough to handle the changing package types that the manufacturer must use in order to stay competitive in their marketplace.



Trays of bottles

Package types **Figure 5-27**



Trays of jars



RSC cases

### Mixed Load Palletizing

As discussed in the first chapter, mixed pallet loads are becoming more popular due to club stores requiring display ready pallets and retail stores needing to minimize the amount of inventory in the storage area. This created a demand for display pallets, mixed layer pallets and true mixed loads. With the addition of a bar code reader and proper product accumulation prior to the palletizer, conventional palletizers can create display pallet loads and mixed layer pallet loads. These are loads that contain a single package size but with different product flavors by column or by layer.



Mixed pallet load **Figure 5-18**



Mixed pallet load **Figure 5-19**



# Multiple Line Solutions

This chapter discusses the four common palletizing solutions available for multiple production lines; dedicated palletizers, accumulation conveyor to a high speed palletizer, robotic palletizers and mixed palletizing solutions. In addition, this chapter will explain what needs to be considered when working with these palletizing systems:

- Dedicated Palletizers
- Accumulation Conveyor to a High Speed Palletizer
- Accumulation Conveyors
- Multiple Lines to a Single Robotic Palletizer
- Mixed Solutions
- Speed

### Dedicated Palletizer

The majority of palletizers in operation today are fed by a single conveyor from one packing line. This is called a dedicated machine. A dedicated palletizer must complete one full load of one SKU (Stock Keeping Unit) before starting to palletize a new SKU. Dedicated palletizers that are fed by a single line can be close coupled to the case sealer and to the other lines nearby, saving on floor space.



Multiple lines with dedicated high level palletizers **Figure 6-1**



Multiple lines with dedicated robotic palletizers **Figure 6-2**

### Accumulation Conveyor to a High Speed Palletizer

It is also possible to have several packing lines feeding into one higher speed palletizer (Figure 6-3), thereby reducing the number of palletizers required. However, multiple line palletizing introduces a new consideration; the need for an accumulating conveyor to store a full pallet load of product prior to palletizing.



Multiple lines to single high speed palletizer **Figure 6-3**

In the example shown here, three lines are feeding into one palletizer. Each line may have a different product; some lines may carry corrugated cartons, some may carry trays or some may carry poly bundles. The products, however, are not mixed on the same accumulation conveyor.

When a full load is detected on one of the accumulating conveyors, that line's meter belt starts and a count photocell counts the required number of packages onto the delivery conveyor. When the count is complete, the meter belt stops and the packages are allowed to accumulate on that conveyor again.

As soon as another line has a full load accumulated, it will also meter and count the packages onto the delivery conveyor immediately behind the first load. The conveyor controls system releases each line based on either a first come, first served or other prioritized basis. Several loads may be on the delivery conveyor at one time with one load of corrugated followed by a load of trays or poly bundles, or vice versa. It is not unusual to have the length of delivery conveyor measure a quarter of a mile.

The full loads on the delivery conveyor are tracked by either the PLC or a bar code, which is read prior to the packages entering the palletizer. The PLC controlling the conveyor system or bar code reader signals the PLC, including pattern configuration and number of layers. As soon as the previous load has been built by the palletizer, the PLC resets the program to the new data, automatically adjusting row and layer guides if necessary.

### Accumulation Conveyor

As mentioned previously, when feeding multiple product lines into a single palletizer, consideration must be given to the accumulation of a full pallet load of each product prior to feeding them to the palletizer. The length of each accumulation conveyor is typically 1½ times the full load length (assuming similar accumulation rates). This allows additional accumulation while one line is metering the products to the palletizer.

### Example

If one packaging line is producing 18" long cartons and requires 80 cases to complete a full load, this equates to a full load length of 120 feet times 1½ which equals a total accumulation conveyor length of 180 feet. This simple equation would be repeated for the additional lines feeding the same palletizer.

$$\frac{18'' \times 80 \text{ cases} = 120' \text{ full load length}}{12''}$$

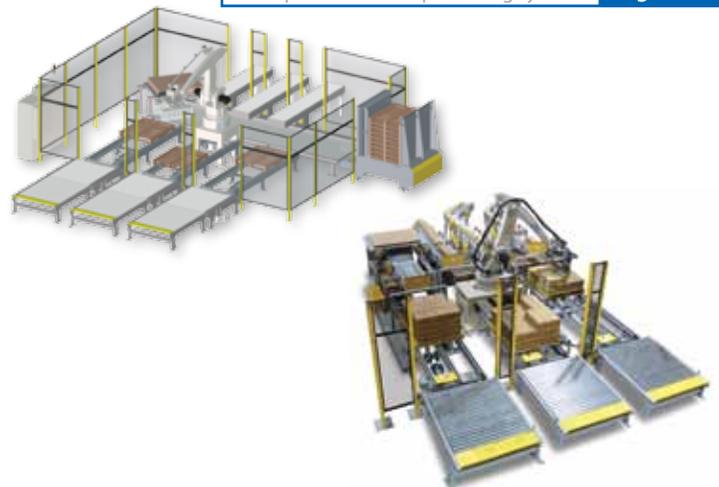
$$120' \times 1.5 = 180' \text{ total accumulation conveyor}$$

You can see from this simple example that if the three accumulating conveyor lines each require 180 feet of conveyor, it can be costly depending on the type of conveyor chosen, especially when installation and commissioning are included. However, this cost must be weighed against the cost and installation of three palletizers.

### Multiple Lines to a Single Robotic Palletizer

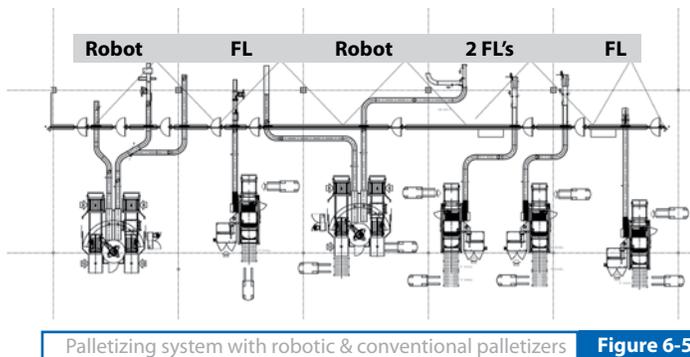
The flexibility of the robotic palletizer allows for a single robot to be able to pick products from up to five production lines and place the product onto five load building stations simultaneously. Depending on the type of end effector purchased, the robot may be able to handle package types such as bags, cases, bundles and trays simultaneously.

Multiple line robotic palletizing systems Figure 6-4



## Mixed Solutions

Today, it is common to walk into a large manufacturing plant and see a combination of the above solutions being used. The following diagram shows how the above solutions could be combined and used in a single plant location.



Palletizing system with robotic & conventional palletizers **Figure 6-5**

When planning for a multiple line palletizing system it is important to consider the appropriate use of the following items:

1. Transportation conveyor for transporting the product from the production facility to the warehouse.
2. Bar code reader at the entry of the sortation center to select the appropriate product for the accumulation conveyor.
3. Meter belts count the product onto the accumulation conveyor.
4. Accumulation conveyor is where the product is gathered until a full pallet load is detected and moved onto the palletizer.
5. Full load power discharged conveyor moves the full pallet load to the shuttle car.
6. Shuttle car move the full pallet load to the appropriate staging conveyor.
7. Stretch wrapper secures the pallet load with film.
8. Full load staging conveyor holds the completed pallet load until a fork truck or automatic guided vehicle removes it.

## Speed

In the case of multiple product lines being fed into a single higher speed palletizer, the machine must be capable of running at a speed approximately 10% - 20% greater (this is in addition to the 10% - 20% safety factor previously discussed) than the total accumulated rates of each of the conveyor lines feeding it. In other words, if three packaging lines running at an accumulated rate of 10 cases per minute per line were feeding into one higher speed palletizer, it must run 10% - 20% faster than the 30 cases per minute being accumulated. The palletizer must handle from 33 to 36 cases per minute total.



# 7 Accessories

This chapter discusses briefly the common accessories that are included in a palletizing system:

- Labelers
- RFID
- Double Stacker
- Stretch Wrappers
- Strappers and String Tyers
- Glue Systems
- Load Transfer Stations
- Pallet Inverters

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## Labelers

There are numerous reasons to apply identifying labels to individual products and/or palletized loads. Some manufacturers use generic containers and apply labels. In other cases, packages have pre-printed SKU labels, but also require identification to line, date, time, etc. for backwards traceability in the event of a product recall. Labelers are also used to apply RFID (Radio Frequency Identification) tags to packages or palletized loads. Many RFID tags also include the information in many readable and barcode forms.

Pallet labelers are used to provide line identification, date/time stamps, customer or warehouse destination, etc. Labels may be required on 1, 2, 3 or on all 4 sides.



Labeler **Figure 7-1**

Labelers can be as simple as applying pre-printed labels from a roll or stack. If a more integrated labeler is needed, a labeler can interface with the production control or warehouse management system that print and apply labels on demand.

Ink jet labelers and ink-roll labelers are often used to place a line number or production date on cartons after they are sealed.

Some labelers apply a label on one side of a palletized load in a consistent location for identification by manual or automatic identification. Other labelers apply a “corner” label that is visible from two adjacent sides of the pallet.

Regardless of the type of labeling required, it is important to coordinate the label manufacturing, design and application with the method of reading the label in subsequent operations or locations.

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## RFID

Radio Frequency Identification (RFID) is a relatively recent development in the product labeling industry. Depending on the type of RFID tag, the type of reader and the software process associated with it, RFID tags can be used to identify and track packages and palletized loads within the complete supply chain. In some cases RFID tags are used to perform warehouse inventory functions by incorporating strategically located readers within the warehouse. They can also be used to improve the efficiency and accuracy of product and/or pallet load picking operations. As the cost of RFID tags and readers decreases, the technology continues to gain greater acceptance. Many large retail operations have initiatives to adopt RFID in their operations.



RFID applicator and reader **Figure 7-2**

## Double Stackers

Some applications require “double stacking,” placing one palletized load onto another to minimize lift truck traffic or improve storage area utilization. Double stacker devices automatically raise one palletized load, allow another palletized load to travel into a position below the raised load, and then place the raised load onto the bottom load. These machines eliminate the need for lift truck operators to perform this function.

Some palletizer manufacturers have an option that includes the capability of a double stacker within the palletizer, saving on floor space.



Double stacker **Figure 7-3**

## Stretch Wrappers

Palletized and unitized loads are often stretch wrapped. Stretch wrapping secures the load to the pallet, increases the stability of the load for transportation and protects the load from the environment.

Stretch wrappers are available in various levels of automation. Semi-automatic stretch wrappers typically require an operator to deliver a palletized load to the stretch wrapper, and initiate the wrapping process.

Fully automatic stretch wrappers can be incorporated into a delivery conveyor system eliminating the need for operator intervention between palletizing and stretch wrapping.

Automatic stretch wrappers are available in several styles including turntable, rotating arm, and rotating arm and ring style.

Turntable wrappers rotate the load while the film carriage moves vertically as required to provide the desired number of film wraps. Turntable wrappers are best applied to stable loads. They may not be suitable for tall, or column stacked loads. Turntable wrappers typically have a lower throughput capacity than rotating arm or ring style stretch wrappers.



Turntable stretch wrapper **Figure 7-4**

Rotating arm wrappers rotate the film carriage around a stationary load. They are suitable for tall or unstable loads. Ring style wrappers are similar to rotating arm wrappers except the film carriage moves on a ring that raises and lowers relative to the load.

Rotating arm and ring style stretch wrappers typically have higher throughput capacities. Very high speed wrappers may utilize two film carriages to improve performance.



Rotating arm stretch wrapper **Figure 7-5**

Stretch wrappers are sometimes supplied with optional top sheet placers, corner board placers or hooders. Top sheet placers insert a corrugated or fiber board sheet above the load prior to the wrapping function to provide additional protection, especially when loads are double stacked. Hooders place a film sheet over the pallet prior to wrapping to provide additional environmental protection. Corner-board placers insert protective fiber board angles on the 4 corners of the pallet to prevent damage in handling or shipment. Any or all of these functions can be added to the stretch wrapper. Care must be taken to assess any performance impact due to performing these functions in the wrapper.

## Strappers and String Tyers

Strappers or string tyers are very useful to ensure load stability. Loads can be extremely unstable if cases are small and square, if there are numerous layers with many cases per layer, if the cases are in columns, or if the case has a high center of gravity (HCG). A strapper or string tyer is incorporated into the palletizer and programmed to strap or tie single or multiple layers making the load extremely stable when moving out of the palletizer.

## Glue Systems

Glue systems are also available for load stabilization. These are used when loads are shipped or exported long distances by road, rail or ship. The majority of glue systems is hot melt and often controlled by the palletizer, ensuring that the top layer of cases is not glued, unless a cap sheet is being used.

## Load Transfer Stations

Palletizing is best performed on top quality pallets. Manufacturers also want to keep the cost of pallets low. Sometimes product is produced on a “pool” pallet, but shipped to a “non-pool” customer. International shipping frequently requires special heat treated or fumigated pallets to avoid pest infestation. To avoid the loss of efficiency of palletizing on specific pallets for specific customers or destinations, a method of moving palletized loads from a production pallet to a shipping pallet is required.

Load transfer stations move the product from the original pallet to the destination pallet by placing the load onto a platen, then onto the destination pallet. The original pallet is stacked for future removal. Both wrapped and unwrapped loads can be transferred using a load transfer station.

Load transfer stations can be semi-automatic or fully automatic. Fully automatic systems can include infeed and discharge conveyor and pallet dispensers allowing loads to be placed on the system for transfer, then picked up when the transfer is complete with no intermediate operator intervention.



Load transfer station **Figure 7-6**

## Pallet Inverters

Pallet inverters are also used to move product from an original pallet to a shipping pallet. The load is placed into the inverter, an operator places a pallet upside down on the top of the load. The load is clamped and then rotated so the destination pallet is now supporting the load and the original pallet is removed. The inverted load is now removed from the inverter. Inverters are also used if product is produced in one orientation but stored “upside down” such as ketchup and other products.



Pallet inverter **Figure 7-8**



Load transfer system **Figure 7-7**

# 8

## Now What?

This chapter discusses what to do once the decision has been made to look into automatic palletizing solution options:

- Identifying Palletizer Suppliers
- Information to Provide Suppliers
- Things to be Considered
- Order Process
- Keys to a Successful Installation

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### Identifying Palletizer Suppliers

There are many sources available to help you identify the top palletizer manufacturers in the industry. A few sources at this time include:

- Associations
- Publications
- Trade Shows
- Referrals From Industry Associates
- Online Sources

Once you have identified palletizer suppliers, it is important to consider the following:

1. Visit the potential supplier to ensure the company has engineering capability, necessary parts backup and dedicated service organization required by your company. Look for an organization that can be reached at every department – whether it's Sales, Engineering, Service or Parts –to answer questions and resolve problems.
2. Obtain a list of customer references. Ask for those with similar machines and applications as the one you are considering.
3. Provide the same project details to all palletizer suppliers to receive comparable quotes.

### Information to Provide Suppliers

All palletizer manufacturers have a form that allows them to gather the necessary details of your project. This will help the company identify the appropriate solutions and options to fit your needs.

Typical information requested by palletizer suppliers includes:

- Product type, size, weight
- Speed (case, tray, bundle per minute)
- Number of cases/layer
- Number of layers/load
- Maximum load height and weight
- Pallet type, size, configuration and orientation
- Sheet location and size
- Pattern configurations
- Infeed & discharge elevations
- Voltage & air requirements
- Door size
- Height limitations
- Layout constraints
- Plant Environment (extreme temperatures, dusty or sterile environments, etc)

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### Things to Consider

After visiting potential suppliers, calling references and receiving comparable quotes it is important to consider the following:

1. Select a palletizer manufacturer that has a long-standing reputation for dependability. This is important as many palletizers are still in operation after 20 to 30 years. You will want a manufacturer that carries adequate supply of spare parts, will provide lifetime support for the equipment and has a well-trained service staff ready to go at a moments notice.
2. Allow for future changes in your packaging line such as new package types, patterns and increased

capacity. A palletizer that is upgradeable can end up saving you money in the future. For example, check whether patterns can be formed with gaps in either or both directions, and whether options can be added at a later date. Options may include sheet dispensers, pallet dispensers and pattern additions.

3. The controls package of a palletizer needs to make the palletizer easy to operate and user friendly. To help make your palletizer user friendly a pattern programming software needs to be considered.

4. Check to ensure adequate documentation is available prior to completion of the palletizer. This includes operation manual, installation manual, recommended spare parts list and training materials. Determine if detailed electrical, pneumatic and hydraulic (if required) schematics are available for reproduction, if necessary.

5. Insist on a performance guarantee.

6. Don't buy on price alone. Remember, the price of the machine is soon forgotten, but the quality is reflected in its performance.

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## Order Process

Now that you have selected a palletizer supplier and a Purchase Order has been submitted, the order process will start. Every palletizer manufacturer may have a variation of the following, but some or all of the following items will take place:

**Approval Package** – An approval package will be sent for you to review and modify if necessary. The approval package includes a specification sheet, machine and system layout, pattern drawings, pallet drawings and sheet drawings. This package typically needs to be approved and sent back to the supplier for the order to begin.

**Test Product** – The palletizer manufacturer will request test product, sheets and pallets to run on your machine to confirm that the machine will operate to your expectations. This product should be extremely well protected for shipment to the palletizer builder. If the product is damaged, it may be difficult for the palletizer to stack accurately.

**Factory Test** – Insist on a factory test to observe the palletizer performing in accordance with the purchase order requirements.

During the factory test, the following items are typically covered:

- Static test of the palletizer includes reviewing the specification sheet to the machine.
- Review safety, mechanical and electrical features of the machine.
- Identify the maintenance check areas on the machine.
- Demonstrate the controls.
- Review start-up procedures.
- Dynamic test of the palletizer includes running the products and patterns at speeds noted in the specification sheet
- Review troubleshooting, including fault recovery, how to get the machine back into automatic mode.
- Meet with the parts and service departments to discuss spare parts requirements, commissioning and training.

## Keys to a Successful Installation

Once the factory test is complete, the customer should leave the manufacturer's facility with all the information required to install the equipment in their own production facility even before contacting the service manager to arrange for commissioning and training.

Most customers use their own contractors (or maintenance employees) to install the palletizing system. These are local contractors who are aware of permits and code requirements. However, some customers ask the manufacturer to carry out installation and commissioning. In either scenario, the following items are to be considered:

### **Pre-Installation Date:**

- Schedule a service technician at least two weeks in advance to the installation date.
- Schedule or confirm appropriate equipment, tooling and personnel are available for unloading and positioning the equipment.
- Arrange to have appropriate product and personnel to test/run patterns.
- Review the installation manual for your palletizer.
- Confirm all upstream and downstream conveyors are operational.

### **Installation Date:**

- Inspect equipment for shipping damage.
- Place equipment according to the plant layout drawings.
- Provide personnel and tooling to anchor the palletizer to the floor.

- Connect main power and air.
- Confirm all sections have been reconnected and wired.
- Confirm all upstream and downstream interlocks have been installed and tested.
- Confirm all guarding is in place.
- Provide appropriate product and personnel to test run patterns.
- Arrange to have all operators and maintenance personnel trained.

### **Preventative Maintenance:**

With the proper preventative maintenance and lubrication schedule, you can expect your palletizer to operate for up to 30 years or more. It is important to discuss the appropriate preventative maintenance schedule with your palletizer manufacturer. Some of the typical items to inspect regularly include:

- Check for bent rollers, frozen bearings, or loose roll covers and bolts.
- Tighten or adjust the tension of chains and belts.
- Inspect pneumatic cylinders, air lines and lube lines for leaks.
- Inspect guides for loose mounting brackets and bent or damaged rails.
- Check gearboxes for proper oil level.
- Lubricate bearings as required.

- ☑ Check overall framework and components for loose fasteners.

Again, the above are just some general items to inspect; it is important to receive a list and or schedule of items to inspect from your palletizer manufacturer.



# Identifying the Palletizer to Fit Your Needs

This chapter is going to discuss the final items you may want to consider prior to researching a palletizer for your plant. This includes details on the following topics:

- Factors to Consider
- Palletizer Truisms
- Why Buy a Palletizer?

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### Factors to Consider

Now that you have read about the fundamentals of palletizing and identified all the options available, you are probably asking yourself “What palletizing solution fits my needs?” The best technology and the best method of palletizing is the one that takes advantage of the plant constraints at the least amount of cost and utilizes the least amount of valuable floor space. For any set of plant conditions the answer can be different. Factors that influence this decision include:

- Production throughput
- Available space and location of palletizer with respect to the packaging area
- Package type and speed; both current and future needs
- Frequency of SKU change over
- Pattern complexity
- Load built on pallet, slip sheet or unitized
- Accessories required
- Number of products and patterns
- Maintenance requirements and resources
- Flexible and upgradeable design
- Life of palletizer
- Interface requirements with upstream and downstream equipment
- Total Cost of Ownership – including initial purchase, freight, installation, maintenance, spare parts, cost of operation, training, etc.

### Palletizer Truisms

In identifying a palletizer that best fits your needs, there are a few “Palletizer Truisms” that may help clarify some of the competitive advantages that one type of palletizer has over the other.

- Robotic palletizers can more accurately place bags, only a robotic palletizer can create an overlapping pallet load of bags.
- Conventional palletizers can achieve higher speeds, typically those over 80 cases per minute need to be handled by a conventional palletizer.
- Robotic palletizers are capable of handling case sizes under 4”.
- High level palletizers are often the choice when a plant is already using high level accumulation conveyor.
- Both conventional and robotic palletizers are able to create complex patterns and handle a variety of package types.

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### Why Buy a Palletizer

How does one determine the need for a palletizer? There are many answers to this question, again unique to each situation. The following are some reasons companies choose to purchase automatic palletizing solutions:

- The cost of the palletizer offsets the cost of manual labor for palletizing.
- Increase in forklift traffic makes the environment unsafe for people to be manually stacking.
- OSHA standards regarding weight and repetitive motion limitations.
- Job related back injuries are costly and can increase a company’s insurance premiums.
- Where increase in throughput makes manually stacking impracticable.

- Automatic palletizers stack a more consistent and accurate load minimizing damage that occurs during shipping.
- Challenge of labor pool availability and the desire of the labor pool to perform manual palletizing tasks.
- An automatic palletizer always shows up for work!

For assistance in identifying the best palletizing solution to fit your needs, complete the postage paid reply card in the back of the book or contact **Columbia Machine, Inc.** at **1-800-628-4065**, **360-694-1501** or visit **[www.palletizing.com](http://www.palletizing.com)**.

## Acknowledgements

The following companies' products are featured in this book:

- **Cascade Corporation** – Manufacturer of fork lift attachments [www.cascorp.com](http://www.cascorp.com)
- **Columbia Machine, Inc.** – Manufacturer of floor level, high level palletizers and load transfer stations [www.palletizing.com](http://www.palletizing.com)
- **Columbia/Okura LLC** – Provider of robotic palletizing systems [www.columbiaokura.com](http://www.columbiaokura.com)
- **Diagraph, An ITW Company** – Supplier of automated label applicators [www.diagraph.com](http://www.diagraph.com)
- **Hytrol Conveyor Company** – Manufacturer of conveyors, conveying systems, and conveyor accessories [www.hytrol.com](http://www.hytrol.com)
- **Kolinahr Systems** – Manufacturer of specialty pallet handling and labeling equipment [www.kolinahr.cc](http://www.kolinahr.cc)
- **Lantech** – Manufacturer of stretchwrappers [www.lantech.com](http://www.lantech.com)
- **Pflow Industries, Inc.** – Manufacturer of vertical lift solutions [www.pflow.com](http://www.pflow.com)
- **Ryson International, Inc.** – Manufacturer of spiral conveyors, spiral curves, incline & decline conveyors and vertical lifts [www.ryson.com](http://www.ryson.com)
- **Wulftec International, Inc.** – Manufacturer of stretch wrapper and pallet wrapping machines [www.wulftec.com](http://www.wulftec.com)

These products are used in this book for illustrative purposes only. Their presence should not be construed as product endorsements by Columbia Machine, Inc., or an endorsement of Columbia Machine, Inc., by these companies

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## References

The following resources were used in writing this book:

- [1] ISO 6780: Flat pallets for intercontinental materials handling – Principal dimensions and tolerances, 2003
- [2] Clarke, John, 2004, "Pallets 101: Industry Overview and Wood, Plastic, Paper and Metal Options"
- [3] National Wooden Pallet and Container Association, 2007, "Uniform Standard for Wood Pallets", pp3
- [4] ISPM Pub. No. 15: Guidelines for regulating wood packaging material in international trade, 2002, FAO, Rome
- [5] National Wooden Pallet and Container Association, 2007, "Uniform Standard for Wood Pallets", pp 28
- [6] Brindley, Charlie, 2008, "Insights into Pallet Rental / Pallet Management Options", [MaterialsHandling.net](http://MaterialsHandling.net)

## Palletizer Information Services

This service offers free brochures, videos and advice to help you identify the right palletizing system to fit your needs! Your palletizing needs are unique and Columbia Machine, Inc. knows this. That's why Columbia offers a wealth of information to help you plan and install a system, custom designed and engineered to meet your specific requirements for years to come.

For more information, mail in the postage free reply card at the back of the book, visit [www.palletizing.com](http://www.palletizing.com) or call Columbia toll free at **800-628-4065** or direct at **360-694-1501**.

## Complete Palletizing Solutions from Columbia

With over 70 years of experience, Columbia has developed a reputation as the world's premier palletizer manufacturer; serving a variety of industries including food, beverage, chemical and consumer products. Efficiently and consistently stack products with a fully integrated palletizing solution from Columbia's complete line of high level, floor level and robotic palletizers, load transfer stations and systems integration. Whether your challenge is speed, space or product type, Columbia has a reliable and economical solution to fit your needs!

## Floor Level - Cost Efficient Palletizers

Palletizing is more affordable than ever with the efficient E Series Floor Level Columbia Palletizers. The E Series palletizers cut valuable production time and costly labor expense by fully automating the end of your packaging line.

- Model FL10 Palletizer - Palletizes 10 or more cases per minute.
- Model FL2000 Palletizer - Palletizes 20 or more cases per minute.

- Model FL3000 Palletizer - Palletizes 30 or more cases per minute.

## High Level – High Quality Palletizers

Columbia's innovative HL series of palletizers are the most flexible high level palletizers in the industry. All of these modular machines are upgradeable to grow with your business, while versatile interfaces allow seamless integration with your production equipment.

- Model HL2000 Palletizer - Palletizes 20 or more cases per minute.
- Model HL4000 Palletizer - Palletizes 40 or more cases per minute.
- Model SP4000 Palletizer – Palletizes 60 or more cases per minute.
- Model HL6000 Palletizer - Palletizes 60 or more cases per minute.
- Model HL7000 Palletizer - Palletizes 70 or more cases per minute.
- Model HL8000 Palletizer - Palletizes 80 to 150 cases per minute.

**Robotic Palletizers – Flexible Layouts**

Columbia/Okura's state-of-the-art robotic palletizers combine maximum reliability and flexibility with easy-to-use operation. Capable of handling up to four production lines and multiple product types simultaneously, the compact design of the robotic palletizer makes them ideal for cramped locations and spaces with low ceilings.

- Robotic Case Palletizer
- Robotic Bag Palletizer
- Robotic Depalletizer

**Load Transfer Stations – Easy Pallet Transfer**

Optimize your facility's lift truck productivity, reduce labor and shipping costs, AND prevent injuries with one of Columbia's load transfer stations.

Columbia's load transfer line provides solutions for plants that want to retain their plastic, Chep, or expensive pallets for use in their palletizing and production process, requiring their product to be transferred to an alternate load base for shipping or storage.

The load transfer product line includes models ranging from the basic stand-alone station to fully automatic versions that can be installed as an integrated part of larger systems. LTS are capable of transferring numerous types of products including cases, combo boxes, bags, glass vials, pails, drums and freezer applications.

**Modifications & Accessories Catalog**

As companies grow and change, it is often necessary to modify equipment to meet new challenges. A new product, package type, or increased speed may require making modifications to your palletizing system. Columbia created an easy to use Modifications & Accessories Catalog to

assist with your palletizer upgrade or retrofit needs. To request your catalog today, contact Columbia's Customer Care Department at 800-628-4065 or direct at 360-694-1501.

**Videos and CDs**

Columbia has a wide range of palletizing solution videos and brochures that demonstrate capabilities of handling a wide variety of package types and sizes. To request a video that best matches your application, contact Columbia today by completing the reply card in the back of the book, visiting [www.palletizing.com](http://www.palletizing.com) or calling 800-628-4065 or direct at 360-694-1501.

## Glossary

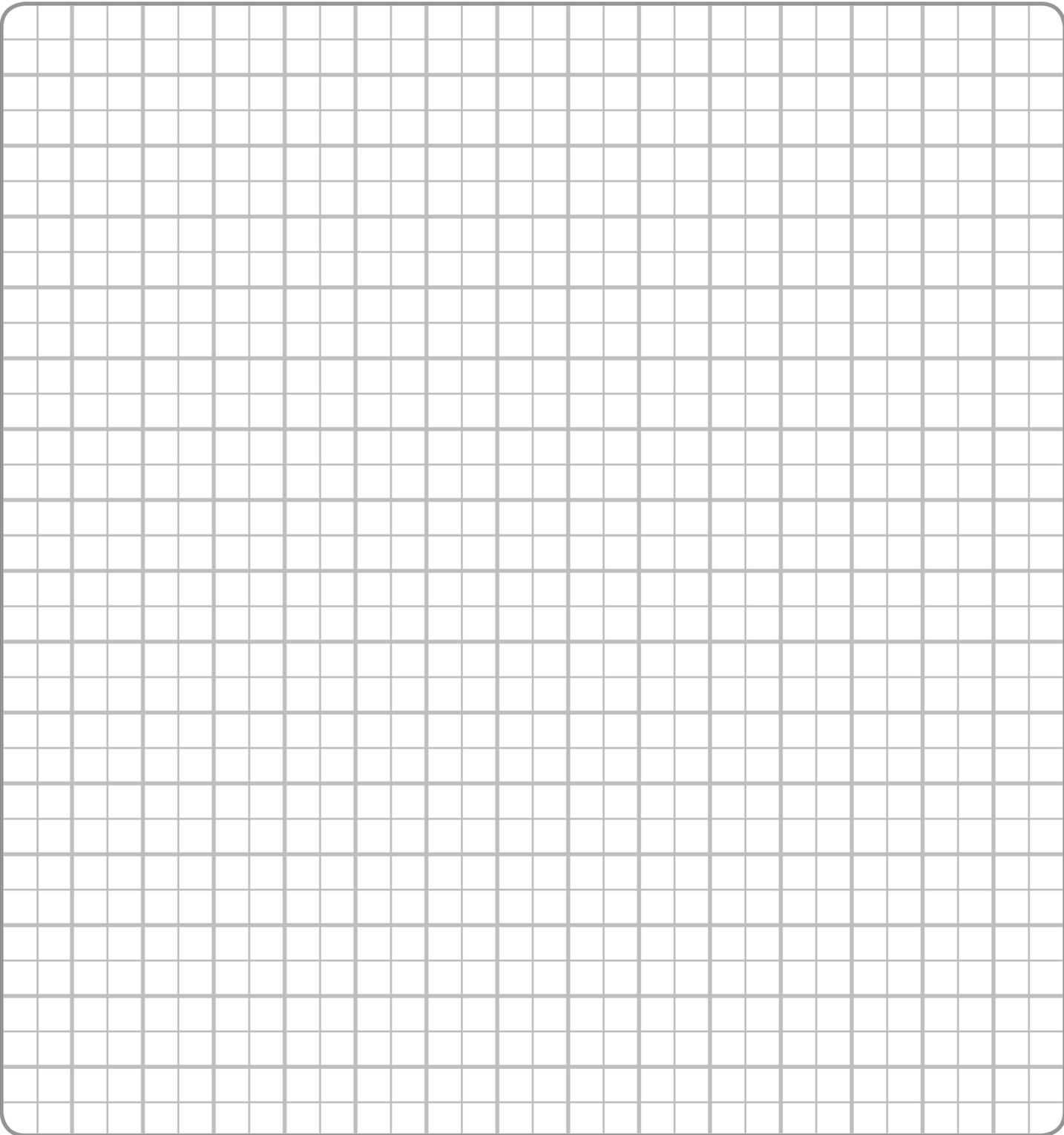
<b>Cap Sheet</b>	A sheet that is placed on the top of a palletized load.
<b>Case Stop</b>	Barriers that are introduced between cases, cartons or packages in a row-forming conveyor to create spaces or gaps in the row and subsequently in the pattern.
<b>Case Turner</b>	A mechanism on a palletizer for changing the direction of a carton, case or package as needed to form a pattern. Also called a Turning Device.
<b>Depalletizer</b>	A machine that removes product from a unit load and places the product onto a conveyor.
<b>Discharge Conveyor</b>	A conveyor capable of receiving and transporting a pallet load or a unitized load of product from the palletizer or unitizer.
<b>Electric Palletizer</b>	A palletizer with an electric hoist rather than a hydraulic hoist.
<b>Flight Bar</b>	A device on a palletizer used to move a layer or row of product to the next section of the palletizer.
<b>Floor Level Palletizer</b>	A palletizer with a case infeed entry level of approximately 30 inches high.
<b>Full Load Conveyor</b>	A conveyor inside the palletizer that transports a full load out of the palletizing section to a discharge conveyor.
<b>High Level Palletizer</b>	A palletizer with a case infeed entry level of approximately 7 feet to 12 feet high.
<b>Hoist</b>	The mechanism on a palletizer by which a layer or load of product is raised or lowered to position the load to accept a layer of product or for discharge of the load.
<b>Hydraulic Palletizer</b>	A palletizer with a hydraulic hoist rather than an electric hoist.
<b>Infeed</b>	Conveyor on a palletizer where the product is turned to orient the product to make the patterns.
<b>Layer</b>	A single level horizontal arrangement of product formed in a pre-determined pattern.
<b>Layer Guides</b>	Guides located above the stripper plate or apron to control the placement of the layer as it is being deposited on the layer or pallet below.
<b>Layer Pusher</b>	A device on a palletizer used to move a layer of product to the stripper plate or apron.
<b>Layer Table</b>	A section of conveyor on a palletizer used to accumulate and hold a layer of product while other sections of palletizer continue to operate.
<b>Load Inverter</b>	A machine that transfers a unit load of product from one pallet type to another pallet type by inverting the palletized load.
<b>Load Transfer Station</b>	A machine that transfers a unit load of product from one pallet type to another pallet type by pushing the palletized load.
<b>Meter Belt</b>	A belt located after the pacer belt on the palletizer that is used to meter product into the system creating gaps between the cases.
<b>Pacer Belt</b>	A belt located at the entrance to the palletizing system. It controls the pace of product entering the Palletizer.

<b>Package Stop</b>	Barriers that are introduced between cases, cartons or packages in a row forming conveyor to create spaces or gaps. In the row package stops may be used to prevent cases from turning around each other when rows are advanced by row pusher chains or pusher bar.
<b>Pallet Dispenser</b>	A mechanism that can accept, hold, and discharge a pallet upon demand.
<b>Pallet Retainers</b>	A cam dog or other element capable of holding a stack of pallets found in a pallet dispenser operating in conjunction with an elevating mechanism to release one pallet at a time.
<b>Pallet Stacker</b>	A machine that automatically receives and stacks pallets.
<b>Pallet Stop</b>	A device on a palletizer used to position a pallet so that it will be ready for its next operation.
<b>Palletizer</b>	A machine that assembles products in a predetermined pattern to form layers and sequentially deposits the layers on a pallet to build a unit load.
<b>Pattern</b>	The geometric arrangement of products to form a layer.
<b>Pusher Bar</b>	A bar that advances a completed row of product onto the layer forming section or stripper plate or apron of a palletizer.
<b>Robotic Palletizer</b>	A machine that assembles products in a predetermined pattern to form layers and sequentially deposits the layers on a pallet to build a unit load.
<b>Row Former</b>	A conveyor on a palletizer used for accumulating product in a row as part of the process of forming a layer.
<b>Row Forming Rolls</b>	A conveyor on a palletizer used for accumulating product in the row forming area as part of the process of forming a layer.
<b>Row Pusher</b>	A device on a palletizer used to move a row of product to the next section of the palletizer.
<b>Sheet Dispenser</b>	A mechanism that contains a stack of sheets moving a sheet from the stack for placement under the load or between layers.
<b>Slip Sheet</b>	A sheet that is placed on a pallet or conveying surface prior to the palletizing of product.
<b>Stripper Apron</b>	A set of idler rolls capable of supporting a layer of product and capable of moving horizontally to deposit a layer of product on the surface beneath the apron.
<b>Stripper Plate</b>	A metal plate capable of supporting a layer of product and capable of being moved horizontally to deposit a layer of product on the surface beneath the plate.
<b>Systems Integration</b>	Combines the palletizer with upstream and downstream equipment.
<b>Tie Sheet</b>	A sheet that is placed between layers of product on a palletized load.
<b>Unitizer</b>	A machine that assembles products in a predetermined pattern to form layers and sequentially deposits the layers on a slip sheet or conveying surface.

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# Columbia

**COMPLETE PALLETIZING SOLUTIONS**



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